Determinants of agricultural productivity in the Indian economic scenario: An assessment of time trends of factors since the Independence eve

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Abstract:

This paper focuses on the trend of the credit supply and its impact on agricultural growth in the Indian scenario since the independence eve. After independence, India emerged as a centre of attraction for national and international policymakers and investors. With the diversified demographic structure, India was tied in one strong thread of economic activity which was agriculture. With time, the need for agriculture is getting higher no matter what number projects.In this pandemic scenario, this was the only sector which reported positive growth. Food was always on the list of basic necessities. So will be in future. Therefore, it is always a prioritised sector to consider while making the fiscal or monetary policies. Under monetary policies, creditsupply is a major indicator to intervene the agricultural productivity and the accompanying factor of production. Henceforth, this paper examined the impact of agriculture and other factor of production like land, labour force participation in agriculture, and irrigation facilities on agricultural productivity. With our paper, important light was thrown upon the various factors like bank credit provided to the rural area, irrigation facilities, technological development, and capital formation and how does it affect the agriculture development in the Indian scenario. Study Found that Land, Labour, and Irrigation are the major factor which can increase the agriculture productivity. But the other Components like Bank credit, Technology, Capital and fertilizer usage must be look after to transform the picture of Indian agriculture.

Key words: Indian agriculture, Agriculture credit, capital and productivity

JEL: O13, Q15, Q18,O33,O16

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DOI: 10.32725/acta.2024.002
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Introduction

Agricultural credit is considered as a prominent factor to change the whole picture of the primary sectors of the economy (Chandio et.al., 2019). Agriculture always being a thrust area for policy maker to balance the economy by adjusting domestic market or international market to contribute in different sectors of the economy. In this order, credit supply to agriculture to maintain other factors of production is considered pivotal (Rizwan et. al., 2019). Hence, it becomes very important to invest in agriculture because of a significant increase in global population and shifting dietary preferences of the burgeoning middle class in developing economies toward better value agricultural goods, there is an ever-increasing need. As per the world bank report (2020), agriculture financing enables marginal section and small holdings farmers to grow their income and food production so that by 2050, they will be able to feed 9 billion people (MOSPI,2021). Agricultural finance is comprised of agricultural loan, saving, income, investment, and capital creation. It is more than just agricultural credit. It is characterised as "an economic study of agricultural company finance." It is the aspect of farm management concerned with the acquisition and usage of capital (Ganesan, 2016). However, this still lies with us “whether agriculture financing and credit can resolve the existing crises orissues in the sectors? Souza (2020) presented the answer after analysing the recent farmers’ protest in his article that before disbursement of loan, need assessment is important to make surethat farmers is getting return on the investment by allocating efficiently. For this motive, he suggested to change the perception towards the poor farmers and proposed to consider themas anuntapped credit market rather than as high-risk, low-quality credit assets. Yadav, P. (2015) An analysis was conducted on the subject of agro-based finance in India, revealing that the current level of lending to the agricultural sector remains inadequate. Small-scale farmers face significant challenges in obtaining loans from banks due to their reluctance, which stems from various factors. The study emphasises the problem of agricultural indebtedness, along with the initiatives taken by provincial governments to alleviate the burden of debt and interest by offering interest refunds and incentives for prompt repayment. The study revealed that despite attempts to encourage peasants to remain engaged in the banking system and avoid relying on money-lenders, the majority of farmers within the banking system did not contribute to the development of these initiatives. Mahendra Dev, S. (2014) This study examines the significance of small-scale agriculture in India, along with the challenges it encounters. This report examines the current developments in the agriculture sector, including trends, diversification, and the involvement of small-scale producers. It focuses on the effectiveness of small-scale operations and their connection to local markets, including the production chain and the role of local suppliers in enhancing livelihoods and generating employment opportunities. The report also discusses policies and infrastructure development aimed at supporting small-scale producers, as well as the challenges and potential benefits associated with small-scale agriculture, including information needs. Additionally, it provides other countries with knowledge gained from India's experience in the field of small-scale agriculture. Ijioma and Osondu ,(2015)conducted a study in 2015. Credit plays a crucial role in facilitating agricultural expansion by enabling farm proprietors to fund new investments and procure cutting-edge technology, as well as support manufacturing and sales activities. It illustrates that farmers have the ability to obtain short-term loans for crop cultivation and medium or long-term financing for the expansion of their agricultural businesses. This illustrates that rural indebtedness has consistently been a prominent and long-lasting aspect of Indian agricultural production, due to the periodic disruption of the monsoon and the unpredictable nature of farming. Based on the findings, a greater proportion of individuals belong to the lowest social class, which possesses the majority of agricultural land but receives comparatively less financial assistance. Choudhury, S. (2018) The economically disadvantaged individuals in developing nations face barriers that hinder their opportunities and worsen their living conditions. In order to be comprehensive, progress must support all facets of

the economic system while removing barriers faced by the underprivileged and vulnerable segments of society, while also ensuring equal opportunities for all participants in the economy. This study examines the impact of financial inclusion and funding for social sectors on regional livelihoods in India. It specifically focuses on how these factors support agricultural productivity and inclusive development. The study employs a simulated modelling approach to make predictions and draw conclusions. Additionally, it offers policy recommendations in this field.

Prior research has examined various facets of agricultural finance, including institutions, challenges faced by farmers in accessing credit systems, and agricultural advancements. Some studies have focused on the availability of agricultural finance and the adequacy of funds in the agricultural sector, as well as the factors influencing the distribution of such finance. However, this literature review has identified a clear gap in research regarding the analysis of agricultural finance trends in India, particularly the lack of sufficient evidence on trends since independence. Therefore, this paper is also looking to get the scope of that changes by analysing the time seriestrend over the decades of the various agriculture factors like productivities, loan disbursement, Bank infrastructure, land holdings and labour force in agriculture. This study plan to proceed infour sections. In section 1, existing literatures were explored to frame a conceptual note for the present study. Section-2 elaborates the mathematical model formulationto examine the datasets.Section three presents the results of analysis to draw the inferences and hypothesis. Section-4 lastly concludes the paper by presenting facts and findings with reasonable arguments.

Agriculture production and production factors:

Agricultural production is usually concerned with a significant time gap between cultivation—or, more broadly, the period during which initial investments and inputs are made—and harvesting/marketing the produce. To fill this gap agriculture credit is important. To examine this Seven and Tumen (2020) examine the cross-country data in turkey and revealed that agriculture credit affect positively the agricultural productivity. They presented more specific results that asserted that doubling agriculture credit produces 4 to 5% increment in agricultural productivity. Ngong et.al (2022) also testify the agricultural productivity function with respectto the agricultural supply in central African countries and revealed that broad money supply without systematic systematic agriculture structure gives negative impact on over all return of agriculture investment. To reach more precise study Chandio et.al. (2017) examination for loanimpact in China is evaluated and found that rather that long term loan, short term loan is havingmore significant impact on agriculture productivity. Awotide (2015) reveal that the totallivestock unit and farm size have a favourable and statistically significant impact on farmers' access to financing in Nigeria whereas the other allied activities are negatively influenced by theaccess supply of credit and create the indebtedness situation. Credit accessibility and influence of credit is not an explicit term it incorporates other regional factors. Hence every region, state and country will reveal different results. In Indian context, Narayan (2015) examines the credit and other aspects which affect the agricultural growth. With analytical tools, concluding remarks indicated that the influence of credit on agricultural GDP is at most marginal, assuming agricultural GDP has a constant credit elasticity. The empirical data suggeststhat the relationship between loan and agricultural GDP is rather weak in the second phase. Additionally, as demonstrated by the regression of agricultural GDP on inputs and prices, few inputs other than fertiliser and labour are significant drivers of GDP. Apart from specific types of government spending and irrigated land, sectoral composition and output pricing appear to be important determinants of agricultural GDP. Further another study conducted by (Shiva Swamy et.al., 2020) in Indian context which examined only the portion of institutional credit performancein Indian agriculture scenario from 1991–2020-time span and revealed that the influence of institutional finance on agricultural production is large and good. As a result, authors recommended to simplifying processes to improve smallholder loan availability, particularly in eastern, western, and north-western areas. Only credit supply is not that influence directly the agricultural productivity but it affects the decision making of the farmers. Sandhu (2020) revealed in his study that several non- quantifiable elements (culture, caste, family size,

education) and relational bank lending procedures influence financial lending choices. Such methods have a negative influence on bankable loan applications, creating moral hazard. Due to diversified culture, political and geographical structure agricultural credit does have different results for agriculture credit.

Sidhuet.al. (2008) revealed from their study conducted in Punjab that in recent years, the state has seen an oversupply of production credit as a consequence of an overly enthusiastic policy of boostinginstitutional agricultural loans, regardless of whether demand existed or not, resulting in the issue of mounting indebtedness. For exploring the fact of agriculture credit supply in recent scenario Maurya and Vishwakarma (2021) Chandio et al. (2019), agricultural credit is essential for balancing the different aspects of agricultural production. Access to credit empowers farmers to allocate funds towards crucial resources such as seeds, fertilisers, machinery, and irrigation, consequently augmenting productivity and yield.Their descriptive study reveals that India's marginal land size categories frequently take out short- and medium-term agricultural loans. The fractionof indebted farm families to total agricultural households grows as land size increases. Punjab, Uttar Pradesh, Andhra Pradesh, West Bengal, Karnataka, Orissa, and Rajasthan had fewer holdings than agricultural families with debt on average. While Satish (2006) found no clear direct link between institutional lending, indebtedness, and suicides in rural Punjab, debt has cascading effects on agricultural households. Debt difficulties, like suicides, do not warrant a limited interpretation or remedy since they are merely symptoms of a wider malaise. Hence, wecan say generalization of study may have reverse conclusion.

Therefore, it is important to identify the gap between the existing research, in the present study, aggregate factors of agricultural productivity and credit supply is considered from 1960 to 2020. Unlike the presented literature, this study includes the impact of economic reforms in 1991 on agricultural productivity and get the differences between the pre liberalization era and post liberalization era.

Methodology:

Study area and Data:

The present study is looking in the historical trend of Indian agriculture system. India agriculture is always considered as an economic center to make the balances in in global market. Therefore, our study is centered in India.

Secondary data is used to explore the facts about the Indian agriculture system and credit. The source of secondary data is agriculture statistics, RBI annual Datasets, World bank reports, Willy, web science articles and annual reports of economic surveys. Agricultural land area, and Agriculture food production, share of agriculture, Consumption of fertilizers, and pesticides spray and agriculture GDP is taken from RBI annual reports on Indian Economy “agriculture”. Labour force participation rate is taken from labour statistics and Net irrigation area is taken from “Irrigation Management for Sustainable Agriculture”. Agriculture Credit is taken from RBI site from Annual report of “Manual on Financial and Banking Statistics”. Further tractor usage in Agriculture is taken from Tractor Manufacturers Association, New Delhidata site. Capital plays an important role in production function hence the data of capital formation in agriculture from public and private sector both is taken from “Ministry of Agriculture, Govt. of India”. Rain fall data is collected from metrological department.

To understand the changes occurs throughout the time since 1951- 2021 (mostly 70 years of independence). In this study, the long-time span is taken to get the thorough analysis of agriculture credit and other input factors on Agriculture output.

To examine this objective, we will follow the following hypothesis:

H0: There is no significant impact of agriculture Input (Credit, Irrigation, Fertilizers, pesticides, Labour force, technology, capital, Land) on Agriculture production.

HA: There is significant impact of agriculture Input (Credit, Irrigation, Fertilizers, pesticides, Labour force, technology, capital, Land) on Agriculture production.

Based on the above hypothesis, the following conceptual framework represent the whole study

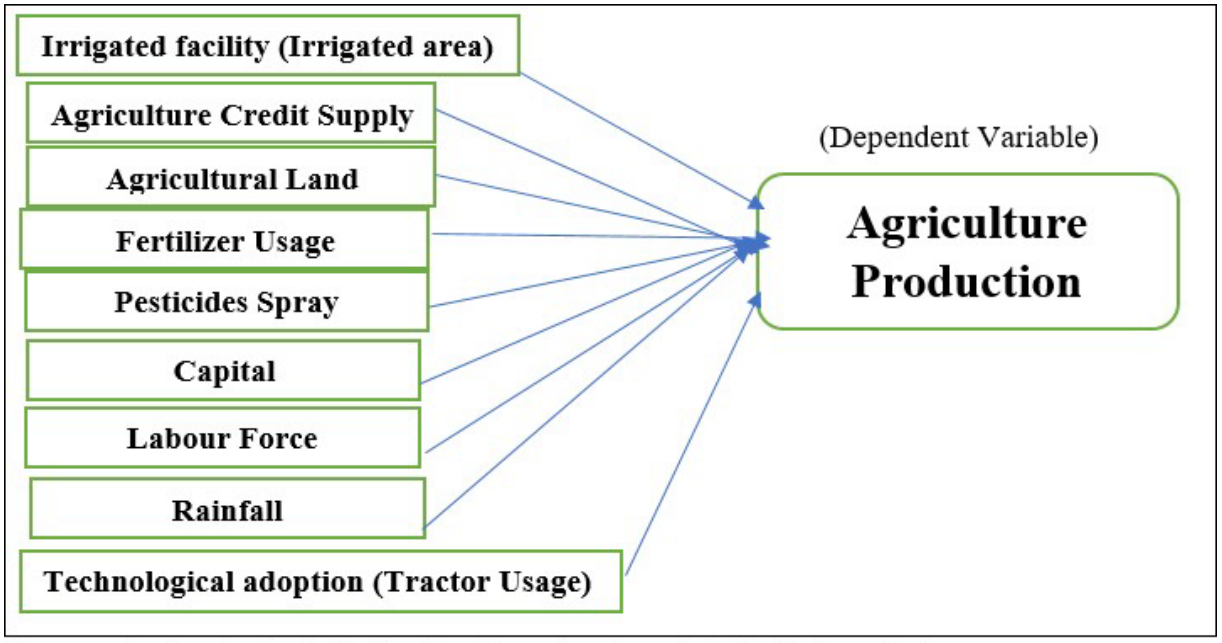
All Variables are recorded in interval and ratio scaling. Hence the linear relationship can be written mathematically in the following way:

$A_p = f\ (A_C, I_l, f_u, P_s, L, L_a, T, K)$.....(1) Where:

$A_C = Agriculture\ Credit, I_l = Irrigation\ Land, f_u = fertilizer\ usage, P_s = pesticides\ spray, L = labour\ force, L_a = Lan\ , T = technology\ (tractor)$, K= CapitalIn

equation number (1) A_p *is the dependent variable and set* $(A_C, I_f, f_u, P_s, L, L_a, T, K)$

is the expression of the independent variables (*explanatory variables*).



Source: Author's study to develop hypothesis and statistical analysis

Nonlinear - Multiple regression analysis:

To examine the relationship between the agriculture production and other factors like credit supply, rainfall, irrigation, fertilizer, pesticide, capital formation, tractor usage, Labour force, agriculture land. To represent this input output relationship, our study makes a base of cobb Douglas function logarithmic linear equation. Hence, our study specified the following equation to express the mathematical form of economic theory:

$\Rightarrow Y = AX^{b1}X^{b2}X^{b3}X^{b4}X^{b1}X^{b6}X^{b7}X^{b8}X^{b9}$..... (1)

1 2 3 4 5 6 7 8 9

Taking natural logarithm of equation (1) and taking all the nine explanatory variable the following log linear equation can be obtained:

$\Rightarrow lnY = b_0 + b_1LnX_1 + b_2LnX_2 + b_3LnX_3 + b_4LnX_4 + b_5LnX_5 + b_6LnX_6 + b_7LnX_7 +$

$b_8LnX_8 + b_9LnX_9$ ..... (2)

In equation (2) $b_0 = natural$ log $of\ A\ i.e.\ intercept.\ lnY\ is\ natural$ log of agriculture product.

LnX_1= natural log of agriculture credit,
LnX_2 =natural log of Irrigated Area,
LnX_3 = natural log of agriculture land
LnX_4 = natural log of Capital,
LnX_5 = natural log of fertilizer usage,
LnX_6 =natural log of pesticides usage,
LnX_7 = natural log of Tractor usage,
LnX_8 =natural log of rainfall,
LnX_9 = natural log of Labour force

Equation (2) is developed to study the annual time series data over the period of 1951-2021. Therefore, at first step, to investigate the nature of the temporal trend, the Phillip-Perron (P- P) unit root test with trend and intercept was used. After the investigation of the unit root, Johansen Co-integration will be used to evaluate the long-term connection between thedependent and independent variables. The out Come of the Phillip Perron test:

Null Hypothesis: The variable contains a unit root (Phillip perron ;1988)

Table 1: Unit Root Statistics:

Number of observations = 70		Newey-west lags = 3		
Interpolated Dickey-Fuller				
	Test Statistics (1)	**1% Critical value (2)**	**5% Critical Value (3)**	**10% Critical value (4)**
Z(rho)	1.56	-13.06	-7.78	-5.54
Z(t)	4.33	-2.61	-1.95	-1.61

Variables	Coefficient	St. Error	t-statistics	P Value
Production	1.02	.009	112.82	0.000
Labour force	1.025	0.12	80.09	0.000
Fertiliser Usage	1.027	.0067	152.78	0.000
Pesticides spray	1.006	.0124	80.78	0.000
Credit Supply	1.099	.0052	209.29	0.000
Tractor Usage	1.089	.0059	181.76	0.000
Capital Formation	1.031	.0135	76.30	0.000
Irrigated area	1.0151	.00266	381.19	0.000
Land	1.0055	.003	328.48	0.000
Rain Fall	0.993	.014	67.94	0.000

Source: STATA (OUTPUT) presented by Author in Tabulated Form

Table-1 depicts the Phillip Perron Unit root test to examine the stationary and non-stationary characteristics of all variables included in the study. From the test, all variables are observed significant and contain p value of 0.000 which indicates the rejection the of null hypothesis that the variable series does have a unit against the alternative hypothesis which suggests that the series doesnot have unit roots. So, it can be concluded that the series of all the variables are stationary as they do not have unit roots.

Johansen tests for co-integration:

H0: There is not a significant relationship between the variables

HA: There is a significant relationship between the variables

Table 2: Long-term relationship between the variables.

Maximum rank	P arms (2)	LL (3)	Eigenvalue	Trace statistic	5%critical value
(1)			(4)	(5)	(6)
0	132	-4599.963	.	506.0276	277.71**
1	153	-4535.3393	0.84636	376.7803	233.13
2	172	-4489.698	0.73365	285.4975	192.89
3	189	-4453.954	0.64515	214.0096	156.00
4	204	-4428.6751	0.51940	163.4519	124.24
5	217	-4404.5948	0.50241	115.2911	94.15
6	228	-4386.2465	0.41247	78.5947	68.52
7	237	-4372.1168	0.33606	50.3352	47.21
8	244	-4360.5877	0.28407	27.2771*	29.68
9	249	-4351.4558	0.23256	9.0132	15.41
10	253	-4346.9492	0.00597		

Source: STATA (OUTPUT) presented by Author in Tabulated Form

Table-2 represents the Johansen tests for co integration to examine the longitudinal relationship between the variable. In this table, Trace value (506.02) is greater than the Critical value at 5% (277.17). which indicates to reject the null hypothesis and accept the alternate hypothesis that variables are having long-term relationship between the all ten variables.

Data Analysis and Estimation:

From figure number 1 to 6. We can see the exponential growth of the loan disbursement in rural areas over the time period. All the institutional loan was increased in late 90s except State government banks. In late 90s other institution were active to provide credit facilities to the farm activities or other economic activities in rural areas. But the question is whether the year significant or not. To explore this, in the further section time series regression model performed.

Data Analysis and estimation:

Loan Disbursement (Rs. In Crore) Trend**:**

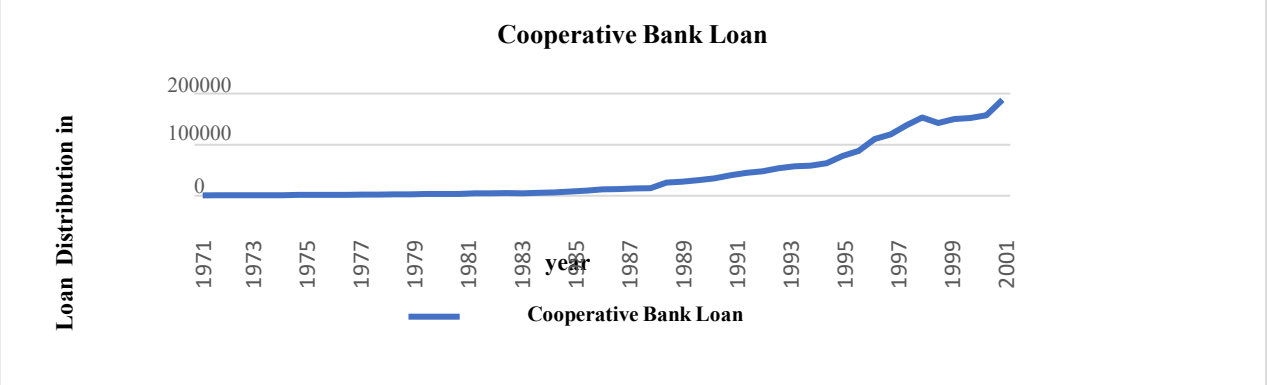


Figure 1: Loan Distribution from co-operative banks Source: RBIs reports

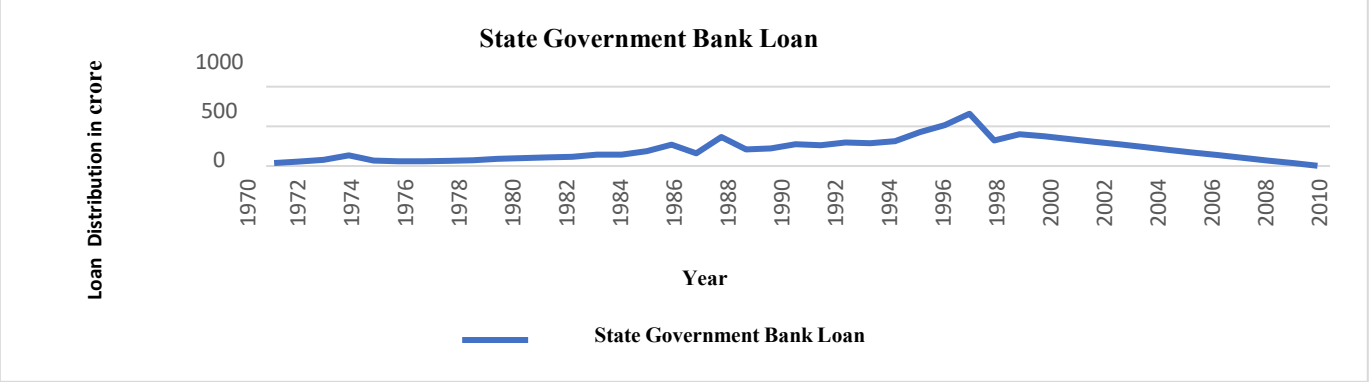
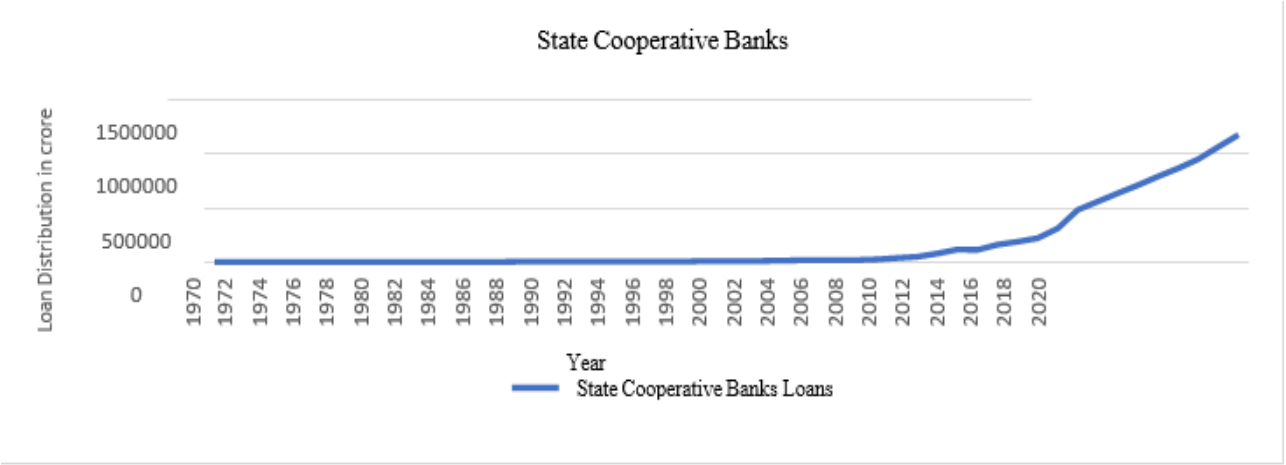


Figure 2: Loan Distribution By state government Loan Source: RBIs reports



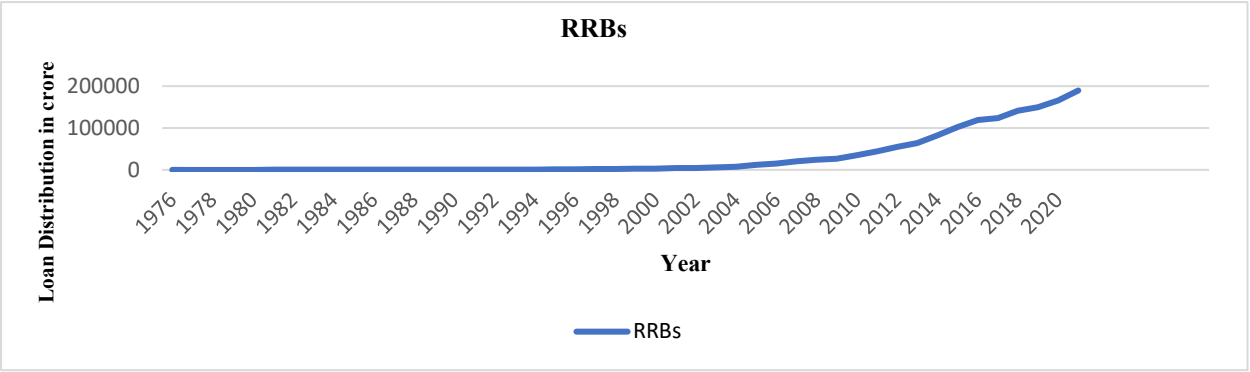


Figure 1: Loan Distribution by SCBs Source: RBIs reports

Figure 2: Loan Distribution by RRBs. Source: RBIs reports

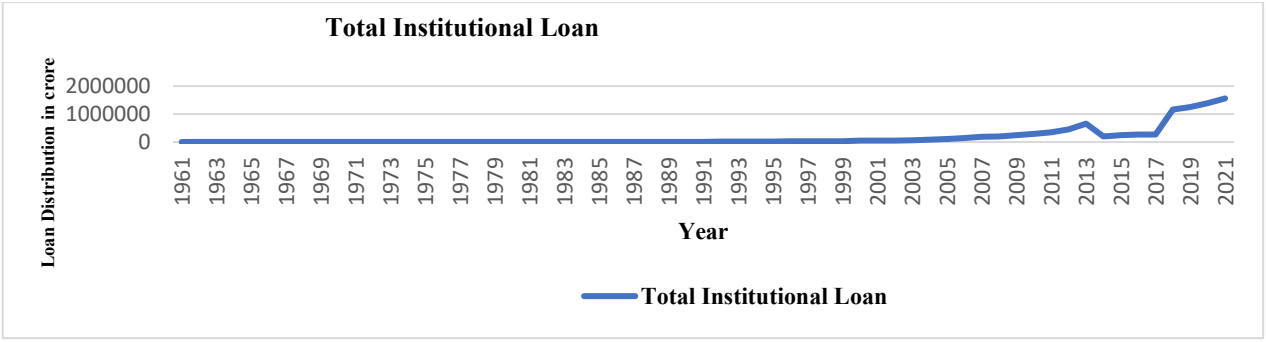


Figure 3: Total Loan Distribution From all Formal Institutions. Source: RBIs reports

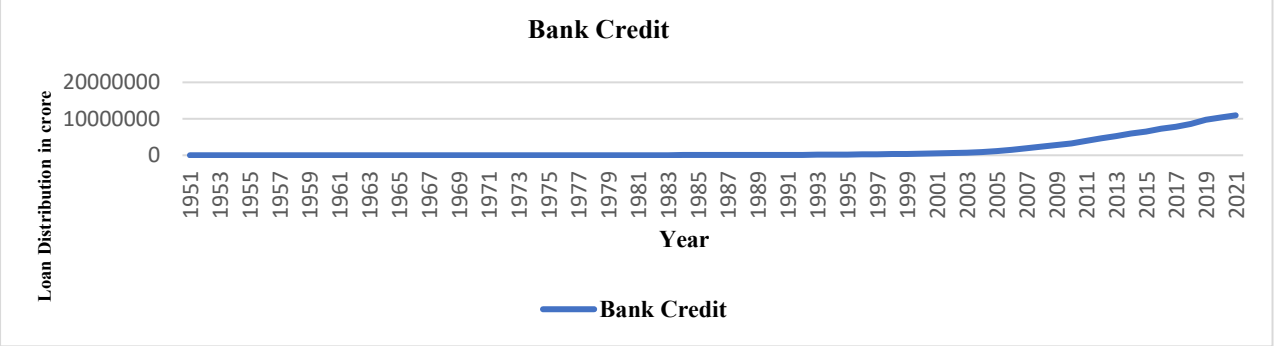


Figure 4: Total Bank Credit Issued by Banking Institutions Source: RBIs reports

Statistical analytics of the parameters:

Table 3: Descriptive statistics of the variables

Variable	Std. Dev.	Min	Max	Rang
(1)	(2)	(3)	(4)	(5)
Production (LAKH tones)	709.2769	508.3	3086.5	2578.2
Total Work-Force (In Million)	263.519	139.5	1071.8	932.3
Work Force in Agriculture (In Million)	125.3144	97.2	515.6	418.4
Fertilizer consumption (Lakh Tones)	98.17935	.66	288.212	287.552
Pesticides spray (Thousand Tones)	21.10211	2.35	75.89	73.54
Credit Supply (Rs. in Crore)	2796996	522	10900000	10899478
Tractor Usage (In Numbers)	424578	2347	1697667	1695320
Capital Formation (Rs. in Crore)	102415.7	187	322723	322536
Irrigated Area (000 hectare)	163.6475	208.5	717.4722	508.9722
Land -Shown Area (000 hectare)	189.6669	1318.9	2064.602	745.702
Labour productivity qt/person	1.509358	5.040473	9.571581	4.531108
Land Yield (000 hectare) /quintal	3.12713	3.853969	14.94961	11.09564
Annual Rain Fall (in MM)	101.9487	936	1401.4	465.4

Source: STATA (OUTPUT) presented by Author in Tabulated Form

Table-3: depicts the Descriptive statistics. In this table the important part is the minima and maxima which reflects the aggregate growth from starting the Independent Indian economy to this current time as all the variables are showing increasing trend. So, credit supply is showing huge range throughout the year. Farmers also adopting more tractors than earlier, whereas agriculture land usage are not that much differences. Fertilizer consumption gets huge differences than pesticides. Workforce participation is not increased as the population proportion. Labour force shifted in other sectors due to low income and high uncertainty in farm business. Land yield has high differences than labour productivity due to changes in cropping pattern and other techniques. To get significant result, whether land is more significant of labour, timeseries regression is applied and presented in the following section.

Regression Table:

(Explanatory Variables)	Coefficient	Standard Error	P-Value
(1)	(2)	(3)	(4)
Work Force in Agriculture (In Million)	.098	.071178	.013***
Fertiliser consumption (Lakh Tonnes)	.015	.042958	.728
Pesticides spray (Thousand Tonnes)	-.050	.044076	.259
Credit Supply (Rs. in Crore)	0.23	.0493643	.034**
Tractor Usage (In Numbers)	-.009	.0334687	.777
Capital Formation (Rs. in Crore)	.017	.0545682	.748
Irrigated Area (000 hectare)	.550	.2606169	.039**
Land -Shown Area (000 hectare)	2.543	.3753477	.000****
Rainfall in mm	.008	.07351	.909
Constant	-15.33	2.71139	000****
Durbin Watson D value	1.9 ~2	Adjusted R	0.975
	(No	Square	
	autocorrelation)		

Source: STATA (OUTPUT) presented by Author in Tabulated Form

Results and Conclusions:

After applying regression of logarithmic variables, land, Labour and irrigation three major components are extracted out of the nine defined variables as a significant driver to affect agriculture. One unit of labour can change .098% agriculture production. One unit of irrigated land can change 0.55% of agriculture productivity. Showing in one-unit extra land input can influence 2.54% of the agriculture productivity which is similar to the finding of Jin et.al. (2012) in the study of impact of irrigation on agricultural productivity. This finding is coping up with the study of Thirlwall (1989) who stated that Land as a distinct element of production has a tendency to be assumed away or absorbed into capital in the production-function approach to the investigation of the sources of growth. This is because the production-functionmethod focuses on how production functions because of time-honoured, conventionally classical concept of land as a constant element of production, which, in the grand scheme of things, is without a doubt accurate. The rest drivers affect but their influences are notsignificant. Like Fertilizer usage and capital formation in agriculture can have positive impact(0.015% and 0.017%) on agriculture productivity but not significant. Further Credit Facilitieshave also the positive impact on agriculture growth. The influence is reported 0.23%. (Siudek,2005) and (Siudek, 2005) do have similar findings that credit from co-operative and commercial bank have positive impact on agriculture growth. technological adoption like tractor usage, pesticides spray and rain fall do have negative impact on agriculture productivity.

That refers that loopholein the policies and implementation to make this available to the farmers. Like this current studySedlacek et.al. (2020) found that fertilizer and pesticides can have negative impact due excessive quantity and bad quality (Distribution in Subsidy policy) of fertilizer application (Jaiswal et.al.,2020), It causes harmful greenhouse gas emissions into the atmosphere as well as river eutrophication. Fertiliser usage may have a detrimental impacton the environment, but researchers are working to reduce this impact while preserving or evenincreasing the amount offood that can be grown with the aid of fertilisers. To better understandthe credit effect, Swinnenand Gow (1997)

Discussed that the inefficiency of credit on agriculture due to the sensitivity of sectors there are least feedback and optimality are examined which led to the negative impact ofcredit on output

when it fails to generate the expected outcome. Further Capital Formation is also not supporting many theories as they asserted that it might have positive influence on agriculture production. But here, other supportive skills are not associated with the farm community and traditional constraint make farmers unskilled to use capital and generate positive impact. Hence our Hypothesis, is rejected and accepted the fact that three major inputs(Land, Labour and irrigation as p value is significant impact on Agriculture but for the rest of the factors does not have significant impact.

Study indicates the traditional components like labour, land and irrigation are significantly having positive influence on agriculture production but the recent reforms and policy contents does not have the expected influence on agriculture. For Fertilizer and pesticides, most of the farmers are depending on subsidies which are not good quality.

Application of these kind of fertilizers and pesticides reduce the productivity instead of increasing them. Likewise, Credit supply also not well executed especially in remote and hill areas of the country. Capital formation only includes large scale farmers whereas small scale farmers get affected reverselydue to disproportionate land and capital ratios. Therefore, the objective of this paper is to draw attention to the detrimental factors affecting production in Indian agriculture. In order to achieve positive growth in this sector, it is crucial to address these factors with utmost care, as they are currently not yielding significant outcomes.

The research examines the intricate relationship between agricultural determinants and productivity, provide valuable insights for enhancing productivity in the Indian agricultural sector through the analysis of factors such as Credit, Irrigation, Fertilizers, pesticides,Labour force, technology, capital, Land on Agriculture production. All such factors are directly related in growth of agriculture.

limitations and future research:

The study possesses certain limitations. The research primarily focuses on general trends and may not fully consider the nuances of regional variations within India's diverse agricultural landscape. Given the limitations of time and resources, it is necessary to conduct separate studies on each determinant (such as credit, irrigation, fertilizers, pesticides, labour force, technology, capital, and land) in order to fully understand their qualitative impact on agricultural production. This statement acknowledges the constraints of the current study while also highlighting the potential for future research.

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