Original Research Article

Pattern and Determinants of Agricultural Investment: A Case Study of Two States of India

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Abstract

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The study endeavours to examine the pattern and determinants of agricultural investment in two states of India viz., Haryana and Odisha of India. Scholars in the past have identified public investment in agriculture as a major determinant of private investment and output, accordingly, emphasis was needed to accelerate the rate of public investment. The present study using primary data is an attempt in that direction. It findsthat private in agriculture has been significantly influenced by canal irrigation, institutional credit, and size of farm in Odisha. While in Haryana, farmer's education, land size and institutional credit positively and significantly affected private farm investment. Capital use in agriculture turned out to be positive and significant variables influencing agricultural productivity in both regions. Public investment has a major role to play influencing investment and output in both regions. Hence Public investment in agriculture in the form of rural infrastructures, irrigation development, research and development, education etc. are vital in stimulating private investment and agricultural output. Public investment in agriculture would ensure inclusiveness as it promotes employment opportunities and sustainable growth in agriculture. In the context of Odisha, being a poorer state. accelerating public investment could serve as an important tool of poverty alleviation.

Keywords: Private Investment, Public Investment, Agriculture, Productivity, Inducement Impact

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1. ITRODUCTION

Agriculture sector provides food grain to the entire economy apart from providing impetus to other sectors of economy through demand and supply channel in India. The sector also plays a major role in provision of employment in rural sector. However, its contribution to the Gross Domestic product has been declining at the rate higher than the reduction in population depending on it. In Indian economy, agricultural sector has performed very poorly in the post reform period (Binswanger 2013, Chand et.al. 2007, Bhalla 2009). Chand (2007). They concluded that while the growth rate of GDP in the agricultural sector registered well in the early period of reforms, there was significant deceleration in the growth rate in the later period especially in the front of food grain production inthe context of two states viz., Odisha and Haryana. The growth experience of Indian economy so far has been nested with service sector with gross negligence to the commodity sectors such as agriculture and industry. Therefore, inclusiveness would be expected to be sounded more when growth in agriculture sustained with adequate production potentialities and employment opportunities

Several scholars in the past concluded that public investment in agriculture is essential for promoting private investment and enhancing agricultural output. Therefore, one of the important reasons put forwarded for such deceleration has been decline in public investment in agriculture especially on irrigation and other rural infrastructuressuch as;rural electricity consumption, rural roads, formal credit etc. The Eleventh Five Year Plan also identified public investment in agriculture as one of the important factors determining of agricultural growth in India.Consequently the Plan laid specific emphasis on public investment in agriculture.

Such reduction in agriculture growth due to declining investment have also led to slower reduction in interregional inequality. In an estimate by Bhalla (2009), the growth rate of crop output decelerated from 3.61 percent from 1980-83 to 1990-93 to merely 1.00 percent from 1990-93 to 2003-06 in Eastern Region, and Odisha registering a negative growth rate (-0.67 percent per annum). In an earlier estimate by Chand (2007), the net state domestic product in agriculture in the state of Odisha grew at the rate of 0.11 percent in the state during the period 1995-96 to 2004-05. The author noted a deceleration in the growth of area irrigated and consumption of electricity in the state during the same period. The level of agricultural productivity in the state is quite lower compared to the other states and at the all India level. The

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stagnant cropping pattern, poor quality and quantity of input use led to poor income earning capabilities of farmers. The poor returns from agriculture must be attributed to inadequate input use and lack of adequate infrastructure in the state which includes irrigations, rural electricity, transport and communications, bank credit etc. that come from public initiative. Since agriculture remains the mainstay of state's economy and sustenance of the life of people, a poor performance of agriculture has severe implication on food security in the state.

2. REVIEW OF LIERATURE

The issue of public and private investment in agriculture discussed widely among the scholars in the late eighties and first half of nineties. The discussion mostly centres around the overall trends of public and private investment in agriculture and the inducement impact of public investment on private investment. Most of the scholars reached the conclusion that there was a clear indication of declining public investment in agriculture especially during eighties (Pattnaik (1987), Rath (1989), Shetty (1990), Mallick (1993), Rao (1994), Dhawan (1996), Gandhi (1996). Further, using National Accounts Statistics, a positive relationship between public and private investment has been noted which implies public investment necessarily induced private investment in Indian agriculture (Krishnamurthy and Pandit 1985), Rath (1989), Shetty (1990), Rao (1994),Rao and Gulati (1994), Dhawan and Yadav (1995), Gulati and Bathla (2001), Chand (2001), Chand and Kumar (2004). At the disaggregated level, Dhawan (1996) studied the impact of government investment on canal irrigation and it's likely impact on private farm investment in Indian agriculture, more specifically, canal irrigation constituting a substantial portion of public investment stimulate private investment in agriculture. It was further asserted that institutional lending to agricultural development in India is more concentrated in irrigated than in dry land tract. Chand and Kumar (2004) observed that the impact of agricultural subsidies on private investment was also positive, but firmly concluded that long term returns from public capital formation are more than double the returns from subsidies. It was also found that terms of trade for agriculture as well as institutional credit were strong determinant of private sector capital formation. With broad series[1], Gulati and Bathla (2001) found that private investment is positively influenced by public investment in Indian agriculture.

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Several other studies indicated that investment on rural infrastructure directly or indirectly meant for agricultural sector have an important role to play for enhancing agricultural investment and output. Binswanger et al (1993) with the help of district level time series data found that education infrastructure and rural banks play an overwhelming role in determining investment, input and output decisions. The expansion of commercial banks into rural areas had a large effect on fertilizer consumption and on fixed private farm investment. Canal irrigation and rural electrifications have also significant impact on agricultural output. Fan et al (1999) analyzing the state level data in India concluded that government spending on agricultural research and development, irrigation, rural infrastructures including road and electricity have all contributed to the growth in agricultural productivity and reduction in rural poverty. In a similar study, Fan et al. (2002) worked out the effect of public expenditure on agricultural productivity and rural poverty reduction across Chinese provinces. Government spending on agricultural research and development substantially improved agricultural production followed by investment on rural education. Roy and Pal (2002) in a state wise analysis of agricultural investment and productivity observed agricultural productivity is central to rural poverty alleviation and infrastructural and technological changes in turn play a key role in determining productivity. Kumar et, al.(2006) also established a strong relationship between rural infrastructural development and the level of net agricultural state domestic product in the Indo-Gangatic Plain of India. It was concluded from the study that there is a significant scope for increasing the value of output from agriculture in backward states by improving the rural infrastructure.

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The Present Study

With this backdrop, the present study examines the pattern and determinants of capital formation of the cultivating households in the context of in the context of Odisha and Haryana agriculture with the help of a field level investigation to facilitate comparison in agricultural investment and factors influencing it.

3. DATA AND RESEARCH METHODOLOGY

Comment [AA17]: This part is missing of refining the sampling method to reduce bias, providing more detailed information on data collection and analysis procedures, and considering alternative methods for estimating farm investment. Additionally, conducting a thorough comparative analysis between Haryana and Odisha would strengthen the study's findings and implications. The methodology briefly mentions various categories of investment, such as farm houses, implements, and animals, but it does not provide detailed information on how these investments will be measured or valued. This lack of clarity may affect the accuracy and reliability of the investment estimates.

At the farm level,the data have been collected through a proposed field survey using structured questionnaires. Haryana and Odisha are the two states where the pace of agricultural growth and development has been quite different and therefore wide disparities in their level of agricultural investment. The state Haryana had the advantage of early adoption of new technology and leading to large scale investment in farm machinery and infrastructure. It may be mentioned that an irrigated belt in Odisha has been chosen to facilitate comparison with that of Haryana. The selection of district in each state has been made on the basis of the level of agricultural development. One district from each state has been selected based on three criterias such as; percentage of rice production in the state, percentage of gross area irrigated and fertilizer consumption (Kg/Hect). Percentage of rice crop is taken as an indicator and given more weightage simply because it is the main crop in Odisha and thus more suitable to facilitate comparison. Based on these two indicators, Karnal in Haryana and Bargarh in Odisha have been selected. Four villages from each district have been chosen randomly. A sample of 150 farmers, from each state has been selected with due representation of all farm size categories. The general sample design is a stratified at several stages. The final stage, the units are households. From amongst 150 households chosen, majority of farmers belong to small farm farmers category defined as cultivating land from 0.1 acre to 5 acre. Medium farmers defined as cultivating land from 5.1 acre to 10 acres constituted 23.3 percent and 26.6 percent in Odisha and Haryana respectively. And, large farmers cultivating land more than 20 acres constituted a little above 10 percent in both regions.

The estimate of farm investment among the farming households in Odisha and Haryana has been arrived at using the money expenditure methods, which is similar to that followed by the All India Debt and Investment Survey (AIDIS) in the various rounds of National Sample Survey. Under money expenditure method, the sum total of expenditures that are devoted to investment or addition to capital asset is taken into account. Several items of expenditure which are essential for agricultural production has been considered in the study include; farm houses and cattleshed, land improvement, modern and traditional implements, irrigation implements, milch and draught animals etc. In case of farm assets such as farm houses, cattle shed, poultry shed, wells etc, the cost of maintenance and repairs has been taken into account. While in case of fixed and high valued assets like tractor, irrigation equipments etc., annual value of allowances for wear and tear of machinery has

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been calculated by straight line depreciation methods. It is a method of allocating the cost of a capital asset over the anticipated life of the asset. The straight-line method (as suggested below) is the most popular and simple way to find depreciation.

$$\frac{\textit{Original Cost of asset- Trade-in-Value}}{\textit{Service life of asset (in years)}}$$

In this method, it is assumed that depreciation occurs at a constant rate per unit of time. But in practice, depreciation of the asset may not remain the same in each year. However, the method is simple to calculate and the margin of error is quite less (Kalhon 1980). In case of low valued traditional implements such as sickle, kudal, khurpi etc, cost at the time of purchase has been considered provided they are in running conditions.

4. RESULTS AND DISCUSSION

Comment [AFAA21]: The analysis focuses on describing the magnitude and pattern of farm investment and its impact on output without delving into deeper theoretical or empirical analysis. The interpretation of the results appears to be oversimplified, lacking nuanced consideration of potential confounding factors or alternative explanations for the observed patterns. The analysis lacks sufficient contextualization within broader theoretical frameworks or comparative perspectives. While regression analysis is used to examine the determinants of farm investment and output, the discussion does not address potential limitations or assumptions underlying this method. Incomplete Discussion of Findings

4.1 An Estimate on magnitude and pattern of Farm Investment

Based on the above method, investment in agriculture per cultivating household by farm size has been depicted in Table 1. It may be seen that investment in agriculture under different items increases as the farm size increases. Investment under modern implements including tractor and accessories among cultivating households in Odisha constituted 51.2 percent of the total investment taking all categories of households together, though it happened to be the major share among the large farmers. Among the small farmers, the proportion of investment under modern implements constituted only 20.5 percent, the major share come from investment for milch animals. Some of the traditional implements like *Desi* plough, bullocks and bullock carts etc., the small farmers have higher share. It may be mentioned that these traditional implements are especially suited for small piece of land, and these implements are being portable in character required lots of time and efforts, which the small farmers can afford to use them. The table also brings out that the magnitudeof investment by the small farmers is very low compared to the medium farmers and the large farmers in both study regions.

Table 1 Households' Capital Formation in Agriculture by Farm Size (Per Household in Rs), Odisha

	Small farmer	Medium farmer	Large farmer	All size
Farm houses, cattle shed and land improvement	121(10.3)	852(15.5)	2107(15.7)	516(14.4)
Irrigation development (Elec pump, well and other sources)	96(8.2)	430(7.8)	949(7.1)	271(7.6)
Modern Implements including tractor and accessories	241(20.5)	3005(54.5)	8584(63.9)	1831(51.2)
Traditional Implements include bullock cart, desi plough, khurpi, kodal, sickle etc.	84(7.1)	126(2.3)	83(0.6)	93(2.6)
Draught animals (Bullocks, He buffaloes)	199(16.9)	406(7.4)	331(2.5)	260(7.3)
Milch animals (Cow, she buffaloes)	321(27.3)	598(10.9)	1086(8.1)	472(13.2)
Others including goatry, piggery, poultry etc.	114(9.7)	94(1.7)	294(2.2)	130(8.6)
Total	1176(100)	5511(100)	13434(100)	3573(100)

Table 2 Households' Capital Formation in Agriculture by Farm Size (Per Household in Rs), Haryana

	Small farmer	Medium farmer	Large farmer	All size
Farm houses, cattle shed and land improvement	95(2.3)	874(5.6)	2955(6.1)	648(5.2)
Irrigation development (Elec pump, well and other sources)	1550(38.0)	3579(22.8)	9863(20.4)	3088(24.7)
Modern Implements (including tractor and accessories, combine harvestor, rippor, fodder cutter etc)	1181(29.0)	9520(60.6)	32915(68.1)	7218(57.8)
Traditional Implements include bullock cart, desi plough, khurpi, kodal, sickle etc.	377(9.3)	252(1.6)	28(0.1)	301(2.4)
Draught animals(Bullocks, He buffaloes)	208(5.1)	674(4.3)	967(2.0)	426(3.4)
Milch animals(Cow, she buffaloes)	612(15.0)	716(4.6)	1382(2.9)	731(5.8)
Others including goatry, piggery, poultry etc.	51(1.3)	106(0.7)	220(0.5)	86(0.7)
Total	4074(100)	15721(100)	48330(100)	12498(100)

Note: Figures in the bracket represents percentage to the total.Source: Field Survey

Investment on modern farm machineries and implements along with irrigation implements constituted a major share for the cultivating households in Haryana. They formed nearly 58percent of the total investment. Mentioned may be made that while a variety of farm machinaries such as tractor, combine harvestor, rippor, threshers have been owned and used in Haryana agriculture. However, in case of Odisha, tractor and power tiller constituted the source of farm machineries.

One of the important observations in the present field level investigation is that the large farmers by virtue of owning farm assets through huge investment were able to maximize their total income by hiring same to the small farmers. Tractor plays a vital role in the adoption of farm machinery in study regions of Odisha. In view of increasing cost of maintenance and the time consuming traditional inputs such as bullocks and bullock carts, even the small farmers in Odisha are increasingly abandoning them. This is also true in Haryana agriculture.It is also observed that use of farm machineries even among the small farmers has been quite impressive by hiring from their large counterparts on a rent. It could be one possible reason as to why the yield per acre among the small farmers is higher, apart from a high labour land ratio. However, there are several inconvenience in hiring farm machineries by the small farmers, most importantly they can not avail those machineries at their own convenience and time which could lead to delay in plantations and crop loss at harvesting. Therefore, the small farmers may be encouraged to invest on this item so as to increase their productivity further and maximise their households' income by putting them in several uses by forming farmers cooperative.

In order to analyse the difference in farm production in both regions, we have estimated the returnsfrom farm production especially in case of rice crop. This is because rice happen to be the major crop grown in the study regions in Odisha. Therefore, to facilitate comparison only rice crop has been considered. Table 5 below presents the net returns from rice production on per acre and per cultivator basis in both states. The figure of net return has been arrived at by deducting the cost of cultivation from the gross values of sales.

Table 3 Net Income from Production(in Rs. for Rice crop)

Farm Size	Odisha	Haryana

	Per acre	Per household	Per acre	Per household
Small farmers	4899	13344	7466	18344
Medium				
Farmers	3801	25347	5863	34634
Large farmers	4680	91247	7138	106060
All size	4505	24896	6778	31802

Souce: Field Survey

Some important observations that can be made from the table are; one that the net returns from rice production in Haryana is higher than in Odisha and secondly; the smaller sized farms are more productive compared to their large counterparts. and thirdly; income per household is an ultimate indicator of households economic well being. The farmers in Haryana are more productive because the quality and quantity of inputs, they are using is much better and that the magnitude of investment in agriculture is much higherthan the farmers in Odisha. The second observation led us to conclude an inverse farm size productivity which was a concluded by scholars earlier (Sen 1962, 1964, Khusro 1964, Rao 1966, Sharma et.al 2000 Chand 2011)is still relevant today. This is because of higher input use per acre by the small sized farmers along with their surplus family farm labour.The small farmers however could be more productive and maximise their household' income if they could form cooperative and invest on their agriculture especially on the front of farm machineries and implements. This would also release labour to the non-farm sector and consequently help to maximise their household income to better their economic well being.

4.2Inducement Impact of public investment at the Farm Level

The differences in productivity in agriculture between Haryana and Odisha as has been observed in the above section could largely be attributed to the difference in the quality and quantity of input use and the pattern and magnitude of farm investment in their respective agriculture. The present section deals with the factors affecting farm investment and farm output among the cultivating households in both Odisha and Haryana using a multiple regression framework. Several independent variables considered in the study are;proportion of canal irrigation, farmers education, and availability of institutional credit which are in the domain of public

authority. In fact, the impact of canal irrigation on private investment is one of the suitable indicators of public investment in the sample region of Odisha since the major source of irrigation is canal water. Size of land can also affect private farm investment in agriculture as large farmers are expected to invest more on their agriculture compared to small farmers. In another equation, output per acre has been taken as dependent variable which are influenced by land size, educational level of farmers, capital use in agriculture and intensity of cropping. Two dummy variables are; education and the other is use of capital. In case of dummy for education literate 1, and 0 other wise, and in case of dummy for capital use, capital use 1 and 0 otherwise. Using the above variables, a stepwise multiple regression analysis has been undertaken to show the impact of several specified independent variables on agricultural investment and output.

In the first equation, Table 4 investment per acre has been taken as dependent variable and several independent variables included are land size, institutional credit, education (dummy) in the field region of Haryana agriculture. The results suggest that land size, educational level of farmer and institutional credit positively and significantly influenced investment in agriculture. This indicates farm investment per acre increases as the farm size increases and that institutional credit plays a vital role financing farm investment. Educational level of farmers also turns out to be positive and significant at 5 percent level of significance. In Odisha as well (table 5), farm investment by the cultivating households are positively influenced by institutional credit and farm size. This suggests that large farm have adequate access to institutional credit in both regions and farmers with greater access to institutional bank credit do have higher investment for their agriculture. The proportion of canal irrigated area also positively influenced private farm investment. A positive coefficient of proportion of canal irrigation indicates that public investment in the form of canal irrigation positively influenced private investment in agriculture. In fact, the presence of canal irrigation have induced farmers to acquire farm implements and machineries, induced investment on land improvement, irrigation equipments, adoption of chemical fertilizers and HYV seeds etc. It is to be noted that the canal irrigated belt in the study region is protective in nature. This induces farmers to invest on private irrigation tools like well irrigation, diesel pump etc. Canal irrigation also complements digging well or owning a pumpset. Further, the impact of

canal irrigation also bears with the livelihood pattern of the people apart from the benefit of crop production. For instance, fishing has been largely practiced among several households in the study region in the canal irrigated belt of Odisha.

The second model considers output per acre as a function of land size, cropping intensity, education (as dummy) and capital use (as dummy) in Haryana agriculture. While in Odisha, the independent variables are of land size, education (as dummy) and capital use (as dummy). The results clearly depicts that farm size defined by operational holding bears a negative relationship with output per acre in both regions. Interestingly, education also does bear an inverse relationship with output per acre in both regions. This could be because most of the small farmers being illiterate have higher output per acre in their agriculture. Likewise, the large farmers being more educated tend to prefer more leisure**.** In other words, small farms with lower level of education endowed with family farm labour, thus turning out to become more efficient. Cropping intensity is another independent variable included in the regression analysis in the context of Haryana agriculture. It has been seen that cropping intensity have a positive and significant relationship with output per acre.

Table 4Regression Results: Haryana

Model 1 Dependent variable: Investmentt per acre					**Model 2**Dependent variable: Output per acre				
Independent variables	Constant	Beta	t-value	Sig.	Independent variables	Constant	Beta	t- value	Sig.
	538.1		2.920	.004		23557.6		9.217	
lsize		.500	7.492	.000	lsize		-.372	-4.904	.000
credit		.199	3.106	.002	edn		-.180	-2.663	.009
Edn (dummy)		.177	2.734	.007	cinty		.173	2.634	.009
Adj R^2 0.40					Capuse (dummy)		.194	2.607	.010
N=150									
					Adj R^2 0.39				
					N=150				

Table 5 Regression Results: Odisha

Model 3 Dependent variable: Investment per acre					Model 4 Dependent variable: Output per acre				
Independent variables	Constant	Beta	t-value	Sig.	Independent variables	Constant	Beta	t-value	Sig.
	131.1		.589	.557		12286.1		57.062	.000
credit		.296	3.974	.000	lsize		-.423	-5.648	.000
lsize		.290	3.866	.000	Edn (Dummy)		-.188	-2.705	.008
irrgnpr		.165	2.259	.025	Capuse (Dummy)		.152	2.067	.041
Adj R^2 0.21					Adj R^2 0.31				
N=150					N=150				

The results presented above indicates that the use of capital is a strong factor influencing farm productivity. The coefficient of capital use turns out to be 0.19 in Haryana and 0.15 in Odisha significant at 0.05 percent level. It thus came out that use of capital have significant role to play in enhancing farm production. This is especially true, because not all categories of farmer own capital assets which are lump sum in nature.Small and marginal farmers tend to hire agricultural implements and machineries from their large counterparts on a rent. This is because of increasing cost of maintaining bullocks and bullock carts and other traditional implements, leading themto increasingly substituting machineries and implements by hiring these modern implements. It provides significant insights to the fact that despite small and marginal farmers do not own high payoff farm implements, use of capital in their farms are quite at par with the big farmers in terms of hiring them from the later. Nevertheless, a comparison of the ratio of farm capital per cultivator household suggests that farmers in Odisha lag far behind than farmers in Haryana. The small and marginal farmers in a backward agriculture such as Odisha have therefore to depend more on the large farmers or to the owners of capital asset as

compared to a developed region such as Haryana. Because of few ownership of farm asset in Odisha agriculture, the dependent had to wait or stand in queue to hire them; some times they had to pay a higher rent or as demanded by the owners. In some cases, crop loss are reported by these dependent farmers as they can not avail the hired machineries.

5. CONCLUSION

The present study with the help of a field level investigation estimated the pattern and magnitude of private farm investment and factors influencing them in two states of India viz., Odisha and Haryana. The study observed that investment among the cultivating households in Haryana is much larger than among the households in Odisha. And further that, the composition of farm investment is better in Haryana agriculture; in that the investment under farm machineries and implements including irrigations had a major share than Odisha agriculture. This resulted with a higher farm production in Haryana on both per acre and per household basis.

The study also attempted to identify several factors that may influence private investment and output in agriculture. Private investment in agriculture has been significantly influenced by canal irrigation, institutional credit, and size of farm. While in Haryana, farmer's education, land size and institutional credit positively and significantly affected private farm investment. Canal irrigation and institutional credit could be considered as the important variables that are under the public domain; and as these variables turned out to be positive and significant, we may conclude that public investment have induced private investmentin the context of both Haryana and Odisha agriculture. The facilities of assured canal irrigation in Odisha proves to have a cumulative impact on agricultural income and investment. Flow of agricultural income as a result of canal irrigation induced farmers to acquire farm machineries and implements and several other inputs which helped to increase farm productivity. Capital use in agriculture turned out to be positive and significant variables influencing agricultural productivity in both regions. Farm size and educational level of farmer however, bears a negative relationship indicating that small farmers are more efficient and have poor educational attainment.

6. IMPLICATION AND POLICY RECCOMMENDATIONS

Keeping in view the fact that large proportion of population depending on it, there is a need to accelerate agricultural growth to address the issue of food security in the coming years in Odisha. Public investment in agriculture in the form of rural infrastructures, irrigation development, research and development, education etc. plays a greater role in stimulating private investment and agricultural output which should be a top priority in the state. Minor irrigation programmes, soil and water conservation measures and research and development to improve productivity in rain fed areas hold the key.Public investment in agriculture would ensure inclusiveness as it promotes employment opportunities and sustainable growth in agriculture. It could serve as an important tool of poverty alleviation.

[1] It has been pointed out that bulk of public investment in agriculture is accounted for by investment in irrigations as defined by CSO series. Broad series includes investment in other rural infrastructure such as rural electricity, markets, rural roads etc apart from investment in irrigations.

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