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Food Consumption, Food Chains and Market Evolution in São Tomé e Principe: A Case Study in Sub-Sahara Africa

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Abstract

São Tomé e Principe is a small country in the middle of the Atlantic and exactly located at the Equator. It is a country where food consumption has been mainly dependent upon local production (where nature is very exuberant), but where imports, donations and globalization are determinant elements in consumption changes in the last decades.
This article provides an analysis of the most significant changes in the last decades, showing how local product consumption is associated with lower income households, how recent improvements are maintaining the local consumption basis in many cases, and also how food markets are missing improvements with big price differences across different regions. This behavior is consistent with many problems in market performance, showing how important can be adequate technical support.
Market problems are not the only important constraint for supply growth and food chain development but provide evidence of the need for better food policy and technical intervention to improve production systems while, at the same time, providing a better use of local resources and of the international trade/cooperation for better quality of live and food security.

Keywords: *food consumption. Food chains, sub-sahara Africa*

1 Introduction

The present work follows the tradition on food consumption studies and food policy analysis, looking at food consumption habits and respective changes over time. Starting with the perception of little consumption changes unless induced from external forces, which means great resistance to changes, to show that under specific circumstances changes occurred driven by market evolution. S. Tomé and Principe is a little country in the middle of the Atlantic, with less than 200 thousand people but with relatively stable economy and with economic performance improving during the last decade. The study will provide questions and respective hypothesis about changes in food consumption that are crucial to understand markets performance, supply and demand dynamics, and also the other way around, that is how markets also provide constraints to people behavior. The country within a very small area is divided in 5 regions where markets work with completely different conditions. Food chains are also very limited, with the chain based on few transactions between the producer and the final consumer. However we can observe the potential for policy intervention providing information about the difficulties observed and building better conditions for improved markets which will be crucial to support a sustainable development process in agricultural production.
The main objective of the study is to characterize consumption behavior changes over time and look at the relative importance of local versus imported foods. The study also explored the potential growth of local production alternatives showing how markets can improve (or not) based on the analysis of market efficiency and food chains.

2 Economic basic information and consumption characterization

São Tomé and Principe is located around 300 km from the African Continent in the Guinea Golf in front of Gabon. It is an archipelago with two main islands and several others with no significant dimension. The two main islands are São Tomé with an area approximately of 859 km2, and Principe with an area around 142 km2. They were discovered in 1470 and 1471 respectively and initiated occupation in 1481. There is an enormous variation in weather conditions derived mainly from orographic conditions, from a volcanic origin with several mountains (the highest point is "Pico de S. Tomé" with 2024 meters in the island with the same name, and in Principe another "pico" (pico papagaio) with 948 meters). The average temperature is around 25 ºC (degrees centigrade) within a range of 22 for minimums and 29-30 for maximums. Relative humidity is around 80% and with great rainfall variation, from more than 3000 mm in the South region to 800 mm in the capital (airport registration).

The economic characterization can be done starting with data from the Human Development Report from 2011 (United Nations Development Program – UNDP).
Since 1990 the Human Development Reports published indicators for development analysis going beyond income measures, with health and education dimensions adding up to income considerations. The Human Development Index (HDI) is a composite index assessing long term progress in three basic dimensions: health conditions, education and income. Table 1 below shows the relative position of São Tomé and Principe in relation to other references, local and world data, showing the country well above the other Sub- Sahara African countries and also Low Income/Low Human Development countries.

Table 1.
HDI – Human Development Index

Year	Sao Tome and Principe	Low human development	Sub-Saharan Africa	World
2011	0.509	0.456	0.463	0.682
2010	0.506	0.453	0.460	0.679
2009	0.503	0.448	0.456	0.676
2008	0.496	0.443	0.451	0.674
2007	0.496	0.437	0.445	0.670
2006	0.489	0.430	0.438	0.664
2005	0.483	0.422	0.431	0.660

Source: Human Development Report 2011

Other indicators are important to characterize the object of our study. Population is estimated to be 168,5 thousands in 2011, with 63% in urban areas. Some basic indicators can be presented, table 2 (based on 2010 reference year).

Table 2.
Basic Indicators (2010 e 2011).

	Value	Obs
GDP per per capita in PPP (constant 2005 US$)	1653	2011
GNI per capita in PPP (constant 2005 US$)	1792	2011
GDP per capita current US$	1190	2010
Population growth rate (annual %)	1,8%	2010
GDP growth (annual %)	4.5	2010
Life Expectancy at birth, total years	64.1	2010
Mortality rate, infant (per 1000 live births)	53.1	2010
Literacy rate, youth female (% of females ages 15-24)	95.8	2010

UNDP(2011) – Quick facts

The basic information given provided above can be seen together with table 3 data (which is complementary) about changes over time in the last decade. With these information a better perspective of today´s situation is possible with improved perception of the present problems and opportunities.

Table 3.
Economic Evolution (in the last decade)

Indicator	2000	2005	2010
Population Growth rate (annual %)	1.8	1.5	1.8
GNI per capita, _Atlas method (current US$)	…	770	1200
GDP growth (annual %)	…	5.7	4.5
Inflation (GDP deflator annual %)		7.6	13.1
Mobile cellular subscriptions (per 100 people)	…	8	62
Internet users (per 100 people)		13.8	18.8
Life Expectancy at birth, total (years)	62	63	64
Mortality rate under -5 (per 1000)	87	83	80
Primary completion rate, total (% of age group)	…	74	85

Source. World Bank Indicators Database

3 Methodological Considerations

The main objective of the present research is to understand human consumption behavior in São Tomé e Principe and its evolution, providing insights for better food policy intervention but also to explore some important elements for consumers and for production activities and rural development which are the food markets behavior.

One of the relevant elements of the present study is the significant research time frame (almost 20 years of direct research), exploring changes in the last decade, but comparing also the evolution based on previous data bases. The enormous effort made includes 5 different household inquiries and one specific market oriented research, looking at prices along the chain in different locations (10 different markets).

The specification about the data is given in annex, regarding the sample dimension, locations and main objectives.

The data analysis is explored, first on the base of specific characterization of each variable, and afterwards looking at possible models to explore the rationale behind changes and behavior. Factor Analysis work basically with quantities and explore the possible associations among variables. Principal components extraction defines new variables with each initial variable being associated with this “new factor” to which we can usually associate a specific denomination.

Latent Classes Extraction (using software “Latent Gold 3.0) worked with frequency data and search for typologies trying to find the relationship between variables with a “latent variable” with two or more classes (Marsden (1985), in Severino (2008)).In regard to the variables used in the study, all used the same scale and can be model based on multinomial distribution. For a more complete description about the latent classes extraction using the maximum likelihood method using the algorithm EM – Expectation-Maximization, it is possible to look at McLacklan and Peel (2000) and Fonseca and Cardoso (2005) cited in Severino 2008.

4 Food consumption analysis

In general the country is performing reasonably well and moving ahead in economic and social indicators, where food consumption is also important, but in the context of some natural resource abundance. The research within which the present work is performed allowed some comparisons with data beginning in 1992. One way to define food consumption patterns is through frequency per week/household considered in table 4 (% of households with consumption frequency above two times per week).

The overall pattern is very constant but some changes can be identified. Bread (wheat bread) is very frequent (a clear European influence), but also rice and fish. Regarding rice we can say we have had a raising consumption (slightly) with income growth. However decrease consumption at higher income levels is observed in some cases. That is, more diversification and lower rice and fish consumption is expected at very high household income levels.

In regards to fish we can see a very high frequency level, with almost no consumption frequency changes but raising quantities consumed with income growth through time (table 6).

Table 4.
Household percentage (families %) with consumption frequency per week and per family above two times per week

	1992	2002	2008
Bread(units)	99.9	98	97
Rice	99.2	97	94
Imp Oil	72.2	86	97
Fish	99.1	98	98
Banana	84.4	94	86
Matabla*	49.6	43	24
Milk	67.8	56	14
Beans	68.6	93	75
Fruta Pão**	52.2	50	50
Eggs	60.9	54	31
Palm Oil	85	89	34
Meat	27.8	72	18
Fuba (corn powder)	87.9	25	13
Cassava	12.1	37	12
Sugar	99.1		98

Source: Data base from authors inquiries
* - Matabala scientific name is *Xanthosoma sagittifolium.* Sometimes is used Taro as a generic name for several different tubers in the tropics. Indeed, Taro is a different plant, *Colocasia esculenta* very frequently used as food in the African continent. In São Timé e Principe, Taro is used for animals.
** - Fruta Pão scientific name is *Autocarpus communis*

One of the most significant changes is related with oil consumption, local palm oil decreasing, and imported oil dominating consumption. However it is important to note that some local products gained relevance, such as banana. Fruta-pao, a local specific product, showed no significant changes.

One product with a lot of changes that are not easily explained is meat consumption that rose as expected with time (and income), but during the last decade fell enormously in frequency terms. What we can see in the data based on quantities for 2002 and 2008 is that average quantities consumed decreased slightly, in general maintaining the same consumption level.

The question now is how to explain this fact and better understand what is going on with those changes. The results on the next table (table 5), since it has been impossible to work with quantities consumed, derive from an explicit effort to understand meat consumption and related products, such as fish and other local products (meat from buzios and other shellfish) really provided some insights.

Table 5.
Household percentage (%) with consumption frequency per week greater than 2 times per week of the specified product (main protein food products) several meats and "buzios"

Consumption Household %	Chicken	Pork	Ducks	Goats	Sheeps	Bovine	"Buzio Mato"	Buzio Mar
2002	**0.92**	**0.96**	**0.14**	**0.29**	**0.16**	**0.2**	**0.74**	**0.9**
2008	**0.99**	**0.67**	**0.27**	**0.29**	**0.06**	**0.2**	**0.84**	**0.82**

Source: Data base from authors inquiries

The information gathered showed a significant decline in pork and sheep consumption, and a raise in chicken. Bovine meat seems to be stable and the two different types of "Buzios" have a very important presence, but a significant change is not evident. For protein consumption the only relevant information we have is about fish consumption quantities that really improved from about 4 to 7 kg per week and per family? (from 4,1 to 6,9 kg per week and per family- table 6 below). That is, today we know how important "buzios" consumption is, but data was not collected previously and is not available.

Information provided about consumption evolution in quantitative terms is, generally speaking, consistent with the consumption frequency analysis, but allowed a more deep and complete analysis about consumption behavior and habits. The research conducted in the country provides a general overview about consumption evolution almost in the last 20 year period. The research covered the same district and can be considered to be comparable, although the data for 1992 is directly from a sample in the capital city, and the other two samples from the same region located at Agua Grande district.

The most significant changes derived from table 6 are consistent with the previous analysis based on frequency. For energy sources it is important to note how local products such as banana, matabala/taro improved their importance, fruta-pão at more or less the same level. Rice consumption also improved. For protein sources, fish is now much more important, and meat decreased slightly.

Table 6.
Consumption quantities per family and per week
In São Tomé e Principe island – Agua Grande district (capital region)

Agua Grande	Cons. Fam. Week			
District		1992	2002	2008
Men Eq.		>5	4.9	4.8
Bread	unid.10g	57	50	59
Rice	Kg	3.7	4	4.5
Imp.Oil	Liter	1.4	1.3	1.6
Fish	Kg		4.1	6.9
Banana	dedo		69.3	98.7
Matabala (taro)	molho		1.8	8.5
Milk	Kg	1	1	2.1
Beans	Kg	1.36	2.2	1.1
Fruta-Pao	cabeça		4.9	4.3
Eggs	Units		10.6	9.9
Palm Oil	Liters	1.9	1.4	1.1
Meat	Kg		2.6	2.4
Fuba – Corn fl.	Kg	2.01	1.5	1.4
Cassava fl.	molho		1.8	3.3
Sugar	Kg	2.3		1.9

Source: Data base from authors inquiries

With the intention to understand what is going on in regard to meat consumption, and explore the relevance of local products in general and in the main protein food products, some other technical analysis were introduced (econometric and biometric analysis) with factor analysis – principal components extraction and latent classes extraction.

5 Main Results

The data treatment followed the same basic structure of information and models for 2008 and 2002 and it is presented in table 7, where the factor loadings for the selected Principal Factors provided enough information to test the hypothesis and characterize the changes. The model for 2008 and 2002 selected with two factors, define a typology where we can classify each factor as “+ modern pattern” and “+ traditional pattern” in regard to consumer behavior in each year.

Table 7.
Factor loadings in principal components (2 factors)

Factor Loadings - Varimax		**Normalized**			
2008	Factor 1	Factor 2	2002	Fact.1	Fact 2
	+ Modern	+ Tradit.		+ Tradit.	+Modern
Fish	0.42	0.29	Fish	0.14	0.59
Meat	0.56	0.09	Meat	0.13	0.82
Men Equivalent	0.08	0.70	Men Equivalent	0.68	0.09
Milk	0.39	-0.41	Milk	-0.09	0.81
Bread	0.25	0.69	Bread	0.56	0.23
Eggs	0.66	-0.27	Eggs	-0.13	0.75
Corn	-0.04	0.10	Corn	-0.13	-0.03
Rice	0.21	0.53	Rice	0.76	0.07
Beans	0.60	0.36	Beans	0.70	0.05
Palm Oil	0.37	0.06	Palm Oil	0.59	0.05
Imp Oil	0.26	0.65	Imp Oil	0.12	0.39
Banana	0.17	0.33	Banana	0.65	-0.27
Matabala(Taro)	0.31	-0.04	Matab.(Taro)	0.54	0.05
Fruta-Pão	0.02	0.46	Fruta-Pão	0.81	-0.24
Fuba.Corn fl	0.35	0.20	Fuba.Corn fl	0.22	0.44
Cassava fl	0.46	-0.16	Cassava fl	0.39	0.15
Sugar	-0.06	0.66			
Food Exp. US$	0.80	0.39			
Ln (Income)	0.35	0.07	Income	-0.17	0.79
Ln (Expend.)	**0.78**	**0.41**	**Expend**	**0.62**	**0.70**
Expl. Var	**3.59**	**3.29**		**4.25**	**3.94**
Prp.total	**0.18**	**0.16**		**0.24**	**0.22**

Factor loadings in blue for values >0,5

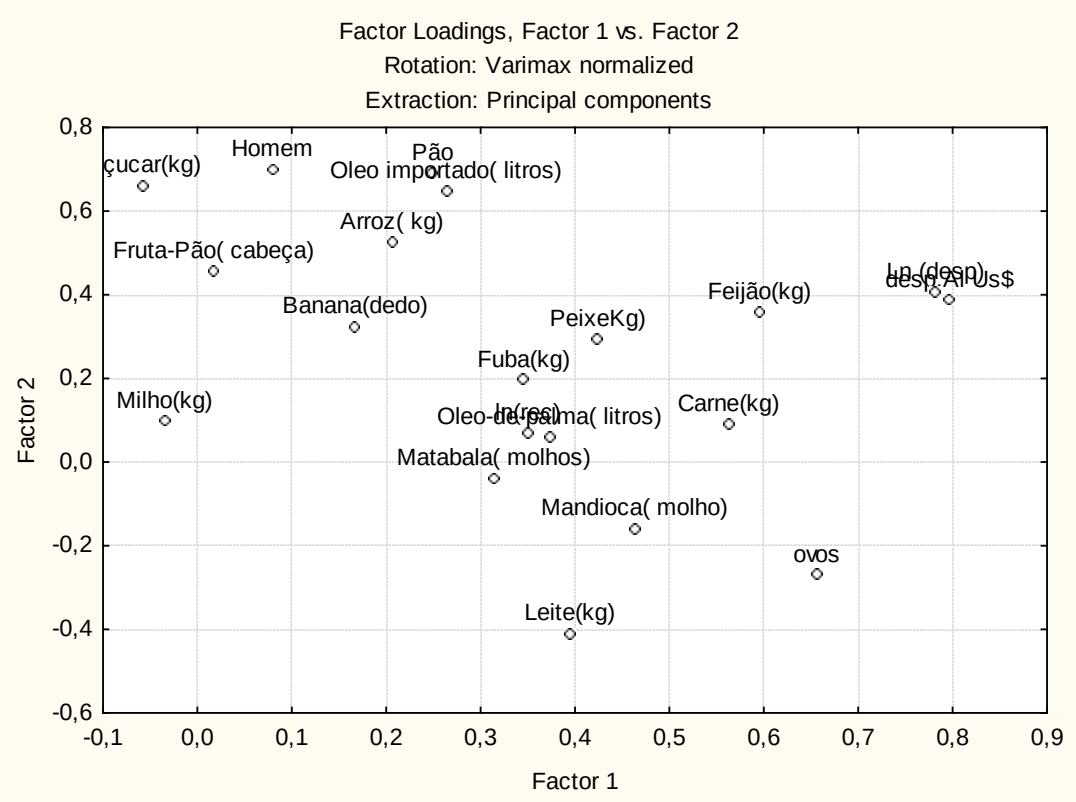

Figure 1. Factor Analysis 2008 – Factor 1 is named "+modern households," Factor 2 denominated "+ traditional" households
Source: Data analysis with "statistica6" program

Mapping the different factor weights in a graphical presentation provides a clear picture of the variables association with the main (determinant) variables which define the factor.

In figure 1 the respective weight of each variable in the factor was used (which denomination is related with the relative position of the variable set in the factor) to show that food protein products are associated with higher income levels and expenditures such as meat, fish and milk but also with beans, cassava, matabala/taro and palm oil.

Should be notice that rice appeared more associated with factor 2, which is very much associated with the higher dimension of the household and lower income. Banana and Fruta-Pão are also more associated with the "+traditional" households and already were in 2002 as shown below.

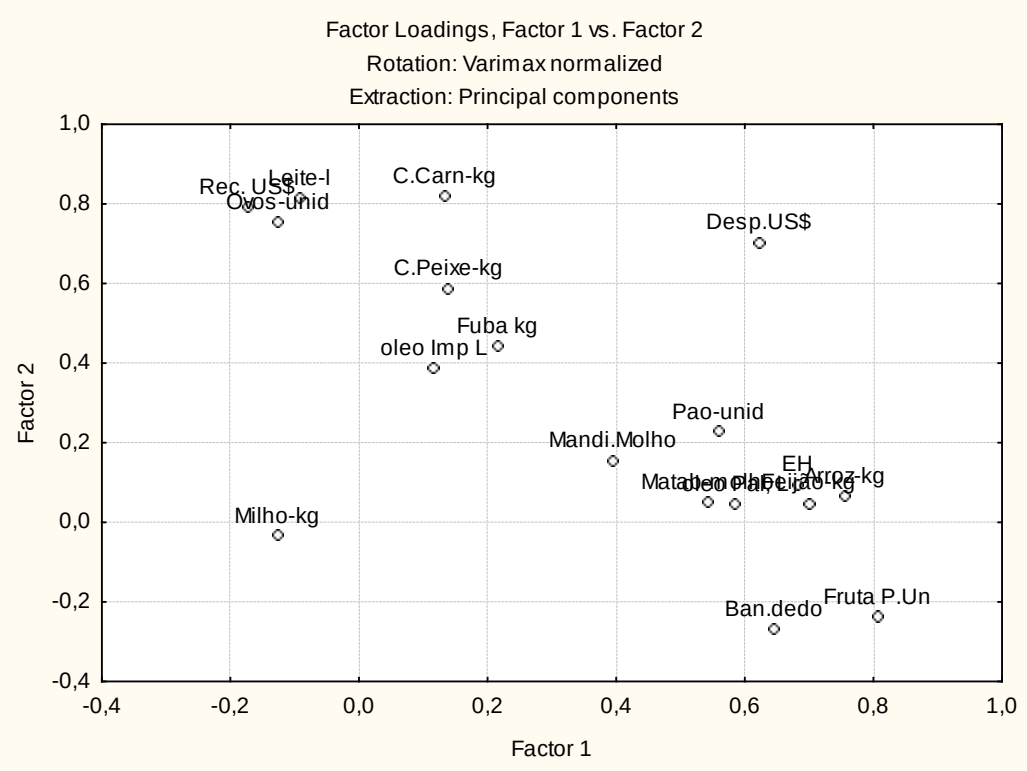

Figure 2. Factor Analysis 2002 – in this output Factor 1 is denominated the "+traditional" households, and Factor 2 is denominated the "+ modern" households
Source: Data analysis with "statistica6" program

One of the surprises is the position change of imported oil. In 2002 imported oil was more associated with "+modern households" which was not the case more recently in 2008, where imported oil in association with the "+traditional" households.

The changes in the last decade regarding "meat consumption group" are significant:

a) Consumption of fish is now assuming relevance in both groups and increasing significantly per capita terms;

b) For beef we saw the same level of consumption and lower consumer frequency maintaining the levels besides the income growth.

c) The following analysis with cluster analysis and latent classes' extraction, which was performed for the same data sets is explored here only in regard to meat consumption behavior.

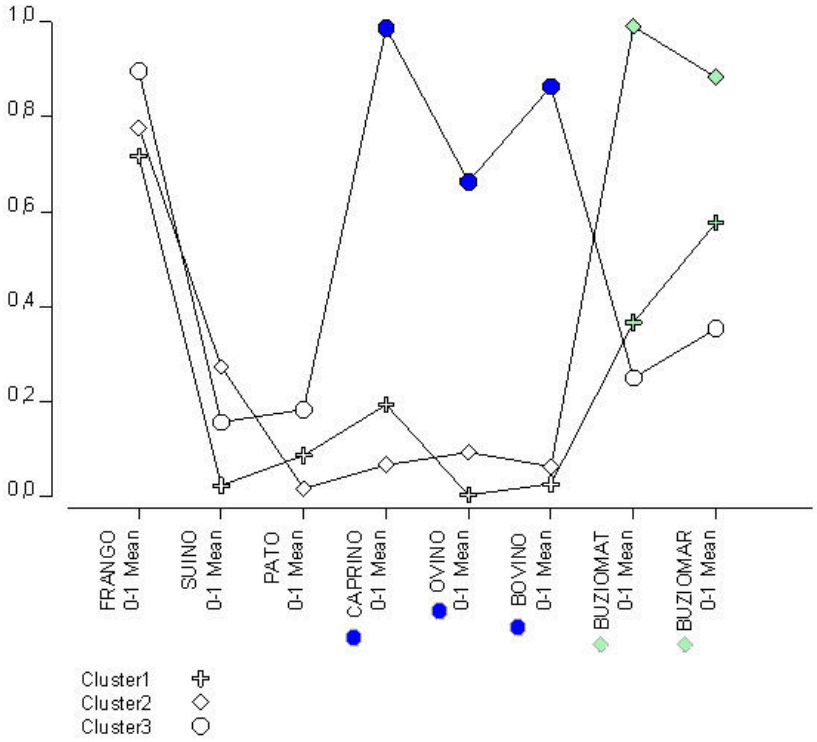

Figure 3. Meat Consumption in 2002 – Agua Grande District. Cluster analysis
Source: Data analysis 2012, data base 2002 and 2008 in Severino (2008)

In figure 3, with the cluster analysis for 2002 sample, it was possible to identify and show 3 different consumption groups, which differ in terms of bovine and other meat product consumption, not in chicken and pork products where consumers seem reasonably similar. One of the most significant aspects, besides the separation in 3 groups is the differentiation in regard to “Buzio” consumption habits.

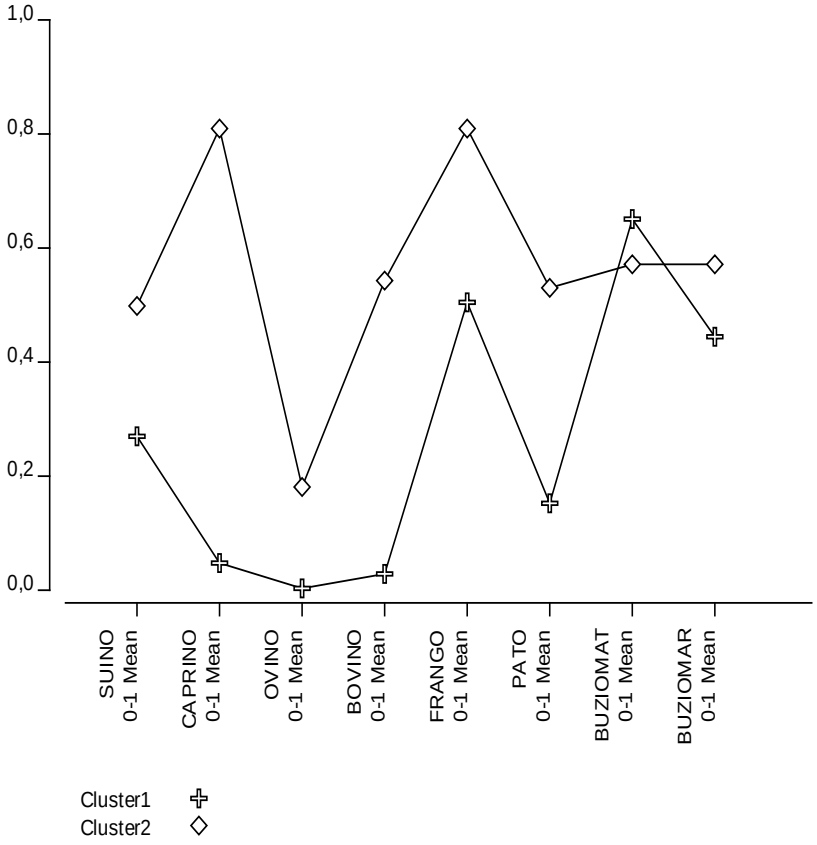

Figure 4. Meat Consumption in 2008 – Agua Grande District. Cluster analysis
Source: Data analysis and Severino (2008)

The analysis for the 2008 sample showed only two different groups, maintaining the differences in terms of bovine meat, similarities in chicken products, but now, the most significant change, "buzio" consumption is very similar between the two groups. That is, a local product (buzios) is now accepted at low and middle/high income households and no significant differences exist among groups.

6 Market analysis

It is not our intention to provide at this point a deep market analysis framework. However prices depending on supply and demand behavior also have an important impact in induced demand changes and consumer behavior through time. Other factors are important such as good information about sources of available products and how they are relevant in nutritional terms, education and also some marketing among other issues, like official policy. We have seen that local products and local production still are the main source for solving nutritional needs and some of them are well accepted at higher income levels.

A first attempt to explore the potential for greater growth in production, given the natural conditions in the country is to look at the "market efficiency" among regions. Efficient markets are the ones where communication and regional integration occurs, that is, price differences among regions should reflect mainly economies of scale and transport costs (logistic infrastructure). Given the differences among regions about the origin of production, research was centered in the calculation of commercialization margins, that is, differences

on price paid to producers and prices at consumption markets (final consumption price), which is called Commercialization Gross Margin (CGM) or "Margem Bruta de Comercialização" (MBC).

The "gross"commercialization margin (MBC/GCM) is defined as follows:

$$\mathbf{MBC\ (\%) = ((Pm - Pp) / Pp) \times 100}$$

where Pm – Price at consummer level
Pp – Price at producer level

Table 8.
"Market Efficieny" – commercialization margins – MBC/CGM (%)

Districts	Markets	Produts		
		Banana	Fruta-pão	Matabala-Taro
Água-Grande			412,5	35,1
	Feira-Grande	120,4		
	Oque-del-rei	189,5		71,6
	Feira-Ponto	124,5	967,9	55,8
Lobáta			440,4	46,3
	Guadalupe	42,0		
Mé-Zochi				
	Cruzeiro	141,4		
	Trindade	110,5	733,8	84,3
	Batepá	190,2		
Lembá			224,8	33,0
	Neves	118,8		
Cantagalo			554,5	64,2
	Riboque Santana	83,4		
Caué			286,8	
	Angolares	88,3		

Source – Data analysis and Severino (2008).

What is evident from the data analysis is the enormous opportunities for better market functions.

7 Results discussion and conclusions

The results obtained provided a very interesting perception of the changes that occurred in the last decades in São Tome e Principe regarding food consumption behavior and food habits

Data analysis based on consumption frequency information and also based on quantitative analysis showed to be consistent with each other and at the same time showed how they can be complementary in explaining some unexpected results such as the phenomena with meat consumption.

Meat and fish consumption is always associated with more("+") modern and high income households, but recently fish consumption is now more frequent and important also with more traditional (an poorer) households. Some unexpected movements from "+ traditional" to "+ modern" households was also highlighted. This was shown to be the case with buzio consumption habits, that is, this habit is now almost equal in both groups, higher income and lower income.

Regarding caloric food products it is important to note that some other local products still maintain their importance such as matabala and cassava, and rice is now more associated

with traditional households. Inclusive for oil, palm oil is now more important in "+ modern" households and imported oil in "+ traditional" ones.
The importance of local products was shown and how they have been taken into consideration in the consumer choices in most modern and higher income households.
The potential for improved agricultural production activities with value creation and higher production share of value generated in the food chain is outlined. On the other hand it was shown how markets are still performing with great inefficiencies which seems an area were policy intervention can be made with great impact.

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World Bank Indicators Data Base – on line information.

Appendix 1. São Tomé main regions

Appendix 2. Main Food Movemments from Production Areas to Consumption Markets

Appendix 3. Data base information on performed inquiries

Primary Data Collection

Nº	Description	Objectives	Reference and action year	Country geographical units (districts)	Sample dimension (family units)
1**	Inquiry to family units in rural and peri-urban areas	Socio-Economic and Consumption Data	1996	Água-Grande, Mé-Zochi, Cantagalo, Lembá e Lobáta	100
2**	Inquiry to family units in rural areas	Mainly Consumption Data	1998	Mé-Zochi, Cantagalo, Lembá e Lobáta	184
3**	Inquiry to family units in peri-urban areas	Mainly Consumption Data	2002	Água-Grande	100
4**	Market and production units inquiries in rural and peri-urgan areas	Mainly MARKET data	2006- 2007	Água-Grande, Mé-Zochi, Cantagalo, Lembá, Lobáta e Caué	10 Markets
5**	Inquiry to family units in urban areas	Mainly Consumption data	2008	Água-Grande	102
6*	Inquiry to family units in the capital	Consumption data and Market analysis	1992	Água-Grande	115

6