

Modeling of the Redevelopment of Agglomerations in aqueous environments in the face of the Sustainable Development Goals, case of squatting in Kinshasa

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Abstract: The abundant rainfall experienced by the city-province of Kinshasa, with climate change and intense heat are the subject of natural disasters and loss of human life. This study of the redevelopment of agglomerations in aqueous environments in the face of the Sustainable Development Goals (SDGs) is one of the solutions to national challenges and a priority for the Ministry of Housing and Infrastructure. It is in order to improve the living conditions of the residents of the aqueous environment of the City of Kinshasa in particular, of Africans in general and because of the protection of the ecosystem. Well-being is also one of the development engines of any nation, because good health is the first wealth that an individual has. This problem of habitat degradation is attracting the attention of researchers, scientists, whose architects, town planners, landscape architects and environmentalists make it a concern in the world to offer an appropriate framework meeting standard standards by the "Yakam Matrix" finally to understand the interface between a human and his shelters, shelters and his environment by the physical states of matter. Our objective is to contribute to the integral development and ensure the good vital condition recommended by the 11th objective of Sustainable Development, by the construction of social housing and ecological cities or garden cities. This article will be accompanied by some sketches of a typical case of one of the areas of Kinshasa – DR Congo. The general considerations and conceptions,

Key words: Yakam Matrix, Well-being, ecosystem, renewable energy, sustainable development, Eco-architecture, aqueous medium.

Introduction

Since the appearance of man, a shelter has always been his need and nature, his environment, because he and all his activities find refuge there. This is what makes the importance of architecture, town planning, civil engineering, etc. on the other hand, at the Johannesburg summit in 2002, the environmental question imposed itself as a major concern for all of humanity.

Indeed, faced with this challenge, the Brundtland report (1987) indicated the paths to follow for an integrated sustainable development which takes into account the "three dimensions of sustainability (environmental, economic and social) in a dialectic which constitutes the essential current debates on the impact of human activities on the natural and social habitat".

Professionals in the building and industry sector strive to design and build climate systems that save energy and have a low environmental impact; they oversee its management and maintenance. With a view to energy transition, this approach must combine sobriety, energy efficiency and the promotion of renewable energies in agglomerations in an aqueous environment.

The agglomeration as a grouping of buildings (hamlet ortown). Here we discuss the aspect of rural settlements. The latter, which draws the attention of researchers to compliance with climatic, energy and environmental engineering, the regulation to be applied in these systems should allow the maintenance of hygrothermal ambient conditions according to use (comfort) and to optimize the energy consumption and the use of green energies in order to protect the environment and contribute to sustainable development.

This modeling of redevelopment by the Yakam Matrix Method serves to determine the interfaces of the agglomeration with its interacting parameters. It is assumed the presence of three physical states of matter inevitably. These are: solid(s), liquid (l), vapor or gas (g) and sometimes Laser, part of the "Yakam Matrix" first introduced in 2007¹, limited to 3 states. Currently the matrix covers all present physical states of matter with plasma (p) and colloidal (c).

$$\mathfrak{Y} = \begin{bmatrix} I_{ss} & I_{sl} & I_{sg} \\ I_{ls} & I_{ll} & I_{lg} \\ I_{gs} & I_{gl} & I_{gg} \end{bmatrix} \quad (1)$$

The evolved Yakam matrix with the matrix relation (1) evolved from which is a matrix completed by (p) like plasma, colloidal (c) state and many other physical states of matter which will be discovered in the future by (2). The current "Yakam matrix" is as follows: $\mathfrak{Y}_\infty = [I_{slgp...c}]$

$$\mathfrak{Y}_\infty = \begin{bmatrix} I_{ss} & I_{sl} & I_{sg} & I_{sp} & \cdots & I_{sc} \\ & \vdots & & & \ddots & \vdots \\ I_{cs} & I_{cl} & I_{cg} & I_{cp} & \cdots & I_{cc} \end{bmatrix} \quad (2)$$

This massive phenomenon of fragmentation is hardly addressed, barely understood from a scientific point of view, too little taken into account by decision-makers and other actors in urban dynamics on the continent.² What are the socio-economic and environmental effects of the production of urbanization and peri-urbanization during the fragmentation of agglomerations in aqueous environments? The triple social, economic and environmental aspect of town planning and development poses a problem of the sale of fragmented plots, both in town and in slums, and even in an aqueous environment and along waterways.

We limit ourselves to the state of the city of Kinshasa according to the map Figure 1 which is taken into account as a pilot site in sub-Saharan Africa, under the auspices of the "Academy of Sciences and Engineering for Africa Development" ASEAD.

The agglomeration of Kinshasa describes its genesis and its urbanization in a brutal way in two stages. The first corresponds to the colonial era, when the city benefited from a well-developed urban plan, and the second, to the postcolonial period, a period during which the city developed in an anarchic manner, without an urban plan. It is even the period of town planning spontaneous and anarchic construction. It housed 100,000 people in 1945 (Belgian Congo) and 400,000 at independence (1960). Which made it the largest agglomeration in Central Africa. Fifteen years later, after the city was given the name Kinshasa (1966), its population had already passed the 2 million mark.

Kinshasa population statistics date back to 1950 and a projection of 2035 according to World population review. We notice an eccentric demography from 1990 to 2020 whose rural exodus is strongly manifested after the looting and the dysfunction of provincial companies, we note a weak demography, with the Sustainable Development Goals (SDGs) which impact the countries of the great lake and DR Congo through participatory development at the local, regional and global level.

¹ Leonard Kabeya Mukeba (2007), Study of contact line trapping during droplet evaporation, PhD Thesis of University of Liege, Belgium.

² Watson, V. (2009), The planet city sweeps the poor away.*: Urban planning and the 21st century urbanization. Progress in Planning, 72, 2009, 151-193.

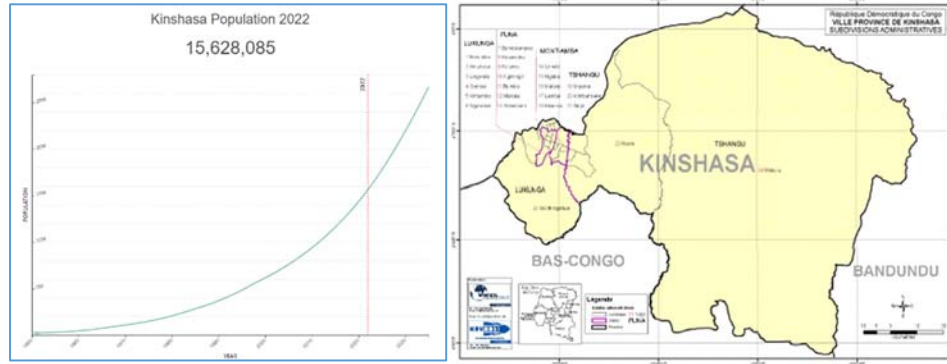


figure1(a and b): Evolution curve of the population of Kinshasa and the map of Kinshasa

Picture 1: Evolution of the Kinshasa population until 2035

Year	Population	2030	21,914,342	2021	14,970,460	1980	2,052,873
2035	26,681,824	2029	21,035,846	2020	14,342,439	1975	1,481,820
2034	25,678,856	2028	20,181,968	2015	11,597,706	1970	1,069,714
2033	24,700,252	2027	19,354,424	2010	9,381,673	1965	717,018
2032	23,746,090	2026	18,552,820	2005	7,589,069	1960	442,853
2031	22,818,048	2025	17,778,474	2000	6,140,419	1955	292,398
		2024	17,032,322	1995	4,824,684	1950	201,905
		2023	16,315,534	1990	3,683,274		
		2022	15,628,085	1985	2,811,896		

This agglomeration of Kinshasa is divided into 4 districts and 24 communes, including the poor state of the road system in several communes, to the point that many streets are impassable by vehicles, outside the dry season. The 9th and 11th Sustainable Development Goals are being implemented in the urban area of Kinshasa. However, rehabilitations are sometimes ineffective or even unfinished.

World Urbanization Prospect foresees a rate of 53%³ share of urban population to total population by 2030 for Africa. While the rural exodus rages in the cities of sub-Saharan countries with anarchic construction and disruption of standards or urban plans.

Région	Taux d'urbanisation (part de la population urbaine par rapport à la population totale)		
	1975	2000	2030 (prévisions)
Afrique	25	37	53
Asie	25	37	54
Amérique latine et Caraïbes	61	75	85
Europe	67	73	80
Amérique du Nord	74	77	84
Océanie *	72	74	77

These few data are enough to show that towns and cities have and will increasingly have a key role to play in the decades to come. Under these conditions, and taking into account the fact that certain aspects of their current evolution risk seriously compromising the economic, ecological and social balances, sustainable development appears as the "Ariane's thread" of a new balanced conduct of their management. On the other hand, they bear the full brunt of the energy, economic and ecological upheavals that our times are going through.

Dysfunctions of social agglomerations

An agglomeration plays a positive role in the economic and social field of a nation, poverty, inequalities and even exclusion develop in Kinshasa. The urban fabric is fragmenting. Some outlying districts of urban agglomerations combine handicaps and tend to become impoverished and marginalized. The city centers themselves are experiencing difficulties, and the excluded no longer find accommodation there, we notice anarchic constructions in certain outskirts. Under these conditions, the city no longer manages to ensure the social cohesion that made it rich and strong. It no longer plays its fundamental role as a place of meetings and exchanges. This phenomenon of fragmentation is observed at different levels and characterizes society as a whole;

³Source: World Urbanization Prospect: The 2001 revision (United Nations publication)



figure2(a and b): In the heart of downtown Kinshasa, causes of anarchic construction

Environmental risks and forgotten SDGs

Urban growth and the economic and political upheavals that accompany it cause a certain number of tensions within urban agglomerations. Concentration and urban forms have a significant impact on the environment. The biosphere is the first to suffer.



figure3(a and b): State of development of agglomerations in cities and slums (air pollution versus soil pollution)

Cities are experiencing acute problems of space consumption and the use of scarce resources (water, energy, natural environment, etc.). They produce a large number of nuisances, most often in neighborhoods experiencing social dysfunction (air pollution, waste, noise, etc.). In many cases, past “unsustainable” activities have had negative impacts (underground cavities, mines or quarries, soil and groundwater pollution, etc.) that need to be reabsorbed. It is therefore essential to carry out an inventory, measure changes in the environment, inform citizens and take protective measures.

Regarding transport, our cities have not adapted, they were not designed for this, to car traffic, a source of pollution, damage to public health, nuisance, energy waste, gas emissions Greenhouse effect...

The theme of health is becoming more and more present in the concerns of the inhabitants. A social demand is clearly expressed in the various fields relating to public health.

This demand is at different levels:

- **the environment:** air quality (outside and inside the dwelling), water quality, pollution linked to car traffic and certain industrial activities, the building or the dwelling (asbestos removal for example),
- **production methods:** food safety,

- **the organization of the local medical system:** prophylaxis (e.g. about avian flu, cholera, chikungunia⁴...), disease screening, the fight against AIDS, tuberculosis, the organization of city medicine, the proximity of hospital services (emergency services and maternity hospitals in particular) and the quality of their reception.

Discussions

SDGs and Kinshasa

Local Agenda 21: coherent political action, Based on these observations, more and more local authorities around the world are embarking on a sustainable development approach, a local Agenda 21, referring to one of the main recommendations of the Rio Earth Summit in 1992 (Chapter 28 of the Rio Agenda). But, let us remember, there are enormous differences between the problems faced by urban regions in developing countries, in particular the government project for the integral development of 145 territories which must solve the various challenges at the national level (water and sanitation, transport, infrastructure, etc.)

The interest of local policies based on the concept of sustainable development therefore appears today clearly. Cities are undergoing major changes in terms of governance: over the years, they have become increasingly present political actors alongside States. This development has been reinforced by the decentralization policies carried out in a number of countries which have given local authorities new powers.

How, for example, with a doubling of the share of Congolese over the age of 50 by 2030, how can we think about personal services, mobility... even more so in rural areas? How to control urban sprawl in a context of strong real estate pressure and reconcile it with a reinforcement of territorial mobility? What transformation for access to traceable and local food production? These questions find their solutions in the results.

Urban space

The urban dispersion of housing, activities and services is costly in economic terms, transport, consumption of space, the environment and quite simply daily life. Hence a number of reflections to fight against urban sprawl around themes such as: "the agglomeration reconquered on itself", "urban renewal", "the city of short distances", "the compact city". In the medium term, they should lead to new planning approaches. Each of these legislative measures can be considered as a useful tool for sustainable development initiatives. However, the practice will have to endeavor to organize a coordination which has often not been provided for by the legislator.

Architecture and building

This is about High Environmental Quality (HQE) in its various dimensions: choice of building materials, insulation of buildings, concern for air quality inside the home, water savings, use solar energy, recycling demolition materials, etc.⁵

The HQE approach mainly concerns new construction; it should also be extended to the rehabilitation of old buildings with a view to the conservation of heritage under the standards of sustainable development, which requires the clear affirmation of a new, extremely important political orientation to be implemented as quickly as possible in this domain. The quality of housing, their number, their price, their location in the city, their environment, are at the heart of the social problem and therefore of sustainable development.

In fact, the right to dignified and decent housing and the adaptation of the built heritage to energy requirements are closely linked.

Example of the demolition of Kinshasa Shopping Center (called ZANDO⁶), a demolition of heritage whose materials were not recycled but sold by law enforcement officers (National Police supposed to monitor the site).

⁴Disease from mosquitoes in peri-urban areas

⁵Piéchaud Jean-Pierre, Cities and sustainable development, Encyclopedia of Sustainable Development EDD, n°11 - June 2006, pp5

⁶ZANDO: Market in Lingala (language spoken in Kinshasa)

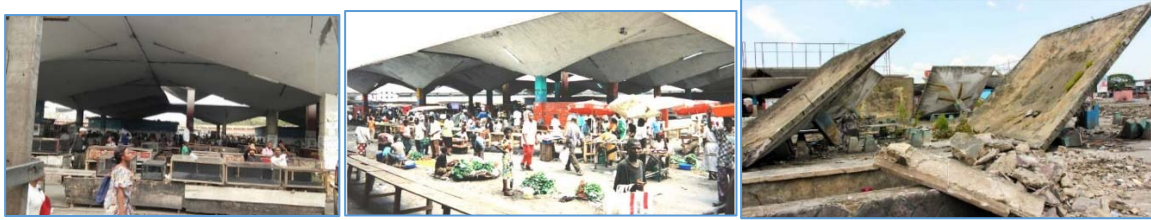


figure4: A symbolic heritage destroyed in the middle of the SDGs

A large shopping center has been demolished since March 2021, the work of which should be completed in 2023

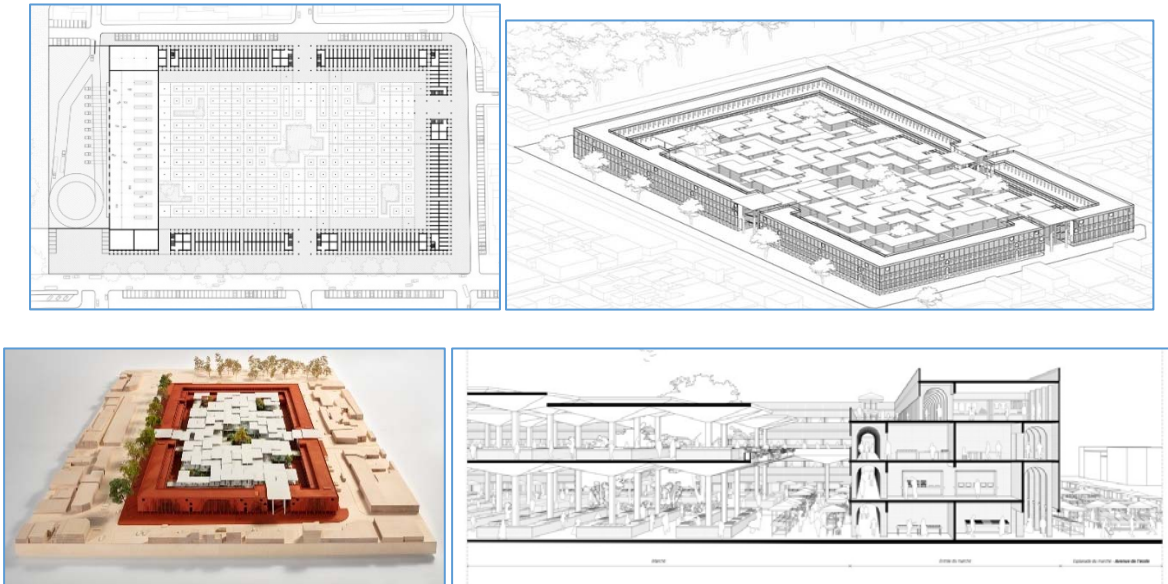


figure5(a,b,c and d): New shopping center project

Environment

Designing the future of African cities in harmony with their plant environment, respecting or even helping to enrich the biodiversity of the region where they are located, are objectives that are essential in a post-carbon perspective. They overlap in part with those discussed in the previous paragraphs devoted to town planning, housing and transport:

Agglomerations that save space, water, taking into account the supply but also the treatment of waste water and sanitation still pose problems in the squatting areas of the city of Kinshasa.

Sustainable development implies very broad social support, in all areas and at all stages of preparation and implementation of local policies, from the definition of a long-term strategy to the implementation of development programs. action and their evaluation. This social support can only exist following public debates organized within the framework of local political life, during which the actors concerned will have been able to participate in the decision-making process. There will be no sustainable development without deepening participatory democracy.

The approach described above through different thematic “entries” is that of the local Agenda 21. This quantitative objective has the merit of driving a movement in favor of sustainable development in territorial policies. One can think that a significant proportion of these Agendas will be the result of urban territories, cities or agglomerations. It will therefore be useful to monitor its implementation by comparing what is being done in DR Congo with what is being done in other African countries and internationally.



figure6: Population facing environmental risks

The population living in an aqueous or rural environment is left to their fate, while the agglomerations should organize in the best conditions the chain of collection, sorting and recycling of waste, which fight against air and water pollution. water, which control their greenhouse gas emissions. Beyond cleanliness, waste treatment has other objectives: saving raw materials, creating jobs (in recycling), combating health risks and pollution... In this area, even if there is still much to do, African cities have put in place significant means over the past two decades, generally well received by the inhabitants.



figure7(a and b): Promiscuity in the face of insalubrity and HQE

Overcrowding which is another scourge on the urban fabric, the causative agent of disease. We have seen a strong spread of contagious diseases and during the COVID-19 crisis. With an anarchic construction in non-durable materials, without taking into account HQE.

Sustainable development saves natural resources, energy and construction materials in particular. But this concern extends to all modes of production and consumption that concern us all, whether we are producers or consumers. How can we contribute, each at our level, to reducing the consumption of resources? This is a constant struggle, which involves public debates, awareness-raising, education and training actions to be carried out at the local level, with a view to reaching consensus, area by area.

The fight against the greenhouse effect concerns the whole planet and is at the heart of one of the principles of sustainable development: the principle of solidarity. While decentralized cooperation also falls within the framework of the principle of solidarity, it is inseparable from development aid. This can go through so-called “decentralized cooperation” actions, made up of exchanges of experience between local authorities or between local actors in the North and South (or East). Sustainable development implies and establishes solidarity between rich and poor regions of the world, decentralized cooperation can be one of the levers.

Energy

The energy problem is tending to disappear with the installation of a prepaid network in the Kinshasa agglomerations. While in certain corners of Kinshasa, the use of new energies is often exploited by individuals living in peri-urban areas. In addition, promiscuity and anarchic construction remains a major problem in the face of energy, the artisanal distribution of electricity outside the standards creates deaths of 1/10 each month, because the houses built of galvanized sheet metal without insulation.



figure8: Promiscuity in the face of energy

Results

Kinshasa squat modeling

As we described above that demography is one of the factors that contributes to the degradation of ecosystems, the occupation of squatting creates water and atmospheric diseases by the high humidity rate, which is explained in the graph below -below.

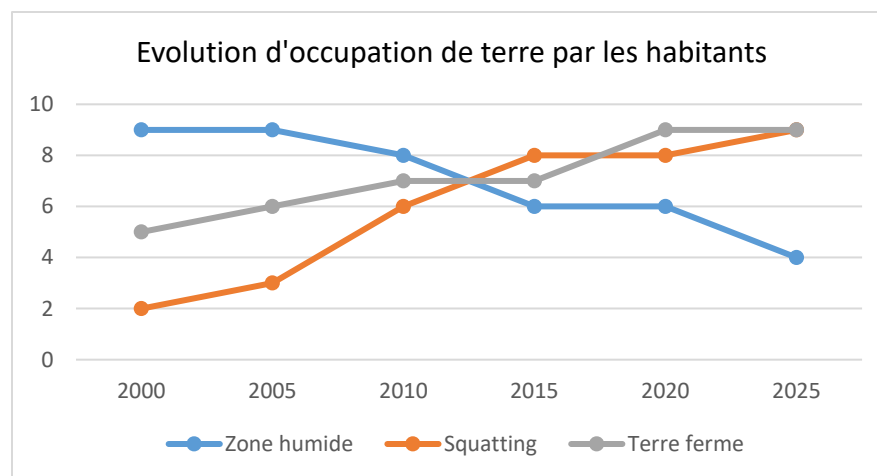


figure9: Occupation of the population in wet and aqueous zones

This table presents the evolution of land use in marshy, humid and dry land areas in Kinshasa. The rural exodus observed in the city-province of Kinshasa (2010 – 2020)

This demonstrates that the method of natural elements corroborates fractal geometry by applying fragmentation phenomena in interdisciplinarity, of which Table 1 below illustrates the actions of fragmentation: Table 1: Concept of urban engineering in the division of plots.

Domains Fragmentation actions Properties Behavior.

- Civil Engineering Computational Complexity Constraints and Plasticity.
- Architecture Miniaturization Philosophy of life adapted to Cost.
- Reduced space town planning Sanitation criteria.
- Compliance with non-standard environmental impacts.
- Mechanical structure Minimization Oversized Hyper structure.

This demonstrates that the natural elements in the Yakam matrix method corroborate the fractal geometry by applying the fragmentation phenomena in the Internal sector, whose Table 1 below illustrates the fragmentation actions:

Picture2: Concept of urban engineering in the division of plots.

field	Fragmentation	Properties	Behavior	(I)
Civil Engineering	Strain calculation	Strains	Plasticity	Iss
Architecture	Miniaturization	Philosophy of live	Adapted cost	Islg
Urban Planning	Reduced Space	Sanitation criteria	Biodiversity	Issg
Environment	Not standard	impacts	Compliance	Iijk
Structure	Minimization	Oversized	Hyper structure	Iss

Action – Transition

In a context of crises, a harmonious development of the territories will have to be able at the same time to propose to the citizens sources of satisfaction, to make the best use of the local resources in the service of the well-being of the populations and to integrate the challenges sustainability and equity. It is, through this, the lifestyles, the uses of resources, the mobility and ways of living, the modes of production and consumption that are questioned. However, because they are the level of proximity, the territories are the first actors in these transformations to come.

The territories will have to act simultaneously on the transformation of production models, the stimulation of innovation, the establishment of regulation and progress in behavior, eco-development. It is therefore a question of a profound change of paradigm that must take place: it will be done thanks to a shared vision of society and adherence to this collectively established project.

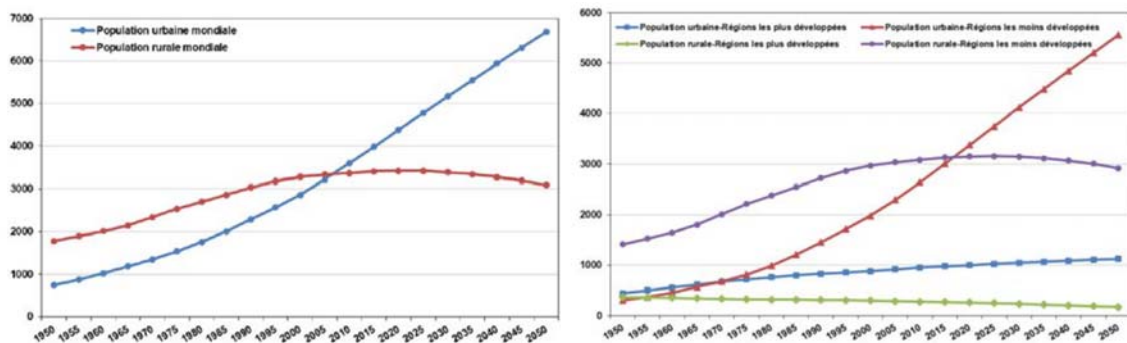


figure10: (a) World urban population and world rural population. (b) Urban & Rural population/area projection.

Picture 8. To ensure the transformations but also to accept the efforts or modifications by everyone, to ensure the long-term involvement of the actors in the dynamics of transition, the territories are therefore challenged in their ability to locally set in motion their responses to the challenges with local actors and available resources. Participation thus becomes one of the fundamental essential elements

Ecological transition of territories

Sustainable development pursues the dual objective of greater equity in development and better management of natural resources. Responsibility is therefore generalized and differentiated according to the capacity for action of the multiple actors. The magnitude of the challenges to be met is played out at the height of each and every organization, in their professional responsibilities, in their private acts, in their relationship to their environment and to society.

The revitalization of society thus requires a new form of contract, social and moral, between the citizen, society and its representative bodies.

From this logic flow several major imperatives:

- Raising citizens' awareness to make them aware of their daily actions and their consequences.
- Make the various professional bodies, inhabitants, NGOs contribute, so that they understand, integrate and support the transformation of territories in their acts of operation and development.

Building the collective political project based on a collective construction of the general interest and no longer solely on participation in discussions. Establish the link with the other territorial levels in a logic of subsidiarity and articulation of policies, skills and solutions to be implemented in terms of regional planning, social cohesion, concerted management of the resource...

Apply and enforce existing standards in the field the responsibility of economic players (Corporate Social Responsibility, ISO 26000, etc.).

“Experimenting with change during a project facilitates its appropriation and its ability to be transferred to other approaches and projects. The “DD democracy” cannot be decreed, it is cultivated! »⁷

Methodological revolution

The conditions under which participation will be conducted will fundamentally condition the quality of the resulting project, its adequacy with local and global issues, its ability to be part of the long term and to mobilize the living forces of the territory in the implementation. .

A few fundamentals should be looked at:

The fundamental requirement of projection into the future, of observation of the possible evolutions of the territory with regard to the hypotheses of transformation and the impacts of externalities on the latter;

The complex but rich approach of cross-expertise which alone can bring to the project the finesse in the knowledge of the territory, its challenges, its spatial, geographical, human, partnership operations, environmental or social;

The main methodological principles to be pursued, the questions and things to be defined well in advance, to avoid any waste of energy and money and to ensure that this participation achieves the ambition it set itself at the start.

Conclusion

The abundance of information on sea level rise, warming temperatures or CO₂ emissions is opposed, for example, to the discretion on the storage times of greenhouse gases in the atmosphere or the "cumulative carbon budgets" not to be exceeded by 2050. Few echoes have been given to the controversies relating to the timetable or even the realism given these cumulative effects of a stabilization at less than two degrees warming by 2100, still considered accessible in each successive IPCC report. Time is not forgotten, but confined in “black boxes”, with the consequence of often giving a distorted view of realities, such as characterizing the evolution of greenhouse gases essentially in terms of flux.

The desire to come up with easily understandable recommendations leads⁸ squatting or watery areas, rural and urban environments, are essential to the implementation of sustainable development. It is at their level that the economic, social and cultural approaches of ecological agglomerations concretely confront (or confront each other) and that these must go beyond their contradictions and find their complementarities.

The first Rio Conference strongly affirmed this in chapter 28 of its Agenda. The Rio+20 conference in June 2012 recalled this again in its final declaration.

Be economical in terms of space, energy and raw materials, be low-polluting, limit greenhouse gas emissions, respect the natural environment, practice non-segregative policies and implement social diversity, be open to the World, and

⁷ Mélanie Goffi, consultant.

⁸ The work published in 2008 by the American Academy of Sciences (Ramanathan and Ferg, vol. 105), the stock of gas at greenhouse effect accumulated in the atmosphere in 2005 would already trigger a warming of 2.4 degrees by 2100. On these controversies see the article published by Amy Dahan and Hélène Guillemot in the special issue of Nature Science Société devoted in June 2015 to the challenges of the Paris conference (“Thinking differently about the climate issue”).

at the same time be at the heart of economic action, such may be the objectives of agglomerations in post-carbon aqueous environments for decades to come.

With all their complexity, they are therefore a central issue for sustainable development. But, in this perspective, urban policies must be based on a deepening of local democracy so that everyone can think about their future with serenity.

In sub-Saharan Africa in general and in DR Congo, the lack of funds and technologies necessary for the implementation of green buildings, associated with a high discount rate, that is to say a strong preference for the present linked . A lack of information and qualifications sometimes makes it difficult to apply the principles of sustainable building, including those that would be profitable in the very short or medium term.

A change in behavior and in the current paradigm governing the construction sector is necessary. Watson (2009)⁹ cites in his study general principles such as:

- The rehabilitation of informal settlements rather than the construction of skyscrapers or “modern” buildings;
- The development of traditional markets rather than the construction of particularly energy-intensive shopping centers;
- Programs aimed at truly combating poverty rather than excluding it from urban centers to preserve the city's image.
- More generally, urbanization policies should therefore pay greater attention to poor populations and the preservation of the informal economic sector.
- The massive urbanization and population growth characterizing tropical areas, as well as the inadequacy of current urban policies and the difficulties.

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Bibliography

- [1] « *Agenda 21 et participation : la voix de tous sur la voie de l'intérêt général* », Observatoire national des agendas 21 locaux et pratiques territoriales de développement durable, 2012
- [2] Action 21 “Conférence des Nations Unies sur l’environnement et le développement de Rio” Chap.28, *Le rôle des collectivités locales à l'appui d'Action 21*.
- [3] Antoine Perrau, #4 Construire bioclimatique en climat tropical et à la Réunion : le regard de l'architecte Antoine Perrau, #4 *Construire bioclimatique en climat tropical et à la Réunion : le regard de l'architecte Antoine Perrau (construction21.org)*, consulté le 15/10 2021
- [4] BATI ADVISOR, L'ARCHITECTURE VERTE, TOUT CE QU'IL FAUT SAVOIR, *L'Architecture Verte, tout ce qu'il faut savoir - avis (batiadvisor.fr)*, consulté le 25 juin 2022
- [5] ENERGIES 2050, Guide du bâtiment durable en régions tropicales, Tome 1 : Stratégies de conception des nouveaux bâtiments en régions tropicales, c Institut de la Francophonie pour le Développement Durable (IFDD), Decembre 2015, ISBN version électronique : 978-2-89481-215-0
- [6] Ernisse Laurence, La participation, la voix de tous sur la voie de l'intérêt Général, Encyclopédie du Développement durable EDD, n°191 - mars 2013
- [7] Federico M. Butera and all., CONCEPTION DE BATIMENTS DURABLES EN MILIEU TROPICAL, Principes et applications pour l'Afrique de l'Est, publiée à Nairobi en aout 2014 par ONU-Habitat. ISBN : 978-2-89481-218-1
- [8] Francis Lelo NZUZI, Les bidonvilles de Kinshasa, le Harmattan- RD Congo, ISBN : 978-2-343-12467-4
- [9] Jean Desmons, Aide-mémoire : Génie Climatique, 2e édition, Dunod, Paris, 2009
- [10] Jean Kitoko di Sola, Mbambu Kabeya Shaloom, Tshiswaka Ngalula Kanyinda Martin, Kinyoka Kabalumuka, Cimbela Kabongo, Mondjalis Poto, Mbikayi Mpanya, Léonard Kabeya Mukeba Yakasham. “Yakam Matrix” as a Predictive Fractal Fragmentation Model of RSNEM: Sustainable Technico-Economic Neo-reconfigurability at the

⁹ <http://www.unep.org/sustainablesocialhousing/>(accessed November 2014).

Inter Housing Sector. International Journal of Sustainability Management and Information Technologies. Vol. 7, No. 2, 2021, pp. 36-47. doi: 10.11648/j.ijsmi.20210702.12

[11] *Le développement durable, une autre politique pour les territoires ? Définition pratique, mise en oeuvre*, Réseau des Agences régionales de l'énergie et de l'environnement (RARE), 2000.

[12] Lelo Nzuzi F. et Tshimanga Mbuyi C.(2004), Pauvrete à Kinshasa, Cordaid, la Haye.

[13] Léonard Kabeya Mukeba (2007), Etude du piégeage de la ligne de contact lors de l'évaporation des gouttelettes, PhD Thesis of University of Liege, Belgium.

[14] Leonard Kabeya Mukeba Yakasham (2004), Numerical simulation of interfacial free energy by finite element method, EURADH 2004.

[15] Mbambu K. Shaloom, Kitoko di Sola, Léonard Kabeya Mukeba Yakasham (2019) Fractal modelling of partition habitable areas in urban environment overcrowds in Democratic Republic of Congo in Subsaharian Africa, International Journal of Civil Engineering, Vol. 6, 9, 2019,

[16] ONU-HABITAT (2021), Journal ONU-Habitat, 10 fevrier 2020 et ODD du 30 mars 2021.

[17] *Paul Ouédraogo, Ph. D., Développement durable Comprendre et analyser des enjeux et des actions du développement durable pp.4*

[18] Piéchaud Jean-Pierre, La ville, l'habitat, l'aménagement du territoire. , Encyclopédie du Développement durable EDD, n°202 - décembre 2013

[19] Piéchaud Jean-Pierre, Villes et développement durable, Encyclopédie du Développement durable EDD, n°11 - juin 2006

[20] *Repères pour l'Agenda 21 local*, Territoires et développement durable/ 4D, 2001.

[21] Shaloom Mbambu, Kabeya Nahum, Ruth Mutala, Kabeya Mukeba ; "Renewable Energy and Architecture: What Political issues for Responsible Innovation in the Democratic Republic Of Congo?", International Conference on Civil and Environmental Engineering (I2C2E), to be held in Cairo, Egypt 12th - 13th June, 2019. <http://researchworld.org/Conference2019/Egypt/1/I2C2E/>

[22] Shaloom Mbambu, Kitoko di Sola, Léonard Kabeya Mukeba Yakasham, "Fractal Modelling of Partition Habitable Areas in Urban Environment Overcrowds in Democratic Rep. Congo in Sub-Saharan Africa" SSRG International Journal of Civil Engineering 6.8 (2019): 1-10. <http://www.internationaljournalssrg.org/IJCE/paper-details?Id=360> du 17/05/2021

[23] *Territoires et développement durable, Tome 2 / Comité 21*, 2004.

[24] Theys Jacques, Le climat avant et après la COP 21 : D'abord une question de temps, Encyclopédie du Développement durable EDD, n°233 - septembre 2016

[25] UN-HABITAT (2020), Rapport de 2018 et de 2020 https://urbanoctober.unhabitat.org/sites/default/files/2020-11/Final%20World%20Cities%20Report%20Press%20Release_French.pdf.

[26] Watson, V. (2009), The planet city sweeps the poor away. *:Urban planning and the 21st century urbanization. *Progress in Planning*, 72, 2009, 151-193.

[27] Yannick Blanc, Faire ensemble 2030, entre urgence et prospective, Éditorial de la Tribune Fonda n°237 « Faire des ODD un projet de société », Mars 2018

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