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ENERGY USE IN AGRICULTURE IS BOON OR BANE ON AGRICULTURE SECTOR PERFORMANCE IN INDIA : A STATE LEVEL OF ANALYSIS

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ABSTRACT

Energy is central to the economic growth in all the sectors including agriculture. This study focuses on the agricultural energy usage for agricultural production in states of India and the growth performance of agriculture production in India during 2005-06 to 2017-18. This study has planned to make an analysis of the agriculture production output and the agriculture energy (input) use in states of India to know about the role of energy consumption by agriculture sector for its growth.This study focuses on major energy (inputs) namely electricity, fertilizer, pesticides and machinery use in agriculture activities only. The objectives of this study are to identify the energy use pattern in agriculture sector in states of Indiaduring the period between 2005-06 and 2016-17 andto study about the effect of energy use in agriculture on its growth in various states of India. The present study is based on the secondary sources of information, taken from the various year of Agriculture Statistical at a Glance Reports and ICAR (Indian Agricultural Statistics Research Institute) – Agricultural Research Data Book 2017. The researchers have used CAGR and percentage to find out the growth performance of selected energy and the food grains crops. The study claims that the energy use plays a significant role in the production and productivity of agricultural output. Therefore steps must be taken to improve energy use in agricultural sector and get optimized benefits. Based on the findings, the study suggests that the timely availability of agriculture energy like short lifespan of adequate irrigation facilities and new variety of seeds, introduction of modern mechanization, enough electricity voltage and timely availability of relevant and availability of chemical fertilizer etc., will help in the development of energy use in agriculture sector and will lead to development of the economy as well.

KEY WORDS: *Energyuse in Agriculture, Food Grains Production, Agriculture Sector Performance in Indian states*

INTRODUCTION

Energy consumption in agriculture production system directly involves through involvement of labour for different cultural operations from sowing to harvest and processing and burning of fossil fuels (diesel/ petrol) to power machinery for tillage, irrigation, etc. and indirectly in the production of fertilizers, pesticides, and farm equipment's.Energy is central to the economic growth in all the sectors including agriculture. Energy is a basic requirement of human life, just like in agriculture, industry, transportation, communication and all other economic activities of the present civilization. Energy in agriculture is one of the most valuable inputs in agriculture production. In a land scarce, populous agrarian economy like India, additional production has to be achieved in large volumes by judicious management of energy resources. Agriculture requires energy as an important input to production. Agriculture uses

energy directly as fuel or electricity to operate machinery and equipment on the farm, and indirectly in the fertilizers and chemicals produced off the farm(Energy use in Agriculture: Background and Issues 2004).

Agriculture plays a vital role in India's economy and 54.6 per cent of the population is engaged in agriculture and allied activities (Census 2011) and it contributes 17 per cent to the country's Gross Value Added 2015-16 (Annual Report 2016-17). The agriculture and allied sector continues to be fundamental to the sustainable growth and development of the Indian economy. Not only does it meet the food and nutritional requirements of 1.3 billion Indians, it contributes significantly to production, employment and demand generation through various backward and forward linkages. Moreover, the role of the agricultural sector in alleviating poverty and in ensuring the sustainable development of the economy is well established (State of Indian Agriculture 2015-16). This study focuses on the agricultural energy usage for agricultural production in states of India and the growth performance of agriculture production in India during 2005-06 to 2016-17.

IMPORTANCE OF THE STUDY

Agricultural production situation, being a dynamic entity, has kept developing continuously. The present stage of changes being met by the agricultural sector, such as reduced availability of quality water, nutrient deficiency in soils, climate change, farm energy availability, loss of biodiversity, emergence of new pest and diseases, fragmentation of farms, rural-urban migration, coupled with trade regulations, are some of the new challenges (Vision 2050).The modern agriculture needs modern energy use in agriculture. These two are closely linked for developing countries. It could be seen that energy use in agriculture is governed by a host of factors like agro-climatic conditions, nature of farming, governmental support through subsidies, precipitation, farm size, credit availability, price support, extent of area under irrigation and high-yielding varieties, agricultural investments, cropping pattern, level of inputuse, commercialization and availability of natural resources.In view of the above factors observed, this study have planned to make an analysis of theagriculture production output andthe agriculture energy (input) use in states of India to know about the role of energy consumption by agriculture sector for its growth.

STATEMENT OF THE PROBLEMS

The farmer has to take care of lot of issues before the agriculture production is complete. These include availability of high quality seeds, inputs such as water, fertilisers, pesticides, machinery and finance at both the pre-harvest and post-harvest levels, logistics in moving the goods and finally marketing where it is sold to the consumer. The agriculture sector in Indianstates is facing many problems and this study focuses on major energy (inputs) namely electricity, fertilizer, pesticides and machinery use in agriculture activities only.

OBJECTIVE OF THE STUDY

This study on energy use in agriculture activities in Indian states and its growth performance focuses on the following objectives

- To identify the energy use pattern in agriculture sector in states of India during the period between 2005-06 and 2016-17
- To study about the effect of energy use in agriculture on its growth in various states of India

METHODOLOGY

The researchers have planned to study energy use in agriculture is Boon or Bane on agriculture sector performance in Indian states during the period of 2005-06 to 2015-16. This study is based on secondary source of information collected from various issues of Government reports of India and other reliable sources. To study the energy use in agriculture performance in Indian states the researchers have used the data published by the various years of Agriculture Statistical at a Glance Reports and ICAR (Indian Agricultural Statistics Research Institute) – Agricultural Research Data Book 2017. The study covers the

period from 2005-06 to 2016-2017 and all the states of India. As far as the statistical tool for analysis is concerned, the researchers have used CAGR and percentage to find out the growth performance of selected energy and the food grain crops.

DATA ANALYSIS AND RESULT'S DISCUSSIONS

Table 1:Consumption of Electricity (GWh)for Agriculture and its Percentage in States of India During 2005-06 to 2013-14

State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
AP	15.76	16.49	14.63	15.41	15.75	14.87	13.53	13.52	14.31
Assam	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02
Bihar	1.28	0.8	0.63	0.74	0.66	0.31	0.25	0.23	0.21
Chhattisgarh	1.36	1.42	1.4	1.9	1.47	1.54	1.55	1.71	0.16
Goa	0.02	0.02	0.04	0.04	0.09	0.02	0.02	0.01	0.01
Gujarat	11.76	11.37	10.51	10.88	10.72	10.55	9.57	10.16	9.64
Haryana	7.14	6.94	7.04	6.83	7.69	6.56	6.72	5.61	5.59
Himachal Pradesh	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.03
Jammu&Kasmir	0.16	0.2	0.26	0.25	0.17	0.16	0.1	0.2	0.18
Jharkhand	0.06	0.07	0.06	0.06	0.05	0.06	0.07	0.06	0.06
Karnadaka	9.7	11.32	10.41	10.5	10.36	10.73	11.33	11.65	11.84
Kerala	0.21	0.22	0.23	0.22	0.22	0.19	0.21	130.45	0.21
MP	7.13	7.1	7.23	5.77	5.01	5.39	5.69	6.77	7.76
Maharashtra	12.29	9.84	12.17	12.12	11.1	13.23	17.54	14.96	14.57
Odisha	0.2	0.15	0.17	0.13	0.13	0.14	0.11	0.11	0.11
Punjab	8.1	8.31	9.62	8.65	8.76	7.88	7.27	7.31	6.69
Rajasthan	6.23	6.72	7.82	9.08	10.1	10.47	10.89	6.25	11.3
TN	10.99	10.46	10.29	9.77	10	10	7.63	7.63	8.05
Tripura	0.01	0.01	0	0.03	0.03	0.03	0.03	0.03	0.02
Uttarakhand	0.45	0.36	0.29	0.28	0.25	6.08	0.23	0.4	0.23
UP	5.91	7.03	5.95	6.37	6.14	6.08	6.21	6.25	6.68
West Bangal	1.01	0.95	1.07	0.78	1.11	1.43	0.92	0.84	0.77
All India	100	100	100	100	100	100	100	100	100

Source: Various years Agricultural Statistics at a glance, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics

The above table shows the percentage distribution of electricity consumption for agriculture by states in Indiafor 2005-06 to 2013-14. The highest level of electricity was used in Andhra Pradesh with around 13.5 to 16 per cent of total electricity used in India during the study period. Then in states like Gujarat, Karnataka and Maharashtra more than 10 per cent of total electricity consumption for agriculture in India was used. In Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh 5 to 10 per cent of electricity consumption in India was used for agriculture. In all other states, less than 5 percent of electricity was used for agriculture purposes.

Table 2: Consumption of Fertilizers(Thousand Tonnes) for Agriculture in Terms of Nutrients (N, P and K) and its growth in States of India During 2005-06 to 2015-16

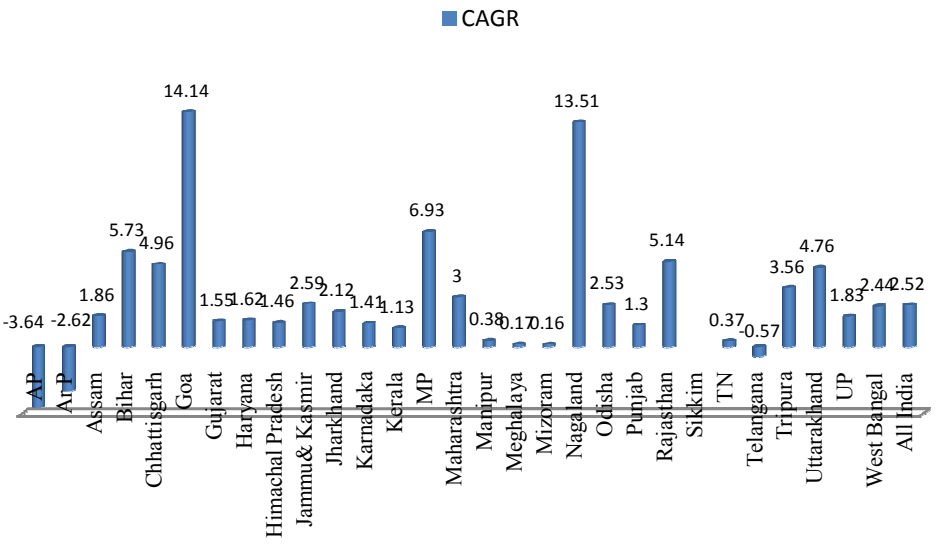
State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CAGR
AP	12.55	11.59	11.82	12.33	16.81	19..27	12.03	10.76	7.27	6.80	6.35	-3.64
Ar P	NA	NA	NA	NA	2.23	2.06	NA	NA	NA	NA	NA	-2.62
Assam	0.97	0.73	0.95	0.89	46.65	46.19	0.99	1.08	1.12	1.12	0.91	1.86
Bihar	4.52	4.97	5.34	5.45	5.42	3.41	4.97	5.98	5.15	5.26	6.34	5.73
Chhattisgarh	1.84	2.22	1.96	1.86	69.08	69.09	2.14	2.36	2.32	2.37	2.38	4.96
Goa	0.01	0.01	0.03	0.03	3.92	2.82	0.01	0.02	0.02	0.02	0.02	-8.84
Gujarat	6.29	6.55	7.19	6.89	8.84	8.99	6.24	5.26	6.39	6.58	5.67	1.55
Haryana	5.55	5.20	0.01	5.18	5.19	6.09	3.67	5.29	4.76	5.10	5.04	1.62
Himachal Pradesh	0.24	0.22	0.22	0.23	40.53	91.94	0.19	0.19	0.20	0.20	0.21	1.46
Jammu&Kasmir	0.45	0.41	0.35	0.42	72.80	40.43	0.36	0.43	0.42	0.43	0.46	2.59
Jharkhand	0.66	0.62	0.64	0.59	51.74	61.65	0.62	0.77	0.42	1.95	0.63	2.12
Karnadaka	7.50	6.81	6.68	7.35	7.95	7.04	8.40	6.00	6.70	7.16	6.65	1.41
Kerala	0.99	0.98	0.92	1.05	70.92	72.60	1.08	1.09	1.32	0.82	0.85	1.13
MP	4.63	5.51	5.77	5.71	60.15	59.62	6.81	7.32	7.76	7.03	7.35	6.93
Maharashtra	9.68	10.64	10.30	10.30	10.04	10.44	5.80	9.68	11.37	10.99	10.18	3
Manipur	0.07	0.09	0.08	0.05	33.56	19.07	25.81	0.04	0.04	0.06	0.06	0.38
Meghalaya	0.02	0.02	0.02	0.01	6.53	10.23	0.02	0.02	0.02	NA	NA	0.17
Mizoram	0.01	0.01	0.02	0.02	42.12	31.12	0.00	0.01	0.01	NA	0.01	0.16
Nagaland	0.00	0.00	0.00	0.00	0.87	2.00	0.01	0.01	0.01	0.01	0.01	0..51
Odisha	1.94	1.96	2.00	2.15	42.58	40.36	1.85	0.77	1.99	5.74	1.94	2.53
Punjab	8.29	7.75	7.52	7.10	7.24	6.89	5.10	7.72	7.00	6.72	7.27	1.3
Rajasthan	4.34	4.20	4.37	4.22	35.73	41.44	3.29	5.26	4.97	5.08	5.72	5.14
TN	5.40	4.98	4.77	5.08	152.15	150.77	4.55	3.71	3.70	3.97	4.28	0.37
Telangana	-	-	-	-	-	-	-	-	5.47	4.60	4.92	-0.57
Tripura	0.07	0.07	0.05	0.06	20.51	35.26	0.07	0.10	0.09	0.07	0.08	3.56
Uttarakhand	0.59	0.66	0.67	0.61	91.05	90.58	0.60	0.60	0.66	0.69	0.75	4.76
UP	17.03	17.17	0.67	16.19	126.38	119.11	15.32	18.21	15.69	16.70	15.81	1.83
West Bangal	6.09	6.36	6.09	6.10	124.67	112.72	5.82	6.11	5.01	5.74	6.04	2.44
All India	100	100	100	100	100	100	100	100	100	100	100	2.52

Source: Various years Agricultural Statistics at a glance,Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics

Note: NA- Not Available

The above table shows the percentage distribution of usage of fertilizer in agriculture in Indian states. The highest percentage of fertilizer was used in Uttar Pradesh with around 15 to 18 per cent of total fertilizer usage in India. In states like Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Punjab and West Bengal more than 5 percent of the total fertilizer has been used during the study period. In other states, around 5 per cent and less than 5 per cent of fertilizer has been used.

Figure 1. Growth of Total Consumption of Fertilizer in States of India



The figure 1 shows the CAGR of usage of fertilizers in the states of India during 2005-06 to 2015-16. It has been highest in the state of Goa with 14.14 per cent of growth rate followed by Nagaland with 13.51 per cent. States like Andhra Pradesh, Arunachal Pradesh and Telangana have registered negative CAGR of usage of fertilizers(the Government of India createdTelanganastate in 2014,hence the state negative growth performance). All other states have registered positive growth of CAGR, implying the increased usage of fertilizers in these states.

Table 3: Consumption of Pesticides (Technical Grade) for Agriculture and its Growth Ratein States of India during 2005-06 to 2015-16

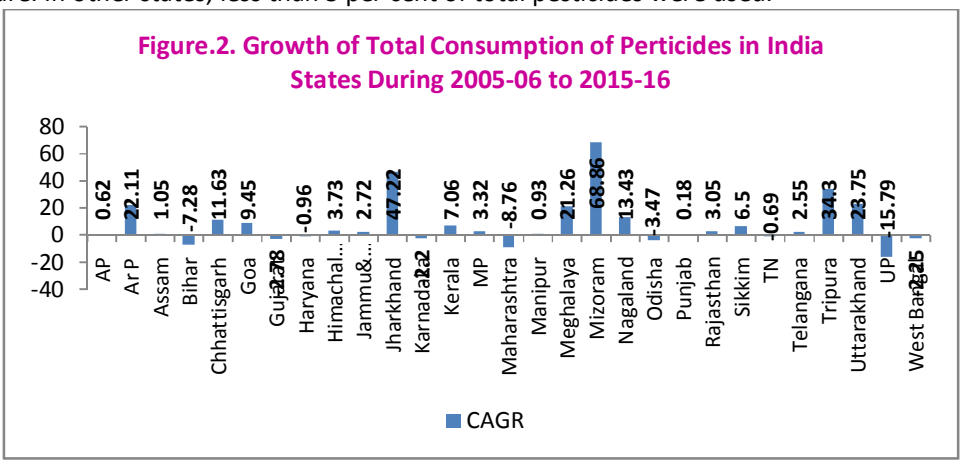
State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-12015-16	CAGR
AP	5.02	3.36	3.53	3.15	2.43	15.97	17.53	6.14	7.06	6.79	3.92	0.62
Ar P	0.01	0.04	0.04	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.03	22.11
Assam	0.41	0.40	0.36	0.34	0.05	0.27	0.30	0.40	0.32	0.34	0.34	1.05
Bihar	2.20	2.14	1.99	2.09	1.98	1.22	1.24	1.51	1.27	1.37	1.52	-7.28
Chhattisgarh	1.13	1.32	1.31	0.62	0.49	1.03	1.13	1.78	1.69	1.78	2.77	11.63
Goa	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	9.45
Gujarat	6.79	6.43	6.10	6.27	6.22	4.68	4.13	2.65	3.87	3.21	3.63	-2.78
Haryana	11.47	11.08	0.68	0.73	0.78	7.31	7.64	8.88	6.77	7.10	7.52	-0.96
Himachal Pradesh	0.75	0.70	2.86	6.11	3.92	0.59	0.59	0.70	0.57	0.62	0.82	3.73
Jammu&Kasmir	3.60	2.00	2.86	6.11	3.92	3.27	3.23	3.92	2.86	3.35	3.53	2.72
Jharkhand	0.18	0.20	0.19	0.19	0.21	0.15	0.29	0.33	0.71	1.13	9.04	47.22

Karnadaka	4.12	3.28	3.64	3.82	3.94	3.35	2.67	3.54	2.88	2.98	2.35	-2.2
Kerala	1.44	1.31	2.02	0.62	1.51	1.18	1.52	1.56	2.12	1.60	2.22	7.06
MP	1.98	2.31	1.60	1.51	1.54	1.14	1.60	1.85	1.64	1.21	2.07	3.32
Maharashtra	8.04	7.69	6.99	5.47	11.09	14.97	12.69	14.51	18.20	19.60	2.14	-8.76
Manipur	0.07	0.06	0.06	0.07	0.07	0.05	0.06	0.07	0.05	0.05	0.06	0.93
Meghalaya	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.08	0.07	0.05	0.09	21.26
Mizoram	0.06	0.10	0.10	0.10	0.09	0.01	0.01	0.01	0.84	1.41	14.59	68.86
Nagaland	0.01	0.01	0.01	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	13.43
Odisha	2.42	1.87	2.55	2.64	3.80	1.57	1.05	1.33	2.02	2.93	1.20	-3.47
Punjab	14.11	14.39	13.94	13.13	13.89	10.32	10.62	12.56	9.49	9.94	10.49	0.18
Rajasthan	2.53	8.59	8.72	7.60	8.43	6.52	5.29	5.61	4.54	2.54	2.57	3.05
Sikkim	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	6.5
TN	5.56	4.93	9.03	5.28	5.58	4.25	3.71	3.87	3.55	3.65	3.76	-0.69
Telangana	-	-	-	-	-	-	-	-	-	4.89	5.41	2.55
Tripura	0.04	0.05	0.06	0.09	0.13	0.02	0.50	0.60	0.51	0.54	0.66	34.3
Uttarakhand	0.35	0.50	0.62	0.50	0.53	0.36	0.39	0.54	0.29	0.23	2.70	23.75
UP	16.78	17.86	16.80	20.45	22.87	15.23	16.68	19.85	16.86	17.20	1.85	-15.79
West Bangal	10.69	9.23	9.04	9.35	7.85	6.33	6.93	7.60	5.29	5.34	6.06	-2.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	2.91

Source: Various year ICAR (Indian Agricultural Statistics Research Institute) - Agricultural Research Data Book

The above table shows the consumption of pesticides in Indian states during 2005-06 to 2015-16. Among the states, the highest percentage of pesticides was used in states of Maharashtra, Punjab and Uttar Pradesh where more than 10 per cent of pesticides were used in most of the years in the study period. Then Andhra Pradesh, Gujarat, Haryana, Rajasthan and West Bengal 5 to 10 per cent of the pesticides were used for agriculture. In other states, less than 5 per cent of total pesticides were used.

Figure.2. Growth of Total Consumption of Perticides in India States During 2005-06 to 2015-16



Source: Table 3 CAGR

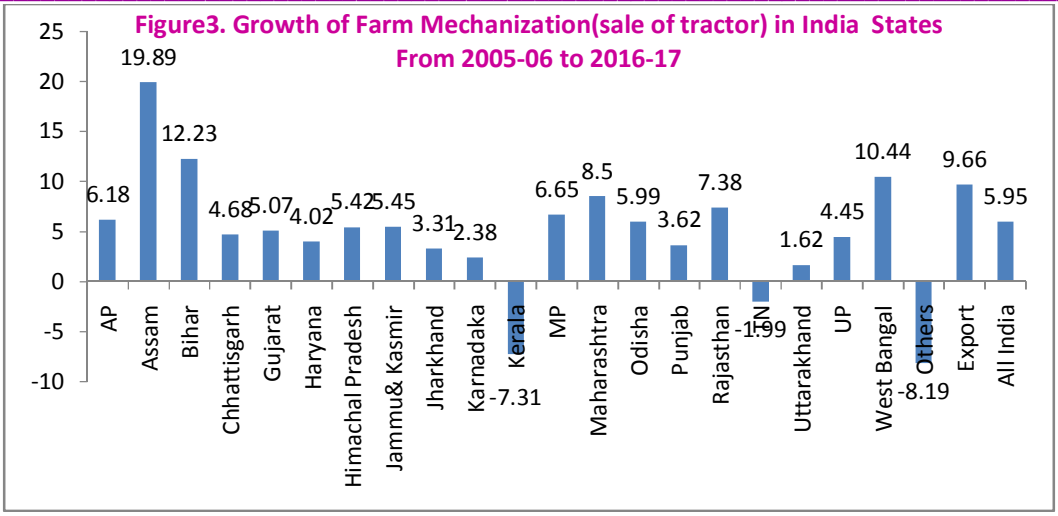
The above figure shows the CAGR of usage of pesticides in the states of India during 2005-06 to 2015-16. It has been highest in the state of Mizoram with 68.86 per cent followed by Jharkand (47.22) Tiripura (34.3) Uttarkand (23.75) and Arunachal Pradesh (22.11) per cent. Overall, in the states of Tamil Nadu, Haryana, Karnataka, West Bengal, Gujarat, Odisha, Bihar, Maharashtra and Uttar Pradesh the usage of pesticides has reduced over the years and have registered negative growth rate. In other states the pesticides usage have increased and registered positive growth rate.

Table 4:Consumption of Farm Mechanization(sale of tractor),(Numbers) in Indian States From 2005-06 to 2016-17

State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CAGR
AP	7.42	10.48	13.08	11.55	8.23	6.45	8.75	10.72	10.76	5.91	7.60	6.18
Assam	0.25	0.33	0.39	0.48	0.85	0.45	0.34	0.36	0.35	0.57	0.99	19.89
Bihar	3.29	3.48	3.92	5.28	6.88	4.88	4.28	4.79	4.33	5.76	6.20	12.23
Chhattisgarh	3.37					2.04	1.52	1.56	1.74	3.19	2.95	4.68
Gujarat	7.64	8.73	7.55	6.07	5.76	8.09	6.90	5.21	6.34	7.40	6.97	5.07
Haryana	4.86	6.00	7.06	6.78	6.79	5.21	5.19	4.02	4.39	4.89	3.97	4.02
Himachal Pradesh	0.25	0.33	0.27	0.27	0.28	0.26	0.23	0.21	0.22	0.24	0.24	5.42
Jammu&Kasmir	0.43	0.35	0.40	0.34	0.38	0.39	0.43	0.61	0.54	0.41	0.41	5.45
Jharkhand	1.88	NA	NA	NA	NA	1.20	1.10	1.14	1.20	1.30	1.42	3.31
Karnadaka	8.37	6.61	5.15	4.16	5.65	5.00	4.80	5.90	5.81	5.39	5.74	2.38
Kerala	0.25	0.54	0.15	0.11	0.14	0.12	0.10	0.10	0.06	0.04	0.06	-7.31
MP	7.88	5.70	5.45	7.31	7.90	8.89	8.33	11.99	12.61	10.17	8.47	6.65
Maharashtra	5.68	7.67	8.91	7.70	8.10	7.51	9.32	7.32	6.70	7.95	7.37	8.5
Odisha	2.21	2.12	1.49	1.53	1.87	2.36	2.18	2.68	3.49	1.74	2.22	5.99
Punjab	3.98	4.77	5.40	6.02	6.78	4.43	45.53	4.72	5.07	4.16	3.12	3.62
Rajasthan	9.24	10.18	8.80	7.74	7.54	9.83	9.41	7.49	9.39	10.30	10.71	7.38
TN	6.05	6.44	5.05	4.39	3.74	3.79	4.33	3.12	1.42	1.29	2.57	-1.99
Uttarakhand	0.77	NA	NA	NA	NA	0.71	0.88	0.78	0.71	0.35	0.48	1.62
UP	14.65	14.18	11.86	15.48	17.46	14.12	13.60	14.32	13.73	14.71	12.52	4.45
West Bangal	1.43	1.65	1.60	1.83	2.18	2.39	2.01	2.16	1.97	2.03	2.26	10.44
Others	0.80	0.52	0.45	0.60	0.55	0.34	0.36	0.15	0.18	0.17	0.17	-8.19
Export	9.29	9.94	13.02	12.37	8.91	11.53	11.65	10.65	9.00	12.02	13.56	9.66
All India	100	100	100	100	100	100	100	100	100	100	100	5.95

Source: Various year ICAR- Indian Agricultural Statistics Research Institute- Agricultural Research Data Book 2017

The above table shows the usage of machinery in agriculture in Indian states. Overall the use of mechanization has been highest in the state of Uttar Pradesh with around 11 to 17 percent of the total machinery use in the country. Then, in states like Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan around 5 to 10 percent of the machinery has been used. In other states, less than 5 per cent of the total machinery in India has been used for agriculture during the study period.



The above figure shows the CAGR of mechanization in agriculture in the states of India. The growth has been highest in Assam with 19.89 per cent of CAGR followed by followed by Bihar (12.23) and West Bengal (10.44). Among the states, Kerala and Tamil Nadu have registered negative growth rate signifying decrease in usage of machinery in agriculture. In all other states there has been considerable increase in the usage of machinery in agriculture during study period.

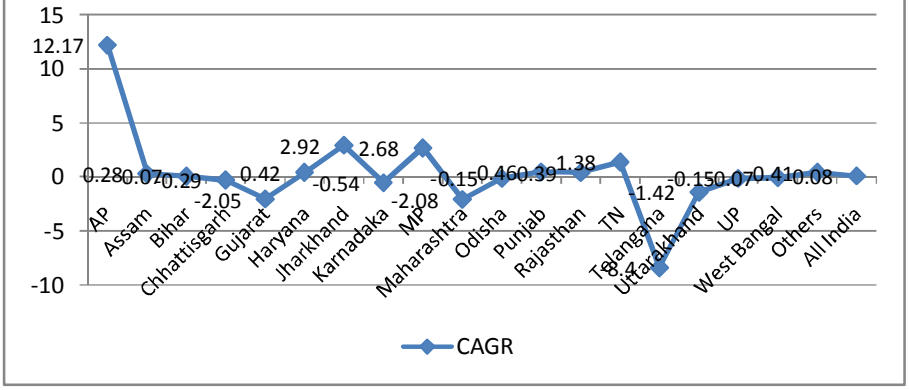
Table 5. Growth Rate of Area Under the Cultivation of Total Food Grains in Indian States During 2004-05 to 2015-16(Million Hectares)

State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CAGR
AP	5.9	5.88	5.96	6.06	5.5	6.34	5.84	5.79	5.91	3.19	3.38	12.17
Assam	2.14	1.92	2.03	2.17	2.23	2.19	2.2	2.23	2.13	2.17	2.19	0.28
Bihar	5.39	5.42	5.67	5.63	5.46	10.29	5.37	5.58	5.12	5.41	5.38	0.07
Chhattisgarh	4.24	4.09	4.09	4.04	4.01	3.92	3.98	4.21	3.98	4.07	4.07	-0.29
Gujarat	3.26	3.69	3.61	3.31	3.04	3.58	3.8	2.96	3.5	2.84	2.58	-2.05
Haryana	3.51	3.52	3.61	3.75	3.74	3.73	3.71	3.64	3.52	3.58	3.64	0.42
Jharkhand	1.59	1.92	1.97	1.98	1.34	1.18	1.86	2.01	1.82	2.05	2.16	2.92
Karnadaka	6.25	6.02	6.34	6.07	6.56	6.51	5.96	6.04	6.03	5.78	5.84	-0.54
MP	9.61	9.52	9.1	9.7	10.27	10.15	10.82	11.71	11.46	12.44	12.74	2.68
Maharashtra	10.49	10.87	10.66	9.3	9.98	0	8.71	8.76	9.17	9.21	8.25	-2.08
Odisha	4.49	4.37	4.42	4.42	4.46	4.2	3.94	4.16	4.11	4.16	4.38	-0.15
Punjab	5.2	5.09	5.08	5.26	5.36	5.14	5.22	5.44	5.24	5.3	5.42	0.46
Rajasthan	10.24	10.27	10.97	10.75	10.94	11.9	11.58	10.27	10.73	10.32	10.59	0.39
TN	2.73	2.56	2.5	2.6	2.5	2.5	2.57	2.18	2.75	2.85	3.15	1.38
Telangana	-	-	-	-	-	-	-	-	-	2.1	1.79	-8.4
Uttarakhand	0.85	0.8	15.38	0.84	0.83	0.78	0.76	0.77	0.71	0.72	0.72	-1.42
UP	16.15	16.2	0.81	16.09	15.92	15.63	16.14	16.53	16.11	16.15	15.75	-0.15
West Bangal	5.3	5.14	5.13	5.32	5.14	4.39	4.84	5.04	5.02	4.93	5.21	-0.07
Others	2.69	2.72	2.68	2.71	2.73	2.74	2.71	2.69	2.7	2.73	2.79	0.41
All India	100	100	100	100	100	100	100	100	100	100	100	0.08

Source: Various year ICAR- Indian Agricultural Statistics Research Institute- Agricultural Research Data Book 2017

The above table shows the percentage of area of food grains cultivated in the states of India during 2005-06 to 2014-15. Among the states Uttar Pradesh has the highest percentage of area under cultivation of food grains, which is around 16 per cent of the total area cultivated in India. Then in states like Madhya Pradesh, Maharashtra and Rajasthan around 10 percent of the total area in India comes under cultivation of food grains. States like Andhra Pradesh, Bihar, Karnataka, Punjab and West Bengal around 5 to 10 percent of the total area have been cultivated. In other states less than 5 percent of the total area in the country has been cultivated.

Figure. 4. Growth Rate of Total Food Grains in India States during 2004-05 to 2015-16



Source: Table 5 Colum CAGR

The above figure shows the CAGR of area under cultivation of food grains in the states of India during 2005-06 to 2015-16. From the Table 5 and figure 4 it can be clearly seen that the CAGR has been highest in Andhra Pradesh with 12.17 per cent of CAGR, followed by Jharkand (2.92), Madhya Pradesh (2.68) and Tamil Nadu with 1.38 per cent. Apart from these states, Punjab, Haryana, Rajasthan, Assam and Bihar have registered positive growth. In all other states the area under cultivation of food grains have reduced and registered negative growth rate.

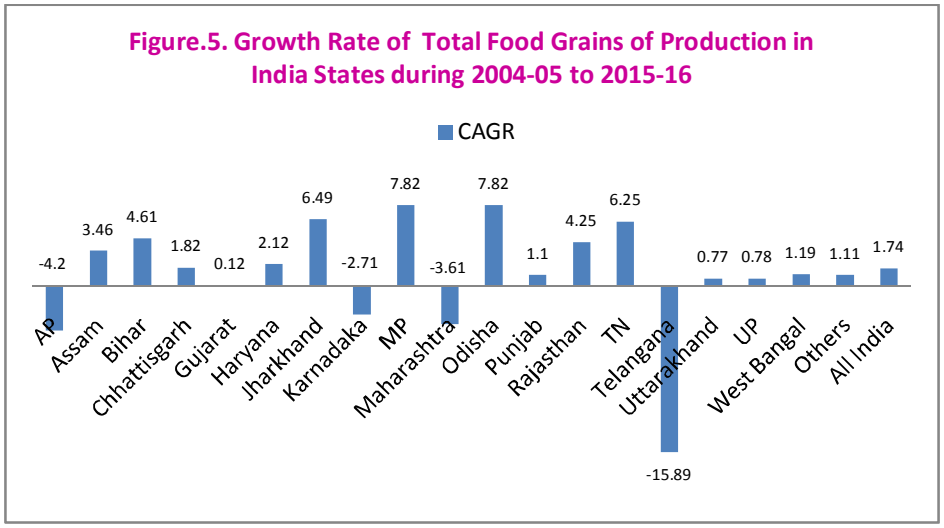
Table 6. Growth Rate of Production of Total Food Grains in Indian States During 2004-05 to 2015-16(Million Tonnes)

State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CAGR
AP	8.13	7.47	8.39	8.71	7.01	8.31	7.08	7.26	7.42	4.16	4.19	-4.2
Assam	1.76	1.41	1.51	1.77	2.05	2.00	1.80	2.05	1.92	2.17	2.12	3.46
Bihar	4.12	5.11	4.72	5.21	4.65	3.77	5.42	6.20	4.87	5.24	5.59	4.61
Chhattisgarh	2.74	2.67	2.73	2.20	2.25	2.89	2.65	2.97	2.87	2.96	2.76	1.82
Gujarat	2.95	2.99	3.57	2.76	2.64	3.41	3.42	2.75	3.46	2.82	2.47	0.12
Haryana	6.23	6.79	6.65	6.66	7.04	6.80	6.93	6.31	6.40	6.05	6.49	2.12
Jharkhand	0.99	1.70	1.81	1.79	0.99	0.77	1.61	1.77	1.62	1.90	1.62	6.49
Karnadaka	6.47	4.42	5.30	4.81	5.02	5.68	4.67	4.22	4.61	4.82	3.95	-2.71
MP	6.33	6.33	5.25	5.93	7.34	6.11	7.86	9.21	8.67	11.38	11.98	7.82
Maharashtra	5.80	5.82	6.60	4.87	5.77	6.31	4.84	4.27	5.23	4.49	3.20	-3.61
Odisha	3.53	3.38	3.54	3.16	3.46	3.12	2.47	3.12	3.15	3.56	2.61	7.82

Punjab	12.07	11.65	11.66	11.66	5.67	11.40	10.95	9.93	11.12	10.59	11.26	1.1
Rajasthan	5.49	6.54	6.98	7.11	5.66	7.70	7.51	7.14	6.75	7.79	7.18	4.25
TN	2.94	3.80	2.86	3.03	3.44	3.10	3.91	2.17	3.31	3.82	4.73	6.25
Telangana	-	-	-	-	-	-	-	-	-	2.82	1.99	-15.89
Uttarakhand	0.76	0.80	0.78	0.75	0.83	0.74	0.71	0.71	0.67	0.65	0.69	0.77
UP	19.37	18.97	18.29	19.93	19.81	19.33	19.39	19.74	18.88	15.71	17.45	0.78
West Bangal	7.48	7.35	6.98	6.95	7.22	5.92	6.17	6.44	6.44	6.56	7.05	1.19
Others	2.85	2.80	2.69	2.69	2.45	2.76	2.61	3.74	2.61	2.52	2.66	1.11
All India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1.74

Source: Various year ICAR- Indian Agricultural Statistics Research Institute- Agricultural Research Data Book 2017

The table 6 shows the percentage distribution of food grains production in the states of India. The percentage share of food grains production has been highest in Uttar Pradesh with around 19 per cent of the total food grains; followed by Punjab with around 9 to 11 per cent of the total food grains production in the country. Then in states like Andhra Pradesh, Haryana, Madhya Pradesh, Rajasthan and West Bengal around 5 to 10 per cent of the total food grains production were made. Other states contributed less than 5 per cent of the total food grains production in the country.



Source: Table 6 Column CAGR

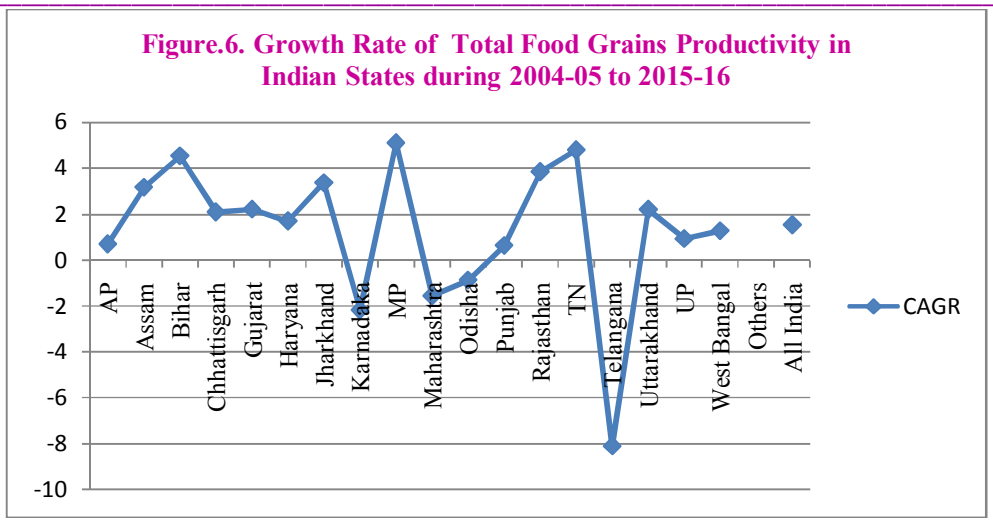
The figure 5 shows the CAGR of production of food grains in the states of India during 2005-06 to 2015-16. The production of food grains has been highest in the states of Madhya Pradesh and Odisha with 7.82 per cent of CAGR in both states, followed by Jharkand (6.49 per cent) and Tamil Nadu with 6.25 per cent growth rate. Among all the states, Karnataka, Maharashtra, Andhra Pradesh and Telangana (the state created in the year 2014) have registered negative growth rate and in all other states the production of food grains have increased.

Table 7. Growth Rate ofProductivity of Total Food Grains in Indian states During 2004-05 to 2015-16(Kg/Hectare)

State/Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CAGR
AP	2365	2231	2613	2744	2294	2531	2519	2670	2661	2650	2555	0.7
Assam	1416	1286	1378	1551	1662	1762	1701	1962	1917	2021	1995	3.17
Bihar	1311	1656	1546	1766	1530	1478	2097	2366	2017	1964	2135	4.53
Chhattisgarh	1111	1148	1238	1041	1008	1423	1385	1506	1525	1475	1395	2.09
Gujarat	1551	1656	1831	1595	1560	1841	1871	1970	2097	2016	1973	2.21
Haryana	3045	3393	3420	3388	3383	3523	3879	3689	3858	3427	3665	1.7
Jharkhand	1073	1550	1709	1720	1330	1262	1701	1876	1891	1872	1544	3.36
Karnadaka	1776	1289	1548	1511	1377	1684	1629	1488	1619	1687	1393	-2.18
MP	1130	1167	1069	1168	1285	1163	1510	1676	1603	1855	1935	5.1
Maharashtra	948	940	1150	1001	1039	1183	1155	1038	1207	988	797	-1.56
Odisha	1349	1359	1484	1363	1397	1432	1303	1592	1626	1738	1226	-0.87
Punjab	3986	4017	4255	4231	4144	4281	4361	3890	4501	4054	4273	0.63
Rajasthan	919	1119	1180	1263	931	1249	1348	1480	1334	1529	1393	3.85
TN	1847	2610	2125	2225	2477	2394	3162	2131	2552	2720	3090	4.79
Telangana	-	-	-	-	-	-	-	-	-	2723	2300	-8.09
Uttarakhand	1548	1760	1785	1715	1780	1838	1802	1962	1996	1813	1967	2.2
UP	2057	2057	2206	2365	2236	2386	2498	2542	2484	1972	2278	0.93
West Bangal	2423	2511	2525	2493	2522	2603	2647	2717	2719	2698	2783	1.27
All India	1715	1756	1860	1909	1798	1930	2078	2129	2120	2028	2056	1.54

Source: Various year ICAR- Indian Agricultural Statistics Research Institute- Agricultural Research Data Book 2017

The above table shows the productivity of the food grains production in the states of India. Among the states the productivity has been highest in Punjab and Haryana throughout the study period and the productivity has been less in the state of Maharashtra. The productivity depends to a large extent on the usage of energy inputs like electricity, fertilizers, pesticides and machinery. Likewise, the states that have used more percentage of energy inputs have realised more level of productivity. For instance in states like Punjab, Andhra Pradesh, Gujarat, Tamil Nadu, Uttar Pradesh and West Bengal the energy input usage has been higher and correspondingly the productivity has also been higher in these states. But surprisingly in states like Maharashtra, Karnataka and Rajasthan despite higher usage of energy inputs, the productivity has been comparatively lesser. On the other hand, in Haryana despitelesser usage of energy inputs, the productivity has been considerably higher. This might be due to the other major factors like geographic, climatic and political conditions in those states.



Source: Table 7 Colum CAGR

The figure 6 shows the CAGR of productivity of food grains in the states of India during 2005-06 to 2015-16. The growth of productivity of food grains has been highest in Madhya Pradesh with 5.1 per cent CAGR followed by Tamil Nadu (4.79 per cent) and Bihar with 4.53 per cent of growth rate. Among the states, Odisha, Karnataka, Maharashtra and Telangana the productivity has reduced and have registered negative growth rate and in all other states there is positive growth of productivity of food grains.

CONCLUSION

The present study has deliberated the energy use in agriculture sector at the state level. The major finding of the present study is agriculture energy consumption in Indian states have increased day by day due to improved use of new technology.To conclude overall it can be said that the energy use plays a significant role in the production and productivity of agricultural output. Therefore steps must be taken to improve energy use in agricultural sector and get optimized benefits. Based on the findings, the study suggests that the timely availability of agriculture energy like short lifespan of adequate irrigation facilities and new variety of seeds, introduction of modern mechanization, enough electricity voltage and timely availability of relevant and availability of chemical fertilizer etc., will help in the development of energy use in agriculture sector and will lead to development of the economy as well.

REFERENCE

Agricultural Statistics at a Glance (2016), Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics.

EbrahimZareiShahamat et.al.(2013), "Energy Use and Economical Analysis of Sugarcane Production in Iran a Case Study: DebelKhazaeei Agro-Industry", *International Journal of Agriculture and Crop Sciences*,Vol.5,No.3

ElumalaiKannan (2013), "Do Farmers Need Free Electricity Implications for Groundwater Use in South India", *Journal of Social and Economic Development,* Vol.15, No.2.

Ramachandra Murthy (2009), "Analysis on Electrical Energy Consumption of Agricultural Sector in Indian Context", ARPN Journal of Engineering and Applied Sciences, Vol.4, No.2.

http://iasri.res.in/agridata/17data/HOME_17.HTML

http://www.icfa.org.in/assets/img/year-book/yb-2016.pdf

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