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Determining the Factors Affecting Agriculture GDP Using Econometric Analysis

AUTHOR

Abstract: *Large segment of the Indian population is dependent on agriculture for livelihood, increasing food insecurity is still a big challenge for major section of our country. In the post-reform period, the performance of Indian agriculture is found to be lacklustre due to the stagnation of agricultural investment. Agriculture GDP is impacted by the following factor: rainfall, public and private investment, area under fruits and vegetables, total factor productivity, other inputs like pesticides, electricity, rainfall, fertilizer and seeds. An attempt has been made by the author to empirically investigate this aspect using time series data in the Indian economy for the duration 1991-2019, the semi-log model has been constructed to study the factors affecting Agriculture GDP in India. As per our results, some other variables show insignificant impact on the agriculture GDP, indicating limitations of the model, which could be suffering from issues such as problems of simultaneous equation bias, endogeneity problem, non-stationary series, severe multicollinearity.*

Keywords*: Agriculture GDP, Capital Formation, Net Sown Area, Growth, Development*

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I. Introduction

The major imperatives for placing agriculture on the top of development agenda are: a large segment of population depending on agriculture for livelihood, positive relationship between agriculture growth and poverty reduction, key to higher GDP growth rate through supply and demand routes, widening and deepening rural – urban development divide, increasing food insecurity (S. Bisaliah & S. Mahendra Dev, 2010). As per report of the "Committee on Doubling Farmers Income", in absolute terms, the additional private investment in agriculture sector that will be required to enable the doubling of farmers' real income in India by 2022-23 is Rs. 78,424 crore at 2015-16 prices (Rs. 46,298 crore at 2004-05 prices). While public investment usually strengthen infrastructure of the sector, private investment is associated with enhanced productive capacity. In order to incentivize corporate sector investments in agriculture sector, Government has already rolled out the following policy reforms: (i) The Model Agriculture Produce & Livestock Marketing (Promotion & Facilitation) Act 2017, which provides the opportunity for private sector to set up private markets, alternate marketing channels, online market platforms etc. in both agriculture and livestock marketing. (ii) The Model Agriculture Produce & Livestock Contract Farming & Services Act (Promotion & Facilitation) Act, 2018, which enables private sector investments by way of capital, technology and extension all along the value system. (iii) Exemption to Farmer Producer Companies (FPCs) under Income Tax Act - the Budget 2018 has offered an IT exemption to all FPCs with a turnover of upto Rs 100 crore per annum, by considering their incomes as agricultural income. This will incentivise corporate sector to partner with farmers as FPCs. (iv) 100 per cent FDI in food retail – this will encourage foreign investments in establishing appropriate post-production infrastructure to strengthen the food supply chains. (https://pib.gov.in/Pressreleaseshare.aspx?PRID=1579545).

In the post-reform period, the performance of Indian agriculture is found to be lacklustre due to the stagnation of agricultural investment while there has been a contemporaneous rise in agricultural subsidies, and thus, policy makers suggest that there is a urgent need to put into effect an expenditure switch from subsidies to investment to lift Indian agriculture from its current stagnation (Raghbendra Jha, 2007).

1.1 Aim of the Study

In this paper, we aim to analyse the factors affecting agriculture GDP in the Indian economy using time series data for the duration 1991-2019.

II. Literature Review

Chand, Ramesh and Kumar (2004), estimates a simultaneous equation model using private and public sector capital formation and GDP agriculture as independent variables to find out the determinants of capital formation and their impact on GDP agriculture, and have concluded that GDP agriculture is affected by both capital formation as well as subsidies, besides terms of trade.

Archana S. Mathur, Surajit Das and Subhalakshmi Sircar (2006), in their paper on Status of Agriculture in India: Trends and Prospects, identifies factors which impact agriculture growth at the all India and state level, for which they estimate the production function by using trans-log equation. Their period of study was 1980-81 to 2004-05, and they find that factors such as subsidy for fertilizer usage, agriculture prices, electricity consumption, agriculture prices and public investment are crucial for agriculture growth.

Kannan, Elumalai, (2011) studies the trends in growth of crop sector at the sub national and national level in India for the period 1967-2008. Various variables such as input use, production, value of output, area has been considered for 17 major states for 44 crops in their study. The findings include that there has been significant change in the cropping pattern in India with a shift-over from food grain production to commercial crops. It is also found that higher capital formation, normal rainfall, increased fertilizer consumption, improved irrigation facilities shall boost the crop output in the economy.

Chand, Ramesh et. al (2011), analyzes trends in agricultural productivity at national, and state level in India and identifies the factors responsible for varied performance of different segments of agriculture and states. They have found that rainfall, public and private investment, area under fruits and vegetables, fertilizer, TOT, etc. wielded significant effect on GDP Agriculture.

Chand, Ramesh and Shinoj (2012), paper analyses the trends in agricultural productivity at the national and state levels and attempts to identify the major factors responsible for the varied performance of agriculture in different periods and in different states, and suggest growth of the sector has been highly uneven across time and regions.

C. Obasi, P., Henri-Ukoha, A., S. Ukewuihe, I., & M. Chidiebere-Mark, N. (2013), in their paper on "Factors Affecting Agricultural Productivity among Arable Crop Farmers in Imo State, Nigeria", identifies factors which affect the agriculture productivity in Nigeria using multiple linear regression model. They investigate that factors like age, level of education, farm size, fertilizer use, labour use, planting materials, years of farming experience and extension contracts are the major determinants of agriculture productivity.

Kumar, Ajay, Sharma, Pritee (2013) in their article on "Impact of climate variation on agricultural productivity and food security in rural India" analysis the effects of climate change on the agriculture productivity in terms of value of production and quantity terms for the time 1980-2009 using multi-linear regression model. Their findings imply that climate change negatively impacts agriculture productivity for most food-grain and non food-grain crops in terms of value of production, and quantity produced per land unit.

Biswashree Tanaya Priyadarsini & Chittaranjan Nayak (2017) in their study on paper titled "Determinants of Agricultural Productivity in India: An Econometric Analysis" examines impact of varied factors on the productivity of agriculture in India (both in short run and long run). Their study takes into account time period from 1980-2013, and by applying vector correction model and Johansen cointegration model, analysis the efficacy of factors like fertilizers, electricity, irrigation, private investment. The findings suggest that there is only short term significant effect of irrigation and private investment on the agriculture productivity. However, there exists long term relations between agriculture productivity and all the determinants, and they are all found to have significant influence on productivity in long run.

John W. McArthura, Gordon C. McCord (2017) in their paper on Fertilizing growth: Agricultural inputs and their effects in economic development, investigate the role of agriculture inputs on the cereal yield production. They estimate the cereal yield production function by using the panel data for the time period 1965-2001. They find that there is a significant impact of modern seeds, fertilizers and water on augmenting the cereal yield.

Bathla, Seema (2017), found that the low and inadequate public capital formation during the 90's impinged upon farmers' investments and jeopardized technological change and agricultural growth, as researched.

Reddy and Dutta (2018), investigate the impact of Agricultural inputs on Agricultural Gross Domestic Product in Indian Economy. Their period of analysis include 1980-81 to 2015-16. They find that the variables like electricity, pesticides, seeds, and rainfall are statistically significant and are found to have a significant impact on the agricultural GDP. Electricity and presticides are found to have a negative relation while, seeds and rainfall are found to have positive impact on the agriculture GDP.

Abdul Rehman et.al. (2019), in their paper named as "Fertilizer consumption, water availability and credit distribution: Major factors affecting agricultural productivity in Pakistan" use econometric analysis to examine the association between fertilizer consumption, cropped area, water availability, credit distribution, and agriculture GDP in Pakistan. They use time series data for the time period 1975-2015, and analyse using

Augmented Dickey Fuller (ADF) test, Phillips-Perron (P-P) test, and Johansen co-integration test. Their result suggest that factors such as credit distribution, improved seed distribution, and fertilizer distribution had a positive and significant effect on the agriculture GDP.

III. Research Methodology

3.1. Data Source

The data set in the study has been collected from secondary source, collected from varied published sources. The data of Agriculture GDP (at constant prices) for the time period 1991-2019 has been extracted from National Account Statistics from MOSPI. The data for Actual Rainfall Districts with as % of Normal Rainfall (All India), Area Under Irrigation(%),
Consumption of Pesticides in Thousand Tonnes, Consumption of fertilizer (in lakh Tonnes), Consumption of Electricity for Agricultural Purposes, considered in terms of percentage(%) share of agriculture consumption to total consumption, has been extracted from Directorate of Economics and Statistics, Ministry of Agriculture. (Agriculture Statistics at a Glance'2019). However, the data for Net sown area (NSA in Thousand Hectares) has been extracted from RBI Publications as on 31st January'2019. Meanwhile, the data for gross capital formation (GCF) by public sector in agriculture (in Rs. Crores) has been compiled from National Account Statistics, C.S.O., Government of India.

3.2. Empirical Methodology

The data for 1991-2011 was available at 2004-05 prices, while the data for 2011-2019 was available at 2011-12 prices. Through the splicing method, the entire data has been converted into base period of 2011-12 prices.

Huge consensus that has appeared from the abiding literature is that agriculture GDP is impacted by the following factor: rainfall, public and private investment, area under fruits and vegetables, total factor productivity, other inputs like pesticides, electricity, rainfall, fertilizer and seeds. For the analysis purpose in this paper, the semi-log model has been constructed to study the factors affecting Agriculture GDP in India. An attempt has been made to empirically investigate this aspect basis using time series data through the following equation.

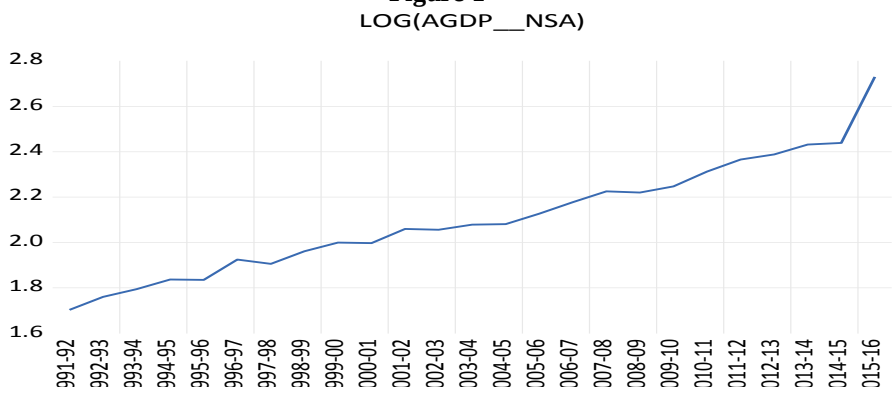
Agriculture GDP = f(Public Investment on Agriculture, Electricity Consumption, Rainfall, Irrigation, lagged Agriculture GDP, consumption of fertilizers and pesticides)

The dependent variable in the regression model considered is Log of Agriculture GDP (at constant prices) as a proportion of Net sown area. However, for the independent variables, following adjustments have been done to normalize the data set. The data on Consumption of fertilizer extracted is considered in terms of log of ratio of Consumption of fertilizer as a proportion of Net sown area. The data on gross capital formation (GCF) by public sector in agriculture was taken as a log of ratio of gross capital formation (GCF) by public sector in agriculture and Net sown area to normalize. Consumption of Pesticides was taken as a proportion of Net sown area to normalize. However, the data for actual rainfall (%), Electricity Consumption in agriculture (%), Area under Irrigation(%), are taken as it is. The data of all the variables in this data set have been provided in the Table 1. The regression analysis in this paper has been done with the help of E-views software.

IV. Data Analysis And Interpretation

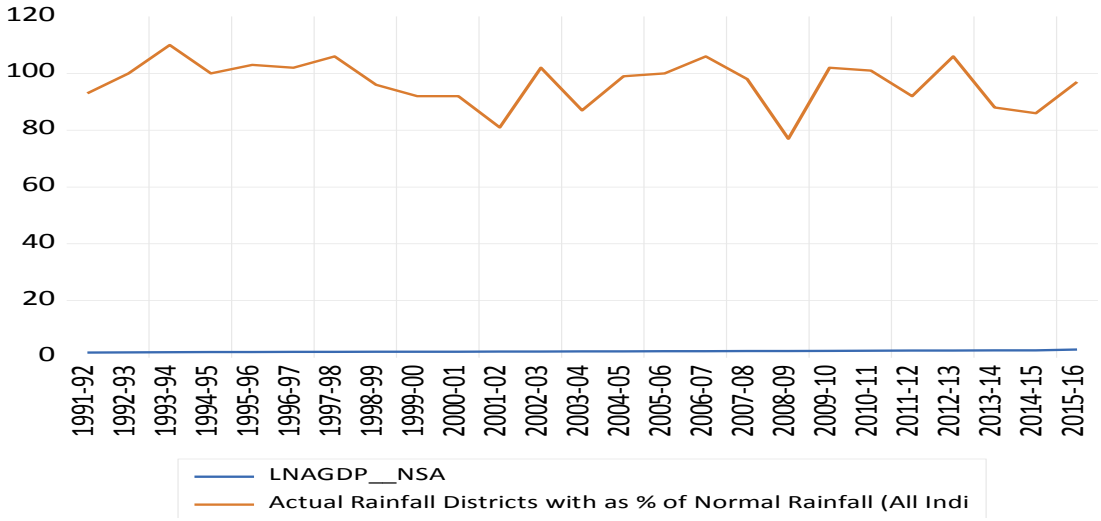
Following graph has been constructed to study the pattern of trend in ratio of log of Agriculture GDP to Net Sown Area (NSA) (figure 1). As can be seen from figure 1, the pattern shows consistent rising trend throughout time period in our analysis from 1991-2019.

Figure 1



Initially, the uncontrolled regression analysis is made, to study the impact of individual factors, on the agriculture GDP.
Firstly, the paper studies the impact of Actual Rainfall as % of Normal Rainfall on the agriculture GDP.
The graph 2 in the table 1 shows the trend relation between Actual Rainfall as % of Normal Rainfall and the per thousand hectare Agriculture GDP estimated by log(Agriculture GDP/ NSA).

Graph 2



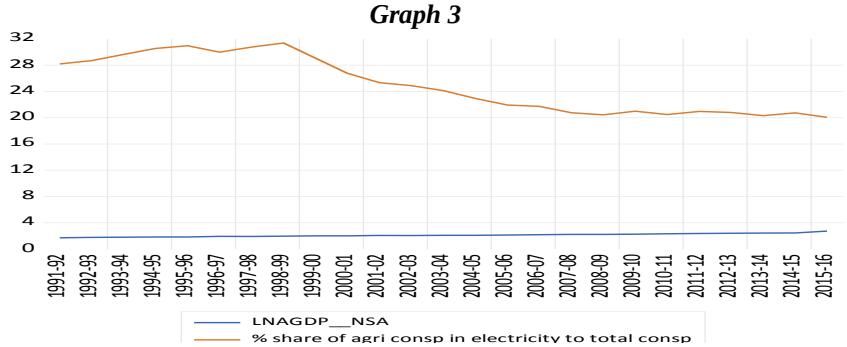
The graph of actual rainfall(%) shows a fluctuating pattern throughout the time period.

The following regression equation is estimated using OLS regression.
Log $Y_i = \beta_1 + \beta_2 X_i + u_i$
……equation (1)
where X_i represents Actual Rainfall as % of Normal Rainfall, and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Actual Rainfall as % of Normal Rainfall	0.241 (0.006)
Constant	0.0001**(0.596)
Adj R-squared	0.018
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:
Log $Y_i = 2.82 - 0.007 X_i + u_i$
As per the results, it can be inferred that rainfall has an *insignificant effect* on the agriculture GDP per thousand hectare.
Next, we study the impact of share of electricity consumption in agriculture to total consumption (%).
The graph below shows the trend relation between share of electricity consumption in agriculture to total consumption (%), and log(Agriculture GDP/ NSA).

Graph 3



The graphs shows a falling trend in electricity consumption in agriculture especially after 1998.
The following equation is estimated using OLS regression.

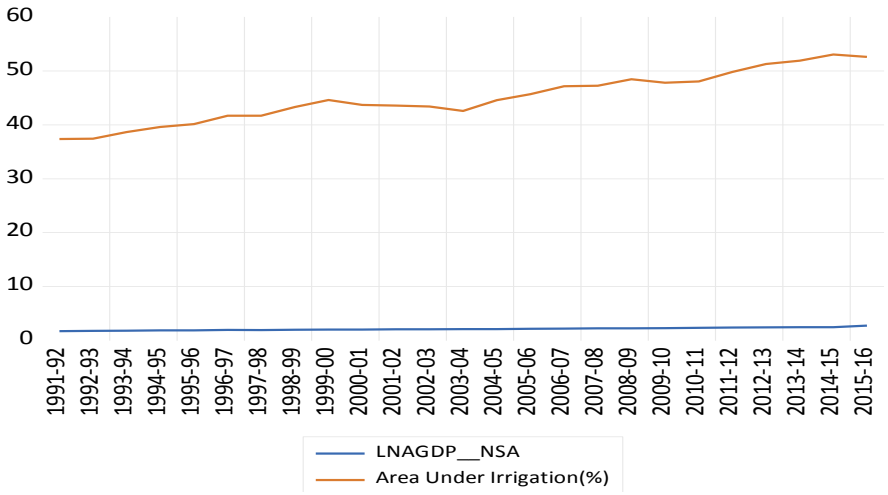
$\text{Log } Y_i = \beta_1 + \beta_2 X_i + u_i$

……equation (2)

where X_i represents share of electricity consumption in agriculture to total consumption (%), and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
share of electricity consumption in agriculture to total consumption (%)	0.000** (0.006)
Constant	0.000**(0.159)
Adj R-squared	0.725
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:
$\text{Log } Y_i = 3.36 - 0.05 X_i + u_i$
As per the results, it can be inferred that electricity has a *significant effect* on the agriculture GDP per thousand hectare.
Next, we study the *impact of irrigation* in agriculture to agricultural GDP per thousand hectare.
The graph below shows the trend relation between area under irrigation(%), and the log(Agriculture GDP/ NSA).



The graph of area under irrigation(%) shows a rising trend throughout the time period.

The following equation is estimated using OLS regression.

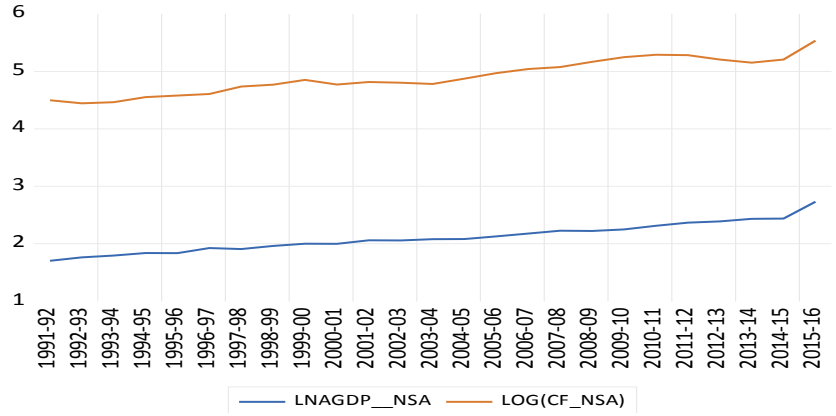
$\text{Log}Y_i = \beta_1 + \beta_2 X_i + u_i$ ……equation (3)

where X_i represents Area Under Irrigation (%), and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Area Under Irrigation (%)	0.00** (0.002)
Constant	0.09**(0.13)
Adj R-squared	0.93
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:
$\text{Log } Y_i = -0.23 + 0.05 X_i + u_i$
As per the results, it can be inferred that Area Under Irrigation (%) has a *significant effect* on the agriculture GDP per thousand hectare.
Next, we study the impact of Consumption of fertilizer to agricultural GDP per thousand hectare.

The graph below shows the trend relation between Consumption of fertilizer and the log(Agriculture GDP/ NSA).



The graph of log of (Consumption of fertilizer/NSA) shows a rising trend throughout the time period.

The following equation is estimated using OLS regression.

$LogY_i=\beta_1+\beta_2Log(X_i) + u_i$

……equation (4)

where X_i represents ratio of Consumption of fertilizer to Net Sown Area and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Log (Consumption of fertilizer/ NSA)	0.000** (0.047)
Constant	0.000**(0.231)
Adj R-squared	0.923
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.

The estimated equation for the above regression analysis is as follows:

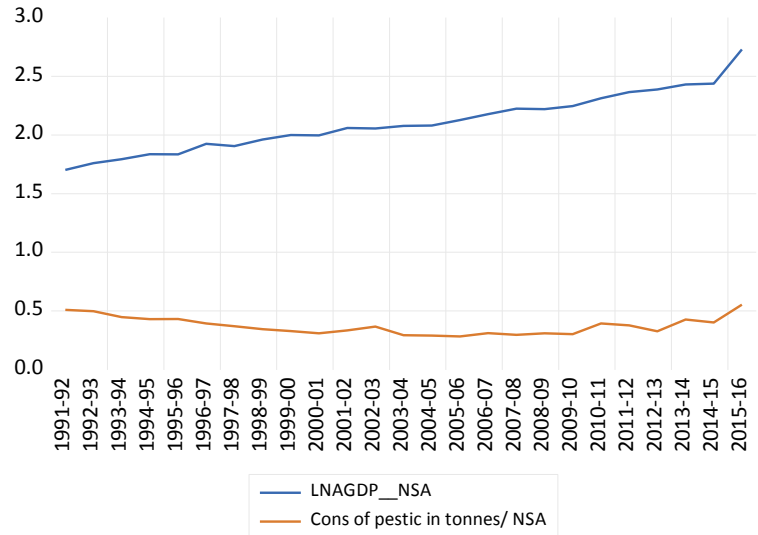
$Log\ Y_i = -1.82 + 0.80\ X_i + u_i$

As per the results, it can be inferred that Consumption of fertilizer has a *significant effect* on the agriculture GDP per thousand hectare.

Next, we study the impact of Consumption of Pesticides to agricultural GDP per thousand hectare.

The graph below shows the trend relation between Consumption of Pesticides and the log(Agriculture GDP/ NSA).

The graph of log of (Consumption of fertilizer/NSA) shows a rising trend throughout the time period.



The graph of (Consumption of fertilizer/NSA) shows a rising trend throughout the time period.

The following equation is estimated using OLS regression.

$\text{Log } Y_i\ \beta_1+\beta_2\ (X_i) + u_i$

……equation (5)

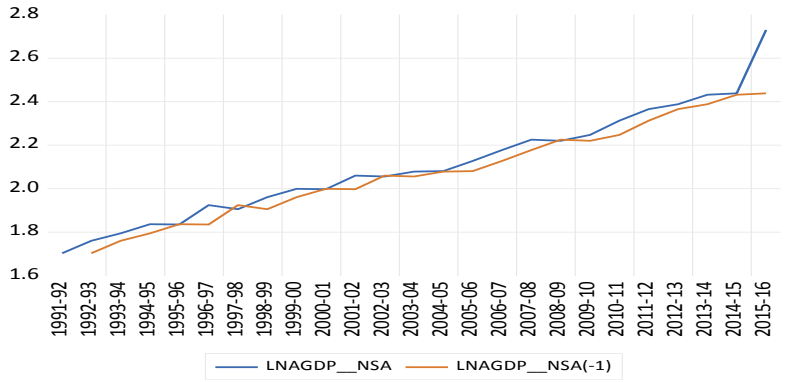
where X_i represents ratio of Consumption of Pesticides to Net Sown Area and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Consumption of Pesticides/ NSA	0.712 (0.693)
Constant	0.000**(0.262)
Adj R-squared	-0.03
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:

$\text{Log } Y_i = 2.20 - 0.25\ X_i + u_i$

As per the results, it can be inferred that Consumption of Pesticides has an *insignificant effect* on the agriculture GDP per thousand hectare.
Next, we study the impact of lagged agricultural income on agricultural GDP income.
The graph below shows the trend relation between lagged agricultural GDP per thousand hectare and log(Agriculture GDP/ NSA).



The graph of log of lagged (Agriculture GDP/ NSA) shows a rising trend throughout the time period.

The following equation is estimated using OLS regression.

$\text{Log}Y_i=\beta_1+\beta_2\text{Log } Y_{i-1} + u_i$

……equation (6)

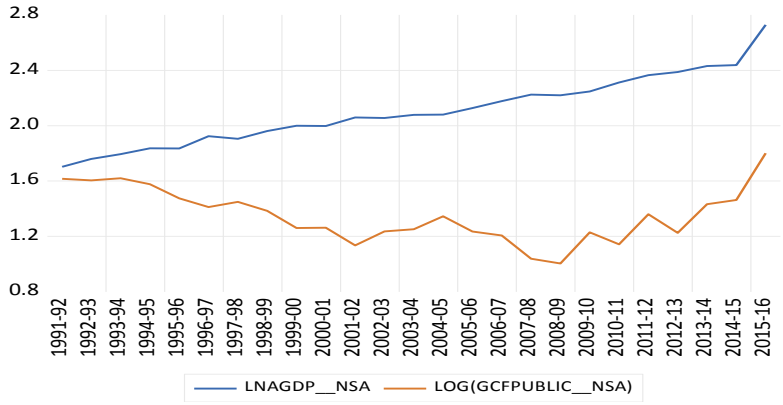
where Y_{i-1} represents lagged value of ratio of Agriculture GDP to Net Sown Area, and
Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Log(AGDP/ NSA)(-1)	0.000** (0.117)
Constant	0.387**(0.056)
Adj R-squared	0.939
No. of observations	24 (after adjustment)

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:

$\text{Log } Y_i = -0.10 + 1.07\ \text{Log } Y_{i-1} + u_i$

As per the results, it can be inferred that lagged value of ratio of Agriculture GDP has an *significant effect* on the agriculture GDP per thousand hectare.
Next, we study the impact of Capital formation (public) in agriculture on agricultural GDP per thousand hectare.
The graph below shows the trend relation between Capital formation (public) in agriculture and log(Agriculture GDP/ NSA).



The graph of public investment initially shows a falling trend till 2008-09, and then rising trend thereafter, during the analysis period of 1991-2019.
The following equation is estimated using OLS regression.

$\text{Log}Y_i=\beta_1 +\beta_2 \text{ Log } (X_i) + u_i$

……equation (7)

where X_i represents ratio of Capital formation (public) in agriculture to Net Sown Area and Y_i represents ratio of Agriculture GDP to Net Sown Area.

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Log(Capital Investment/ NSA)	0.000** (0.356)
Constant	0.394**(0.261)
Adj R-squared	-0.01
No. of observations	25

Note: Variables specified in log.** denote statistical significance at 5% level, respectively.
Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:

$\text{Log } Y_i = 2.41 – 0.22 \text{ Log } (X_i) + u_i$

As per the results, it can be inferred that Capital formation (public) in agriculture has a *significant effect* on the agriculture GDP per thousand hectare.
Since, many variables studied in the analysis above have been found to have a significant effect on the agriculture GDP, we need to run multi-variate regression as per the theoretical aspect of Agriculture GDP being affected by multiple factors.
Next, we study the impact of all the factors on agricultural GDP per thousand hectare.

YEAR	AGDP (in Rs. Crores)	NSA (Thousand Hectares)	AGDP/ NSA	% share of agriculture consumption in electricity to total consumption	Con of fertilizer - in tonnes / NSA	GCF public/ NSA	Actual Rainfall Districts with as % of Normal Rainfall (All India)	Area Under Irrigation(%)	Cons of pesticides in tonnes/ NSA
1991-92	7,77,442	141632	5.49	28.2	89.87	5.034	93	37.37	0.51
1992-93	8,29,150	142645	5.81	28.7	85.20	4.972	100	37.42	0.50
1993-94	8,56,700	142419	6.02	29.63	86.83	5.053	110	38.66	0.45
1994-95	8,97,102	142960	6.28	30.54	94.88	4.841	100	39.61	0.43
1995-96	8,90,864	142197	6.26	30.95	97.59	4.369	103	40.13	0.43
1996-97	9,79,240	142931	6.85	29.98	100.10	4.103	102	41.71	0.39
1997-98	9,54,233	141945	6.72	30.75	114.04	4.259	106	41.71	0.37
1998-99	10,14,545	142753	7.11	31.38	117.67	3.992	96	43.31	0.34
1999-00	10,41,625	141063	7.38	29.07	128.09	3.525	92	44.63	0.33
2000-01	10,41,545	141336	7.37	26.76	118.17	3.532	92	43.7	0.31
2001-02	11,04,112	140734	7.85	25.33	123.35	3.109	81	43.58	0.33
2002-03	10,31,194	1,31,943	7.82	24.88	121.98	3.440	102	43.42	0.37
2003-04	11,24,502	140708	7.99	24.13	119.39	3.495	87	42.6	0.29
2004-05	11,26,566	140642	8.01	22.93	130.81	3.837	99	44.59	0.29
2005-06	11,84,466	141162	8.39	21.92	144.10	3.435	100	45.7	0.28
2006-07	12,33,684	139823	8.82	21.73	154.85	3.339	106	47.18	0.31
2007-08	13,05,192	141016	9.26	20.75	160.05	2.822	98	47.28	0.30
2008-09	13,06,406	141899	9.21	20.43	175.54	2.727	77	48.47	0.31
2009-10	13,16,961	139173	9.46	20.98	190.31	3.417	102	47.84	0.30
2010-11	14,30,184	141563	10.10	20.48	198.65	3.133	101	48.06	0.39
2011-12	15,01,947	140980	10.65	20.95	197.12	3.893	92	49.82	0.38
2012-13	15,24,288	139936	10.89	20.8	182.48	3.402	106	51.3	0.33
2013-14	16,09,198	141427	11.38	20.31	173.11	4.188	88	51.92	0.43
2014-15	16,05,715	140130	11.46	20.74	182.52	4.318	86	53.06	0.40
2015-16	16,16,146	105402	15.33	6.058	97.00	52.62	0.552	52.62	0.552

The descriptive statistics has been specified in ***Table 1*** below:

1. *Source: Directorate of Economics & Statistics, DAC&FW; Agriculture Statistics at a Glance 2019; NSSO*

2. *Note: The table presents NSA (Net sown area) given in Thousand Hectares;*
Gross Capital Formation in Public Sector in Agriculture is taken at (At 2004-05 prices) (Rs. lakhs)
Consumption of pesticides are computed in tonnes
Consumption of fertilizer are computed in lakh tonnes
AGDP represents Agriculture GDP at factor cost at 2011-12 prices (in Rs crores)

The following equation is estimated using *heteroscedasticity and autocorrelation consistent (HAC)* regression. The HAC correction is done to ensure there is no presence of heteroscedasticity and autocorrelation in our estimation.

$$\text{Log } Y_i = \beta_1 + \beta_2 \text{ Log } (Y_{i-1}) + \beta_3 \text{ Log } (X_{1i}) + \beta_4 \text{ Log } (X_{2i}) + \beta_5 (X_{3i}) + \beta_6(X_{4i}) + \beta_7(X_{5i}) + \beta_8(X_{6i}) + u_i \quad \text{.....equation (8)}$$

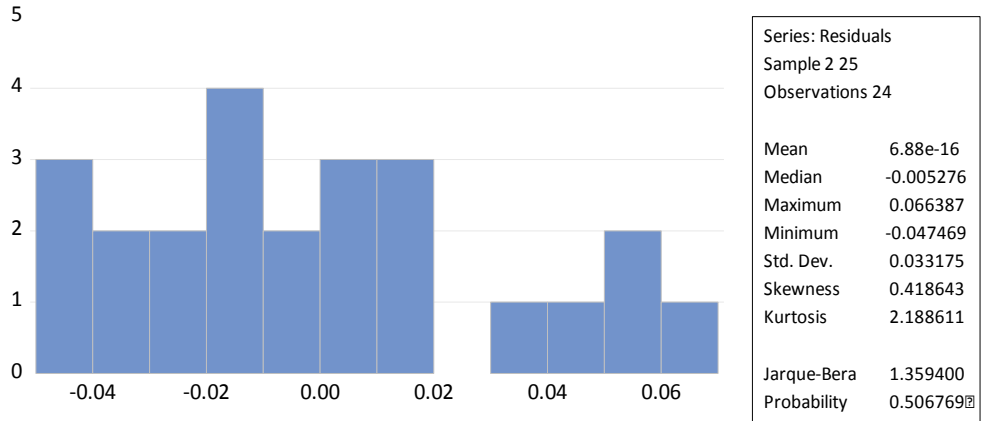
where Y_{i-1} represents lagged value of ratio of Agriculture GDP (*at 2011-12 base prices, in Rs Crores*) to Net Sown Area (*in thousand hectares*),
X_{1i} represents ratio of Capital formation by Government in agriculture (*at 2004-05 prices in Rs. lakhs*) to Net Sown Area (*in thousand hectares*),
X_{2i} represents ratio of Consumption of fertilizer (*in lakh tonnes)* to Net Sown Area (*in thousand hectares*),
X_{3i} represents Area Under Irrigation (%),
X_{4i} represents Actual Rainfall as % of Normal Rainfall,
X_{5i} represents share of electricity consumption in agriculture to total consumption (%),
X_{6i} represents ratio of Consumption of Pesticides (*in tonnes)* to Net Sown Area (*in thousand hectares*),
and Y_i represents ratio of Agriculture GDP (*at 2011-12 base prices, in Rs Crores*) to Net Sown Area (*in thousand hectares*).

Dependent Variable - Log (AGDP/NSA)	
Independent Variables	
Y_{i-1} Log(AGDP/ NSA)(-1)	0.424 (0.313)
X_{1i} Log(Capital Investment/ NSA)	0.147** (0.064)
X_{2i} Log (Consumption of fertilizer/ NSA)	0.314*** (0.159)
X_{3i} Area Under Irrigation (%)	0.008 (0.015)
X_{4i} Actual Rainfall as % of Normal Rainfall	0.0009 (0.001)
X_{5i} Share of electricity consumption in agriculture to total consumption (%)	0.006 (0.003)
X_{6i} Consumption of Pesticides/ NSA	0.227*** (0.116)
Constant	0.71 (0.514)
Adj R-squared	0.972
No. of observations	24 (after adjustment)

Note: Variables specified in log.** denote statistical significance at 5% level, .*** denote statistical significance at 10% level, respectively. Figures in parentheses are standard errors.
The estimated equation for the above regression analysis is as follows:

$$\text{Log } Y_i = -0.71 + 0.424 \text{ Log } (Y_{i-1}) + 0.147 \text{ Log } (X_{1i}) + 0.314 \text{ Log } (X_{2i}) + 0.008 (X_{3i}) - 0.0009 (X_{4i}) - 0.006 (X_{5i}) + 0.227 (X_{6i}) + u_i$$

As per the results in our analysis, it can be inferred that Capital formation by Government in agriculture, Consumption of fertilizers, and Consumption of Pesticides have a *positive and significant effect* on the agriculture GDP per thousand hectare. It can be interpreted that 10% rise in capital investment causes 1.4% rise in agriculture income. Further, 10% rise in consumption of fertilizers causes 3.1% rise in agriculture income; and 10% rise in consumption of pesticides causes 2.27% rise in agriculture income.
Error normality test: The Jarque Bera test result shows that the error terms are normality distributed, as p value<0.05, so the null hypothesis of normality is accepted.



Following is the result of autocorrelation & heteroskedasticity test.

Breusch Godfrey LM test (Heteroskedasticity)	F statistics (0.455) p value <0.05
Newey-West Test (Autocorrelation)	F statistics (1.48) p value <0.05

The result shows that there is no autocorrelation and heteroskedasticity present in the model.

Limitation of the Analysis

However, there could be other limitations of the analysis, as a result of which some other variables show insignificant impact on the agriculture GDP. The analysis could be suffering from various issues such as problems of simultaneous equation bias, endogeneity problem, non-stationary series, severe multicollinearity, in the estimated model and hence the desired results may be not be achievable.

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