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An analysis of area, production and productivity of major vegetables in Darrang district of Assam (India)

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Abstract
The present study was conducted to analyze the supply chain of major vegetables in the Darrang district of Assam. Both input and out put supply chains for selected vegetables are studied. Compound Annual Growth Rates (CAGR) for Area, Production and Productivity for vegetables were estimated. The important vegetables selected were brinjal, bottle gourd, tomato and cabbage for detailed analysis. Two important markets viz., Kharupetia and Besimari were selected and from the surrounding villages of each market from which bulk of products come to the market, three villages were selected randomly. A simple random sample of 20 percent was drawn without replacement from marginal, small, medium and large categories of farmers form the selected villages. In case of kharif vegetables, the annual growth rate in area was 2.96 percent per year 5.912 percent per year in production and 2.86 percent in productivity where as in case of rabi vegetables the annual growth rate in area was 2.67 percent per year, in production and 2.86 percent per year and productivity in 2.42 percent per year. The increased CAGR have been due to the initiatives taken by the Government and State Agriculture Department by providing various financial and technical supports to the farmers.

Keywords: Compound Annual Growth Rates (CAGR), Productivity, vegetables, random sample

1. Introduction
Vegetable is the designation given to that group of horticultural plants grown for human consumption either for their roots, tubers, shoots, stems, leaves, flower buds, flowers, fruit or seed. About two-thirds of the world's population relies on a largely vegetarian diet and vegetables are indispensible component of vegetarian meal. Vegetables are rich and comparatively cheaper source of vitamins. In addition to the contribution of valuable nutrients, vegetables add variety, taste, color, and texture to diets which provides fiber for digestion and to prevent constipation. Their consumption in plenty provide fair amount of protein. They also play key role in neutralizing the acids produced during digestion of pretentious and fatty foods and also provide valuable roughages which help in movement of food in intestine.

Table 1: Top five vegetables growing country in the world

Rank	Country	Production(Million Metric Tons)	% of world total production
1	China	583.7	51.3
2	India	121.02	10.6
3	United states	34.28	3.01
4	Turkey	28.05	2.49
5	Iran	23.6	2.08

Source: Food and Agricultural Organization Database Statistics 2015

Vegetables are important in human diet because 280 gms of vegetables are recommended per day/per man by ICMR. India is known as fruit and vegetable basket of the world. India being a home of wide variety of vegetables holds a unique position in production figures among other countries. India is the second largest producer of overall vegetables production in the world (Table 1), after China and one of the centers of origin of many vegetables with the total production of 583.7 million tones of vegetables till the year end 2013 (NHB, 2013) [6] contributing 13 percent of the world's vegetable production.

In India West Bengal occupies the 1st position in terms of vegetable production (Table 2). Assam has the potential to meet the demand of vegetables in the state of its own because of its rich natural climatic conditions but till date the state has not performed to its potential.

Table 2: Top ten vegetables growing state in India

Rank	Country	Production (Million Metric Tons)
1	West Bengal	25.4
2	Uttar Pradesh	19.5
3	Bihar	16.3
4	Madhya Pradesh	12.5
5	Andhra Pradesh	12.01
6	Gujrat	10.5
7	Odisha	9.04
8	Maharashtra	8.08
9	Tamil Nadu	7.89
10	Karnataka	7.84

Source: Food and Agricultural Organization Database Statistics 2015

2. Scope of the study

The study is proposed to identify the prevalent supply chain of vegetables in the Darrang district. The study will be helpful in identifying the best possible supply chains of inputs and outputs which will help the policy makes to draw planes policies for developing the vegetable subsector in the district. The constraints and critical gaps in the supply chain of vegetables will help to formulate possible intervestim strategies to minimize the gaps and remove the constraints.

3. Methodology

This chapter presents general description of the study area, sampling design, data collection and the methods being used for analysis of data to fulfill the objectives of the study. Darrang district has one sub division viz., Mangaldai Sadar, having seven development blocks and fourteen revenue circles. The data were collected from the sample households through personal interview method. A Pilot survey was done before conducting the main survey to know the status of vegetable growers in the district. Two important markets viz., Kharupetia and Besimari were selected and from the surrounding villages of each market from which bulk of products comes to the market, three villages were selected randomly. List of vegetable growers was prepared from each selected village and categorized on the basis of operational holdings. On the basis of operational land holdings farmers from each village were categorized as marginal, small, medium and large. (Economic survey of Assam, Govt. of India 2014). A simple random sample of 20 percent was drawn without replacement from each category of farmers for detail analysis. Necessary data were collected with the help of pretested schedules and questionnaires for fulfilling the objectives of the study. Data collected pertained to the year 2015-16.

3.1 Study area and selection of Sample

The present study was carried out in the Darrang district of Assam. Darrang District is situated in between Kamrup and Sonitpur District.

3.2 Area, production and productivity of vegetables

The secondary data on area under different crops, production and productivity of crops were used to analyze the trends. The time series data on area, production, productivity of vegetables and fruits crop was available from 2004-2014 onwards The required secondary level time series data on area, production and productivity of vegetable were collected from different publications, websites etc. Compound Annual Growth Rates (CAGR) of area, production and productivity of vegetable was calculated by using the formula given below.

The formula for Annual Growth Rates (CAGR),

Y = abt or in log form

Log Y = Log a + t log b

Where,

Y = Area/production/productivity of vegetables

t = Number of years

a = Constant

b = Regression coefficient or trend value

The Compound Annual Growth Rates (CAGR) has been defined as

CAGR = (Antilog b - 1) x 100

4. Discussion and results

4.1 Area, production and productivity of vegetables

Data regarding the area under cultivation of vegetables, production and productivity in India along with computed values of CAGR is presented in (Table 3)

Table 3: Growth rates in area, production and productivity of vegetables in India

Year	Area (000 ha)	Production (000mt)	Productivity (t/ha)
2004-05	6744	101246	15.0
2005-06	7213	111399	15.4
2006-07	7581	114993	15.2
2007-08	7848	128449	16.4
2008-09	7981	129077	16.2
2009-10	7985	133738	16.7
2010-11	8495	146555	17.3
2011-12	8989	156325	17.4
2012-13	9205	162187	17.6
2013-14	9396	162897	17.3
CAGR %	3.37	4.87	1.14

Source: Directorate of Economics and Statistics, 2014 Government of India and NHB data base, 2013 [6].

The (Table 3) reveals that CAGR of area under vegetable cultivation in India was 3.37 percent during 2004-14. In the same period CAGR of production and productivity was 4.87 percent and 1.14 percent respectively. The positive growth rates indicate a promising vegetable production scenario for the country. However the growth rate of productivity is still lower than the CAGR of area and production. It could be referred here that India's contribution to world production of vegetables in 2012-13 was 14 percent. India is also the largest vegetable producer after China. India produces 16 million tons of vegetables compared with China's 57 million tons. However, India's productivity is the lowest compared to the top 10 countries around the world with just 17.6 million tons/ha whereas Spain tops with 39.3 million tons/ha in 2012-13. Efforts are being made to improve productivity through Mission for Integrated Development of Horticulture during 2014-15, providing new infrastructure development, market promotion, boosting quality and transport. The National Horticulture Mission, set up by the government in 2005-06, has also helped the sector evolve over the years. (NHB database, 2013) [6].

Table 4: Growth rates in area, production and productivity of vegetables in Assam

Year	Area (000'ha)		Production (000' t)		Productivity (kg/ha)	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
2004-05	68.55	153.69	1062.53	2598.10	15500	16905
2005-06	72.20	159.42	1119.29	2698.96	15503	16930
2006-07	76.31	159.72	1182.96	2704.13	15502	16930
2007-08	78.33	159.92	1287.00	2707.80	16433	16932
2008-09	79.13	160.72	1320.02	2799.85	16682	17421
2009-10	77.00	174.00	1225.00	3030.00	15909	17414
2010-11	79.00	181.00	1287.00	3183.00	16291	17586
2011-12	80.00	183.31	1328.00	3243.00	16787	18251
2012-13	83.73	188.74	1445.20	3534.23	17260	18725
2013-14	79.08	178.98	1363.03	3208.34	17235	17925
CAGR%	1.44	1.54	2.52	2.13	1.07	0.59

Data Source: Statistical Hand Book of Assam 2014, and Directorate of Economics and Statistics, 2014 Government of Assam. CAGR is computed by the researcher.

The (Tables 4) reveal that in kharif vegetables the annual growth rate in area was at 1.44 percent, production at 2.52 percent and productivity at 1.07 percent during 2004-05 to 2013-14 over the years in the state. The greater increase in production as compared to increase in area resulted a positive impact on the growth of yield. Though it was still lower than the CAGR of area and production over the years in the state. In case of rabi vegetables the annual growth rate in area was 1.54 percent, 2.13 percent in the production and its productivity at 0.59 percent. It was found that the growth rate in area was more in rabi (1.54 %) as compared to kharif (1.44%) vegetables. The increasing CAGR have been due to the initiatives taken by the Government and State Agriculture Department by providing various financial and technical supports to the farmers. But the CAGR in productivity is lesser in rabi (0.59%) than kharif (1.07%). This may be due to lack of commercial importance and market value (Directorate of Economics and Statistics, Assam, 2014). The area under kharif vegetable in the year 2013-14 (79.08 thousand hectors) which was less as compared to 2012-13 14 (83.73 thousand hactors) which led to decreased production in the year 2013-14 (1363.03 thousand tons) than 2012-13 (1445.20 thousand tons). Productivity of kharif vegetables in the year 2013-14(17235kg/ha) was also less as compared to the year 2012-13 (17260 kg/ha) due to flood in the year 2014 (The Times of India, Oct 2, 2014). Also in case of Rabi vegetables similar picture was noticed in the year 2013-14 (178.98 thousand hectors) where as area under cultivation was less as compared to 2012-13 14 (188.74 thousand hactors) along with the decreased production in the year 2013-14 (3208.34 thousand tons) than 2012-13 (3534.23 thousand tons). This further resulted decreased productivity in the year 2013-14(17925kg/ha) as compared to the year 2012-13 (18725) kg/ha. During peak harvesting season of Rabi Vegetables i.e., from January to March, the markets are overloaded with vegetables and the farmers have to dispose off their produce at a very low price on the very market day due to non-availability of cold storage facility within and near the market.

Table 5: Growth rates in area, production and productivity of vegetables in darrang district of Assam

Year	Area (000'ha)		Production (mt)		Productivity (kg/ha)	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
2005-06	3.75	13.95	34.218	146.888	9125	10545
2006-07	3.86	14.25	35.781	158.673	9270	11135
2007-08	4.52	16.25	49.398	163.980	10928	11900
2008-09	4.12	15.10	41.686	166.175	10118	11221
2009-10	3.95	14.54	39.421	163.153	9980	11005
2010-11	4.43	16.75	47.157	184.166	10645	10995
2012-13	4.65	17.22	51.391	198.512	11052	11528
2013-14	4.89	17.86	57.462	216.552	11752	12125
2014-15	5.02	18.16	60.738	243.166	12099	13390
CAGR %	2.96	2.67	5.91	5.17	2.86	2.42

Source: Directorate of Economics and Statistics 2014, Government of Assam; and Glimpses of Agriculture in Darrang district, Assam, Mangaldoi, 2015-16.

(Table 5), shows that in kharif vegetables, the annual growth rate in area was 2.96 percent per year 5.91 percent per year in production and 2.86 percent in productivity. The greater increase in production as compared to increase in area resulted a positive impact on the growth of yield. Where as in case of rabi vegetables the annual growth rate in area was 2.67 percent per year, in production and 2.86 percent per year and productivity in 2.42 percent per year. It was found that the growth rate of areas more in kharif vegetables. The increased CAGR have been due to the initiatives taken by the Government and State Agriculture Department by providing various financial and technical support to the farmers like subsidies on purchase of tractor (49nos), power tiller (265nos), STW (14824nos), and LLP (246 no's) under various schemes till 2015(Dept. Agril.Engineering, Darrang). Also Most of the people of Darrang district are Muslims of immigrant origin. The farmers of this immigrant origin are traditionally very hard working and efficient in farming. They stick consistently in agriculture operations and apply fertilizer, pesticides and insecticides, HYV seeds and modern farm appliances in farming. Both Rabi and Kharif crops are extensively cultivated. But the CAGR in

productivity of Rabi vegetables (2.42%) is less than Kharif vegetables (2.86%) which may be due to non-availability of adequate facility for irrigation as Rabi vegetables require assumed irrigation. Moreover the soil character, physiographic difference and the attitudes of social groups, etc. are also responsible for low agricultural productivity During 2009-10 the area(3.95 thousand hactors), production (39.421 MT) and productivity(9980 kg/ha) of Kharif vegetable and also of Rabi vegetables with area(14.54 thousand hactors), production(163.153 MT) and productivity(11005 kg/ha) were low as compared to 2008-09 due to irregular monsoon and also non-availability of water in large patches during the non-monsoon period. As per DPR(Detailed Project Report) of Integrated Watershed Management Programme 2009-10, during the years 2009-10 great enthusiasm was shown in utilization of ground water by installing shallow tube well and pumping water through diesel pump sets.

5. Conclusion

In case of kharif vegetables, the annual growth rate in area positive which were 2.96 percent per year 5.912 percent per year in production and 2.86 percent in productivity where as in case of rabi vegetables the annual growth rate in area was 2.67 percent per year, in production and 2.86 percent per year and productivity in 2.42 percent per year. Where Ajay Tegar *et al*. (2016) [7] were also found that the growth in area, production and productivity of major vegetables in Chhattisgarh State for the period 2004-05 to 2014-15 was positive. The annual growth in area of selected vegetables appeared to be significant in cabbage as 13.62 per cent with mean area of 12913.82 ha followed by cauliflower as 11.58 per cent with mean area of 15736.92 ha. It was found that the growth rate of area was more in kharif vegetables. Also found in his study that the area and production of selected vegetables was observed annual growth rate in positive manner during the study period. The increase in demand for vegetables, better prices and improvement in income levels with improved varieties and production technology in recent years might have encouraged the growth in vegetable production in the state. Onion, okra, brinjal, cardamom, ginger and coriander are the different vegetable and spices crops grown in the state. The growth in area under vegetables and spices has recorded an annual increment of 2.80 per cent per annum. The growth in production of vegetables and spices increased significantly at the rate of 3.51 per cent per annum. It was found that the growth rate of areas more in kharif vegetables. The increased CAGR have been due to the initiatives taken by the Government and State Agriculture Department by providing various financial and technical supports to the farmers.

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