

Pakissi, Cesar

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Impact of utilities distribution in the population scattering: one analyzes of the African reality -Huambo Angola

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1- Introduction

The growth of urban centers has been the primary factor of social imbalance. There are extreme social inequalities at these towns and to them, aspects such as non-access to public services namely water, public safety, electricity, education services and health as well as the economic speculation from parallel markets created as a supply source for these populations. From this perspective, works have been developed so as to understand the population distribution phenomenon (Langford, Higgs, Radcliffe, & White, 2008).

This increase in population density towards urban centers results in emigration processes influenced by many factors. The phenomenon has had different phases and contrary senses “ rural towards urban or urban towards rural”, on several survey about **population fluxion** the migratory tendencies and population densification are related to aspects such as social safety, earth productivity, quality of life, employment and access to social services causing changes to the way a population spreads around a territory (Gimba, 2004; Yilmaz, Daçdesmir, Atmis, & Lise, 2010). This is an obvious reality in developing countries that have a great part of their active population go towards more urbanized towns in quest of better opportunities, thus affecting the economy of regions decreasing in population as well as those upsurging in them, thus challenging management forms of existing resources.

Population fluxions in European countries has had cyclic form, an accelerated urbanization period during the industrial revolution influenced by the force of industry attracted rural populations towards cities causing serious lifestyle alterations due to the development process. This very fluxion forced governments to rethink urban spaces so as to provide a series of services suitable for urban lifestyle – water, energy, roads and transports, schools and health centers. While ending the urban densification phase, today, these same regions are facing a new migratory tendency caused by the saturation of urban environment whose cost of living is not bearable for everyone principally in a job-shortage period, or seeking new opportunities in rural regions has been a reality.

On the contrary to developed countries, developing countries especially African ones are in a rural-leave phase, caused not only by the agrarian mechanization force or by the loss of earth productivity, but of course by search for employment and better-off lifestyles as a mean to guarantee offspring access to available services and equipments in cities. The migratory tendency has caused a strong population densification in “urban areas” thus affecting urban services whose dimension does not correspond to the accelerated growth of population. As a result, problems such as rent inflation and costs of products, social

inequality and an overcrowding basic services managing the economic context are translated as problems' emergency and social conflicts.

Fox, (2014) confirms that in Africa, Ásia and Latin America more than 800 million populace live in urban regions in extreme poverty, despite the fact that they are near big centers social problems are extreme. The United Nations' projections (2008) suggest that not every population growth in the next 50 years will be rationalized by the cities of developing countries. The change to urban areas (suburb) is particularly a threat to Subsaharan Africa that contains 13% of urban population, 25% of whom live in shantytown and more than 60% Subsaharan population that live in urban areas are in slum conditions (Miljkovic & Rimal, 2008).

Angola is not exempt from this reality not only for its geographical context, but of course for various existing factors that systematically attract populace from rural areas to urban ones, thus upsurging the population density of urban centers the same way the economy inflates and, being unable to prove proper urban equipments, the quality of life decreases. Surprisingly, few studies focus their attention in understanding the population fluxion dynamics and its implications. Around this controversial question, the point is to know what governing policy or measures can re-direct the actual urban density? How certain economic and urban restructuring factors influence population spread? Or still, will employments related to basic services such as education and heath influence in population grouping so as to create new intermediate centers? Or is it the population density instead that attracts these employments? Facing this reality, the actual assignment intends to estimate the impact of the allocation of public services (education and heath) in population spread, and also seeks to understand the interaction between public services and population space distribution, analysing five different sets of basics works associated with education and heath.

2- Is it that employments attracts populations or that populations attract employments?

2.1- Governing Policies and Migration

Cities are in essence economic activity places. They in fact are connected to "hinterland" economies (national economies) as well as to "outer land" economies through commerce and investment. Changing the consumption and production forms has significant special effects, especially in urban sale's systems. Dicken, (1992) affirms that, the capital and production ways are restored through the economic development process, the composition of economic activity, the technology used, the organization of production process and also

the changed work patterns, thus enabling a major capital flow, goods and people in some deserted regions and densification in more capital-structured areas.

Despite the fact that people are leaving big cities in some developed countries, the quest for better-off life, access to infrastructure and economic factors will make the number of people living in big cities grow in the forthcoming years (UNO Habitat, 2014). In the last three decades, there has been an unprecedented demographic growth caused by distinct factors in developing cities around the world, and particularly in Africa (Beauchemin & Schoumaker, 2005).

The scientific community has lately focused major attention on urban densification of developing countries. Yeung, (1995) states that as a result to the success of UN Habitat Conference in Vancouver in 1976, organizations like World Bank, USAID, United Nations Children's Fund (UNICEF), Asian Development bank, (ADB) Africa Development Bank (BDA), International Labour Office (ILO) and the United Nations Centre for Human Settlements (UNCHS) are in active work about urban poverty and focus all attention to the population agglomeration and urbanization phenomenon in big cities. In urban studies urban equipments, access, productivity and the ability to maintain and satisfy economic dynamics of regions has been considered key factors for rural-urban migration. Investigating in areas such as: geography, economy, sociology, medicine and engineering (Thao & Agergaard, 2012), (Riva, Curtis, & Norman, 2011), (Paveliuc at al., n.d.), (Solarin & Shahbaz, 2013), that focus on territory survey, its development and applicable models, focus on territorial cohesion as well as the reduction of existing social inequalities.

However, Tadaro (1997) considered one of the factors that impulsed, impulses and will impulse the demographic phenomenon are post-war periods, and estimated that the post-war demographic growth promises a rapid growth of cities in developing countries, and if in 1950 about 275 million people lived in third world cities, and represented only 38 percent of the 724 million people of total urban population, according to the United Nations' estimates, the world urban population had reached 2,3 billion in 1990, with 61 percent (1,4 billion) living in cities of developing countries. The ONU projects indicate that in 2025, more than 4 billion, or 77 percent of the world urban inhabitants will stop living in less developed regions. This number represents the global increase of 186 percent, or 2,61 billion new urban inhabitants of Africa, Asia and Latin America since 1990. According to the nature of following development strategies, rough estimates point that total population living in urban areas in 2025 will substantially be superior or inferior to 4 billion people.

Despite the obvious fact of African big cities growth (see fig.1), the point about growing urbanization in these countries, especially, Subsaharan African ones is still discussable.

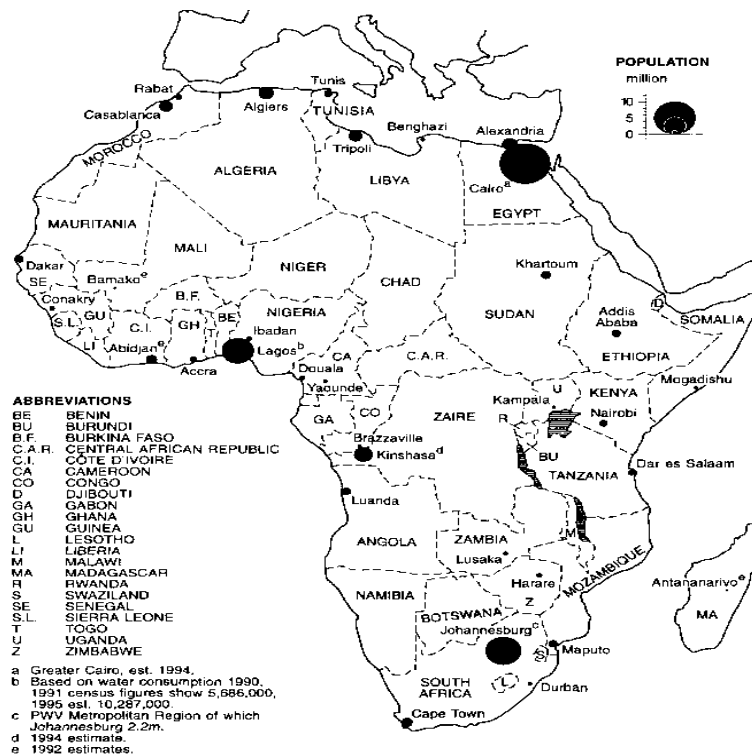


Figure 1- African cities. 2005 urban estimates. Source: ONU-Word Urbanization Prosect. Some studies report that the urbanization process needs to be more accelerated in Subsaharan African countries, with inner migration process in search of formal employment (Cornwell & Inder, 2004) being a major cause for population density increase in big centralities (Batterbury & Fernando, 2006). Potts, (2012) on the other hand attracts attention on how African urbanization is fundamental. As he refers:

“On the contrary to various datas there are errors in the survey of African urbanization to consider, as Nigeria is the most populated subsaharan country, all datas from 1952 are frequently refused and there still aren’t accurate datas about urban population; the Democratic Republic of Congo being considered the third most populated in this region did not organize any census since 1984; and also Luanda’s population growth has been frequently discussed but the real size and dynamics of the Angolan population are still uncertain.” (Potts, 2012)

In the meantime, despite the discovery of real datas about population density in these countries and about what concept big population agglomerations are to be classified on, the point is, the population density of big centers affects the sustainability of urban management. Fox (2014) affirms that in this region, the existing suburbs are a threat in

such a way that only 13% of population live on formal urban areas, 25% live in urban slum and more than 60% of subsaharan populace live in urban areas with no urban service. This fact raises relevant questions about the influence of population fluxion.

2.2- What attracts what? Reflections about factors related to population fluxion

Influencing or attracting factors of population fluxion have been a controversy in various areas of investigation, geographers, economists and politicians seek to understand factors that influence or determine population fluxion. Others however, debate the relevant thinking: wouldn't it be that population attracts certain economic factors instead of economic factors attracting population?

Understanding different perspectives of attractiveness in the territory becomes as pertinent as appealing (Stark et al., 1991) in his book "The Migration of Labor" approaches the rural-urban migratory phenomenon based on below factors:

- a) Rural unemployment, caused by the loss of fertility in rural areas fields is key factor for the quest of livelihood towards big cities;
- b) Education influence, as families believe the fact that better educational conditions are in big towns, and in search of quality of education their children relocate to big cities and once accustomed to the new lifestyle never go back to origin areas;
- c) Unequal distribution of revenues cause population densification in areas where resources are more expressive;
- d) Urban migration and growth, that goes in direction of and seeks urban services since besides the urban lifestyle, emigrants also have major possibility of finding formal jobs, what is almost impossible in rural areas where the economy is based on informal activities;
- e) The economic policies, where analysis made about the economic impact of the migratory phenomenon for cities, are described as key elements for inflation as it honors more urban lifestyle;
- f) Political decisions and measures seek to set the rural exodus phenomenon.

Hagen-zanker (2011), considers that many social factors such as the need for safety, the incorporation of better economic models has to be considered in the migratory process, but, as different theories confirm the author affirms that different factors aren't isolated, but rather affect each other certain moments.

Broadly speaking, the crucial element in this territorial analysis could be redirecting policies. Rather than trying to get better comprehension on rural-urban migration, and its social and sectorial implications, it is vital to appeal for contention or reversing measures of the rural-urban migratory process. In this perspective, Gimba (2004), approaches

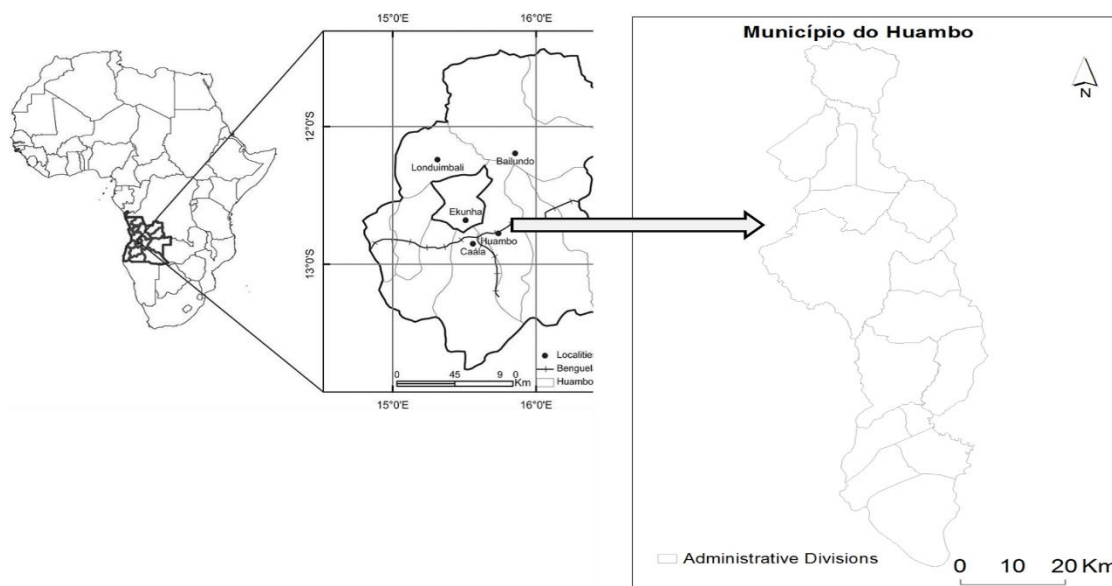
Todaro's model 1969 and 1970 that practices the rural-urban migration model and the relation with urban insufficiencies in developing countries, and states that the starting point for change in this actual scene could be to handle the phenomenon effectively for national development as well as the development of people's quality of life.

Different other approaches report that on the basis of decision-making and organization it is crucial to consider that macro structural factors affect micro decisions, and the social capital, institutions and structural connections help the migratory process.

The points about why people emigrate continues to be an interesting subject in order to explain several territorial thesis, for the simple reason that despite strong evidence about rural-urban migratory factors, literature points clear existence of influencing factors in the process to enable analyze the phenomenon region per region.

3- Characterization of the area in inspection

Angola is a Sub-Saharan African country that shares a border with the Atlantic Ocean in west, with the Republic of Zambia in east, the Republic of Namibia in south and the Democratic Republic of Congo in north. With 1.246.700 km², Angola has countless natural resources such as gold, diamonds and oil, in which the economy strongly relies on. From the 18 provinces, Huambo is the most important with respect to the connection between north and south of the country (see figure), west and east.



The Province of Huambo, also known as Planalto Central, is located in the center-east region of Angola, and is linked to Province of Bié in north-east, in south to Province of Huila, in west to Province of Benguela and in north-west to Province of Cuanza Sul. With 35.771 km², Huambo represents 2,6% of the whole country.

The Huambo township is one of the eleventh townships at the Province of Huambo and

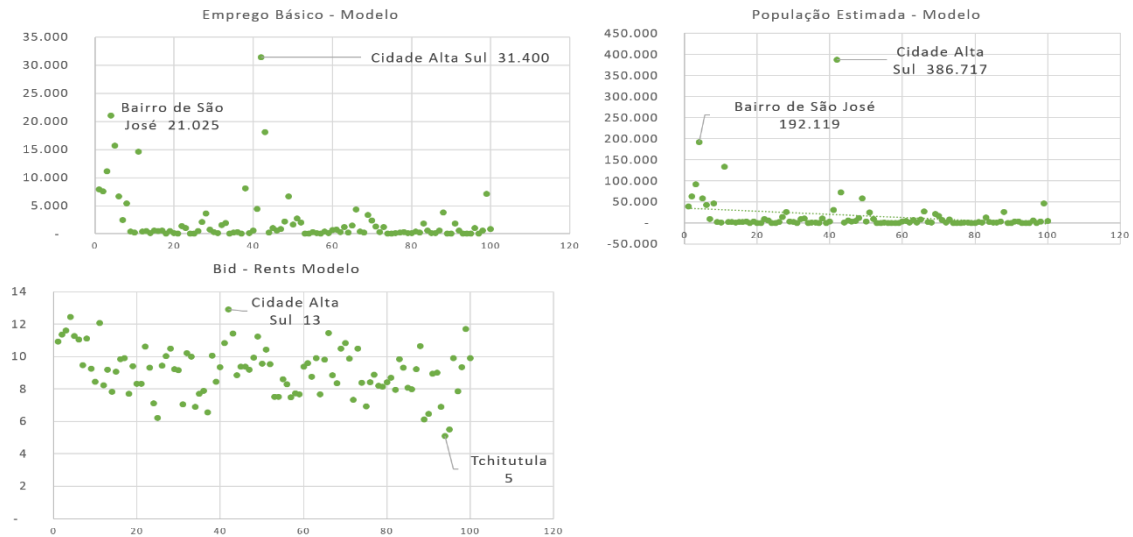
has 2720 km². It consists the central municipality (551,5 km²) and others like Chipipa, in north and south (813,8 km²), (1354,6 km²) Calima, as the distance is about 24 km and 18 km from the city of Huambo. Huambo municipality is approximately 7% of the Province of Huambo and, in 2004 the population was about 40% of the Province population, urban infrastructure represents 10% of total urban area that has had constant change since the end of Angolan war in 2002. The shantytown area lacks infrastructures and equipments as one gets closer to suburbs. This infrastructural inequality and lack of formal work in the suburb areas causes population fluxion for urban centers, and population densification in urban areas. This actual assignment about the impact of work and population fluxion analyses five scenes allowing future public services allocation by the education and health services according to the prospectus PND-Angola 2013-2017. This scheme plans the creation of 5797 basic employments associated with educational and health services in the municipality of Huambo (PND, 2013), with which analysing scenes are formed.

3.1. - Formal employment creation scenes at the municipality of Huambo

Based on these datas and facing the question impacts create basic employment allocation in populace spread at the Huambo municipality? A survey of 100 villages of huambo allowing employment distribution scenes as described below:

3.1.1. - Scene 1: Estimation with employments distribution to city centers, from an analysis of efficiency and equity pointers.

For this scene, the hypothesis of distributing 5.797 employments for 13 city centers of Huambo was analyzed on the basis of efficient distribution and equity indicators (Pakissi & Dentinho, 2014). Thus the selected city centers (see fig.2) were Académico quarter, having the possibility to create 1075, and 395 for these quarters; Cambunda, Candiombo II, Lufefena II, Nanguenha I, Ndango de Cima, Petroleo, Santo Amaro, Salucombo Samutaca Sandjepele III, Tchianga II and Camunda I.

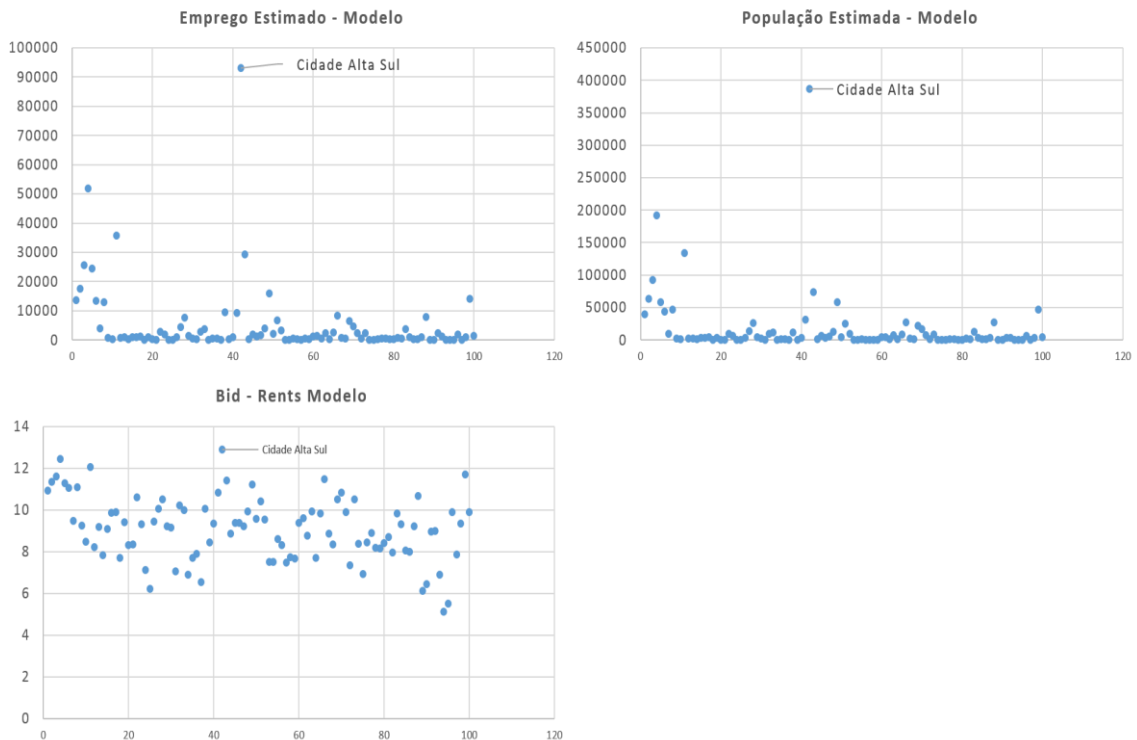


Graphic 1- estimates basic employment distribution model, population and Bid-rents for scene 1

Basic employment to be created as previously described are always associated with education and health. The estimation shows that Académico is the principal quarter, more populace, rent and employment are concentrated south-downtown.

3.1.2. - Scene 2: Estimate with employment distribution in the logic of being historically kept in the city as sole center.

For this scene, was seen a possible way of keeping the center historic, allowing 5.792 employments for Académico quarter I, (as described in fig.3).

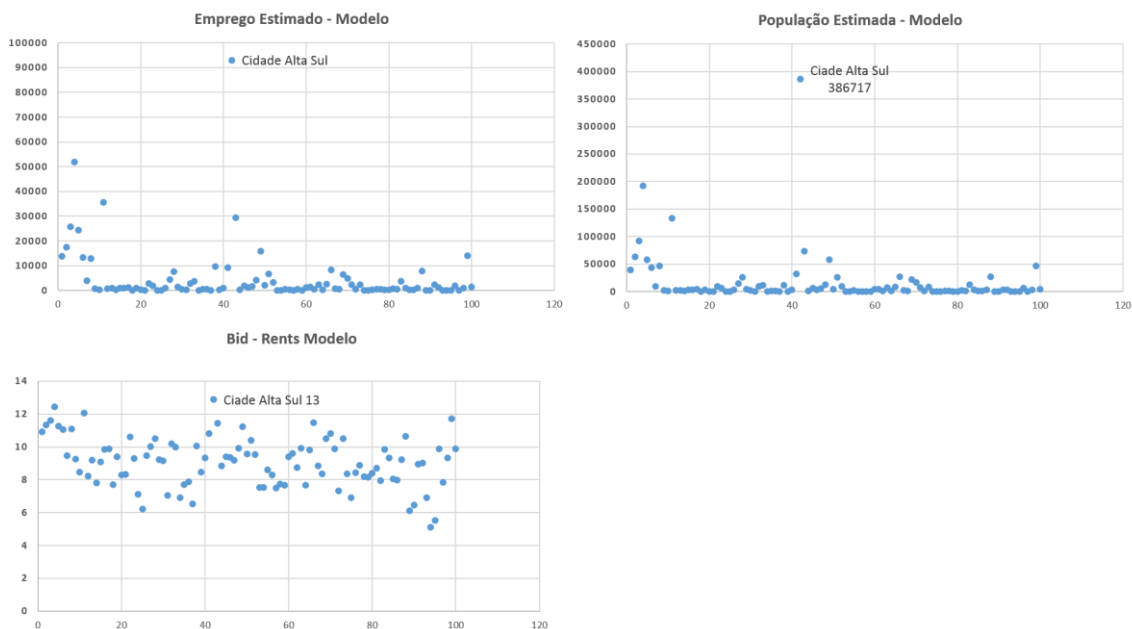


Graphic 2- estimates basic employment distribution model, population and Bid-rents for scene 2

The estimation model for this scene shows exclusive work allocation at Académico I, 3 factors cause considerable fluxion for south-downtown, this population center attracts populace as rent multiplies.

3.1.3. - Scene 3: Employment distribution in three different levels

For this scene, a possibility to create three levels of which a distributing possibility of 5.792 employments in 12 city centers, considering that Académico represents primary level, 2.051 new basic employments; Cambunda village could be considered second level with 468 employments; as for the third level 298 employments for Candiombo, Lufefena, Nanguenha, Ndango de cima, Raimundo, Santo Amaro, Salucombo, Samutaca, Sandjepele and tchianga (see graphic 3)



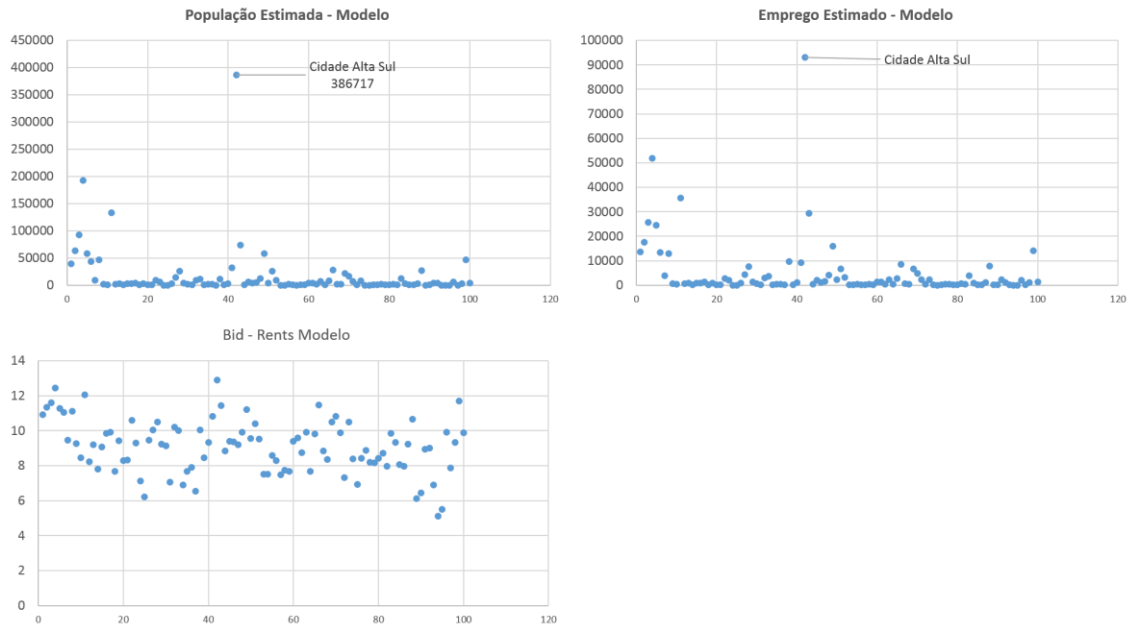
Graphic 3- estimates basic employment distribution model, population and Bid-rents for scene 3

An estimation model creating three levels in work distribution south-downtown, being a major dimension center in all aspects, meanwhile major grouping in other centers is possible.

3.1.4. - Scene 4: Estimation with employment distribution to populace centers, considering existing infrastructures

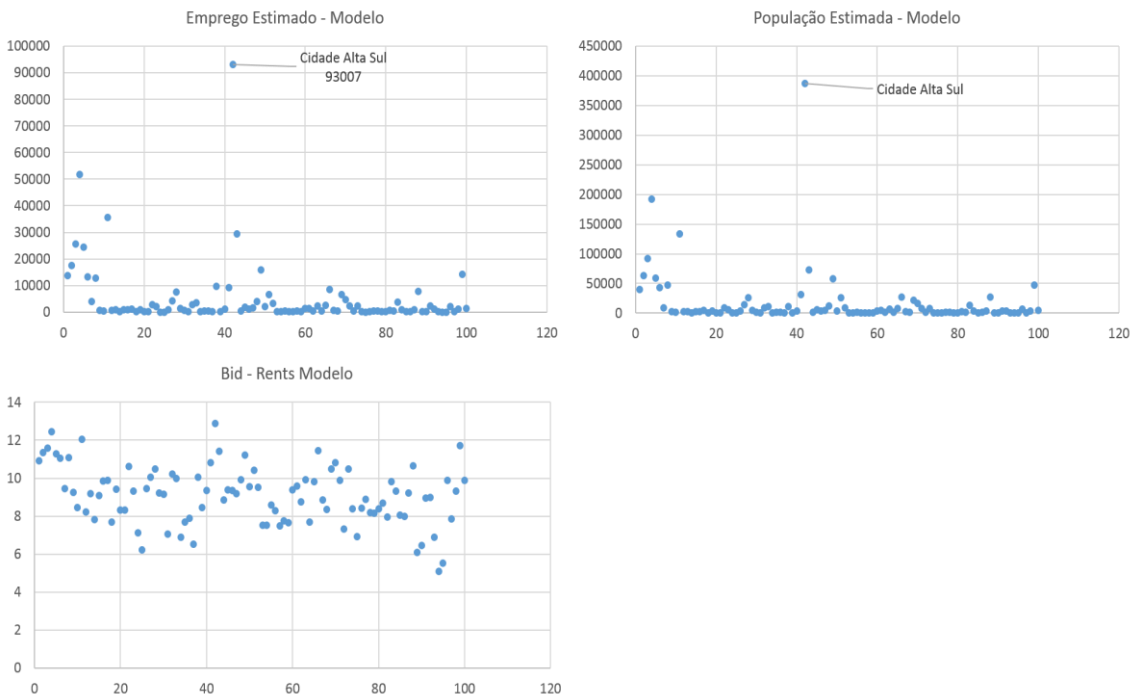
In the fourth scene, it is possible to distribute employment in other communities that already have some infrastructures. 659 employments could be distributed at Académico I and 1285 at Cambunda, Candiombo, Lufefena II, Samutca and Tchianga II according to

the estimation model on graphic 4.



Graphic 4- estimates basic employment distribution model, population and Bid-rents for scene 4

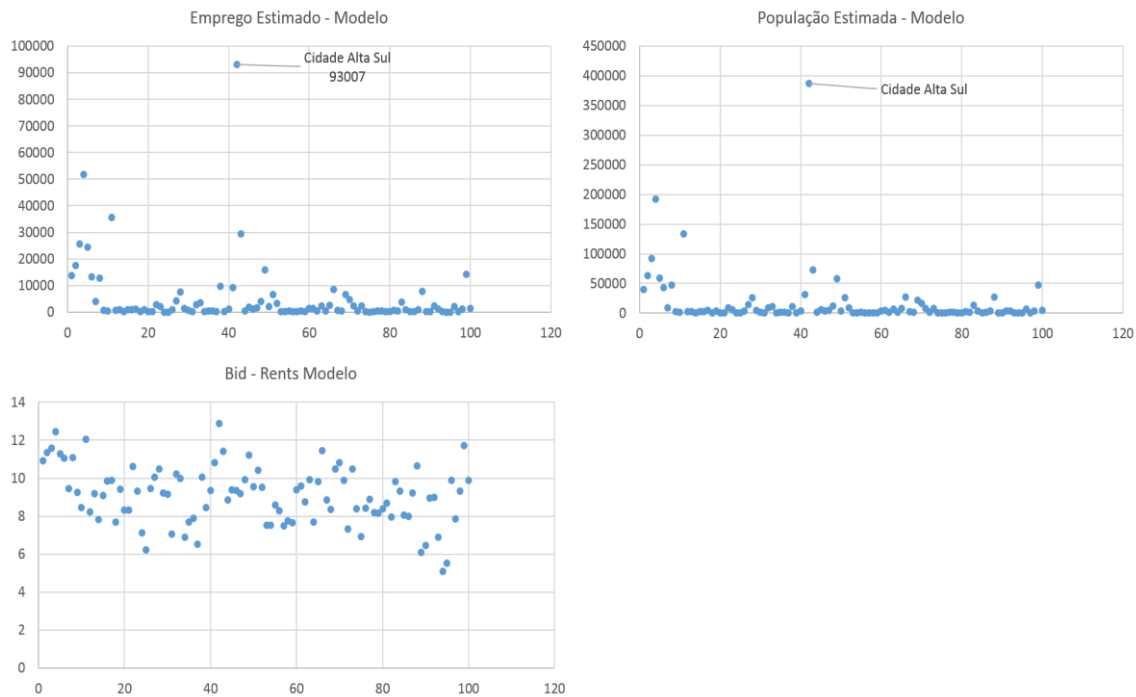
The model shows other city centers have significant alterations in terms of population concentration while south-downtown I is maintained as a principal center.



3.1.5. - Scene 5: Employment distribution commensurating existing population

This last scene considers the possibility to commensurate employment allocation with the existing population of 100 city centers. Thus the Amidos community having 48262 inhabitants would receive 200 new basic employments and other communities with less

population density such as Candiombo I and Candiombo II with approximately 182 and 67 inhabitants would receive one and zero basic employment each. The model is presented in graphic 5.



Graphic 5- estimates basic employment distribution model, population and Bid-rents for scene 5

There is no significant basic employment allocation in other scenes. In the meantime, in order to maintain how population fluxion can vary with basic employments in each scene, there was a need to use the space interaction method developed by Matlab as above described.

4- **Methods**

a) Spatial Interaction Model Formulation

The developed SIM uses the structure of a basic model (Tiebout, C.M., 1956) and assumes that consumer behavior is described by a production-constrained spatial interaction model with a negative exponential function for distance and an attraction factor for center representation of various sizes. The developed SIM considers that exports (basic activities - E_B) are the propulsive factors of the economy and it distributes employment (or income) and population (or consumption) by the different considered zones of a region. Consumers are considered by the model as potentially travelling from any origin to any destination zone under the effects of centre attraction and distance friction.

The formulated SIM is a modified Lowry model (Lowry, 1966) and assumes that the spatial interaction (T_{kl}) between two entities is directly related with the beginning and destination attributes (A_k and B_l), and indirectly related with the distance between them (d_{kl}).

Considering a specific zone k and its interaction with a considered zone l , the population (P) that exists in each zone k is dependent of the basic employment (E_b) and non - basic employment (E_{nb}) that is established in the zone, the attraction of the zone (W_k) and distance between k and l :

$$T_{kl} = E_k \frac{r \cdot W_k \cdot e^{-\alpha d_{kl}}}{\sum_l r \cdot W_k \cdot e^{-\alpha d_{kl}}} \quad (1)$$

For all zones k , and:

$$P_k = \sum_k T_{kl} \quad (2)$$

Where T_{kl} is the commuter that works in zone l and lives in zone k , E_k is the employment of zone k , r is the inverse of the activity ratio (population/employment), W_k is the attraction of zone k , α is a parameter that defines the friction produced by distance for the commuters, d_{kl} is the distance between zone k and l , and P_k is the population in zone k .

The activities generated for each zone serves the population P that lives in all the other zones within a service range:

$$S_{kl} = P_k \frac{s \cdot W_k \cdot e^{-\beta d_{kl}}}{\sum_l s \cdot W_k \cdot e^{-\beta d_{kl}}} \quad (3)$$

For all zones k , and:

$$E_k = \sum_k S_{kl} \quad (4)$$

Where S_{kl} is the activity generated in zone l that serves the population in zone k , P_k is all the residents in zone k , s is the non-basic activity ratio ($E_{nb}/\text{Population}$), W_k is the attraction of zone k , β is the parameter that defines the friction produced by distance for the people that look for activity services, d_{kl} is the distance between zone k and l and E_k is the employment of zone k .

The attraction parameter W_k of a specific zone corresponds to the number of people that come from other zones to work or to search for services. Economically speaking, a high attraction for employment represents a high demand of ground and is respectful to a high

rate of export of money.

The endogenous variables (P_k and E_k) can be obtained from the exogenous variable for E_b through the use of matrices [A], [B] and identity matrix I_M :

$$E_k = \{I_M - [B][A]\}^{-1} \cdot [E_b] \quad (5)$$

$$P_k = \{I_M - [B][A]\}^{-1} \cdot [E_b][A] \quad (6)$$

Where:

$$[A] = \frac{r \cdot W_k \cdot e^{-\alpha d_{ki}}}{\sum_l r \cdot W_k \cdot e^{-\alpha d_{kl}}} \quad (7)$$

$$[B] = \frac{s \cdot W_k \cdot e^{-\beta d_{ki}}}{\sum_l s \cdot W_k \cdot e^{-\beta d_{kl}}} \quad (8)$$

To reach a desired equilibrium regarding the residence-employment and population-services average costs in the considered region, the model is iteratively calibrated until the predicted average costs are similar to the real average costs. The parameter α is calibrated in order that the average residence-employment cost predicted by the model is similar to the real/pretended average commuting cost. Similarly, parameter β is calibrated so that the average costs for the population to access to services in zone k are similar to real average costs. Finally, W_k are iteratively calibrated to guarantee the accomplishment of constraints related with job and service supply and available space in each zone.

The W_k calibrated attraction values can also be interpreted as bid-rents (Roy & Thill, 2004). The bid-rent (ω_k) is complementary to the transportation costs and is directly proportional to the attraction values as would and should be expected in spatial equilibrium models. Therefore, we can assume that:

$$\omega_k = - \left(\ln \frac{1}{W_k} \right) \quad (9)$$

And equations (7) and (8) can be expressed as (10) and (11), respectively:

$$[A] = \frac{r \cdot e^{\omega_k - \alpha d_{ki}}}{\sum_l r \cdot e^{\omega_k - \alpha d_{kl}}} \quad (10)$$

$$[B] = \frac{s \cdot e^{\omega_k - \beta d_{ki}}}{\sum_l s \cdot e^{\omega_k - \beta d_{kl}}} \quad (11)$$

Spatial Interaction Model Development in MATLAB

The SIM described in the earlier section was coded and integrated in MATLAB 2013a (Mathworks, Natick, United States). The developed tool is user – friendly, unlocks the spatial constraints regarding matrix operations with previously used software, speeds up the iterative processes, allows the outputs to be exportable to spreadsheet format and supports model calibration and scenario simulation functions. The developed SIM flowchart for both calibration and simulation phases is illustrated in Annex 1.

Regarding the calibration phase (left part of the Annex 1 flowchart), it is initiated externally through the manual insertion of the necessary inputs on an Excel standardized workbook which was previously pre-defined and integrated with MATLAB. For each zone, the user must insert the data for zone name, basic employment, space for population and space for employment. The distance matrix and r and s parameters are also inserted in the Excel template workbook. The r and s parameters are calculated by the following formulas in equations (12) and (13), respectively:

$$R = \frac{\text{Total Population}}{\text{Total Employment}} \quad (12)$$

$$S = \frac{\text{Total Employment} - \text{Total Basic Employment}}{\text{Total Population}} \quad (13)$$

Afterwards, the program is initiated and the excel workbook is loaded from the database into MATLAB environment. Next, the user is prompted to make optional modifications in the some data. Other inputs are inputted manually, which include friction parameters (α and β), average distance costs for both jobs and services, maximum number of iterations (I_{max}) and required tolerance to stop the iterative cycle ($error_t$).

After all the inputs were inserted, the process starts. In each iteration I and through matrix operations, residence-employment and population-services matrices, estimated employment and population values are calculated. For each zone and on each iteration I , attractions W_k are calibrated by multiplying the estimated attraction values on each iteration step with a factor that corrects them in relation to the ratio between the inserted and estimated space values and regarding the spatial constraints of the available space for

each zone. If the estimated space values are lower than the available space, W_k on $l + 1$ corresponds to the calibrated attraction. If the estimated values are higher than the available space in a specific zone, bid-rents are calculated based on the calibrated bid-rents but W_k of $l + 1$ is the W_k of the current l . We always consider and display the bid-rents from the calibrated attraction as bid-rents are a direct measure of the value of the land.

The attrition parameters α and β are adjusted by Hyman's calibration method (Hyman, 1969). For a hypothetical parameter γ and iteration l :

$$\gamma_{l+1} = \frac{[(C_{real} - C_{estimated}(\gamma_{l-1})) \gamma_l - (C_{real} - C_{estimated}(\gamma_l)) \gamma_{l-1}]}{[C_{estimated}(\gamma_l) - C_{estimated}(\gamma_{l-1})]} \quad (14)$$

With C_{real} being the real average costs and $C_{estimated}$ being the model estimated average costs.

As initially described, the model is iteratively calibrated until the average costs predicted by the model are similar to the previously inputted real average costs. The optimum stop condition is activated if the absolute value of both the differences of average costs is lower than the $error_t$ parameter previously defined:

$$|EC_e - C_e| \wedge |EC_s - C_s| < error_t ; stop \quad (15)$$

With EC_e being the estimated average commuting cost, C_e is the real average commuting cost, EC_s is the estimated average cost for the population to access to services, C_s is the real average cost for the population to access to services, and $error_t$ is the maximum tolerance to end the iterative cycle.

To prevent an infinite cycle regarding non - convergence, a maximum number of iterations is defined at the start. If the loop does start to exhibit chaotic behavior, the iterations are automatically stopped.

When the maximum number of iterations (l_{max}) is lower than the current iteration, or when the equation (15) is achieved, the program outputs the calculated data to a spreadsheet compatible format for further numerical and graphical examination of the given results in compatible spreadsheet and statistical packages. The output contains multiple sheets with information regarding initial inputs, intermediate matrices, parameter calibration changes over the iterations and average cost values and ratios on each iteration. Subsequently, we can save the calibrated model to a MATLAB specific format and store it in the database in order to use the saved data to perform scenario simulation. After we have a calibrated

model as a result of the modelling phase, we can load it on the program to perform a scenario simulation methodology (right part of the flowchart in Annex 1) to simulate scenarios and how they can impact the studied region of the calibrated model in terms of population and employment distribution, average costs and bid-rents. The process starts with the loading of a previous calibrated model. Afterwards, the user performs necessary input modifications for scenario simulation in basic employment, space for population, space for employment and distance matrix variables. α and β are considered static as we consider no change in the region global friction, and the real average costs are the calibrated model estimated costs. Next, the user inputs the maximum number of iterations (I_{max}) and the tolerance to stop the iterative process ($error_t$), and the iterative process starts. A stop counter equal to 0 is initialized with the beginning of the process.

The iterative process stops differently in the scenario simulation procedure. As the costs may change due to possible input modifications, convergence might occur for other estimated costs. Due to this, the function will consider the current and last iteration difference between the model calibration costs and the estimation costs to achieve convergence:

$$|EC_{s,I} - C_{s,I-1}| \wedge |EC_{s,I} - C_{s,I-1}| < error_t ; Stop Counter + 1 \quad (16)$$

$$Stop Counter \Rightarrow 10; stop \quad (17)$$

Therefore, if the difference between these costs in both estimated costs for the current iterations and the previous iterations are both below $error_t$, the program adds 1 to the stop counter. Otherwise, the stop counter is reset. If equation (17) is achieved, the program stops and assumes that a convergence has been achieved.

When the maximum number of iterations is lower than the current iteration, or when the equation (17) condition is achieved, the program outputs a new spreadsheet that compares the model calibrated data with the new scenario simulation data, which is very useful for analyzing the possible differences in both calibration and simulation outputs.

b) Results discussion, a point of view about employment allocation and population fluxions

Based on the question about the impact of basic employments' allocation related to public services analyzed by Mat Lab, five hypothetical scenes for the Province of Huambo are described below.

The application of model described in scene 1, consists of an increase of 5135 inhabitants

for south-downtown and 3014 inhabitants for Sao Joao quarter, since other city-centers do not have alterations reaching 2000 inhabitants (see fig 2).

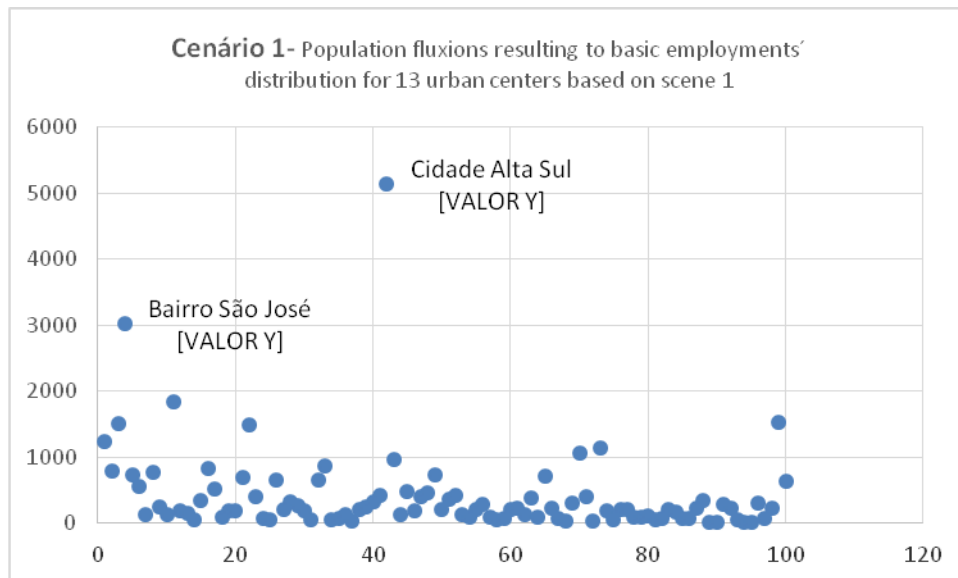


Figure 2- Population fluxions resulting to basic employments' distribution for 13 urban centers based on scene 1

This result does not show significant alterations in terms of population fluxions, or the migratory tendency from rural areas to big centers at Huambo is maintained, as previously described this increase does not commensurate population well-being in urban centers, the quality of life and access to various services.

The second application of model was to admit that there could be a political decision so as to allocate employments at the central region of Huambo in order to satisfy the actual demand, which is the urban center populace density. Results show that south-downtown could have its populace fluxion reach 9000 inhabitants and Sao José would be the second center with much more alterations with an increase of 6565 inhabitants, and all other centers in the suburbs would not have much alterations apart from Cacilhas and Académico that would have a 3000 inhabitants increase, other centers would not have a populace increase over 2000 inhabitants. (see fig. 2). There could also be an increase at other suburbs such as Catumb, which could lose 104 inhabitants.

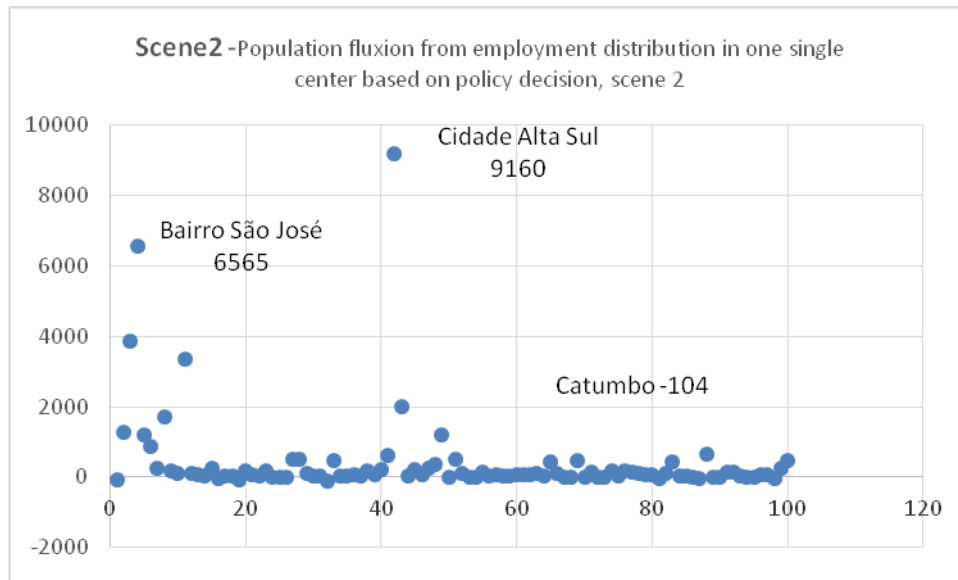


Figure 3- Population fluxion from employment distribution in one single center based on policy decision, scene 2

This scene indicates a clear tendency of population flow towards the center, since the population growth in suburbs are clearly and moderately marked with migration towards urban centers.

The third scene analyzes the possibility of creating centers with three different levels, results show that there are distinct alterations in relation to previous scenes. Downtown-south with more than 5864 inhabitants and then Sao José with an increase of approximately 4000 inhabitants, other centers keep having 2000 inhabitants (see fig. 3), and at Cambunda, despite increase of employments the population growth does not reach 1000 inhabitants.

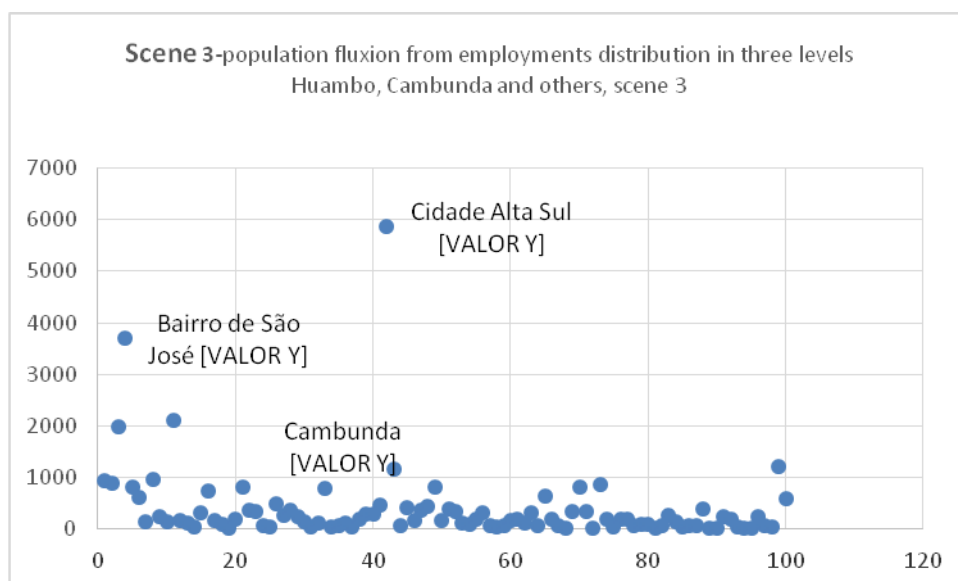


Figure 4- population fluxion from employments distribution in three levels Huambo, Cambunda and others, scene 3

The fourth scene represents employments distribution to areas already having certain infrastructures, or the more employments opportunities the more schools and medical centers. Thus results show for the very first time downtown-south with a population increase not reaching 4000 inhabitants and suburbs like Calieque, Vila Graça and Cambunda, aprat from Sao José, with an increase of 2000 inhabitants, and five other suburbs with an increase of 1000 inhabitants. There also could be mentioned the loss of 205 inhabitants in oil, which is an area opposite to the center.

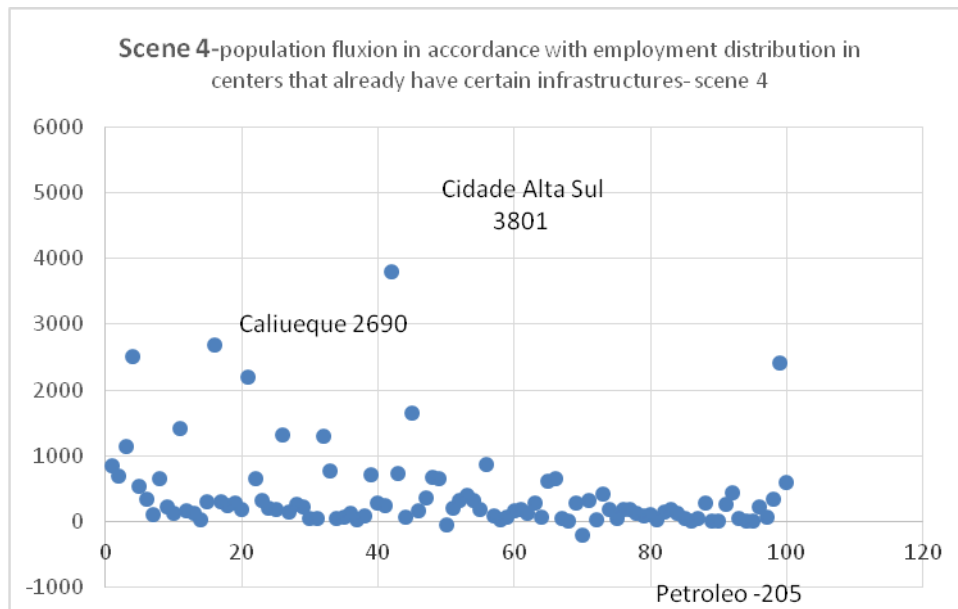


Figure 5 population fluxion in accordance with employment distribution in centers that already have certain infrastructures- scene 4

Results show more population fluxion in suburbs, which confirms the analysis that migrations are related to the number of basic employments created, but also that other infrstructures help people access social services.

The fifth and last scene represents that the number of distributed employments commensurate the population density, and the model shows a similar scene as that of the first, that downtown has a much more population increase and other suburbs such as Sao José with 4032 and Cacilhas with approximately 3000 inhabitants.

And some loss at other suburbs such as Catumbo (see fig. 5)

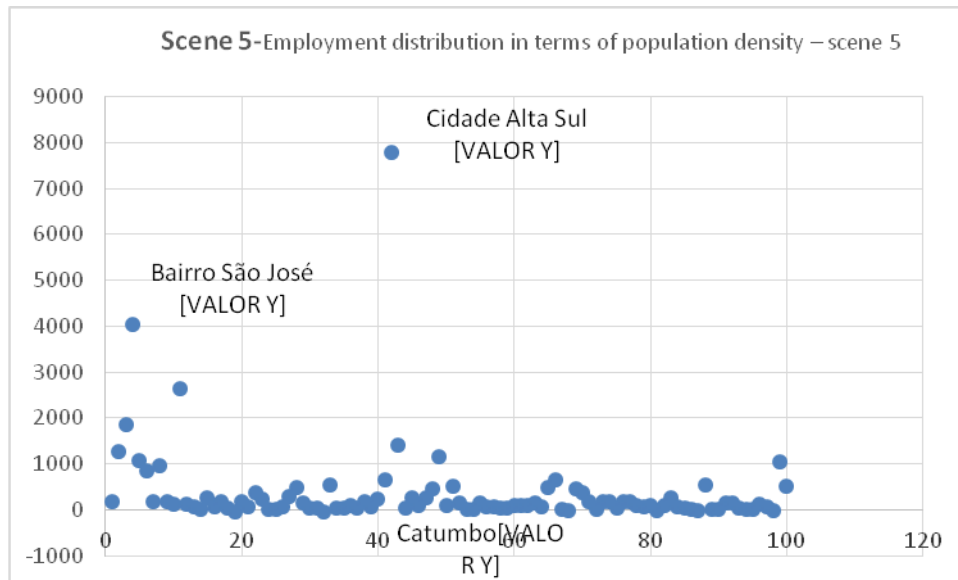


Figure 6- Employment distribution in terms of population density – scene 5

The result of this scene shows that population would be concentrated to urban centers and suburbs would gradually lose population, the loss could be accelerated by the increase of other social infrastructures in urban centers.

4- Final comments

The article aim is to have some reflection about the impact of employments in relation to Rural-Urban migratory fluxions and possible urbanization of other new areas in the city of Huambo, thus analyzing five hypothetical scenes in a programming model developed by MATLAB and following and the below results:

- Rural-Urban migrations are impulsed by the quest of services such as education, health and other urban social infrastructures.
- The populace aggregational tendencies at the municipality of Huambo can happen not only for basic employments but also for urban infrastructures as main factors to population fluxions.
- The used methodology analyzes more developed ways of getting the right knowledge to describe populace fluxions tendencies and also help manage and organize cities.
- The obtained results help reflect about the need in the forthcoming assignments to develop an analysis of costs and benefits of each scene and have coherent tools during the inspection process of new populace centers.

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