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CROP-LIVESTOCK INTEGRATION AND FOOD SECURITY AMONG RESOURCE-POOR RURAL FARMERS IN NORTH-WESTRN NIGERIA- AN EMPIRICAL STUDY FROM ZAMFARA STATE.

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ABSTRACT

This study describes the relationship between food production, revenues and different soil management practices in the Zamfara Forest Reserve, North-western Nigeria. Data were collected between December 2001 and August 2002 from farmers using structured questionnaires. Partial budgeting analysis was used to determine net revenue profiles of farms under integrated and non-integrated practices in the study area. Results show that integration helps the farmers to manage their soil better by use of manure. The integrated farmers have better crop yields and hence better income than the non-integrated ones. The analysis has also shown that the integrated farmers have more food for their family consumption and marketable surplus to generate income for family non-food needs.

KEYWORDS: Crop-livestock integration, food security, resource-poor farmers, soil fertility management

INTRODUCTION

Land degradation and soil fertility depletion has been identified as a major inhibitor of food security among the resource-poor rural farmers in West Africa (Oucho, 1998). This is mainly due to soil fragility associated with high population pressure and limited arable land that are poorly maintained for subsistence requirements. In the past, the Nigerian government was heavily involved in fertilizer subsidization to enable all categories of farmers have access to soil fertility enhancement by the use of fertilizer. However, with the recent debt burden and in an attempt to reduce wastage associated with distribution by the Ministry of Agriculture, the fertilizer market has been deregulated, with virtually all subsidies removed. This has in a way made the prices to go beyond what the poor rural farmers can afford. In addition, there is lack of credit facility to facilitate their capacity for fertilizer or other farm inputs procurement. For farmers to be able to cope under this condition demands being innovative to the extent of generating local resources for soil fertility management. To this end, the resource-poor rural farmers in the north generally have adopted crop-livestock integration as a production process because of its numerous advantages which are, giving the farmer access to animal traction power, generation of additional income from animals and animal by-product sales, as sources of manure for cropping, as a form of savings and as a traditional production method. Two main integration methods have been identified. The first is a situation in which crop and livestock production are combined under same management (McIntire *et al*, 1992). The second is a situation in which the herder and cropper are separate but are involved in an exchange contract based on the exchange of manure for crop residues grazing with transhumance herders (Williams *et al*, 1995; Powell *et al*, 1996). While the first is referred to as closely integrated farms, the second have been termed segregated integrated farms (McCrown *et al*, 1979). Whichever form of the two integration is practised, the main objective of integration is geared towards manure for crop production, draught force and milk (Mortimore *et al*, 1990; Mortimore and Adams, 1998). The main objective of this study is to compare the income and food situation under different farm soil management strategies with respect to the two forms of integrated farms with non integrated ones in the study area so as to ascertain how the food requirement of the families is being met under these different production practices bearing in mind that manure from integrated farms serves as medium for soil fertility management.

METHODOLOGY

Study area, manure contracting process

Zamfara grazing Forest Reserve is located between 6^0 30' and 7^0 15' E, and 12^0 05' N in the North of Zamfara state, and sharing a border with the Niger Republic to the north, Sokoto state to the West and Runka Reserve of Katsina state to the East. The annual rainfall within the reserve ranges from 500 mm in the north to about 850 mm in the south with considerable inter-annual variations. The vegetation of the reserve is of a northern Sahel savannah type.

The Zamfara reserve was established in 1918, and covers as of today an area of about 2300 km^2, including the four enclaves, villages located within the reserve, namely, Shamashalle, Dumbrum, Ajja and Tsabre. There are about 50 other villages lined up in the western fringes of the grazing reserve. About 130,000 people live within and around the reserve and are utilising its natural resources (ARCA, 1995). The reserve is very important for livestock grazing in the rainy season for the transhumance pastoralists as well as the herds being raised by the sedentary farmers living in the enclaves and the adjoining villages. After grain harvest, most of the livestock are fed on stubbles. At the heart of the dry season, most of the transhumance pastoral herds leave the region in search of greener pastures and water. However, about one third of the Fulani who have become sedentary stay in the region throughout the year (Schaefer *et al*, 1998).

In spite of the low average population density of about 80 persons per Km^2, pressure on cropland is very high. The estimate of the actual land area available per household of about 8 persons (Eckert, 1998) is between 1.6 and 1.8 ha for Dumburum, Ajja, and Shamashalle, but about 5.4 ha for Tsabre (Hoffmann, 1998). Plot size among farmers in Zamfara reserve ranges from 0.2 to 4 h with an average of 1.1 ha. As arable land is increasingly becoming limited due to population growth, shifting cultivation and fallow are no longer practised, and therefore the cultivated fields are under permanent use for the past 40 years, thus making the fertility maintenance of the cultivated field a very important requirement for sustainable production. The maintenance of the area already designated for cultivation in this forest reserve has the potential of reducing further deforestation and therefore essential for the sustainability of the forest reserve in itself. This is so in view of the unilateral bush clearing activities often embarked upon by farmers to enlarge their farms or to acquire fresh land due to loss of fertility of the old ones they have abandoned (Hoffmann, 1998). The position stated above has made the

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fertilization of the cropping area to be more compelling and underscores the importance of manure contract adoption in solving the fertility maintenance problems among the farmers in the Zamfara grazing reserve.

Manure contract exchanges between croppers and herders are normally carried out under a mutual trust agreement between the croppers and the herders. The pastoralists night-corral their herd on fields in the late dry season, when no more crop residues are on the field and the surrounding vegetation get scarce. Animals are graced on shrubs and the near-by bush during daytime. Corralling of livestock during the late dry season results in a net transfer of nutrients from rangeland to the cropland. It also returns dung and urine to the soil, and results in better crop yields than dung alone (Powell *et al.*, 1996). Crop farmers usually pay for such manure deposited mostly with a 100 Kg bag of grain for a week contract and occasionally with cash when grains are not available for exchange. However, the other exchange involving crop residues grazing after crop harvest do not attract payment since the residues on the croppers' field at this time compensate for the manure deposited and in some cases, the pastoralists may be required to part with some monies or gifts if the quantity and quality of residues on the field was very high.

The study was carried out in four enclaves, namely, Dumburum, Shamushalle, Tsabre and Ajja in the Zamfara Reserve in the North-western Nigeria between December 2001 and August 2002.

Data source and analysis

The study relied mainly on the use of primary data. The primary data were collected by the use of structured questionnaires. Information was collected on parameters such as general characteristics of farmers, crop and livestock activities, croppers with and without manure contract, land use, input-output relationships in both livestock and cropping activities. The method of stratified random selection was employed to select 143 agro-pastoralists and 85 croppers interviewed from the four enclaves during the process of data collection. The 85 croppers were made up of 45 non-manure contract and 40 croppers that were involved in manure contract for the purpose of managing soil fertility. This gave altogether 228 households from the total figure of 1190 households living in the villages within the grazing reserve. Descriptive statistics such as means, percentages etc. were used to describe the general farming condition in the area.

Partial budget analysis

Partial budget analysis was used to determine the profitability of farm enterprises based on various farm practices as observed in the study area bearing in mind the various levels of resource-use and taking into consideration as the case may be the households combining animals with cropping (agropastoralism). The general form of the gross margin analysis is as follows:

$GM = GI - TVC$

Where:

GM = Gross Margin/Family, GI = Gross Income/family, TVC = Total variable cost/family

RESULTS AND DISCUSSIONS

Size of family and farm holding among various farmer groups

Table 1 bellow shows farm size and the size of family among farmers involved in various farm practices in the study area. The mean land holding varies from one group of farmer to the other. For the Agro-pastoralists, the mean farm size was 2.8 hectare while for croppers, it was 1.77 ha and 1.58 ha for manure contract and non-contract farmers respectively. It is evident from this result that those farmers with livestock have better capacity to crop larger area because they could get manure from own livestock to manage their crop production. It has also shown that those croppers that were involved in manure contract have slightly larger mean farm size than their counterpart that have no means for soil fertility maintenance. This underscores the importance of manure in crop production in the study area where most of the farmers could not afford conventional chemical fertilizer for soil fertility management.

On the other hand, the family size as shown in the Table indicated that the mean size for agro-pastoralists was 14 people per household while it was about 10 and 8 for the croppers with manure contract and without contract respectively. Among the rural populace in Nigeria, the large family size is seen as a status symbol and consequently those with larger family are assumed to have the capacity to provide food and other means of living for the family members. The larger family sizes among the agro-pastoralists and the manure contract farmer is an indication that these groups of farmers have larger and more productive farms arising from better soil management made possible from manure either from owned animals or the manure contract participation with the herders.

Table 1: showing sizes of farm and family among farmers with various farm practices

Statistics	Agro-pastoralists		Croppers with manure contract		Croppers without manure usage	
	Farm size	Family size	Farm size	Family size	Farm size	Family size
Mean	2.81	14.00	1.77	9.52	1.58	8.43
Std. deviation	2.83	8.05	1.38	6.28	0.93	5.29
Minimum	0.40	1.00	0.20	1.00	0.40	1.00
Maximum	24.00	44.00	1.00	31.00	3.60	28.00
N	143	143	40	40	45	45

Source : Field Survey, 2002.

Size of livestock owned by household in the area

The Table shows the mean number of livestock owned by household in the study area. We see that on average, an agro-pastoralist household has about 7 livestock in Tropical Livestock Unit (TLU). With such animals, the agro-pastoralists are better off since they not only get manure from the animals but milk and income from all year round sales of some of the animals to generate additional income for household needs. Since the initial capital to establish herds is difficult to come by, the farmers with livestock are considered to be relatively wealthier compared with farmers in the other group with no livestock. There are however some socioeconomic factors

Table 2: Number of Livestock owned by household in the study area (TLU)

N	Minimum	Maximum	Mean	Std. deviation
143	0.10	55.86	6.9762	9.15484

Source: Field survey, 2002

Why farmers have embraced crop-livestock enterprise combination.

Effort was made to ascertain why many of the farmers in the study area have embraced crop-livestock as production method. In Table 3 below, there were six reasons given by farmers for embracing crop-livestock enterprise combination. The overall summary shows that manure availability has the highest frequency of 41 farmers representing about 29%. Followed closely is the need for animal traction with frequency of 35 farmers representing about 25% and the need for more income with a frequency of 26 farmers representing about 18%. It was also discovered that savings was important in the decision to combine animals with cropping since these farmers can store their wealth in terms of keeping animals that could be sold when there is need for money rather than keeping physical cash since there is virtually no rural banking scheme in the area. So rather than keep money in the house that could motivating these farmers to keep livestock and they are as discussed in the next section.

be stolen or lost to accidental fire, farmers prefer to buy and keep animals with the proceeds from the sales of their crops. Other important factors motivating farmers to keep animals with their cropping activities are the need for more food and as part of their tradition. Food need represents about 8% while as part of their tradition represents about 5%. The traditional food of the people of the study area is millet usually prepared into local delicacy called "fura" and taken with milk. The presence of livestock in the household has always helped to facilitate availability of milk that is needed to enrich the family menu as well as making the food complete. On the other hand, as tradition, the people in the study area are traditionally Muslims and they usually require animals for the Muslim festivals twice in a year. Having animals in the household is advantageous since that has always prevented buying at exorbitant prices from the market for the religious festivals celebrations.

Table 3: Reasons for households participation in crop-livestock enterprise combination in the study area:-

Reasons for animals - crop enterprise	Ajja zone Freq %	Dumburum zone Freq. %	All Agro-pastoralists Freq. %
More income	12 16.70	14 19.70	26 18.20
Traction	18 25.00	17 23.90	35 24.50
Manure	23 31.90	18 25.40	41 28.70
Savings	9 12.50	14 19.70	23 16.10
Food	6 8.30	5 7.00	11 7.70
Tradition	4 5.6	3 4.20	7 4.90
Total	72 100.00	71 100.00	143 100.00

Source: Field survey, 2002

Nature of manure contract and mode of payment to the participating herders

The manure-crop residues contract is carried out in such a way that there is an agreement between herder and cropper for the herder to camp his animals for certain number of days on the croppers field in return for various items as agreed between them. Table 4 below shows the various items of exchange between cropper and herder during exchange. While the cropper gets manure, he gives the items listed in the table below to the herder in return for the manure deposited on his field based on numbers of days agreed between the two of them. However, there are about 45% of the respondents who could not give an account of what they give to the herder involved in contract with them. This could be that the herders they were involved with were not particular about gift and as such animals may not have camped for days as obtained in well negotiated contract.

Table 4: Moue of payment by croppers to the participating herders for manure contract.

Payment mode	Frequency	Percent	Cum %
0	18	45.00	45.00
Manure/residues	6	15.00	60.00
Manure/money	2	5.00	65.00
Manure/grain	7	17.50	82.500
Manure/other gifts	7	17.50	100.00
Total	40	100.00	

Source: Field survey, 2002

Yield performance of crops from integrated and non-integrated farms in the study area.

The yield from the integrated and non-integrated farms are compared in Table 5 below. The agro-pastoralists have an average yield of 1988 Kg/ha in grain equivalent. These are the yields from millet, sorghum, cowpeas, groundnut and cotton converted to grain equivalent of the same unit. The highest crop yields from this group of farmers was most probably due to much availability and use of manure for the fertilisation of their soil. In the same vein, the yields from the croppers that were engaged in manure contract was higher than those not engaged in contract and that was 1724 Kg/ha in grain equivalent. There is no doubt here that the higher yields were due to the effect of the manure made available for soil fertilisation through the manure contract. However, croppers without participation in manure contract have the lowest crop yields that were 1232 Kg/ha in grain equivalent. The absence of manure without conventional fertilizer substitute for these farmers have had very negative effect on the yields performance of their crop and consequently their income.

Table 5: Yields of various groups in grain equivalent/ha

	Agro-pastoralists	Crop-manure contract	Crop-no manure contract
Yields (Kg)/ha	1988.50	1723.74	1232.43

Source: Field survey, 2002

Revenue profiles of farmers with various soil fertility management practices in the study area

Table 6 below shows the revenues per farm household for agro-pastoralists, croppers involved in manure contract and those croppers without manure contract in the study area. The revenue was evaluated per household because the animal portion of the agro-pastoralists could not be calculated on per hectare basis since these animals are on free range system. The result has shown that farmers with either form of integration have better yields and consequently better income as compared with those without integration in the study area. Soil fertility and its management is a major problem confronting production in the study area and indeed in the whole of Savannah region of Nigeria. Since these farmers cannot afford fertilizers and the poor roads infrastructures in the area have alienated them from the formal markets due to transport bottleneck, those farmers that have livestock are able to raise substantial quantity of manure from their animals while those involved in manure contract participation were also able to get manure from contract as means of managing their soils so as to enhance better yields and consequently better net incomes from their crop production. Better crop yields will equally ensure that these groups of farmers are more food secured than those not involved in any form of crop integration since integration is now viewed as having the means of managing soil fertility in the area. From the table, it is seen that while agro-pastoralists have an average net income of about one hundred and seventy six thousand, seven hundred and fifty four naira (N176,754.51) per farm household from crops, those farmers that participated in manure contract as way of managing their soil have an average net income of about eighty nine thousand three hundred and seventy naira (N89,370.87) per farm household. Conversely, croppers that were not involved in manure contract or not involved in integration have the lowest net income of about forty thousand, three hundred and nine naira (N40,309.35) per farm household. This is a poor performance when compared with either agro-pastoralists or the croppers with manure contract. This result shows the important position of manure in soil fertility management in the area and has demonstrated the vital role of integration in farm productivity enhancement among the resource-poor farmers in the North-western Nigeria. If we add the additional revenues per household accruing from livestock, we further see a lot of improvement of over sixty thousand naira (N67442.21) in the farm household income due to integration of livestock into the farming systems for the agro-pastoralists. It could be seen that when the revenue from livestock was added for agro-pastoralists, their net income was more than double that for the cropper with manure contract and more than six times the net income of croppers without any form of integration. It all goes a long way to demonstrate that integration is very vital to the success and survival of the farmers in the study area.

Table 6: showing the revenue profiles of various categories of farmers per family in the study area

Agro-pastoralist n =143, Farm size =2.8 ha	Cropper-manure contract n = 40 Farm size =1.8 ha	Cropper- no manure n =4 5 Farm size = 1.6 ha
Total yields in grain equivalent =5567.8 kg	Total yields in grain equivalent =3102.73 kg	Total yields in grain equivalent =1971.89 kg
Revenues	Revenues	Revenues
Values of crops= ₦270422.29	Values of crops = ₦150948.67	Values 0f crops = ₦94104.50
Animal sold in the year =N103015.4	Expenses on Crops	Expenses on Crops
Milk sold = ₦14136.71	Labour = ₦58054.32	Labour = ₦50960.64
Expenses on Crops	Others = ₦3523.48	Others = ₦2834.51
Labour = ₦66314.64	Total = ₦61577.80	Total = ₦53795.15
Others = ₦27353.14	Net revenues crops = ₦89370.87	Net revenues crops = ₦40309.35
Total = ₦93667.78		
Net revenues crops = ₦176754.51		
Expenses on animals		
Grazing cost = ₦41472.46		
Costs of sup- feeds = ₦6609.99		
Veterinary expenses = ₦1627.45		
Total expenses = ₦49709.90		
Net revenues animals = ₦67442.21		
Total net revenue = ₦244196.72		

Source: Field survey, 2002

Quantity of food produced versus home consumed

In developing countries, farmers in general and small scale farmers in particular are known to pursue multiple production goals. While some of these goals are economic like income generation, a host of them are related to socio-economic considerations such as producing enough food to meet family need, avoiding borrowing for farming and so on. However, food security for family members is seen among the farmers in Nigeria as a very vital production objective and that explains the production of many crops on the same fields at the same time to cater for varieties of food requirement of the family. Below is presented in graphical forms the quantity of food produced versus the quantity consumed at home by the family. This is a simple measure of food availability to farm household since in most cases, the family food need must be satisfied before the marketable surpluses are sold.

3.6.1. Level of food security among the agro-pastoralists

The field results as shown in the figure i below show the quantity of food crop produced versus the quantity consumed at home by the agro-pastoralists. From this graphical presentation, it is seen that almost over 90% of the millet produced were consumed by the family of farmers in this group and hence millet is their major food crop. On the other hand, very little of sorghum and cowpeas produced were consumed while there were substantial marketable surpluses for sales to generate income for the household use. Among this group of farmers, the production has gone beyond subsistence and one could rightly say that they are able to produce enough food to feed their families when compared with farmers in the other two groups.

Level of food security among the Manure contract croppers

From figure ii below, it is seen that millet was also the major food consumed by the household members of croppers with manure contract. Out of over 900 Kg of millet produced, more that 600 Kg was consumed leaving some marketable surpluses. However, it was discovered that nearly all the sorghum produced were consumed by the households of these farmers. Moreover, of nearly 300Kg of cowpea

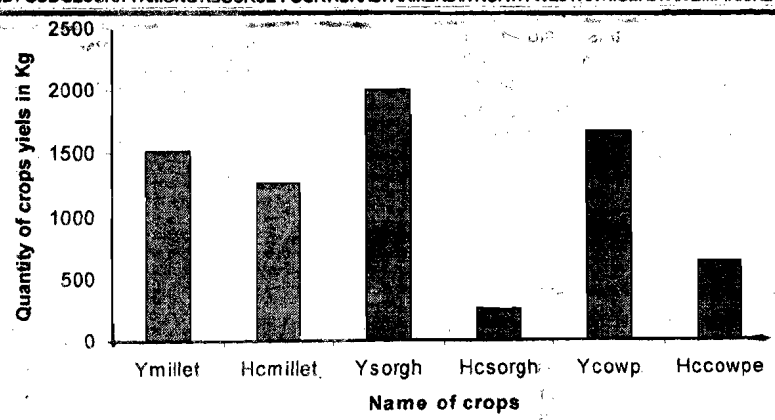

Figure i: Graph showing crop yields and quantity consumed at home for Agropastoralists
Source: Field survey, 2002

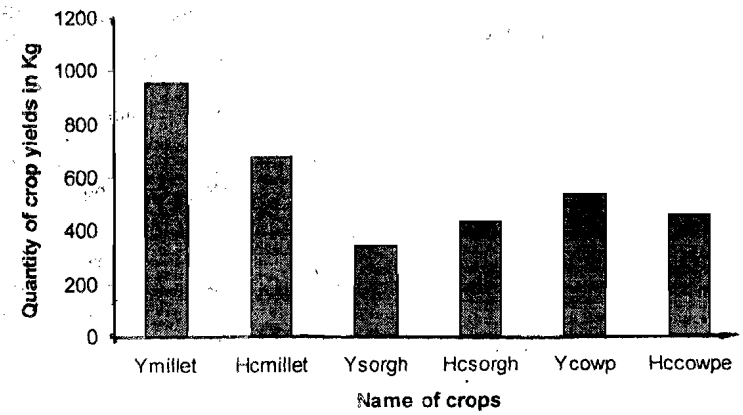

Figure ii: Graph showing crop yields and quantity consumed at home for contract farmers
Source: Field survey, 2002

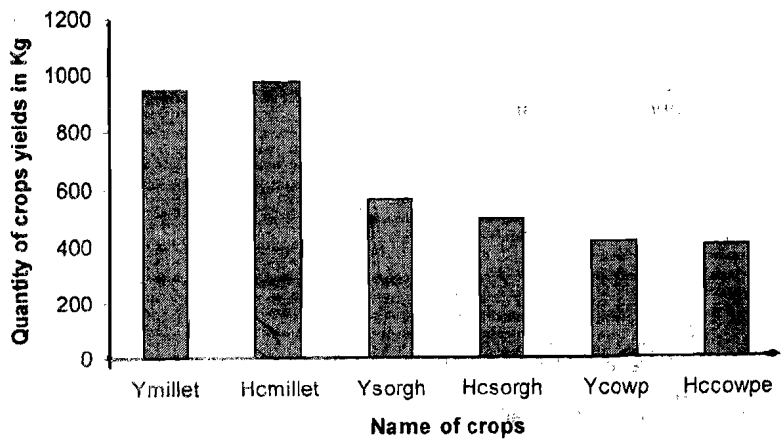

Figure iii: Graph showing crop yields and quantity consumed at home for non-contract farmers
Source: Field survey, 2002

produced, the farmers households consumed well over 200 Kg leaving some marketable surplus. By and large, one could say that the farmers in this group were operating barely above subsistence level. They produced a little above their food requirements and have little for sales to generate income for other uses. Their participation in manure contract no doubt has been of immense help in sustaining the fertility of their soil to enable them have enough food and some marketable surplus as compared with those farmers not involved in manure contract.

Level of food security among the non-contract croppers

From figure iii, it could be seen that there is little or no difference between what these group of farmers harvested and what was consumed by their households. In fact, there was a deficit in the quantity of millet harvested and what was

consumed by the households. A deficit in this major food source is a source of worry among this group of farmers in the study area. It shows that the farmers in this group are still experiencing food shortage and will therefore not be able to contribute any surplus to the food market in the area. It was also noticed that the non-contract farmers consumed more legumes than the farmers that were involved in manure contract. The main reason for this was that while other categories of farmers see legume particularly beans as cash crop, the farmers not involved in contract see everything that was produced as food. Their major goal was still satisfaction of household food need while others are already becoming marker driven in their production objective in addition to meeting their family food need. The main reason for this is lack of soil management strategy due to non involvement in manure contract and lack of money to procure conventional fertilizer. Efforts are therefore needed to get this group of farmers embrace manure contract which is the cheapest alternative strategy for soil fertility maintenance in the area.

CONCLUSIONS

The study has shown that crop livestock integration either closed integration as represented by having crops and livestock under the same management or segregated as represented by the two players under separate management but interacting through manure contract to exchange products have been very beneficial to the farmers involved in the following ways:

Integration has helped the farmers in the area to manage their soil better by use of livestock manure.

ii The integrated farms have better crop yields and consequently better income.

iii The farmers involved in integration are better food secured than non-integrated farmers.

iv The farms with animals can generate income all year round by sales of animals and animal products like milk and calves and as such have far better income than other categories of farmers.

Additionally, the crop residues are fed to livestock either by agro-pastoralists or the herders involved in manure residues contract and thus providing quality feeds to livestock from cereals and legume straw produced in the area. However, the non contract farmers in the area are still facing serious problems that pose threat to their ability to produce enough food for their family. Effort should be made by appropriate government organs to sensitise these group to participate in soil management practices like manure contract which is presently the most affordable option in the area. The contract participation should be given some customary legal backing so as to avoid cheating among the participants so as to popularise the process among the farmers in the area.

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