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Growth and variability of agriculture in Odisha: A case study of Balasore district in Soro block

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Abstract
Indian agriculture had reached the stage of development and maturity much before the now advanced countries of the world embarked on the path of progress. At that time, there was a proper balance between agriculture and industry and both flourished hand in hand. Indian agriculture in the pre independence period can be correctly described as a "Subsistence" occupation which yielded "too little to live on and too much to die on".
Agriculture in Odisha generally means growing rice. It is the staple food of almost the entire population of Odisha; therefore, the state's economy is directly linked to changes in rice production. Rice is the major crop, covering about 63% of the total area under food grains.
The state economy is directly linked with the increase in productivity of Rice as it is the staple food in the state. Orissa agriculture is highly concentrated in low productive and high water consuming paddy cultivation. The yield rate of rice which is the staple cereal crop of Orissa, the picture is, also, not encouraging.
The net sown area of the country has reached a point where it is not possible to make any appreciable increase. Thus, raising the cropping intensity and raising productivity seem more viable strategies to increase production of farm products and farmers' incomes. Cropping intensity refers to raising a number of crops from the same field during one agriculture year. Higher cropping intensity means more than one crop from the same area in an agricultural year. Cropping intensity is highest in Punjab, followed by West Bengal, Haryana and Himachal Pradesh in the country.

Keywords: minimum support price, cropping intensity, cropping pattern, HYVS, instability, gross irrigated area, wage rate, unemployment rate, net irrigated area, fertilizer consumption

Introduction
Agriculture is defined as art of practice of cultivation of land. It is the main economic activity of any state which encompasses cultivation of crops; cattle rearing and trade. Indian agriculture had reached the stage of development and maturity much before the now advanced countries of the world embarked on the path of progress. At that time, there was a proper balance between agriculture and industry and both flourished hand in hand. This situation continued till the middle of the eighteen century. The interference from the alien British Government and its deliberate policy of throttling the village handicrafts and cottage industries destroyed the fiber of balance and the economy of the country was badly shattered. Indian agriculture in the pre independence period can be correctly described as a "Subsistence" occupation which yielded "too little to live on and too much to die on". A majority of farmers were just able to eke out a level of subsistence from agricultural activities. It was only after the advent of planning that some farmers started adopting agriculture on a commercial basis.

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Table 1: Rice production of India in global context

Year	World Production (In Million MT)	Indian Production (In Million MT)	India's Share (In Percent)
2001-02	399	93.34	23.39
2002-03	380	71.82	18.90
2003-04	390	88.53	22.70
2004-05	405	83.13	20.53
2005-06	423	91.79	21.70
2006-07	427	93.35	21.86
2007-08	438	96.69	22.08
2008-09	459	99.18	21.61
2009-10	457	89.09	19.49
2010-11	449	95.98	21.38
2011-12	456	104.32	22.88
2012-13	463	103	22.25
2013-14	471	102	22.03
2014-15	476	103	21.89
Mean	435.21	93.94	21.62
S.D	30.37	8.62	1.19

Source: http://drd.dacnet.nic.in/Downloads/Rice-Varieties-Upto-2015.pdf.

Objectives of the study
1. To analyse to trend of growth and productivity of rice production in Odisha in general and in particularly Balasore district for period 2001-2015.
2. To study the degree and extent of variation in rice production in Balasore district and the factors for instability in rice production.
3. To suggest and recommend different policies for improving the rice production.
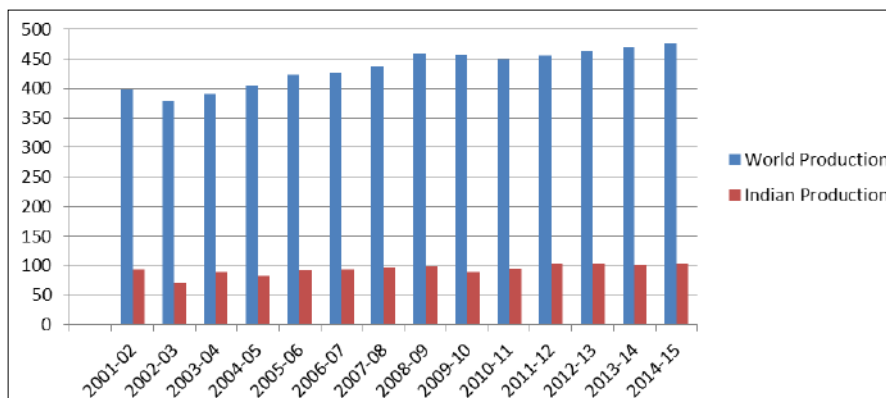
Fig 1: Rice production of India in global context

Methodology
Generally research study is always based on statistical technique and analytical frame work. The study will be relevant and strong if the methodology is correct. Methodological frame work is the foundation to create different paths for finding the relevant and correct data in a complete form. The proposed study are based on primary & secondary data. The secondary data are collected from food statistics (Directorate of Civil Supply, BBSR) agricultural survey in India, Odisha. Economic survey (2013-2014), district statistical handbooks, NSS reports and other publications of Bureau of economic and statistics Govt. of Odisha, India Economic Survey (2013-14). The primary data is collected from 200 farmers in 2 blocks in Balasore districts.
The annual growth rates and compared growth rate are calculated using different statistical techniques. The co-efficient of variation and standard deviations are calculated to study the variability in the rice production in Balasore district.

Selection of district
The research study presents the rice production in Balasore district of Odisha.

Selection of block
Block is taken as the third unit of research study. Balasore district consists of 12 blocks such as, Soro, Bahanaga, Basta, Bhograi, Jaleswar, Upada, Baliapal, simulia, khaira, Nilagiri, Remuna, Oupada.

Selection of villages

Table 2: The Villages are the fourth stage units of present study. The sample selected from different villages is stated below.

Sl. No.	Name of the Village	No. of Sample
1	Mangalpur	20
2	Mohumuhan	20
3	Siripur	20
4	Kesharipur	20
5	Manipur	20
6	Mulisingh	20
7	Nadigaon	20
8	Sarasankha	20
9	Anantapur	20
10	Narasinghpur	20
	Total	200

From this primary studies, very well known that most of the villages are not sufficient irrigation facilities. In mangalapur village, farmers are depended on mining because irrigation facilities is most important problem. Most of the land are dried up most of the time in a year. In mohumuhan village, farmers are depended on the lift irrigation but irrigation and subsidies, fertilizers. In siripur village, co-operative society is not helpful to farmers. Some extent, irrigation facilities are not available. But standard of farmers are not good People are not attracted to agriculture. In kesharipur, Manipur, mulisingh, farmers are facing many problems irrigation facilities, pesticides, lack of co-operative societies. Nadigaon, sarasankha, Anantapur, Narasighapur villages are most fertile. Agricultural land gives more harvesting. Standard of living of farmers are good some extent. But problem is irrigation facilities, fertilizer and not application of modern technology. The borrowers under study falls under the above listed villages and data are collected in printed questionnaires from these villages while considering the selection of villages for the 4th stage of unit and 10 villages have been selected for the study.

Selection of crops

Agriculture in Odisha generally means growing rice. It is the staple food of almost the entire population of Odisha; therefore, the state's economy is directly linked to changes in rice production. Rice is the major crop, covering about 63% of the total area under food grains. It is a very essential part of the daily meal in Odisha, where wheat is frequently eaten, rice holds its own and is cooked daily as well as on festivals and special occasions Pulses and oil seeds are also taken for comparing their area and productivity with rice.

Nature and source of data

The present study is based on primary data and time-series secondary data on area, yield, production, irrigated area (gross and net), fertilizer consumption, rainfall, power consumption, seed, credit for major crops rice, pulses, oilseeds and total food grain at the aggregate level Attempt has been made to study the changes in the agricultural instability in area, yield and production for major crop groups in Odisha for the aggregate of crop-sector physiographic zone wise. The data have been collected from the various issues of Agriculture Statistics of Odisha published by Directorate of Agriculture and Food Production, Government of Odisha. Analysis is extended to disaggregate level using the district level data for the state, as there exists, vast variations in agro climatic conditions across the districts. The state has been divided into four physiographic zones. The physiographic zone wise analysis has been undertaken on the basis of 30 districts. The study estimates the instability in agriculture by dividing the entire study period into two phases. The data for a period of twenty-one years, from 1991 to 2012 were collected from various issues of Odisha Agricultural Statistics, Status of Agriculture published by Directorate of Agriculture and Food Production, various issues of Economic Surveys and statistical abstracts of Odisha published by Directorate of Economics and Statistics Govt. of Odisha and Govt. of India and Centre for Monitoring Indian Economy (CMIE), Agricultural Data Book. The data on rainfall and temperature were collected from the database of Indian Meteorological Department (IMD), Pune. The data on population and agricultural workers are collected the Census

of India 2011 and the data on operational land holdings are collected from the agricultural Census of various years.

Methodology

The present study is based on strong statistical methodology. The important methodology used in the study Growth of any variable represents its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over period of time. It clearly indicates the performance of the variable under consideration and it can be very well used for making policy decisions. In the present study growth rate analysis was carried out to compare performance of production rice during the study period. The growth function was estimated separately for period one and period two and the period as a whole. The growth in area, production, yield, and prices of rice in Odisha and Balasore are estimated by using compound growth function.

District wise and period wise compound growth rate of area production and yield of rice production will be calculated by fitting the equation:

$$Y = AB^t$$

Where Y – is the area, production and yield of the crop, A – is a constant, t – is the time period.

Simple statistical tools such as averages, percentages, regression, correlation, standard deviation, have been used in the study. The Simple growth rate, compound growth rate are used for the growth analysis. The coefficient of variation is used for the instability analysis.

Instability analysis

In order to study the variation in area, production and productivity the co-efficient of variation (CV) was computed. The CV is a unit free measure. It is always expressed as percentage. The CV will be small if the variation is small.

$$CV = \frac{SD}{Mean} X \ 100$$

In order to analyze the instability in Odisha, Balasore, and production a method proposed by Mehra (1981) and Hazell (1984) was adopted. This method uses statistical identities to provide an exact decomposition of the components of change in average production and change in variance of production. This method is appropriate since the area, productivity and production keep changing between the years and between districts.

Mean

The mean is the value arrived by dividing the sum of observations by the number of observations. Symbolically, for a sample of n observations

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}$$

The symbol Σ (read as 'sigma') means sum the individual values $x_1, x_2, \cdots$. of the variable, X. Usually, the limits of the summations are not written, since it is understood that the summation is over all n values.

$$\bar{x} = \frac{\sum x}{n}$$

Augmented Dickey-Fuller unit root tests

In statistics and econometrics, an augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejections of the hypothesis that there is a unit root at some level of confidence.

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_{p-1} \Delta y_{t-p+1} + \epsilon_t$$

Where α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modeling a random walk and using the constraint $\beta = 0$ corresponds to modeling a random walk with a drift.

By including lags of the order p the ADF formulation allows for higher-order autoregressive processes. This means that the lag length p has to be determined when applying the test. One possible approach is to test down from high orders and examine the $t - values$ on coefficients. An alternative approach is to examine information criteria such as the Akaike information criterion, Bayesian information criterion or the Hannan–Quinn information criterion.

The unit root test is then carried out under the null hypothesis $\gamma = 0$ against the alternative hypothesis

of $\gamma < 0.$ Once a value for the test statistic

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$

is computed it can be compared to the relevant critical value for the Dickey–Fuller Test. If the test statistic is less (this test is non-symmetrical so we do not consider an absolute value) than the (larger negative) critical value, then the null hypothesis of $\gamma = 0$ is rejected and no unit root is present.

Rice production and inputs in Odisha

Food grains account for a major proportion of gross cropped area in Odisha. The percentage of gross cropped area under food grains was 89.4 percent in 1998 which has declined to 78.62 percent. The average per hectare yield rate of food grain in Orissa is only 1737 kg, whereas the all-India average is 2125 kg in 2012-13. The state economy is directly linked with the increase in productivity of Rice as it is the staple food in the state. Orissa agriculture is highly concentrated in low productive and high water consuming paddy cultivation. The yield rate of rice which is the staple cereal crop of Orissa, the picture is, also, not encouraging. The average per hectare yield rate of rice in Orissa is only 2361kg, whereas the all-India average is 2462 kg. In Orissa trends in area, production is fluctuating for both food grains and rice from 1995-2013[9]. In eastern India, Orissa had more than 3percent growth but other states continued to have low growth. Hence this study focuses on the factors affecting the production of both rice and food grain in Odisha is presented in the table

Table 3: Factors affecting food production and rice production

Year	Food Grain Area (Lakh hc)	Food Grain Production (lakh metric ton)	Rice Area (Lakh hc)	Rice Production (Lakh MT)	Rainfall (mms.)	Seed (Paddy) (in qtls.)	Irrigation (Utilized) (th. ha.)	Fertilizer (In 000 MT)	Credit (In Crore Rupees)	Power (In million Unit)
1995-96	71.94	79.23	45.29	62.26	1588	113274	26.29	237.53	252.00	7532
1996-97	63.6	53.47	44.67	44.37	990.1	120717	22.63	250.76	275.00	5418
1997-98	66.16	73.11	44.97	62.05	1493	199976	23.18	290.8	326.00	5571
1998-99	64.52	63.78	44.47	53.9	1277.5	231636	23.58	299.14	463.00	5431
1999-2000	66.87	62.66	46.02	51.87	1435.7	230251	25.12	359.94	595.00	5603
2000-01	62.63	55.35	44.34	46.17	1035.1	220135	21.26	319.21	611.00	6090
2001-02	66.83	82.33	45	71.49	1616.2	254886	25.46	344.66	754.00	5792
2002-03	59.92	40.45	42.74	32.44	1007.8	138096	17.12	290.56	869.00	6745
2003-04	65.68	77.37	45.01	67.33	1663.5	145085	25.18	326.21	1107.00	7208
2004-05	65.76	75.88	44.92	65.37	1256.7	127427	26.91	355.3	1481.00	7598
2005-06	67.9	82.21	44.79	69.63	1497.7	160223	29.66	394.88	2111.00	8144
2006-07	68.4	82.98	44.5	69.28	1682.8	169464	31.49	402.88	2494.00	9288
2007-08	68.84	92.54	44.52	76.55	1583.2	291850	33.08	462.32	2665.00	10761
2008-09	69.11	86.33	44.55	69.15	1523.6	360044	31.77	534.87	2614.00	11747
2009-10	69.20	87.07	43.65	70.22	1362.6	499350.04	30.38	519.34	3944.91	12228
2010-11	67.83	87.69	42.25	69.31	1293.0	523298.27	31.05	521.8	5448.78	13099
2011-12	64.82	76.16	40.04	58.95	1338.1	521374.78	30.87	514.68	6852.00	13054
2012-13	65.60	113.98	40.22	94.96	1384.1	535128.59	33.65	490.20	8457.02	13342
Mean	66.42	76.26	44.00	63.07	1390.48	269012.00	27.15	384.17	2295.54	8591.72
SD	2.79	16.72	1.65	13.94	217.69	151816.10	4.60	99.81	2418.22	2980.47
CV	4.20	21.93	3.76	22.10	15.66	56.43	16.93	25.98	105.34	34.69
Min	59.92	40.45	40.04	32.44	990.10	113274.00	17.12	237.53	252.00	5418.00
Max	71.94	113.98	46.02	94.96	1682.80	535128.60	33.65	534.87	8457.02	13342.00
SROG	-8.81	43.86	-11.19	52.52	-12.84	372.42	-8.81	43.86	-11.19	52.52
CAGR	-0.01	0.02	-0.01	0.03	-0.01	0.10	-0.01	0.02	-0.01	0.03

Source: Agricultural Statistics, Odisha, Status of Agriculture, Odisha (Various Years), Statistical Abstract of Odisha 2012, Odisha.
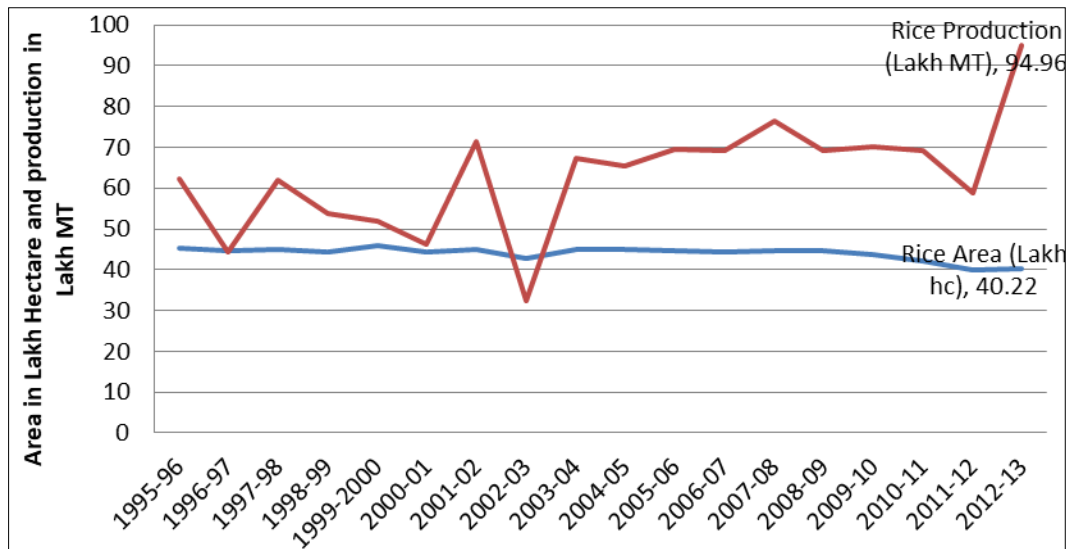
Fig 1: Trend of rice production and area in Odisha

The average food grain area from 1995-2013 in Odisha is 66.42 thousand hectare. But there are fluctuations in its trend. Food grain area is less fluctuated as its standard deviation is low. The simple rate of growth of food grain area is -8.81 this means that food grain area is declining over the time. The compound growth rate is also found to be negative. The average food grain production in Odisha is 76.26 thousand MT. Food grain production has wide variations over the years since standard deviation is 16.72. Coefficient of variations of food grain is also very high 21.93 from 1995-2013.The maximum food grain production in Odisha is 113.98 thousand MT in 2012-13and minimum is 40.45 thousand MT in 2002-03. The simple rate of growth is found to be positive and it is 43.86. The compound growth rate food grain production is very low. Hence food grain production growth rate is very low. The average area under rice cultivation in Odisha is 44 hect from 1995-2013. Area under rice is also shows fluctuating trends over the years. Rice area is also less fluctuated than area under food grain as its standard deviation is 1.65. The simple growth rate of rice area is -11.19. It shows that area under rice is slowly decreasing over the years. The compound growth rate calculated for area under rice is also negative. The average rice production in Odisha from 1995-2013 is found to be 63.07 mt. There is large variation in rice production over the time period from 1995-2013. Since the standard deviation is 13.94. Coefficient of variation of rice production is 22.10 which is higher than coefficient of variations of food grain production. Standard deviation and coefficient of variation of rice in Odisha from 1995-2013 is217.69and 15.66. It implies that rainfall in Odisha is highly unstable and erratic. Average seed distribution in the state from 1995-2013 is 269012.The simple rate of growth of seed distribution is 372.42 and its compound growth rate is 0.10. The simple growth rate of seed distribution is very high and positive whereas compound growth rate is very low. It refers to seed distribution is increasing over the years. Its standard deviation and coefficient of variation is also very high i.e. 151816.10 and 56.43 respectively. There is high instability in Seed distribution over the time. The maximum seed distribution is 535128.60 in 2012-134 and minimum is 113274 in 1995-96. Average irrigated area utilized in the state from 1995-2013 is 27.15 thousand hectare. But there are oscillations in its trend. Irrigated area

utilized is less fluctuated as its standard deviation is very low i.e.4.60. But its coefficient of variation is 16.93.
The simple growth rate of fertilizer consumption in the state is 43.86 and its compound growth rate is 0.02. It means that the simple growth rate of fertilizer consumption is high whereas compound growth rate calculated for it is low. Fertilizer consumption in Odisha is highly fluctuated over the years from 1995-2013, since its standard deviation and coefficient of variation is very high i.e. 99.81 and 25.98 respectively. It is also refers that the fertilizer consumption in the state is increasing over the time but it is instable. Average fertilizer consumption in the state from 1995-2013 is 384.17. The minimum fertilizer consumption in the state is 237.53 thousand MT in 1995-96 and maximum is 534.87 thousand MT in 2008-09. Average credit distribution in the state is 2295.54 crore rupees. But it has instability over the years, since its standard deviation band coefficient of variation is very high i.e. 2418.22 and 105.34 respectively. The simple growth rate of credit distribution is -11.19 that mean that credit distribution is decreasing over the years. The compound growth rate is also computed to be negative i.e. -0.01.The maximum credit distribution in the state is 8457.02 crore rupees in 2012-13 and minimum is 252.00crore rupees in 1995-96. Average power consumption in the state from 1995-2013 for agriculture sector is 8591.72 million unit. Coefficient of variations of power consumption is also very high 34.69 from 1995-2013.Power consumption shows highly fluctuating trends because standard deviation calculated for it is very high i.e. 2980.47.The simple growth rate of power consumption is 52.52. It implies that power consumption in the state is increasing over the years. The compound growth rate is also found to be positive i.e. 0.03. The table summarizes that food grain and rice production in the state is mainly depends upon rainfall, area under cultivation, seed, and irrigation, credit and power consumption.

Cropping intensity
There are mainly three ways to meet the increasing demand for food and other farm products. One way is to expand the net area under cultivation, the second is to intensify cropping over the existing area and the third is to raise the productivity of production per ha. The net sown area of the country has reached a point where it is not possible to make

any appreciable increase. Thus, raising the cropping intensity and raising productivity seem more viable strategies to increase production of farm products and farmers' incomes. Cropping intensity refers to raising a number of crops from the same field during one agriculture year. Higher cropping intensity means more than one crop from the same area in an agricultural year. Cropping intensity is highest in Punjab, followed by West Bengal, Haryana and Himachal Pradesh in the country.
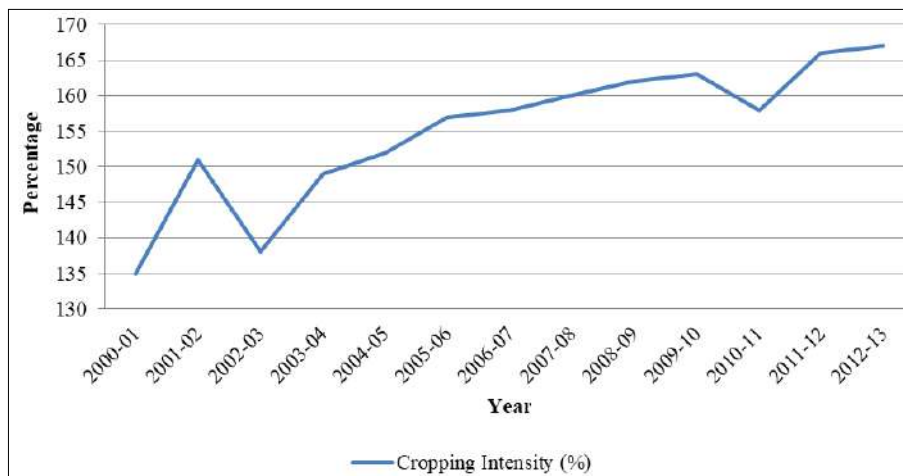
Table 4: Cropping intensity in Odisha

Year	Net Area Sown (In '000 hect.)	Gross Cropped Area (in '000 hect.)	Cropping Intensity (%)
2000-01	5,829	7,878	135
2001-02	5,845	8,798	151
2002-03	5,680	7,853	138
2003-04	5,796	8,637	149
2004-05	5,739	8,718	152
2005-06	5,691	8,928	157
2006-07	5,654	8,960	158
2007-08	5,624	9,016	160
2008-09	5,604	9,071	162
2009-10	5,574	9,074	163
2010-11	5407	8565	158
2011-12	5292	8799	166
2012-13	5331	8879	167
Mean	5620.46	8705.85	155.08
SD	179.84	404.51	9.89
CV	3.20	4.65	6.38
Min	5292	7853	135
Max	5845	9074	167

Source: Directorate of agriculture and food production, Odisha

Table represents the cropping intensity of the state over a period of year's i.e.2000-01to 2012-13. Cropping intensity during 2000-01is135ands it has increased to 151%. But after that despite a fall in the year 2002-03it has continuously shows an increasing trend from149% in 2003-04 to167% in 2012-13. The CV of Net Sown Area, Gross Cropped Area, cropping intensity of the state is 3.20%, 4.65%, and 6.38%respectively.It is found that the net sown area has increased at a simple growth rate of -23.08 and gross cropped area has increased at a rate of -5.27 percent and cropping intensity at 23.53 percent.

Fig 2: Cropping intensity in Odisha

Inter district variation in rice production
Recently various studies on agricultural growth and instability in Odisha have come into sight in reputed journals and publications of research institutions. Swain (2002) [1] and Pattanayak and Nayak (2004) [14] have studied the regional disparity in agricultural development in different districts and zones of Odisha during the benchmark years 1980 and 2000. Then again another study by Swain *et al*. (2009) [3] covering three benchmark years i.e. 1980-81, 1990-91 and 1998-99. A notable finding of the studies is that regional disparities have moderated in the post-reform period 1991-1999 because of implementation of backward area development programmes by the government. The outcome of the study by Tripathy *et al*. (2011) [4] covering the period 1980-81 to 1992-93 also identify the uneven performance across districts with the coastal districts and Sambalpur district of western region show signs of better performance than others. The result indicates high inter-district variations in agricultural productivity with higher productivity in the coastal and plain land areas than others. In a recent study by Reddy (2013) [5] concerning Odisha agriculture covering the pre-liberalization (1971-90) and post-liberalization (1991-2008) periods, table land zones showing commendable performance compared to eastern

ghat and northern plateau zones in both the periods examined perceptible regional disparities in agricultural growth with Coastal Plains and Central In contrast the study by Chand *et al*. (2009) [6] did not show large variations in productivity levels across various districts in Odisha. While measuring the instability across the crop groups among the zones, it is observed that there is less instability in the yield of crop groups in the second period of the analysis. Improved quality input and output markets like credit facilities, seed production and distribution at local markets, policies to increased use of fertilizer, electricity and technology are responsible for bringing stability in the yield rate among the major crop groups in the zones particularly in the late reform period (2002/03 - 2010/11) Mohanty *et al.* (2014) [7].

Important findings of the study
The study has many findings out of which the important findings are as follows:
1. Irrigation potential created has greater instability in Balasore. The growth rate of irrigation potential created in Balasore is 49.63.It refers that irrigation potential created in the district have continuously increasing over the time period but growth rate of Balasore district is more..
2. The coefficient of variation and standard deviation of area under rice Balasore is 5.10 and 12.16 respectively. This implies that area under rice has greater instability in Balasore.
3. Total irrigated area under rice has increased by 4.65 percent and 0.36 percent in the year 2011-12 and 2012-13 correspondingly in Balasore district. Percentage of irrigated area under rice/ paddy to total irrigated area has been declining over the years from 2003-04 (59.00 percent) to 2012-13 (41.85 percent).
4. The rice production over the years has high instability. The rice production is positively correlated with area, rainfall, irrigation and credit in study area and it is also found that rice production is not significantly related with fertilizer consumption. It implies that increase in the amount of area, rainfall, irrigation, credit availability and cropping intensity leads to increase in the quantity of rice production and vice versa.
5. The growth rate of rice production in both districts has been increasing but the growth rate of rice production is higher in Balasore. The percentage of area under rice to gross cropped area in both the district have declined from 2003-2013. The growth rate of rice productivity in this districts has been declining. The average rice productivity of Balasore districts in 2003-2012 is 1675.80 kg/hectare respectively. Coefficient of variation and standard deviations of rice productivity of Balasore is 12.88 and 215.79 which is less than the coefficient of variation.

Suggestion and policy recommendation
The present study on rice production has illuminated many unexplored area regarding low productivity in rice production. The following suggestions are forwarded for improving the yield of rice.
1. Irrigation availability is a primary factor for increasing rice production in Odisha. At present, farmers in dry land like Balasore district rely on shallow due to inadequate availability of canal water. This has increased cost of cultivation at one hand and has depleted the water level on the other hand. This calls for better management and expansion in surface irrigation facilities through investment and monitoring.
2. Provision of institutional credit for small and marginal farmers is an utmost requirement. They should be provided credit for agricultural purposes on easy terms and conditions by expanding institutional sources of credit. More branches of regional rural bank need to be established in Balasore district.
3. The productivity of paddy has reached to saturation level in Balasore districts of Odisha. Since, there is extremely limited scope of area expansion in, priority may be accorded to research and development in yield raising innovative technology further increase production.
4. Looking at the inadequacy of storage facilities in the state, farmers should be encouraged to create storage facilities at the village level through formation of cooperatives.
5. The State Government should make all efforts to provide facilities to the farmers to utilize information, weather forecast and modified agricultural marketing in Balasore district of Odisha.
6. The analysis of growth and instability of rice production in Odisha has shown a information communication technology in the crucial areas such as market/price distressing picture. First, incidences of green revolution and subsequently of liberalization have not provided any improvement in rice production. Second, the irrigation development has been very slow and consequently, much of the cultivated land is still rain fed in Balasore district.

References
1. Abellanosa AL, Pava HM. Introduction to Crop Science, Central Mindanao University, Musuan, Bukidnon Publications Office 1987, P238. http://en.wikipedia.org/wiki /Agriculture.
2. Adeyemi B Busayo, Fasakin I James. Rainfall variability and rice production in Nigeria: A co-integration model approach. Int. J Agric. Extension Social Dev. 2021;4(1):10-17.
3. Aggarwal PK, Joshi PK, Ingram JSI, Gupta RK. Adapting Food Systems of the Indo-Gangetic Plains to Global Environmental Change: Key Information Needs to Improve Policy Formulation, Environmental Science & Policy 2004;7:487–498.
4. Alagh Yoginder K. Agricultural Policy in the Ninth Plan, Hans E. Karl and B. J. Nanjundappa Memorial Endowment Lecture, Bangalore 1999.
5. Alcamo J, Maerker M, Floerke M, Vassolo S. Water and Climate: A Global Perspective, Kassel World Water Ser., Cent. For Environment System Res., Univ. of Kassel, Kassel, Germany 2003;6.
6. Arun G, Singh Dharam Raj, Kumar Shiv, Kumar Anil. Canal Irrigation Management through Water Users Associations and its Impact on Efficiency, Equity and Reliability in Water Use in Tamil Nadu, Agricultural Economics Research Review 2008;21:273-282.
7. Aggarwal PK, Kalra N. Analyzing the limitations set by climatic factors, genotype water and nitrogen availability on productivity of wheat. II. Climatically potential yields and optimal management strategies.

Field Crops Res 1994;38:93-103.

8. Atibudhi HN. Flow of Institutional Credit to Agriculture in Orissa, Chapter 9, Emerging Issues on Rural Credit, Editorial, R. K. Panda, APH, New Delhi 2005.

9. Awasthi PK, Atkara Shrivastava P. Risk and Uncertainty in Paddy Production, Agricultural Situation of India 1987;44:89.

10. Anderson JR, Hamal KB. Risk and rice technology in Nepal. Indian J Agric. Econ 38 wanger 1983;(2);217-222.

11. Ahsan SM. Agricultural insurance;a new policy for developing countries. Gower Aldershot, England 1985.

12. Arya SL, Rawat RKP. Agricultural growth in Haryana-A district wise analysis. Agric. Sit. India 1990;45(2):121-125.

13. Aggarwal PK, Kalra N. Analysing constraints limiting crop productivity; New opportunities using crop growth modeling. In: Deb DL (ed) Natural Resource Management for Sustainable Agriculture and Environment, Angkor Publishers (P) Ltd., New Delhi 1994, P315–332.

14. Adhya TK, Singh ON, Swain P, Ghosh A. Rice in Eastern India: Causes for Low Productivity and Available Options, Journal of Rice Research 2008;2(1):72-84.