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Fertilizer subsidy and agricultural production: a study of India

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Abstract

Objectives: To identify effectiveness of Fertilizer Subsidy in the agriculture production considering agricultural credit statistics for India.
Methods: Annual time series data is collected for India from 1970-71 to 2016-17 from EPWRF database. Variables such as Agricultural GDP, Agricultural Credit and Fertilizer subsidy are collected for the analysis. Time series properties of the variables are checked using Augmented-Dickey-Fuller unit root test and results were confirmed with Phillips & Perron Unit Root Test. Johansen co-integration test were used to check for any long-run co-integrating vector among the variables. Further vector error correction model and impulse response function was used to explain short-run dynamics among the variable.
Findings: Unit root tests confirm presence of unit root among the variables at level and all variables are stationary at first difference. Johansen co-integration test identified at most one co-integrating vector among the variables. After normalizing agricultural GDP, the co-integrating relationship suggests that agricultural credit is positively contributing to agricultural GDP and fertilizer subsidy is negatively contributing to agricultural GDP which means an increase in agricultural credit will increase agricultural GDP where an increase in fertilizer subsidy will decrease the agricultural GDP. The negative relationship between fertilizer subsidy and agricultural GDP is because of the high leakage in the delivery system of fertilizer subsidy. Speed of adjustment parameter suggests that agricultural credit corrects the short-run equilibrium more quickly than fertilizer subsidy. Impulse response function suggests that a standard deviation shock to fertilizer will not reflect in agricultural production for long (less than one year) but a standard deviation shock to agricultural credit may affect the agricultural production severely. Impulses of credit shock will reflect in production for four to five years.
Applications: Attempts by government to withdraw agricultural subsidy and establish cash transfers and more focus on agriculture credits will improve agricultural production in the long-run.
Keywords: Fertilizer Subsidy, Agricultural Credit, Agricultural Production.

1. Introduction

A number of government sponsored programmes and schemes have been introduced in order to meet socio-economic development objectives of financial inclusion and inclusive growth. However, due to leakages and corruption, the schemes have not been effective and have failed to reach the beneficiaries. The introduction of Direct Beneficiary Transfer (DBT), scheme aims at alleviation these fraudulent practices. Under DBT scheme, the beneficiaries get the amount directly in their bank accounts and there is no scope for 'middle-men' to interfere for 'cut' or 'commission'. The transfer is done with the help of biometric-Aadhaar linked bank accounts. The programme covers schemes like education scholarship for students, pension for widows, Old-age pensions, LPG subsidy and Rubber Support Price (Kerala). However, a comprehensive study needs to be done to find out whether the beneficiaries are using the money for the purpose it is meant for or not. This will help to evaluate the success of DBT scheme. Furthermore it will help in extending the scheme to other sectors [1].

Preliminarily, the importance of fertilizer subsidy in agriculture production may be examined in this paper. A subsidy is an inverse of taxation and hence sometimes called as negative taxation. Subsidy is normally given to major inputs or raw materials of core area of production or primary sectors like agriculture, in order to support the sector and/or to make them competent in global market. It is to ensure equitable distribution of the resources. Subsidies are a component of budget non-plan revenues expenditure.

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The government of India started the scheme of subsidies on purchase of various agriculture inputs to facilitate farmer based on recommendations of the food grain committee i.e. Jha Committee. Agriculture subsidy plays an important role in the process of agriculture development during initial phase by addressing market failure and promoting new technologies [2]. Fertilizer subsidy is a development subsidy which accelerates the fertilizer use and thus promotes agriculture production [3]. But India farmers are not receiving the subsidy what is announced in budget but only 50% of it. Also considering price of major food crops they are not actually subsidized in real but 'net taxed' and input subsidy became unsustainable for Indian agriculture sector [4-7]. Input subsidy in agriculture for credit, fertilizer and irrigation is more crucial for small farmers to adopt technology in India. But not it is not the subsidy but government investment in agricultural education and research and in rural roads are contributing more to the production [2]. Agricultural production in India is mostly influenced by government investment/expenditure and then by fertilizer subsidy and agricultural price [8]. Agricultural credit has much to do in Indian agricultural market. But more initiative required in more disintegrate manner [9]. The central government had once reduced the subsidy of fertilizer in the year 2003 due to which the farmers were unable to purchase fertilizers at higher prices and as a result agriculture production declined gradually for that period [10].

Small and medium farmers will be benefited only by lower input prices and higher output prices. Thus subsidies are an effective tool for maintaining the agriculture growth balance and also for safeguarding larger section of farmers [11]. This study seeks to explore the possibility of expansion of DBT scheme to agriculture sector focusing on fertilizer subsidy. It analyses the influence of fertilizer subsidy and agricultural credit on agricultural GDP in India for the period 1970-71 to 2016-17, using Johansen co-integration analysis and vector error correction model. Also this study conducts a pattern analysis of the variable in section 3.

2. Data and Methodology

Annual time series data is collected for India from 1970-71 to 2016-17 from EPWRF database. Variables such as Agricultural GDP, Agricultural Credit and Fertilizer subsidy are collected for the analysis. Agricultural GDP is spliced to 2004-05 base year and all are in constant prices. All variables are in rupee Crores. Pattern of the variables were checked by taking five year average in order to control yearly fluctuation. Variables are plotted in logarithmic form to understand the movement of the variable. Time series properties of the variables are checked using Augmented-Dickey-Fuller unit root test and results were confirmed with Phillips & Perron Unit Root Test. Johansen co-integration test is used to check for any longrun co-integrating vector among the variables [12-13]. Further vector error correction model and impulse response function was used to explain short-run dynamics among the variable. The general form of Johansen co-integration would be;

$$agdp_t = N + \beta_1 fs + \beta_2 ac + E$$

Where, agdp = Agricultural GDP, ℵ=intercept,$\beta 1$=coefficient of fertilizer subsidy, fs=fertilizer subsidy, β_2= coefficient value of agricultural credit, ac= agricultural credit, E=error term.

3. Pattern of fertilizer subsidy in India

It is important to understand the pattern of fertilizer subsidy and agricultural credit in India because it will give a general picture about the movement of the variables over time. It is evident from the Table 1 agricultural credit and fertilizer subsidy was almost similar during 1970-71 periods (around 0.25% of agricultural GDP) over the period agricultural credit made a sharp increase and now outstanding agricultural credits are almost 75% of agricultural GDP. May be agricultural loan waiving by different governments, encouraged this to go high. Till 2005 it can be observed a slow and linear growth in fertilizer subsidy but after that it made almost 100% real growths (2.4% of agricultural gdp to 6.6% in 2006-2010). Over the period agricultural credit also doubled from 15% to 42%. Same trend continued till 2015 and after that we can observe a decline in the growth of both fertilizer subsidy and agricultural credit. But even though agricultural growth rate has not improved by these efforts but maintained a growth rate of around 3%.

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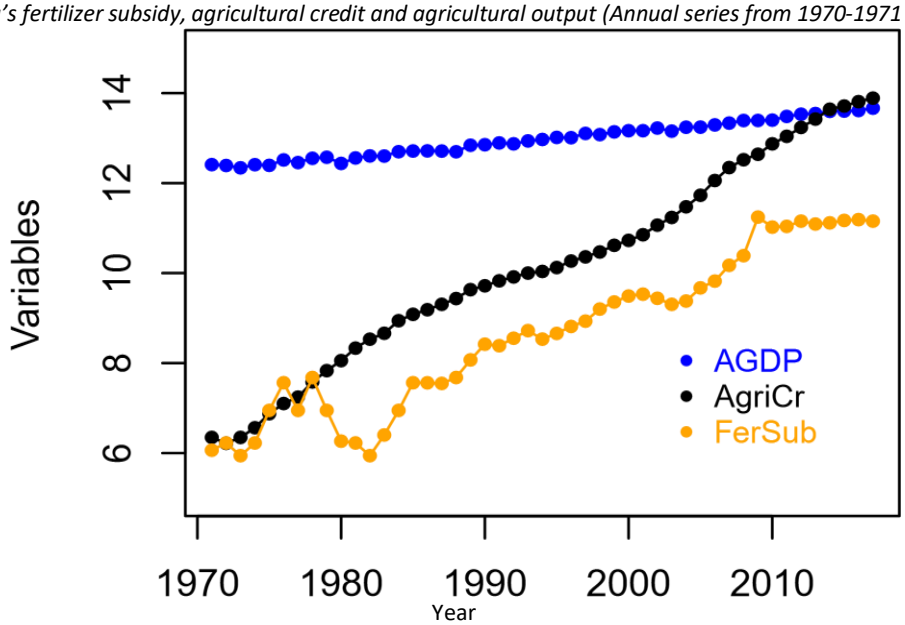
Table 1. Five year average of fertilizer subsidy, agricultural credit and agricultural output in India(1970-1971 to 2016-2017)

Year	FerSub	AgriCr	AgriGDP	FS.AGDP	AC.AGDP	AGDPgr
1971-1975	572.6	664.33	240598.6	0.2375	0.2759	-0.4051
1976-1980	1340.4	2049.56	270978.8	0.4890	0.7603	0.4023
1981-1985	891.8	6299.43	308078.2	0.2812	2.0198	5.2571
1986-1990	2745.8	13039.50	350712.6	0.7687	3.6912	2.5977
1991-1995	5311.6	21738.42	416912.8	1.2737	5.2030	3.1649
1996-2000	9814.2	36446.63	489908.4	1.9859	7.4004	2.8497
2001-2005	13027.2	82460.81	544857.6	2.3897	15.0339	1.4137
2006-2010	43007.8	275356.82	637086.6	6.6502	42.8635	3.0502
2011-2015	67268.4	689050.32	769778.9	8.7426	88.7469	3.9196
2016-2017	60533.6	564551.77	725782.3	8.2712	75.0788	3.1082

FerSub: Fertilizer Subsidy, AgriCr: Agricultural Credit, AgriGDP: Agricultural Value addition to GDP (all three variables are in rupee crores), FS.AGDP: Fertilizer Subsidy as a percentage to Agricultural GDP, AC.AGDP: Agricultural Credit as a percentage to Agricultural GDP, AGDPgr: Growth Rate of Agricultural GDP
Source: Author's Calculation

Figure 1 plots logarithmic value of agricultural GDP and Credit and Fertilizer subsidy. It is evident from the figure that even though agricultural output is not improved much agricultural credit and subsidy has improved very drastically over the period. Outstanding agricultural credit even crossed agricultural output by 2013-2014. The slowly growing fertilizer subsidy is almost stagnant after 2010. It is evident from the figure that serious attempts from government are made to encourage agricultural credit and discourage fertilizer subsidy. On this background this paper will further proceed towards checking impact of agricultural credit and fertilizer subsidy on agricultural output and try to identify possible impact on agricultural sector after the implementation of direct benefit transfer in fertilizer.

Figure 1. India's fertilizer subsidy, agricultural credit and agricultural output (Annual series from 1970-1971 to 2016-2017)



FerSub: Fertilizer Subsidy, AgriCr: Agricultural Credit, AgriGDP: Agricultural Value addition to GDP (all three variables are in rupee crores and expressed in logarithm)
Source: Authors' Calculation Plotted using R(), function: plot()

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4. Empirical results

Since a pattern in the growth of agricultural GDP, agricultural credit and fertilizer subsidy is observed, a scientific and systematic analysis is needed to measure relationship of the variables. As discussed in the section 2, few methods were used for the analysis.

1. Unit root test

Unit root analysis is done for understanding the characteristics of the variables. Results of ADF test and PP test are given in the Table 2. From Table 2 it is evident that the null of unit root is accepted at level and rejected at first difference by both ADF and PP unit root tests under 5% and 10% level of significance. Since all variables are stationary at first difference let's proceed towards further analysis.

Table 2. Unit root test result

	Variables at Level				First difference			
	ADF Test		PP Test		ADF Test		PP Test	
	Stat	P.V	Stat	P.V	Stat	P.V	Stat	P.V
FerSub	-1.51	0.77	-4.80	0.83	-8.27	0.01	-56.07	0.01
AgriCr	0.85	0.99	4.19	0.99	-2.97	0.05	-13.29	0.07
AgriGDP	-0.15	0.99	-2.90	0.94	-11.31	0.01	-61.33	0.01

FerSub: Fertilizer Subsidy, AgriCr: Agricultural Credit, AgriGDP: Agricultural Value addition to GDP (all three variables are in rupee crores), FS.AGDP: Fertilizer Subsidy as a percentage to Agricultural GDP, AC.AGDP: Agricultural Credit as a percentage to Agricultural GDP. Source: Author's Calculation using R(), function: tseries::adf. test () and tseries::pp.test()

2. Johansen co-integration test

Johansen co-integration test is employed to check for any long-run co-integrating vector among the variables. Results of Johansen co-integration test is provided in Table 3. Results rejects the null hypothesis" no co-integrating vectors" and could not reject the null hypothesis" at most 1 co-integrating vectors". There for there will be at least one long-run relationship among the variables.

Table 3. Unrestricted Cointegration Rank Test (Trace Statistics)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.461366	36.41584	29.79707	0.0075
At most 1	0.167222	9.19223	15.49471	0.3479
At most 2	0.025593	1.140761	3.841466	0.2855

*Trace test indicates 1 cointegratingeqn(s) at the 0.05 level, ** denotes rejection of the hypothesis at the 0.05 level, ***MacKinnon-Haug-Michelis (1999) p-values.*
Source: Author's calculation using E views 10

3. Vector error correction

Vector error correction will tell us after normalizing agricultural GDP, how fertilizer subsidy and agricultural credit will influence agricultural GDP in the short run. Negative co-efficient of fertilizer subsidy suggests that an increase in fertilizer subsidy may not necessarily increase agricultural production in the India. This may be due to the leakages in the subsidy distribution system. But positive coefficient of agricultural credit suggests that an increase in agricultural credit is contributing positively to the agricultural production. So attempts of DBT in fertilizer subsidy and encourage agricultural credit can be encouraged.

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Table 4. Normalised co-integrating vector and speed of adjustment parameter

Normalised Co-integrating Vector (Standard Error in the parenthesis		
AGRIGDP CR	FERSUB CR	AGRICR CR
1	-74.56351(-14.49)	0.517256(-1.638)
Speed of adjustment parameter (standard error in parentheses) -0.003084 0.00404 -0.016808 (-0.0044) (-0.00143) (-0.00339)		

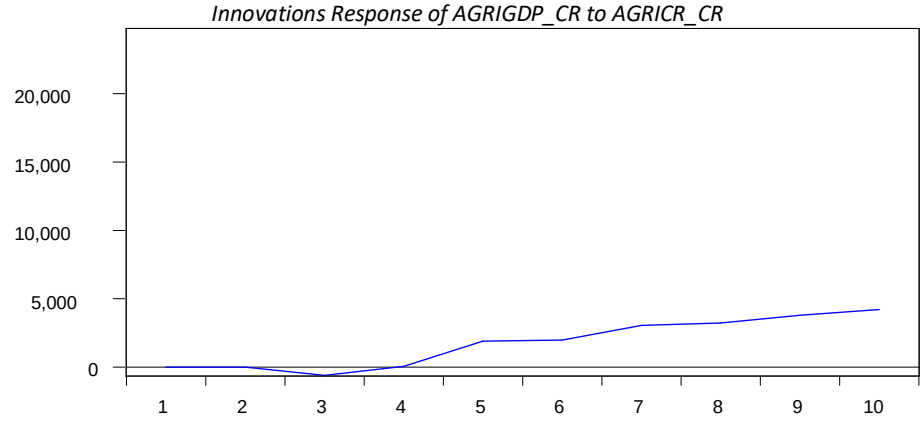
AGRIGDP CR: Agricultural GDP in Crores, FERSUB CR: Fertilizer Subsidy in Crores, AGRICR CR: Agricultural Credit in Crores.
Source: Author's calculation using E views 10

Speed of adjustment parameter explains how fast short-run disequilibrium in the variables is corrected. It can be noted form Table 4 that agricultural subsidy is correcting the short-run disturbances faster than other variables and fertilizer subsidy is slower than other variables. Thus withdrawing fertilizer subsidy can have longer impact on agricultural production. So necessary compensation measures must be taken to tackle the crisis.

4. Impulse response function

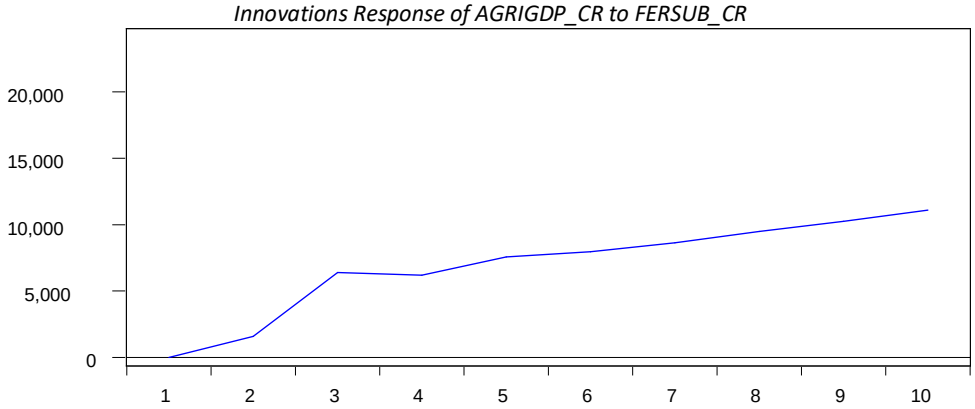
Impulse response function will explain how a standard deviation shock to one variable will reflect in other variables in the short-run. Figure 2 tells that agricultural GDP will respond to a standard deviation shock in agricultural credit. It may be noted that shock to agriculture credit will severely reflect in agricultural production. It will take four to five years to recover form that shock.

Figure 2. Impulse response of agricultural GDP to agricultural credit response to cholesky one S.D. (d.f. adjusted)



Source: Authors' Calculation, Plotted using R(), function: plot()

Figure 3.*Impulse response of agricultural GDP to fertilizer subsidy response to cholesky one S.D. (d.f. adjusted)*



Source: Authors' Calculation, Plotted using R(), function: plot()

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Figure 3 explains the impulse response of agricultural GDP to a standard deviation shock in fertilizer subsidy. It can be observed from the figure that shock to fertilizer subsidy is not making much impact compared to agricultural credit. Shock will last for less than 2 years and then automatically agricultural production will recover.

It can be concluded from the impulse response function that restructuring fertilizer subsidy will not impact agricultural production for a longer period but any restrictions to agricultural credit must be done with at-most attention.

5. Summary and Conclusions

The primary attempt of this study was to see the pattern of fertilizer subsidy, agricultural credit and agricultural GDP of India and further to check how implementation of Direct Benefit Transfer(DBT) by restructuring fertilizer subsidy will reflect in agricultural GDP of the country. From pattern analysis it is observed that over the years 1970-1971 to 2016-2017, agricultural credit of India has grown rapidly and in 2016-2017 it is almost 125% of agricultural GDP. Agricultural loan waving might have caused this agricultural credit outstanding to go very high. Fertilizer subsidy showed a very slow growth in India over time. Fertilizer subsidy was around 0.2% of agricultural GDP in 1970-1971 and it is improved only to 8.11% of agricultural GDP in 2016-2017. After 2005 a sharp 100% improvement in agricultural credit and fertilizer subsidy can be observed from the pattern analysis and after 2015 it started falling again. But all these efforts are not much influenced the agricultural GDP over the period. The growth in agricultural production is very slow. Only notable fact is that it is maintaining a growth rate near 3-4% after 2005.

Since a deliberate attempt to replace fertilizer subsidy with more agricultural credit and direct benefit transfer is noted for the literature and pattern analysis, a few empirical testing has been executed to measure the impact of these activities on agricultural GDP. Johansen Co-integration test suggests that there exist long run relationship among the variables agricultural GDP, agricultural Credit and Fertilizer subsidy. Vector error correction and impulse response function suggests that it's the agricultural credit which positively contributing to agricultural GDP not the fertilizer subsidy.

Also any shock to fertilizer subsidy may not have a longer impact on agricultural GDP. So attempts to encourage agricultural credit and Direct Benefit transfer would be more fruitful in long run than focusing on fertilizer subsidy.

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