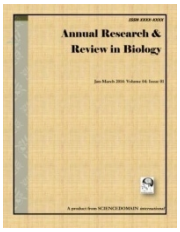

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Does Land Tenure Benefit the Rural Poor of STP towards a Better Diet? Empirical Evaluation in the District of Caué

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Authors' contributions

This work was carried out in collaboration between two authors. Author JRSF designed the study and performed the statistical analysis. Author SES managed the literature searches and carried out the field work. Both authors deal with conclusions, read and approved the final manuscript.

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ABSTRACT

Aims: This article aim is three-fold: (1) first, it intends to depict the profile of food consumption in the poorest district of STP, Caué, before and after distribution of land; (2) second, it aims to screen the evolution of food security in the district Caué facing the emergence of this new class of Small Family Farmer (SFF) in society of STP; (3) we plan to answer the following question: does land tenure benefit the rural poor of STP? The necessity of this research consists on trying to mitigate the gaps of solutions to contribute to improve welfare of the rural poor.
Study Design: n = 385 SFFs were surveyed, using a cluster sampling plan. In the first stage were randomly selected 17 communities (clusters) of the 33 existing through simple random sampling; we gave up the community Rolas Island for two specific reasons: accessibility difficult and reduced population. In the second stage of sampling plan we selected random subsamples, by simple random sampling from the remaining 16 communities selected, corresponding to 48.5% of the 33 existing locations in this district.
Place and Duration of Study: Sample: district Caué, STP between April 2013 and July 2013.

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Methodology: We proceeded to data analysis to meet the objectives outlined by using clustering via estimation of latent class models in the software LatentGOLD 3.0 in order to profile consumers before and after the land distribution and Wilcoxon test with SPSS 20 for comparing consumption before and after the distribution of land. We depicted the profile of food consumption in the poorest district of STP, before and after distribution of land, for the two cases of consumption: general and meats.
Results: By comparison of before and after profiles, our results show a reversal in revenues because now 78% of respondents (cluster 1) have higher revenues and interestingly, they have increased revenues and decreasing costs. On the other hand, we can see that the population of Caué now uses a better diet.
Conclusion: Combining this result with the previous (increasing revenues and decreasing expenses), we can conclude for a positive evolution of food security in the district Caué facing the emergence of this new class SFF in society of STP. Thus, we are able to conclude that the land tenure has benefited the poorest rural.
Concerning policy recommendations based on the findings of this study, we recommend that government can encourage SFF in order to obtain greater production.
Thus, we think that the increase in production will contribute to improve welfare of the rural poor.

Keywords: Food consumption; small family farmer; distribution of land; small family farmer; food security.

1. INTRODUCTION

1.1 Economic Perspective

Sao Tome and Principe has a largely agrarian based economy with much of the population dependent on subsistence farming for their source of revenue. The territory of Sao Tome and Principe, deeply marked by colonization that focused on the intensive farm, inherited structures and mechanisms designed for this purpose optimization of production: agricultural businesses - plantations - were not only laboratories for experimenting with cultures and debugging technical solutions, as well as the basic structure of the physical and human landscape [1]. These structures thus witness the progressive steps of the fight manipulation planning, experimentation and demand of cutting edge technology to overcome challenges to human activity warehouses.

The economy has been dominated by cocoa plantations, known as plantations, that despite the changes in the organization have been the cornerstone of this society sociopolitical African [2]. With independence, has processed to the change in the assumptions that led to the colonial organization of society and the territory in Sao Tome and Principe. The inheritance of a structuring agricultural monoculture and the loss of its relevance to the fragmentation in subsistence farming, as well as changes in the labor and social stratification, introducing mismatches at the level of use of existing structures, their adaptation to contemporary needs and expectations related to them [1]. The socio-economic transformations that occurred in the former state-owned agricultural enterprises under the privatization project, aimed to promote the emergence of a new class of national farmer, food consumption of national products and quality of life of families managers [3]. The beneficiaries of the agrarian reform processes are as a rule, former employees of fields, graduates of public function and some influential individuals either in the policy or trade.

Such a situation would imply a simpler transition between the condition of the landless and the landowner of effective farmer, who mastered the knowledge of production process and by agrarian reform, also happens to have the property or land ownership, i. e. landless farmer to farmer with land [1]. This process is not only a major shift in the division of land but also in agricultural production, with most of these lands passed an intensive culture system and centralized to the proliferation of small subsistence plots devoted to their owners, which is a challenge to their survival, as well as introduces difficulties in projects that go beyond the domestic scale or the collective organization of surplus production.

A big challenge is made by the radical change that took place at ground level, with extensive nationalization of farms and their subsequent distribution by antique workers with subsequent socio-economic changes [1]. It is visible positive impact on the distributive perspective; the process of land reform in his first step was to secure access to land for 98.60% of the current farmers STP. Although other steps must necessarily be implemented, and the process of identity construction of this new group of producers is one of them, it is necessary to emphasize that agrarian reform was an important step in building a career that can allow economic development and social justice in the country [4]. The problem of food consumption is clearly linked to economic and social factors and influences the food security of a people or target group. In general, the data on the availability of food types and food has served as the basis for evaluating the tendency of changes in dietary patterns. The FAO published annually in general, the average potential amount of food available for human consumption in each country [5]. The distribution of consumption in different strata of the population, the quality of statistical production and marketing of food in each country and the inaccuracy of the conversion of food into nutrients should be considered when one wants to study the consumption of a target group within a country.

Although nearly two-thirds of the population live in rural areas a growing proportion is concentrated in and around the capital, São Tomé, which has an estimated population of 55,400, while only about 7,000 people are permanent residents of Príncipe [6]. While the islands of São Tomé e Príncipe (STP) were once a leading cocoa producer, cocoa production is now relatively insignificant and the country is little known today outside the lusophone world [7].

1.2 Reforms and Small Family Farmers

After political independence in 1975 the government of the islands of STP, seeking solutions to the stagnation of the economy deteriorating, adopted in 1987, the Structural Adjustment Programme. International Monetary Fund (IMF) and World Bank, the program mentors share the tasks in order to correct the macroeconomic and structural imbalances and re-establish a competitive economy. In this context while the IMF intervenes in currency areas, introducing a budgetary and fiscal stabilization policy, the World Bank is responsible for the structural long-term reform policy. These reforms aim adjustment issues related to supply and demand with the goal of reducing domestic demand restore the market mechanism and open the national economy to the world market (market liberalization). [8,9] described in detail the reasons for this adoption, referring to the evolution of the current account balance, agricultural production mainly export products.

São Tomé and Príncipe is one of the poorest countries in the world, the poverty level being above the sub-Saharan average and the institutional framework is weak [10]. However, a sustainable development of tourism and entrepôt activities would also strengthen direct backward and forward linkages with agriculture, fisheries and food processing [6].

The second phase of the program, whose implementation period was between 1990/91 and 2001 continued to support agricultural investment, thus resulting in the implementation of a program of land distribution (former state enterprises agro-livestock bankrupt due to mismanagement) under the sponsorship of Project of Agricultural Privatization and Development of Small Properties (PPADPP), to promote diversification and improvement of production.

This project, through the distribution of land to agricultural workers and public graduates, transformed the agrarian structure inherited from colonization, characterized by the existence of large agricultural enterprises, Roças and Glebas in small family units (or SFF) and medium agricultural. By the year 1999 were created 5918 small family units and 4529.60 acres of land were distributed in the form of medium sized enterprises, as Table 1 presents.

However, STP slides towards overwhelming dependence on external assistance in the form of foreign aid and external debt and so its fledgling domestic economy fails to generate enough revenue to sustain its highly import reliant consumption patterns [7].

Table 1. Total area in ha, distributed to 2000

Year	Area (ha)	Area (ha) PFA	Average Area company awarded (ha)	Average Area company reconfirmed (ha)	Average Area company to distribute	Forests (ha)	N.º of families benefited
1993	4452,60	1591,50	0,00	1287,00	91	1483,10	846
1994	8737,10	3083,00	212,90	580,00	183,50	4677,70	859
1995	6849,70	2571,00	2115,50	117,50	105,80	1939,90	917
1996	4432,90	1763,60	321,00	66,00	22,00	2259,80	730
1997	6342,90	2472,30	1691,70	0,00	0,00	2178,90	1151
1998	4615,04	1158,76	188,50	106,00	2180,69	1560,00	665
1999	1394,70	1166,60	0,00	119,00	175,40	113,50	750
*2000	nd	1461,80	nd	nd	nd	nd	nd
Total	36824,94	15268,56	4529,60	2275,50		14212,90	5918

Source: Bureau of Land Reform - Ministry of Agriculture

** Directorate of planning and studies of the Ministry of Econom*

Total area distributed 18336, 36 (ha); Area reconfirmed 2275,50 (ha); Area to distribute 175,40 (ha)

The latest data from the Office of Agrarian Reform, give due that exist, in 2005, a total of 9129 small family units and 6667.3 hectares of land have been distributed in the form of medium sized enterprises. According with [11], land tenure has been considered one of the key factors that define patterns and change in land-use systems. In the case of San Tome and Principe, history and recent analyses confirm that there is a strong comparative advantage in agriculture, implying that investments which enhance productivity and efficiency in this sector would be appropriate for expenditure of oil revenues [12].

Muniz and Neto [4] describe the structure of rural properties in São Tomé and Principe, about 82.80% of the SFFs owns land whose area is less than 5 hectares, including 34.20% who have areas between one and 2 hectares and 15.80% of these properties have less than 1 ha. The Smallholders (ex-farm workers and graduates of the civil service) beneficiaries of small-scale farms are more or less specialized, practicing horticulture, culture cocoa, food crops and mixed systems. Because of the size of the portion SFFs (1.5 to 5.0 hectares)

produce only for the domestic market, based on subsistence agriculture, in which the hand-family labor is dominant. The cultures practiced are feed (banana, taro and other) in mixed cropping with some cocoa plants and horticultural crops. Data available in the Office of land reform in STP not facilitate knowledge about the total amount of existing SFFs. According to [4] almost all farmers had access to plots of land with land reform. This situation opens the possibility for transformation in rural productive sector, ensures minimum working conditions and housing, in addition to some cash income and food security for some very significant contingent of the population of Sao Tome.

With the emergence of SFFs have emerged national and international supports, including interventions concerted among NGOs operating in rural and community associations. Examples achieved were implemented in Caué by [13] emphasized partnerships AMI-PAM implementation and strengthening of distribution network of food and creating school-garden; AMI-RESCSAN (Civil Society Network for Food and Nutrition Security) in creating a space for sharing experiences and good practices; AMI-Ecofac (European Programme for Conservation and Rational Utilisation of Forest Ecosystems in Central Africa) with respect to the conditions of sanitation, with the construction of latrines and the Cross Spanish Red); AMI-Spanish Red Cross) for the construction and implementation of compost bins for organic waste in schools.

The District Caué is one of six districts that constitute the administrative division of the Democratic Republic of Sao Tome and Principe. Situated to the south of the island of São Tomé, this district occupies the largest surface area of the archipelago (26.6%) is less populated (37% of the total population) and consequently has a lower population density (25.8%) as presented in Table 1. According to the results of the 4th general census of population and housing conducted in 2012, the total area of the archipelago 1001 km², the current population is 187,356 and is distributed as presented in Table 2: Agua Grande district encompassing the capital country has 73,091 inhabitants. Medium-Zochi is the second most populous with 46,265.

Table 2. Distribution of the population of STP by districts in 2013

Districts	Area (km2)	Area (%)	Population	Population (%)	Density hab/km2
Água-Grande	16,5	1,6	73.091	39,0	4.429,8
Mé-Zóchi	122	12,2	46.265	24,7	379,2
Cantagalo	119	11,9	18.194	9,7	152,9
Caué	267	26,6	6.887	3,7	25,8
Lembá	229,5	22,9	15.370	8,2	67,0
Lobata	106	10,6	20.007	10,7	188,7
RAP	142	14,2	7.542	4,0	53,1
Total	1.001	100,0	187.356	100,0	

Source: INE, 2013 -IV general census of population and housing

Caué remains the least populous region, 6,887 inhabitants, while lobata continues to grow, currently has 20,007 inhabitants. Cantagalo comes next with 18,194 after Lembá with 15,370 inhabitants. The Autonomous Region of the Prince, who for decades had just over 6000 inhabitants, now recorded 7,542 inhabitants.

The imbalance in the spatial distribution of the population also leads to differences in population density: while the Caué district has been experiencing approximately 23

inhabitants/km², Água Grande exceeded 3,000 inhabitants/km² in the period 2001 to 2006 as presented in Table 3. Currently, the population of Agua Grande exceeded 4,000 inhabitants/km² and the district Caué is 26 inhabitants/Km². In general, the urban population is higher than the rural population and the trend in STP is for an increase in urban population over the rural population.

In view of the district agricultural Caué housed two of the 15 major state-owned agricultural enterprises, Ribeira Peixe and Porto Alegre. The agricultural potential of these companies was cocoa and copra respectively. Agricultural workers of these companies essentially practiced fishing and extraction of palm wine to thicken thin salary.

Table 3. Density of population by district

Districts	Population/Km²					
	2001	2002	2003	2004	2005	2006
Agua Grande	3.144,60	3.136,20	3.235,90	3.282,20	3.328,70	3.423,80
Mé-Zochi	287,70	292,50	298,90	304,60	310,40	317,00
Cantagalo	111,40	114,20	116,20	118,70	121,20	123,00
Cauê	20,60	22,40	22,10	23,00	31,30	23,70
Lembá	46,60	47,20	48,30	49,20	50,10	51,10
Lobata	144,60	154,40	154,00	158,90	163,80	164,30
R.A Príncipe	144,60	154,40	154,00	158,90	163,80	164,30
Total	137,50	140,20	143,00	145,90	148,00	151,80

Source: INE

The São Tome dietary pattern is characterized by large amounts of carbohydrates (banana, taro, rice and bread fruit), animal protein (mainly fish) and fats (especially oil imported). The distribution and trend of change of this pattern at the national level were emphasized by [9] who shown the highest consumption of imported products (rice, cooking oil and chicken) rather than domestically produced products, including fish. This work aims to achieve the following objectives:

1) Depict the profile of food consumption in the poorest district of STP, before and after distribution of land;
2) Screen the evolution of food security in the district Caué facing the emergence of this new class of Small Family Farmer (SFF) in society of São Tome;
3) Try to answer the following question: Does Land Tenure Benefit the Rural Poor of STP?

2. MATERIALS AND METHODS

To meet the objectives outlined we decided to opt for a quantitative paradigm plan research. Concerning how should household or individual food security be estimated, [14] argued that consumption surveys would tell us what was consumed. With regard to food intake, we were careful to separate the frequency of consumption, including products most frequently consumed and infrequently products. For closer to reality, information was collected on the consumption of the last week i.e. the week proceeding the week of the interview.

2.1 Data Collection

To obtain information on consumption in District Caué, 385 SFFs were surveyed, using a cluster sampling plan presented in Table 4.

Table 4. Places surveyed

Places of District of Caué		Places surveyed	Number surveyed
1	S. João dos Angolares	X	27
2	Agua Azeitona		
3	Agua João	X	21
4	AngraToldo	X	24
5	Aliança		
6	Angobo	X	20
7	Angra Toldo (Praia)	X	20
8	Boa Vista		
9	Coimbra		
10	D. Augusta	X	29
11	Estrela		
12	Ermida		
13	Fraternidade	X	27
14	Mateus Sampaio		
15	Nunes de Oliveira	X	20
16	Praia Pesqueira		
17	Praia Io Grande	X	22
18	Ribeira Peixe	X	26
19	Ribeira Peixe Cava	X	28
20	S. João	X	20
21	Soliedade	X	26
22	Vale Carmo		
23	Vila Clotilde		
24	Vila Irene		
25	Vila Malanza		
26	Ilhéu das Rolas		
27	Monte Mário	X	20
28	Ponta Baleia	X	29
29	Porto Alegre	X	26
30	Santa Josefina		
31	Santo António Muss		
32	S. Miguel		
33	Willy		

In this table we specify places surveyed (districts) and the individuals selected from each district, according to the population in each district.

In the first stage were randomly selected 17 communities (clusters) of the 33 existing through simple random sampling; we gave up the community Rolas Island for two specific reasons: accessibility difficult and reduced population.

In the second stage of sampling plan we selected random subsamples, by simple random sampling, from the remaining 16 communities selected, corresponding to 48.5% of the 33 existing locations in this district.

Following this probabilistic plan, 385 SFFs were surveyed, with information before and after land distribution. Intending to conveniently estimate the intakes before and after the land distribution, the confidence level $1-\alpha = 0.95$, assuming a certain inaccuracy of 0.05, we should obtain a sample size greater than 384.16, so we inquired 385 individuals.

2.2 Data Analysis

The information collected through the questionnaire was processed using SPSS. After treatment of the data base, including validity analysis, we proceeded to data analysis to meet the objectives outlined by using (1) clustering via estimation of latent class models [15,16,17,18,19,20] in the software LatentGOLD 3.0, using cluster function, in order to profile consumers before and after the land distribution and (2) non parametric Wilcoxon test [21,22] with SPSS 20 for comparing consumption before and after the distribution of land.

For the establishment of clusters we used the questionnaire variables listed in Table 6 (before SFF) and Table 7 (after SFF) and to complete the information of individuals in each cluster we used the socio-demographic questionnaire variables: education, revenue and expenses.

3. RESULTS AND DISCUSSION

3.1 Crops Cultivated and Production

Confirmatory Factor Analysis (CFA) results provide support to the convergent validity of measures, since estimated loadings for all indicators are significant at $p < .05$ [23].

Furthermore, Cronbach's alpha used to estimate the reliability of the multi-item was in the range .74 to .91. Because all of the alpha coefficients were above the conventional cut-off point of .70 [24], we conclude by an acceptable level of reliability for each construct.

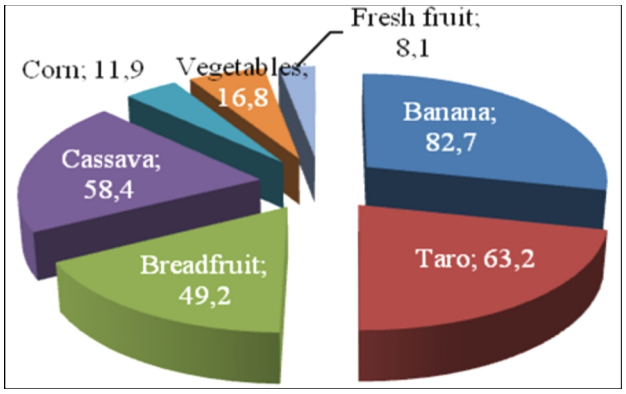

Fig. 1. SFFs and crops grown and (% of respondents)

Currently the SFFs practice the same cultures and claimed to have registered a decline in production. SFFs reported decreased production of banana (51%), cassava (48%) taro (33%), bread fruit (17%), Fig. 1 and Fig. 2 show). This decrease may have several reasons and the most important will be the reduction of the density of plantation crops because of semi-abandonment of plots.

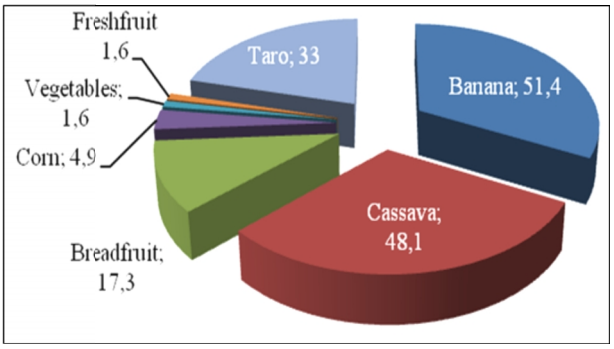

Fig. 2. SFFs and decreased production of crops grown (% of respondents)

3.2 General Profiles of Consumption before SFFs

Through the estimation of latent class models, we obtained the values of the Akaike Information Criterion (AIC_3) [17] listed in Table 5, through data consumption before SFFs.

Table 5. AIC3 criteria values

Model	AIC_3
1-Cluster latent model	7738,966
2-Cluster latent model	6900,738
3-Cluster latent model	6639,305
4-Cluster latent model	6512,740

We decide the optimum number of clusters according the minimum value of AIC_3, when hit. Although the criterion is not minimized, we can conclude that the gain is negligible when *estimating* the model with four components after the estimation of the model with three components. We decide for the number of clusters that shows an elbow stronger, which apply for model with two classes as Fig. 3 presents.

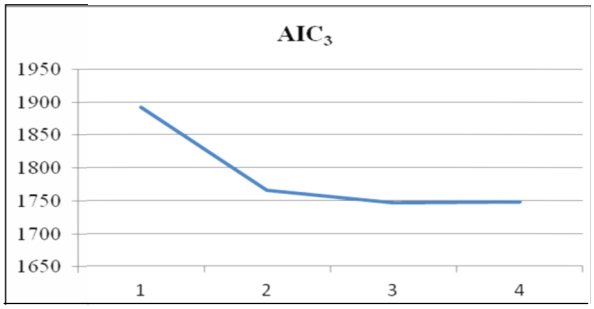

Fig. 3. AIC_3 graph

The estimates of the selected model are shown in Table 6 and represent probabilities, albeit in different types and are expressed in percentages. Thus, 51, 29 and 21 represent the percentages of respondents who were classified into clusters 1, 2 and 3, respectively.

The remaining percentages are percentages of the response to a certain category of variable, given that they belong to one of three clusters: for example, 51, 32 and 19 are the

response rates 4-5 days per week, conditional on belonging to clusters 1, 2 and 3, respectively, because 51 is greater than the other two values, one can conclude that 4 to 5 days per week is a feature of the cluster 1, as presented in Table 7.

Table 6. Two-class model parameters estimates (consumption before)

Cluster Size Indicators	Cluster1 (51%)	Cluster2 (29%)	Cluster3 (21%)
Banana			
Rarely	2	7	0
2 to 3 days a week	42	60	0
4 to 5 days a week	51	32	19
All day	5	1	81
Taro			
Rarely	4	27	0
2 to 3 days a week	54	65	17
4 to 5 days a week	40	8	68
All day	2	0	15
Breadfruit			
Rarely	9	21	0
2 to 3 days a week	35	47	2
4 to 5 days a week	45	28	24
All day	11	4	74
Fresh fish			
Rarely	4	0	0
2 to 3 days a week	60	38	5
4 to 5 days a week	30	42	28
All day	6	20	67
Salted fish			
Rarely	10	34	0
2 to 3 days a week	63	59	19
4 to 5 days a week	25	7	54
All day	2	0	27
Smoked fish			
Rarely	29	76	7
2 to 3 days a week	45	22	30
4 to 5 days a week	22	2	43
All day	4	0	20
Palm-oil			
Rarely	0	7	28
2 to 3 days a week	4	26	43
4 to 5 days a week	13	26	17
All day	83	41	12
Bread			
Rarely	3	15	0
2 to 3 days a week	28	51	0
4 to 5 days a week	28	21	5
All day	41	13	95
Rice			
Rarely	1	5	0
2 to 3 days a week	43	65	1
4 to 5 days a week	53	29	38
All day	3	1	61

Continued Table 6……

Bean			
Rarely	5	19	4
2 to 3 days a week	79	76	75
4 to 5 days a week	16	5	20
All day	0	0	1
Imported oil			
Rarely	32	51	0
2 to 3 days a week	46	40	5
4 to 5 days a week	18	8	25
All day	4	1	70
Milk			
Rarely	41	88	92
2 to 3 days a week	49	12	8
4 to 5 days a week	8	0	0
All day	1	0	0
Eggs			
Rarely	21	27	99
2 to 3 days a week	47	48	1
4 to 5 days a week	28	3	0
All day	4	2	0
Meat			
Rarely	5	79	92
2 to 3 days a week	35	20	8
4 to 5 days a week	60	1	0
Vegetables			
Rarely	8	5	0
2 to 3 days a week	71	66	2
4 to 5 days a week	17	21	13
All day	4	8	85
Fresh fruit			
Rarely	52	81	18
2 to 3 days a week	38	18	42
4 to 5 days a week	10	1	34
All day	0	0	6
Corn			
Rarely	48	78	66
2 to 3 days a week	29	17	23
4 to 5 days a week	23	5	11
Fuba			
Rarely	23	48	69
2 to 3 days a week	49	42	28
4 to 5 days a week	28	10	3
Cassava			
Rarely	1	42	20
2 to 3 days a week	32	52	62
4 to 5 days a week	66	6	18
All day	1	0	0
Covariates Education			
Cannot read	25	35	29
Less than 4th grade	64	47	42
5th to 6th grade	9	16	24
7th to 9th grade	0	2	5
10th to 11th grade	2	0	0

Continued Table 6……

Revenue			
Less than 100 000	24	22	16
100 000 to 399 999	47	71	37
More than 1 million	29	7	47
Expense			
Less than 399 999	27	25	11
400 000 to 669 999	48	64	21
700 000 to 999 999	20	9	34
More than 1 million	5	2	34

These results allow us to display the consumption profile according to the clustering variables, presented in Table 7.

From Table 7 we can see that consumption has three clusters, 51%, 28% and 21%, respectively. Cluster 1 is characterized by frequently (4 to 5 days a week) consumption of Banana, Breadfruit, Bread, Meat, Corn, Fuba and Cassava; they rarely consume Fresh fish and Vegetables are mainly less than 4th grade and they are the less revenue (class1) and expenses. In cluster 2 we have those who rarely consume Banana, Taro, Breadfruit, Salted and Smoked fish, Bread, Rice, Bean, Imported oil, Fresh fruit, Corn and Cassava; they eat frequently Fresh fish, Palm-oil and Vegetables; they cannot read and they have middle revenues (class 2) and expenses (class 3).

Finally, in cluster 3, they consume frequently Banana, Taro, Breadfruit, Fresh fish, Salted fish, Smoked fish, Bread, Rice, Bean, Imported oil, Vegetables and Fresh fruit; they rarely consume Palm-oil, Milk, Eggs, Meat, Fuba and Cassava, they have till 9th grade of education and highest levels of revenue and expenses.

3.3 Profiles from Meat Consumption before SFFs

Let us now find the profile of consumers of meat before SFFs, through the estimation of latent class models.

Table 8 shows that the two criteria select the model with two latent classes: because from AIC_3 values, the gain obtained with the model with three classes is not significant (the graph of Fig. 3 shows an elbow stronger in the model with two classes).

In Table 9 are displayed parameter estimates with two latent classes and through them we found the profile of consumers of meat before SFFs, displayed in Table 10.

Consumers from the cluster 1 often eat all kinds of meat and rarely snails, bush and sea; they have the highest level of education and revenue but the lowest levels of expenses.

Table 7. Profile (consumption before)

Indicators	Cluster 1 (51%)	Cluster 2 (28%)	Cluster 3 (21%)
Banana	4 to 5 days a week	Rarely; 2 to 3 days a	All day (81%)
Taro	-	Rarely; 2 to 3 days a	4 to 5 days a week (68%);
Breadfruit	4 to 5 days a week	Rarely; 2 to 3 days a	All day (74%)
Fresh fish	Rarely; 2 to 3 days a	4 to 5 days a week	All day (67%)
Salted fish	2 to 3 days a week	Rarely (34%)	4 to 5 days a week (54%);
Smoked	2 to 3 days a week	Rarely (76%)	4 to 5 days a week (43%);
Palm-oil	All day (83%)	4 to 5 days a week	Rarely; 2 to 3 days a week
Bread	4 to 5 days a week	Rarely; 2 to 3 days a	All day (95%)
Rice	4 to 5 days a week	Rarely; 2 to 3 days a	All day (61%)
Bean	2 to 3 days a week	Rarely (19%)	4 to 5 days a week (20%);
Imported	2 to 3 days a week	Rarely (51%)	4 to 5 days a week; All day
Milk	2 to 3 days a week	-	Rarely (92%)
Eggs	4 to 5 days a week	2 to 3 days a week	Rarely (99%)
Meat	2 to 3 days a week; 4	-	Rarely (92%)
Vegetables	Rarely; 2 to 3 days a	4 to 5 days a week	All day (85%)
Fresh fruit	-	Rarely (81%)	2 to 3 days a week (42%);
Corn	2 to 3 days a week	Rarely (78%)	-
Fuba	2 to 3 days a week	-	Rarely (69%)
Cassava	4 to 5 days a week	Rarely (42%)	2 to 3 days a week (62%)
Covariates			
Education	Less than 4th grade	Cannot read (35%)	5th to 6th grade (24%); 7th
Revenue	Less than 100 000	100 000 to 399 999	More than 1 million
Expense	Up to 399 999	400 000 to 669 999	More than 700 000

Table 8. Two-class model parameters estimates (meat consumption before)

Model	AIC_3
1 - Latent Cluster Model	1892,102
2 - Latent Cluster Model	1765,388
3 - Latent Cluster Model	1746,423
4 - Latent Cluster Model	1747,075

Table 9. Parameters' estimates of 2-class latent model

Cluster size indicators	Cluster1 (57%)	Cluster2 (43%)
Pig		
Rarely	4	99
2 to 3 days per week	47	1
4 to 5 days per week	49	0
Caprine		
Rarely	79	100
2 to 3 days per week	10	0
4 to 5 days per week	10	0
Ovine		
Rarely	96	100
2 to 3 days per week	3	0
4 to 5 days per week	1	0
Bovine		
Rarely	95	100
2 to 3 days per week	4	0
4 to 5 days per week	1	0

Continued Table 9……

Chicken		
Rarely	10	55
2 to 3 days per week	53	41
4 to 5 days per week	37	4
Ducks		
Rarely	78	98
2 to 3 days per week	15	2
4 to 5 days per week	7	0
Conch bush		
Rarely	28	10
2 to 3 days per week	37	27
4 to 5 days per week	26	38
all days	9	25
Conch sea		
Rarely	98	78
2 to 3 days per week	2	14
4 to 5 days per week	0	8
Covariates Education		
Cannot read	27	31
Less than 4th grade	65	41
5ª a 6ª grade	7	24
7ª a 9ª grade	0	4
10th to 11th grade	1	0

Concerning cluster 2 (43%), they rarely eat meat, except snails, bush and sea; they have lowest and middle education, low revenue (level 2) but quite amazing, they have the highest expenses.

Table 10. Profile of consumption of meat before SFFs

Indicators	Cluster1 (57%)	Cluster2 (43%)
Pig	2 to 3 days per week; 4 to 5 days per week (49%)	Rarely (99%)
Caprine	2 to 3 days per week (10%); 4 to 5 days per week (10%)	Rarely (100%)
Ovine	2 to 3 days per week (3%); 4 to 5 days per week	Rarely (100%)
Bovine	2 to 3 days per week (4%); 4 to 5 days per week	Rarely (100%)
Chicken	2 to 3 days per week (53%); 4 to 5 days per week	Rarely (55%)
Ducks	2 to 3 days per week (15%); 4 to 5 days per week	Rarely (98%)
Conch bush	Rarely; 2 to 3 days per week (37%)	4 to 5 days per week (38%); all days
Conch sea	Rarely (98%)	2 to 3 days per week (14%); 4 to 5 days per week
Education	Less than 4th grade (65%); 10th to 11th grade	Cannot read (31%); 5ª a 6ª grade; 7ª a 9ª grade
Revenue	Up to 100 000 (24%); More than 400 000	100 000 to 399 999 (57%)
Expense	Up to 699 999 (50%)	700 000 to 999 999 (20%); More than a million

3.4 Profiles from Meat Consumption after SFFs

Again, the estimation of latent class models applied to data relating to after SFFs, led to a solution with two classes, as presented in Table 11, because the gain to consider a model with three components is not significant.

Table 11. AIC_3 values

Model	AIC_3
1 - Latent Cluster Model	7403,95
2 - Latent Cluster Model	6771,26
3 - Latent Cluster Model	6441,99

The parameters' estimates are displayed in Table 12. These results allowed us to display the profile of respondents in Table 13. From this profile we can see that in cluster 1 (78%) they consume up to 2 to 3 days a week, Banana, Taro, Salted and Smoked fish; up to 4 to 5 days a week, Breadfruit, Fresh fish, Bread, Rice, Vegetables, Fuba and Cassava; up to all day, Bean, Milk, Eggs, Meat and rarely, Salted fish, Palm-oil, Fresh fruit, Corn; they have middle education, highest revenue and middle expenses.

Clusters 1 and 2, with 51% and 28%, respectively, recorded before the distribution of land, joined in cluster 1, then the distribution for the land, with 78%.

Table 12. Two class-latent model parameter estimates

Cluster Size	Cluster1 (78%)	Cluster2 (22%)
Eggs		
Rarely	51	94
2 to 3 days a week	31	5
4 to 5 days a week	17	0
All day	1	0
Meat		
Rarely	62	99
2 to 3 days a week	13	1
4 to 5 days a week	24	0
All day	1	0
Vegetables		
Rarely	10	0
2 to 3 days a week	54	1
4 to 5 days a week	26	9
All day	10	90
Fresh fruit		
Rarely	72	26
2 to 3 days a week	24	40
4 to 5 days a week	4	30
All day	0	4
Corn		
Rarely	68	66
2 to 3 days a week	21	22
4 to 5 days a week	11	12

Continued Table 12……

Fuba		
Rarely	45	86
2 to 3 days a week	36	13
4 to 5 days a week	19	1
Cassava		
Rarely	22	41
2 to 3 days a week	40	39
4 to 5 days a week	38	20
Covariates Education		
Cannot read	25	32
Less than 4th grade	54	41
5th to 6th grade	15	22
7th to 9th grade	5	2
10th to 11th grade	1	3
Revenue		
<100 000	0	3
100 000 to 399 999	4	14
400 000 to 699 999	28	44
700 000 to 999 999	40	27
1 million to 2 millions	28	10
> 2 millions	0	2
Expense		
100 000 to 399 999	4	11
400 000 to 699 999	1	3
700 000 to 999 999	26	24
1 million to 2 millions	43	32
> 2 millions	26	30

Table 13. Profile of general consumption after SFFs

Indicators	Cluster 1 (78%)	Cluster 2 (22%)
Banana	Rarely; 2 to 3 days a week; 4 to 5 days a week (53%)	All day (70%)
Taro	Rarely (552 to 3 days a week	4 to 5 days a week (75%)
Breadfruit	Rarely; 2 to 3 days a week (55%); 4 to 5 days a week	All day (85%)
Fresh fish	Rarely; 2 to 3 days a week; 4 to 5 days a week (43%)	All day (75%)
Salted fish	Rarely; 2 to 3 days a week (61%)	4 to 5 days a week (51%); All day
Smoked fish	Rarely (50%); 2 to 3 days a week	4 to 5 days a week (37%); All day
Palm-oil	Rarely (58%)	2 to 3 days a week (40%); 4 to 5 days a week
Bread	Rarely; 2 to 3 days a week (35%); 4 to 5 days a week	All day (91%)
Rice	Rarely; 2 to 3 days a week; 4 to 5 days a week (41%)	All day (63%)
Bean	4 to 5 days a week (28%); All	Rarely; 2 to 3 days a week
Imported oil	All day (64%)	Rarely; 2 to 3 days a week (17%); 4 to 5 days a week

Continued Table 13……

Milk	2 to 3 days a week (27%); 4 to 5 days a week or All day	Rarely (95%)
Eggs	2 to 3 days a week (31%); 4 to 5 days a week or All day	Rarely (94%)
Meat	2 to 3 days a week; 4 to 5 days a week (24%) or All day	Rarely (99%)
Vegetables	Rarely; 2 to 3 days a week (554%); 4 to 5 days a week	All day (90%)
Fresh fruit	Rarely (72%)	2 to 3 days a week (40%); 4 to 5 days a week or all day
Corn	Rarely (68%)	2 to 3 days a week (22%); 4 to 5 days a week
Fuba	2 to 3 days a week (36%); 4 to 5 days a week	Rarely (86%)
Cassava	2 to 3 days a week (40%); 4 to 5 days a week	Rarely (41%)
Covariates		
Education	Less than 4th grade; 7th to 9th grade	Cannot read; 5th to 6th grade; 10th to 11th grade
Revenue	700 000 to 999 999 (40%); 1 million to 2 million; More than 2 millions	<100 000; 100 000 to 399 999; 400 000 to 699 999 (44%)
Expense	700 000 to 999 999; 1 million to 2 million (43%)	100 000 to 399 999; 400 000 to 699 999; More than 2 million (30%)

The third cluster occurred before the distribution of land, with 21% remains after the distribution of land with 22% and roughly the same characteristics, the level of consumption.

While before the SFF there were 79% (51 +28) with revenues less than 700 000, after SFF there are 78% with revenues more than 700 000. There was a positive reversal as regards the revenues. Regarding expenses, we can see that most have contained costs in the range 700000 to 2 millions. Thus, we can conclude that the majority could increase revenues, reducing expenses, which is a remarkable fact.

In summary, prior to the distribution of land, 21% (cluster 3) had high revenues, while the remaining revenues were at lower levels, 51% (cluster 1) with revenues belonging to the lowest level and 28% (cluster 2) with revenues belonging to the second tier, also low. Our results show a reversal in revenues because now 78% of respondents (cluster 1) have higher revenues.

More fascinating is the fact that they have increased revenues without increasing costs, as the data show that they have expenses in the middle levels. Based on these results we can answer yes to our fundamental research question (Does Land Tenure Benefit the Rural Poor of STP?): Indeed, the land tenure has benefited the poorest rural.

3.5 Profile Meat Consumption after SFFs

The estimation of latent class models selected two clusters of consumers, as we can see in Table 14 from AIC_3 values.

Table 14. AIC_3 values

Model	AIC_3
1 - Latent Cluster Model	1415,395
2 - Latent Cluster Model	1371,195
3 - Latent Cluster Model	1364,204

We display parameters' estimates for a two-class latent model in Table 15 and these parameters allow us to display the profile of meat consumption in Table 16.

From profile we can see that consumers of cluster 1 (57%) eat frequently Pig, Caprine, Chiken Ducks and Conch bush; they have up to 4th grade of education and highest levels of revenue and expenses.
As far as cluster 2 (43%) is concerned, they rarely eat Pig, Caprine, Chicken and Ducks, frequently eat both conch bush and sea; they have highest levels of education or cannot read and lowest levels of revenue and expenses.

In summary, with regard to the consumption of meats, it can be seen first, a great stability in terms of the number of clusters (2, before and after) and also on the relative size of the two groups (57% and 43% before and after).

Table 15. Parameters' estimates for a two-class latent model

Cluster Size Indicators	Cluster 1 (52%)	Cluster 2 (48%)
Pig		
Rarely	67	91
2 to 3 days a week	12	6
4 to 5 days a week	21	3
Caprine		
Rarely	91	100
2 to 3 days a week	5	0
4 to 5 days a week	4	0
Chicken		
Rarely	4	40
2 to 3 days a week	40	52
4 to 5 days a week	55	8
All day	1	0
Ducks		
Rarely	88	95
2 to 3 days a week	11	5
4 to 5 days a week	1	0
Conch bush		
Rarely	0	13
2 to 3 days a week	0	34
4 to 5 days a week	4	30
All day	96	23

Continued Table 15……

Conch sea		
Rarely	92	85
2 to 3 days a week	6	9
4 to 5 days a week	2	6
Covariates Education		
Cannot read	30	29
Less than 4th grade	62	47
5th to 6th grade	8	20
7th to 9th grade	0	3
10th to 11th grade	0	1
Revenue		
Less than 100 000	21	22
100 000 to 399 999	48	56
More than 400 000	31	22
Expense		
Till 399 999	22	24
400 000 to 699 999	47	48
More than a million	31	38

The most significant difference in consumption with respect to frequent consumption of sheep meat and beef (cluster 1) before the distribution of land consists in the disappearance of consumption after the distribution of land.

The other significant difference is the reduction in expenditure; through profile after, we can see that the majority group presents higher levels of revenue (a couple of minor) and the lowest levels of expenses.

Table 16. Profile of meat consumption after SFFs

Indicators	Cluster1 (57%)	Cluster2 (43%)
Pig	2 to 3 days a week; 4 to 5 days a week (21%)	Rarely (91%)
Caprine	2 to 3 days a week (5%); 4 to 5 days a week	Rarely (100%)
Chicken	2 to 3 days a week; 4 to 5 days a week (55%)	Rarely; 2 to 3 days a week (52%)
Ducks	2 to 3 days a week (11%); 4 to 5 days a week	Rarely (95%)
Conch bush	All day (96%)	Rarely; 2 to 3 days a week (34%); 4 to 5 days a week
Conch sea	Rarely (92%)	2 to 3 days a week (9%); 4 to 5 days a week
Education	Less than 4th grade (62%)	Cannot read (29%); 5th to 6th grade; 7th to 9th grade; 10th to 11th grade
Revenue	More than 400 000	Less than 399 999 (56%)
Expense	More than 700 000	Till 699 999 (48%)

3.6 Comparison of Food Distribution before and after SFFs

We adopted the Wilcoxon Test for comparing consumption before and after the process of land distribution. The use of this test is justified for being paired samples or correspondents, because of two observations of the same individuals (before and after the existence of SFFs). Significant differences were noted in the majority of products consumption as displayed in Table 17. The exceptions were: banana, breadfruit, fresh fish, salted fish, bread and milk. The consumption of taro, palm oil, eggs, meat and vegetables decreased significantly, becoming more rarely consumed, while consumption of imported rice and cooking oil increased the frequency to every day, according SFFs.

We highlight the drop in the consumption of local products and increased consumption of imported products in the district of Caué. This trend was witnessed at the national level since 1996.

In 1996, the national level, the most important products in the diet were the banana, breadfruit, palm-oil, taro and fish products (local production) and rice and cooking oil imported (imported) [9]. The diet was based more on bananas, fish, bread, vegetables and palm oil. Between 2002 and 2008 there was a change in diet (eating habits) of the population in the district of Agua-Large (capital district). In the most common level of consumption remained bread, rice and imported oil. The Banana meat and beans are no longer the most consumed. The frequency of consumption of meat and palm-oil dropped considerably.

Table 17. Comparison of food distribution (before and after SFFs)

Products	Z	p-value (2-tailed)
banana	-,415(a)	0,68
taro	-6,766(a)	0
breadfruit	-,393(a)	0,69
fresh fish	-1,038(b)	0,29
salted fish	-,010(a)	0,99
smoked fish	-2,081(a)	0,04
palm oil	-9,689(a)	0
bread	-1,950(b)	0,05
rice	-5,941(b)	0
bean	-2,962(a)	0,00
imported oil	-8,576(a)	0
milk	-,893(b)	0,37
eggs	-5,180(b)	0
meat	-5,340(b)	0
vegetables	-10,083(b)	0
fresh Fruit	-2,511(b)	0,01
corn	-2,387(b)	0,02
fuba	-3,035(b)	0,00
cassava	-2,840(a)	,01

a Based on negative ranks; b Based on positive ranks

The results reveal that in Caué, identical to the data of Agua Grande in the periods between 2002 and 2008, the frequency of consumption of locally produced products including banana, breadfruit and palm-oil tend to lower and imported products especially rice and oil increases.

Rice, Banana Bread and Fruit appeared more with larger household and low income. The author showed the evolution of this change as follows:

A) The fish was clearly associated with a consumption pattern "higher" before SFF but appears after SFF associated with the default lower of consumption at all levels.
B) The beans, on the other hand, clearly associated with a standard "more basic" consumption, appear in 2008 to be associated with both consumption patterns with more weight at the highest standard.
C) The Oil-for-palm, clearly associated with a basic pattern in 2002 now appears to have some relevance in higher standard.

The most consumed meat in the district of Caué is the pig and Winkle bush. However the consumption of pig decreased and the Winkle bush (Archachatina marginata) increased significantly (p value being < α, for α = .05), as presented in Table 18. 1996 data pointed to higher consumption of pig and chicken at the national level and in 2002 the most frequently consumed meat in the district of Agua Grande were winkles and chicken, followed by swine.

The results of the surveys conducted by the author in 1998 in the rural districts Cantagalo and Mé-Zochi also revealed higher frequency of consumption of pork and chicken. Estimation of Latent Class Models revealed that 99% of respondents reported very low frequency of meat consumption, as presented in Table 13.

Table 18. Comparison of meat consumption (before and after SFFs)

Products	Z	Asymp. Sig. (2-tailed)
swine	-6,699(a)	0
caprine	-3,285(a)	0,001
ovine	-1,890(a)	0,059
bovine	-2,121(a)	0,034
chicken	-3,410(b)	0,001
ducks	-2,237(a)	0,025
winkle bush	-8,117(b)	0
winkle sea	-1,291(b)	0,197

a Based on negative ranks; b Based on positive ranks

4. CONCLUSION

We used a random sample meaningful in relation to the target population, consumers of the district of Caué. Based on the data obtained by questionnaire, using latent class models we worked on the consumption profiles (general and meat) before and after the distribution of land. Then we used the Wilcoxon test to compare the consumption of respondents before and after the distribution of land: in most foods there was a significant increase in consumption.

To sum up, we depicted the profile of food consumption in the poorest district of STP, before and after distribution of land, for the two cases of consumption: general and meats (with this we answer to objective 1). By comparison of before and after profiles, our results show a reversal in revenues because now 78% of respondents (cluster 1) have higher revenues and interestingly, they have increased revenues without increasing costs, as the data show that they have expenses in the middle levels in after profile. On the other hand, from Table 13 (Profile of general consumption *after* SFFs), we can see that the population of Caué now

uses a better diet. Combining this result with the previous (increasing revenues and decreasing expenses), we can conclude for a positive evolution of food security in the district Caué facing the emergence of this new class of Small Family Farmer (SFF) in society of STP (with this we answer to objective 2).

Combining these findings, we are able to conclude that the land tenure has benefited the poorest rural, thus responding to the research question.

Concerning policy recommendations based on the findings of this study, we recommend that government can encourage SFF in order to obtain greater production.

Thus, we think that the increase in production will contribute to improve welfare of the rural poor.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Fernandes AS, Sá MF e Póvoas RF. Regeneration of plantations of Sao Tome and Principe: inheritance and ownership, challenges and potential for development, proceedings of the International Colloquium Sao Tome and Principe from an interdisciplinary, diachronic and synchronic perspective, Lisbon. 2012;157-176.
2. Eyzaguirre PB. The Independence of São Tomé e Príncipe and Agrarian Reform. The Journal of Modern African Studies. 1989;27(04):671-678.
3. Bom Jesus, AJ. Impact of privatization on the draft Agricultural Development Medium Business Sao Tome and Principe. PhD thesis in tropical agricultural production. Technical University of Lisbon (ISA); 2010.
4. Muniz JN, Neto FJA. Agrarian reform and construction of identities: the training of farmers in Sao Tome and Principe, Viçosa, St. Thomas, Federal University of Viçosa; 2008.
5. Mondini L, Monteiro CA. Changes in feeding patterns of the Brazilian urban population (1962-1988). Rev. Saúde Pública. 1994;28:433-9.
6. Klueh U, Pastor G, Segura A, Zarate W. Inter-sectoral Linkages and Local Content in Extractive Industries and Beyond– The Case of São Tomé and Príncipe, IMF Working Paper, WP/07/213, African Department. International Monetary Fund; 2007.
7. Frynas JG, Wood G, Oliveira RMSS. Business and politics in São Tomé e Príncipe: from cocoa monoculture to petro-state,Afr Aff (Lond). 2003;102(406):51-80.
8. Carvalho BP. Structural Adjustment Programs, Economic Policy and Agricultural Production. Series of Development Studies and Management Systems. Agronomy Institute / Section of Tropical Agriculture / Agribusiness Department and Tropical Agriculture. Lisbon. 1995;Ano1.Nº 4.
9. Espírito Santo SN. Structural Adjustment Programme, Production and Food Security in Sub-Saharan Africa: Case Specific S. Tomé and Príncipe, Master's Dissertation of Agronomy, Lisbon, Agronomy Institute Technical University of Lisbon; 2008.
10. Segura A. Management of Oil Wealth Under the Permanent Income Hypothesis:The Case of São Tomé and Príncipe, IMF Working Paper, African Department. International Monetary Fund; 2006.

11. Futemma C, Brondizio ES. Land reform and land use changes in the Lower Amazon: Implications to agricultural intensification. 2003; Human Ecology 31(3): 369-402.
12. Kyle S. DUTCH DISEASE IN SÃO E TOMÉ PRÍNCIPE: POLICY OPTIONS FOR THE COMING OIL BOOM, Working Paper, Department of Applied Economics and Management Cornell University, Ithaca, New York, USA; 2006.
13. AMI - Sao Tome and Principe - DRAFT | 2011-2013 "Holding Hands by Caué" available in http://www.ami.org.pt/default.asp?id=p1p7p28p132&l=1 Accessed on 20 February; 2013.
14. Pinstrup-Andersen, P. Food Security: Definition and Measurement. Food Security. 2009;1:5-7.
15. Fonseca JRS. Clustering in the Field of Social Sciences: That's Your Choice, International Journal of Social Research Methodology. Taylor & Francis Group, Routledge. 2013;16(5):403-428.
16. Fonseca JRS, Cardoso, MGMS. Mixture-Model Cluster Analysis using Information Theoretical Criteria, Intelligent Data Analysis. 2007a;11(2):155-173. IOS Press.
17. Qu Y, Xu S. Supervised cluster analysis for microarray data based on multivariate Gaussian mixture, Bioinformatics. 2004;20:1905–1913.
18. Figueiredo MAT, Jain AK. Unsupervised Learning of Finite Mixture Models, IEEE Transactions on pattern analysis and Machine Intelligence. 2002;24:1–16.
19. McLachlan GP, Peel D. Finite Mixture Models. John Wiley & Sons; 2000.
20. McLachlan GP, Basford KE. Mixture Models: Inference and Applications to Clustering. Marcel Deckker, Inc., New York; 1988.
21. Sawilowsky SS. Misconceptions leading to choosing the t test over the Wilcoxon Mann-Whitney U test for shift in location parameter. Journal of Modern Applied Statistical Methods. 2005; 4(2): 598-600.
22. Wilcoxon F. Individual Comparisons by Ranking Methods. Biometrics Bulletin. 1945; 1(6):80-83.
23. Anderson JC, Gerbing DW. Structural modeling in practice: a review and recommended two-step approach. Psychological Bulletin. 1989;103(3):411–423.
24. Nunnally JC. Psychometric Theory. McGraw-Hill, Inc, New York; 1978.

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