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Is agriculture diversification for sectoral transformation – An emperical study in Coochbehar district of West Bengal

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ABSTRACT

This study analyses the extent of crop diversification or change of cropping pattern for transformation of agriculture towards allied sectors with a unique set of secondary data available from Govt. and other sources w.e.f. 2007 to 2012 in Coochbehar district of West Bengal. Estimates of linear growth analysis show that there is a tendency of shifting areas towards high value crops/enterprises, but cropping pattern is still skewed towards cereal crops. Barring livestock, agriculture and allied sectors have a very negligible progress. Higher value of Simpson's Diversification Index (greater than 0.5) show higher level of crop diversification but it also re-establishes dominance of small and marginal farmers. Improvement in infrastructural facilities and inputs uses (irrigation, road, fertilizer consumption, cold storage, electricity, credit, etc.) are also lacking. Agro-based units show a declining trend in terms of number due to lack of infrastructural and marketing facilities, thus, opportunity for absorption of labor could not be exploited and is reflected in high level of migration (15-20%). Only 4.25 per cent of area is under agricultural allied sectors. Only paddy processing unit is the dominant figure among the agro-based units. Besides, non-cereal sectors have not occupied a reasonable place in the agrarian system which is seemed to be largely responsible for low intensity of agricultural transformation. This may happens due to several technical, commercial and socio-economic reasons which call for further study.

***Keywords*:** Agriculture and allied sectors, agriculture transformation, crop diversification, growth.

Indian agriculture has presently witnessed a structural transformation since the country has started its developmental phase from last two decades. As country develops, manufacturing and services sectors expand at a more rapid rate, and as a consequence, their shares in overall GDP rise. The labour force also starts moving out of agriculture to these sectors. These changes lead to a fall in the share of the agricultural sector in GDP. The other big change that occurs along with this transformation is that the demand for agricultural products, both food and non-food, also changes. The food demand shifts from basic cereals to high value. Non-food products include forest products and other naturally available resources. This transformation has been the resultant of different internal and external forces which are jointly acting on production, marketing and trade (Sharma, 2015).

The Indian economy is predominantly rural and agriculture-based, and the declining size of land holding poses a great concern. Projection states that per capita availability of land will further decline to less than 0.1 ha. by 2020 (Kumar, 2015). Agriculture and allied sectors are the main sources of income and employment in India which have been shown in table 1.

Declining size of landholdings without much alternative livelihood opportunity has become a challenge before agriculture in general. Besides, rising dependency ratio (ratio between dependent population to working population) in rural India is also an important factor for Indian agrarian distress (Kumar, 2015).

Table 1: Agriculture and allied sectors in India

Period (TE)	Agriculture and allied sectors GDP at constant 2004-05 prices (Rs. crore)	Workers employed in agricultural and allied sectors (Million)	Share of agriculture and allied sectors in overall GDP (Per cent)	Share of workers engaged in agricultural and allied sectors to total number of workers (Per cent)
TE 1952-53	162,112	97	56.5	69.8
TE 1972-73	258,070	126	43.5	69.7
TE 1992-93	406,404	185	29.3	64.8
TE 2012-13	745,385	263	14.3	54.6

Source : A.K. Sharma (2014)

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In a developed agriculture, adequate natural resources (land, water, forest, animals, *etc.*) are available for activities of agriculture and allied activities that should be efficiently and economically utilized for the overall welfare of the farming communities (Bradshaw, 2004). Thus, it is necessary to assess the opportunities and constraints of total agricultural activities and developing technologies and strategies towards generation of income and employment particularly for small and marginal farmers in a country like India. Small and marginal farmers, in India, share nearly 85 per cent of total farm households and 52 per cent of total production (approx.) (Dev, 2008). Besides, scopes of non-farm activities are also very important. Ferichani and Prasetya (2012) opined that satisfaction of producer and customer holds the key for sustaining agri-business and they also added that measurement of satisfaction is necessary for strategy.

Since the emerging issues are more complex, the new strategies of transformation based on the principles of need-based diversification and sustainable intensification covering various sub-sectors and allied sectors of agriculture (Govt. of India, 2015). Transition from conventional agriculture to modern agriculture covers the bio-physio-socio-eco-politio-technological issues. Besides, the possibility of increasing agricultural output can be understood under the following agrarian packages (Ghosh, 2011) :

ª% Institutional change in the farming sector

ª% Increase in the cropping intensity of land

ª% Shift in the cropping pattern in favour of crops with higher productivity

ª% Improvement in technique of cultivation.

Agriculture of Coochbehar district shows a special feature of agro-ecology for its geographical location (Terai Zone). The district has adequate natural resources like forest, river, fertile soil etc. Besides, other salient features include sufficient rainfall, variety of crops/ plants, livestock, skilled human resource (labour), etc. Agriculture is the main source of livelihood and employment. Manufacturing industry is yet to set up.

Basic information on land utilization, irrigation, cropping intensity, *etc*. has been presented in the following table 2. Besides, the district has some areas under forestry, fishery, sericulture, tea and various horticultural crops. It may be noted here that during the year 2000-01 the gross cropped area and net cropped area were 508.43 and 264.92 (‘000ha) respectively. Cropping intensity in the same year was 194 per cent. Thus, there is a declining tendency of area under cultivation. More than 90 per cent of the farmers are small and marginal and number of marginal farmers has an increasing trend **(**Table 3). As a consequence, migration of labour is very high (15-20%) (RAWE, 2012). Net cultivated areas under different crops are either shrinking or stagnant. Thus, farming sector is facing a stiff challenge.

Table 2: Crop land utilization status (2011-12)

Subject	Unit	Value
Total geographical area	Ha. (’000)	338.7
Reporting area	Ha. (’000)	331.57
Net area sown	Ha. (’000)	254.18
Area sown more than once	Ha. (‘000)	221.6
Gross cropped area	Ha. (’000)	469.7
Cropping intensity	%	184
Total area irrigated	Ha. (’000)	107.01
Irrigated intensity	%	42

Source: Directorate of Agriculture (Evaluation), Govt. of West Bengal.

Table 3: No. of small and marginal farmers in Coochbehar

Year	Marginal	Small	All	Av. size of holding
2000-01	235934	51459	274702	0.88 (0.82 WB*)
2011-12	254309 (76%)	49158 (23%)	323278 (100%)	0.84 (0.82 WB)

Total household : 6,65,720 and Total population : 28,19,086 *West Bengal

Source : www.coochbehar.nic.in

In the above context, an attempt has been made in this paper to have an overview on the present scenario of agriculture and its allied sectors (forestry, fishery *etc.*) with its existing socio-economic constraints and also to analyze status of agricultural transformation in the district.

MATERIALS AND METHODS

The study is exclusively based on the secondary sources of information. Empirical data pertaining to five years *i.e.* 2007-08 to 2011-12 as available from different Govt. publications, websites have been taken. Besides, earlier data on crop acreages have been mentioned for comparison only. The data cover the existing cropping pattern, practice and scope of different crops grown and status of agriculture & allied activities in respect of acreage or number, production, growth *etc.* to have a thematic presentation of utilization of overall natural resources with a view to generate income and create employment in the district. Besides, Simpson’s Index of Diversity and linear growth rate are also used which have been presented in tabular form for analysis and interpretation.

Simpson's Diversity Index

Simpson's diversity index is commonly used to estimate the crop diversification (Roy, 2015). This was introduced by Edward Hugh Simpson. If *ni* is the number of individuals of species *i* which are counted, and *N* is the total number of all individuals counted, then

$$\frac{\sum_{i=1}^{S} n_i(n_i-1)}{N(N-1)}$$

is an estimator for Simpson's Index for sampling without replacement. It follows that with values near zero corresponding to highly diverse or heterogeneous ecosystems and values near one corresponding to more homogeneous ecosystems.

Another response is to redefine Simpson's index of diversity as

$$\tilde{D} = 1 - D = 1 - \sum_{i=1}^{S} p_i^2,$$

where, $P^2_i = A_i / \sum_{i=1}^{n} A_i$

Ai = Area under ith crop

"A_i = Total cropped area

This quantity is called by statisticians the index of diversity. The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity.

Linear Growth rate (LGR)

Linear Growth Rate (LGR) analysis from time series data for change in acreage under different crops has also been done with the help of linear equation such (Agarwal, 2009) as :

Y = a + bt

The values of the parameters 'a' and 'b' in the equation are estimated by using Ordinary Least Square (OLS) method. The linear growth rate can be estimated with the following formula :

LGR (g%) = b/ȳ x 100

where, 'b' = The estimated regression co-efficient of Y on 't' and

ȳ = Average value of Y.

Results and Discussion

Though economy of Coochbehar district is predominantly agriculture-based, it is blessed with natural resources. So, beside crop production, livelihood options of the people are found to be diversified. Livestock, fishery, poultry, sericulture, horticulture, forestry, plantation crops (tea, arecanut, etc), etc. are also being practiced. Since more than 90 per cent of farm households belong to the category of small and marginal farmers, they usually follow the system of crop diversification for higher income and also to avoid different risks. This exercise will examine the present status of agriculture and allied sectors.

A. Present status of agricultural crops and allied sectors

(a) Cropping sector

During the period, 2007-08 to 2011-12,the district has a declining trend in respect of cereal crops(Table 4) . Among food crops, pulses show a marginal increase in area. Horticultural crops mainly fruits and vegetables have registered an increase in

Table 4: Area under different crops w.e.f. 2007-08 to 2011-12 (Unit : '000 ha.)

Crops	2001-02*	2007-08	2008-09	2009-10	2010-11	2011-12	LGR (%)
Rice	279.19	293.5	309.80	274.00	275.30	273.3	- 2.68
Total cereals	317.7	317.3	329.30	298.00	295.60	294.1	-12.48
Pulses	10.50	5.90	7.10	5.70	5.60	6.20	-1.47
Total food grain	328.20	323.20	336.40	303.70	301.20	300.3	-2.58
Total oil seeds	12.60	20.80	14.60	12.20	14.50	15.00	-7.58
Total fibres	85.645	88.20	85.60	87.60	75.40	79.40	-3.33
Potato	12.20	18.60	27.5	27.90	30.00	23.70	4.97
Misc. crops (Tobacco, tea, sugarcane, chilli, ginger, etc.)	18.20	19.50	20.60	21.80	22.10	26.2	6.67
Fruits	5.15	5.50	5.84	5.92	6.04	6.18	3.33
Vegetables	51.68	52.11	53.07	53.26	56.60	54.06	1.38
Flowers	-	0.90	0.115	0.135	0.136	0.157	-4.97
Total		**527.51**	**543.61**	**512.38**	**505.84**	**505.84**	**-1.79**

**Not included in LGR.*

Source: Directorate of Agriculture (Evaluation), Govt. of West Bengal

acreage but these increases are not significant. Though area under flower is reduced, production is increased from 0.542 to 1.082 (Crores in No.). As a result, total area under different crops has been found to decline. Cereal crop have shown a declining trend but they are still major crops in the district. Data for the year 2001-02 have also cited for comparison only.

(a) Livestock sector

Livestock sector helps the rural people for augmenting their farm income. Livestock are tolerant to climate change also. Viswanathan (2015) concluded that the development of allied sector that conform to local preference and habit, would serve as prelude to investment in the settled agriculture. Though findings are not too optimistic, volume of livestock like cattle, other livestock, poultry, *etc*. found to increase in number

Table 5: Progress of livestock sector (2007-08 to 2011-12) **Unit : No.**

Type	2002-03*	2007-08	2008-09	2009-10	2010-11	2011-12	LGR (%)
Cattle	935899	8,99,339	9,75,790	10,04,630	9,35,899	10,50,889	2.71
Buffaloes	4874	10,213	11,793	11,982	4,874	4,385	-26.54
Total including Other Livestock	1614689	14,47,423	17,61,366	18,72,172	16,14,689	18,30,308	3.63
Poultry	1667453	10,47,702	16,75,771	18,50,061	16,67,453	16,55,786	7.64

**Statistical Abstract, 2008, Govt. of W.B.*

Table 6: Status of fishery sector (2006-07 to 2011-12)

	Total water area (ha.)	Effective area under pisiculture (ha.)	Total production (MT)	Other information
2006-07	6120.83	3155.40	21850	Flowing River : 100 ha.
2011-12	6120.83	3155.40	18317	Family : 28542 Villages : 643 Persons engaged : 28000

**Statistical Abstract, 2008 (WB)*

Table 7: Status of tea crop (2007-08 to 2011-12)

Year	No. of garden	Area (ha.)	Production (in Kg.)	Productivity (kg ha.$^{-1}$)
2007-08	23	2089.50	1863140	891
2008-09	23	2272.97	1867125	821
2009-10	23	2286.00	1872920	819
2010-11	23	2308.00	1875540	812
2011-12	23	2334.00	1880546	805
LGR (%)	**Stagnant**	**2.31**	**1.22**	**-2.41**

Source: Directorate of Agriculture (Evaluation), Govt. of West Bengal

Table 8: Status of area under forest (2004-05 to 2011-12)

Items	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	LGR (%) *
Total area (ha.)	-	-	7330.71	7330.71	7330.71	7330.71	7330.71	
Protected (ha.)	4300	4300	3990.30	3990.30	3990.30	3990.30	3990.30	
Unclassed, Vested and Khas (ha.)			3332.98	3332.98	3332.98	3332.98	3332.98	No change
Corporate sector (ha.)	-	-	4.05	4.05	4.05	4.05	4.05	
Privately owned (ha.)	-	—	3.38	3.38	3.38	3.38	3.38	

Source : Divisional Forest Office, Coochbehar(WB)

Table 9: Sericulture in Coochbehar

Subjects	2007-08	2008-09	2009-10	2010-11	2011-12	LGR (%)
Seri acreage (Total)	872.41	977.44	1056.11	1146.72	1237	8.58

Source : Directorate of Sericulture, Coochbehar (WB)
Total No. of families : 3170(Mulberry-1370 & Muga-1800), No. of Villages : 191

(Table 5). In fact, variation in progress is observed between the years. Population of buffaloes has been drastically declined from 2009 onward, reason of which may be sorted out. Since demand for milk and other livestock products are rising, there is lot of scope for increasing investment. Satyasai *et al.* (2015) has confirmed that share of livestock and crop production in agricultural GDP have improved over time.

(c) Fishery Sector

Fishery in eastern and north-eastern States of India is a very profitable business. This sector has high demand throughout the year. Coochbehar is blessed with lot of water bodies including perennial rivers. Nearly 28000 farmers are involved in this business. Data available from the Govt. source **(**Table 6**)**, indicate that fishery sector, in terms of area, remains stagnant for last few years. New water bodies have not been brought under fishery. Production and productivity are at low level of productivity during the same period. This sector provides full or partial livelihood to 28542 families. Prolonged dry spell, irregular rainfall pattern for couple of years and inadequate infrastructure and management practices may stand in the way of fish production. Institutional as well as farm level efforts are necessary for improvement.

(c) Plantation crop (Tea)

Tea is an important cash crop in this district. The tea gardens are totally operated by the private sector. Unlike other crops, area under tea has been showing a rising trend. Reports reveal that agricultural lands are being replaced with tea plantation. Good technology, assured production, remunerative price *inter alia* are the probable reasons for this. Table 7 displays the recent trend of area under tea crops which shows a positive growth rate.

(a) Forest Sector

In the event of ecological sustainability and mitigation of global climate change, forest plays a very important role. This district is blessed with existence of some areas under forest in the northern part. In fact, there has been no change in area from 2006-07 to 2011-12. Compared to the year 2005-06, area under protected forest is found to decline (Table 8). Privately owned forests are less. There is rising awareness and tendency among the farmers to keep few areas of their farms for forest plants. But there is threat of population pressure on forest resources.

(b) Sericulture

Sericulture is an agro-based cottage industry with good employment opportunity and remunerative price. Two types of silk are produced here viz. (i) Mulberry silk (domestically operated) and (ii) Muga silk (outside rearing). Muga silk is produced only in this district. This sector is highly labour intensive and covers both agriculture and industry. Sericulture has an increasing growth rate in respect of area coverage (excepting 2009-10) (Table 9). A total of 3170 number of families distributed in 191 villages is actively involved. Sericulture is facing challenge from China in terms of quality and price. Institutional efforts (State and Central) are being taken up to tackle this situation.

Table 10: Sector-wise and year-wise distribution of the new units

Sector	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Cereals & pulses processing	6	1	2	1	3	13
Confectionery/biscuit	5	2	5	-	2	14
Dairy & milk	6	-	9	-	1	16
Fruits & vegetable processing	2	-	-	-	-	2
Oil	2	4	-	-	1	7
Others	3	-	1	1	1	6
Pkd. drinking water	-	1	-	1	1	3
Paddy processing	62	43	-	41	80	226
Poultry, meat processing	-	-	38	-	-	38
Snacks/pasta	4	1	-	1	1	7
Spices	-	1	-	1	2	4
Total	**90**	**53**	**55**	**46**	**92**	**336**

Source : www.coochbehar.nic.in

(a) Present status of agro-based units

Present status of agro-based units is shown in table 10 which percolates very incomplete message regarding their consistent growth and progress excepting paddy processing units. Thus, it is observed that out reported area of 3,31,570 ha., 2,54,180 ha. (76.55%) is net cropped shown area and only 14,056 ha (4.25%) is under allied sectors (excluding livestock) implying that agricultural allied sectors are not yet adequately developed.

B. Availability of agricultural infrastructural facilities

Backing up by adequate infrastructural facilities is the key for paving the way for development of agriculture and allied sectors. Except electricity consumption, growth of irrigation, fertilizer consumption, road, warehouse, cold storage, etc. remain almost stagnant (Table 5). Recent data on farm mechanization are not available. During 2003, there were 601 no. of tractor and 328 no. of power tiller which was not satisfactory compared to State's average (Statistical Abstract, 2008). Agro-based units are considered to be the integral component in the changing scenarios of agricultural. During the period, no progress is recorded. Persons engaged in this sector are found to decrease. Thus, the picture on agro-based sector is far from satisfaction.

Sharma (2015) has reported that the transformation of the Indian agricultural sector has been driven by supply side factors such as policies to push growth, better and efficient use of resources like land and labour; introduction of new technology and increased use of modern inputs like chemical fertilisers and expansion of irrigation infrastructure; and, investments in general infrastructure like roads, power as well as demand side factors such as population, income growth, urbanisation,

Table 11: Status agricultural inputs use and related infrastructural facilities in Coochbehar

Year	Area irrigated ('000 ha.)	Fertilizer consumption ('000 tonnes)	Road (km.)	Warehouse (No.)	Cold storage (No.)	Agro-based units (No.)	Elec. for Agril. (KWH)
2007-08	100.50	58.03	817	10	13	90	2958 (112919)
2008-09	101.74	38.4	819	10	13	53	5210 (134690)
2009-10	102.56	45.7	822	10	13	55	3503 (203201)
2010-11	104.73	46.8	823	10	13	46	4723 (230771)
2011-12	107.01	46.7	985	10	13	92	4723 (230771)*
LGR (%)	**1.93**	**4.91**	**3.98**	**Stagnant**	**Stagnant**	**0.44**	**7.21**

**Data repeated, Source : www.coochbehar.nic.in*

Table 12: Progress of institutional credit sectors

Year	Cooperative credit societies			Banking facilities		
	No.	Members	Repayment ('000 Rs)	No.	Av. popn. per office ('000)	% Adv to deposit
2007-08	698	225731	334039	115	24	57.64
2008-09	698	225069	234327	120	23	53.59
2009-10	698	225562	235902	124	23	49.53
2010-11	710	230732	243792	127	22	47.80
2011-12	722	231318	248666	134	21	44.94
LGR (%)	**1.69**	**0.66**	**No Change**	**3.90**	**-**	**-**

Source : www.coochbehar.nic.in

Table 13: Diversification index (Simpson's) of Coochbehar district

Year	Simpson's Index	
	District	Estimated
2007-08	0.7076	
2008-09	0.7284	
2009-10	0.6855	0.6113 (2013-14)
2010-11	0.6711	
2011-12	0.6734	

and demand from the rest of the world through gradual liberalisation of international trade.

Low level of capital possession is another important constraint. Credit is the main source for formation capital. Institutional credit agencies have a very slow progress. Volume of loan/credit taken by the people shows a little encouraging result (Table 12). This implies formation of insignificant level of capital for which economic activities rest has yet to get pace.

C. Status of crop diversification

This part of the study deals with the diversification of agricultural activities. Crop diversification leads to a movement of low-value agriculture to high-value agriculture which is an important way to enhance agricultural output. This collectively implies changes in cropping pattern. Simpson Index (S.I.) of Diversity has been followed here to view the status and extent of crop diversification in the district during the period under study. Though overall feature is not bad but the values of S.I. reveal that the intensity of crop diversification shows a declining trend (0.7076 in 2007-08 to 0.6734 in 2011-12). The estimated value of SI for 2013-14 is 0.6113 indicating further decline. (Table 13) The district has jute-rice cropping system and maximum acreage is still under the cereal crops. In spite of that, higher level of SI values may occur due to dominance of small and marginal farmers. In fact, actual reasons will be ascertained if a separately studied is undertaken with different socio-economic parameters. Ghosh (2011) estimated with Herfindal Indices (HI) of crop diversification for Coochbehar (0.2445) which was at per with the State's average value (0.2402). Satyasai *et al.* (2015) reports that there has been a decline in diversification level (HI value 0.596 in 2003-04 to 0.578 in 2013-14) in India over time across sectors as well as within agriculture that too statistically significant. Kumar (2015) shows that land, opportunity, technology, education and infrastructure have positive relation and age of household and dependency ratio have negative relation with diversification.

Thus, the findings show that there is a tendency of shifting areas towards high value crops/enterprises, but cropping pattern is still remained skewed towards cereal crops. Barring livestock, agriculture and allied sectors display a very negligible progress since only 4.25 per cent of area under agricultural allied sectors. Higher value of diversification index proves higher level of crop diversification but it also shows the dominance of small and marginal farmers. Improvement in infrastructural facilities and inputs uses are lacking. Agro-based sectors show a declining growth trend in terms of number of units due to inadequate infrastructural and marketing facilities. Thus, opportunity for absorption of labor could not be exploited. Besides, non-cereal sectors have not occupied a reasonable place in the agrarian system which is responsible for low intensity of agricultural transformation. All these may appear due several technical and socio-economic issues for which a separate and exhaustive study may be initiated in this line for making future strategy.

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