Contributions of Satellite Images in the Diachronic Study of the Stanley-Pool Sub Basin (Congo- Brazzaville)

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Abstract — *With increased population now days, there is a marked change in morphology of the land when it comes the analysis of space images (satellite) using remote sensing. This study covers a sample application of the use of spatial imagery for mapping land cover in the Stanley-Pool (Congo - Brazzaville). The approach used here is based on confrontation of satellite data acquired on different dates (2001-2005). These images were chosen because of realization a demographic growth during this period. The results of this study show a great advance in land occupation which affected the whole of the autonomous port of Brazzaville.*

Keywords — Remote sensing, Stanley-pool sub basin, Mapping, Spot satellite image

I. INTRODUCTION

The relationship between the morphology of sub basins and hydrological response were previously covered by many studies [1]. The progresses of science in the 19th and 20th centuries have provided several different methods with many applications, especially in the field of geomorphology. The contributions of these tools are considerable. The trend towards natural concentration of flows, demonstrated by the research of [2], is one of the most striking observations in the history of hydrology. The arrangement of water system is also important to consider the path and transit time from source areas to the outlet.

Geomorphologists left behind a significant amount of morphometric index at each time when they created their own methods and analysis tools. Over fifty indicators can thus be identified in the reference study. Despite this, these analysis tools are not adequate to translate the dynamics of basins because they compartmentalize the various morphometric parameters and remain static.

Some writers will cross some clues to create new ones [3]. We can now compare the surface with the water system, the shape with the slope or width of a system with the slopes. However, the indices still have shortcomings, such as the density of the drainage that quantifies a water system but does not characterize the organization. Based on the theory of complex and particular cellular automata systems, the present work aims to quantify global and dynamically structuring and degradation modes of the three sub-watersheds.

Knowledge of the sedimentary dynamics of the silting process in the Stanley Pool region of great practical interest for the development of the port of Brazzaville. Thus, for this study, we had to resort to various methods : Analysis through the satellite image. Similarly, the various factors of measures were used to assess the thickness of the coat of sandy sediments and nature. Furthermore location of these deposits, the focus was also put on their character and origin, through laboratory techniques mentioned above.

At last, to understand the relationships between different hydrological sandbanks and phenomena observed in this study area, a detailed study of the Stanley Pool surface state through a diachronic study of the climate characters, relief, etc. is also necessary.

II. RESEARCH METHEDOLOGY

2.1. Diachronic study

The method of diachronic analysis, based on the comparison of satellite images [4], can appreciate the dynamics of land use in the Stanley-Pool during a given period. It also allows the comparison of results to better understand the impact of silting in the autonomous port of Brazzaville.

A diachronic study is the use of vertical aerial photographs; the scale varies in general between 1/15.000 and 1/30.000 based on topographic maps. For this study, we selected Landsat images from 2001 and Google Earth in 2005, covering a period of four years. The choice was dictated by the desire to complete the study in the laboratory. Between the oldest mission in 1987 and the most recent in 2001, was chosen the 2001 mission given the quality of the image and the interests of the geographic information contained therein.

The following processing steps were performed:

The obtained images were digitized and there have been geometrically corrected and geopositioning. This step is necessary to compare the different shots (Fig. 2.1, 2)

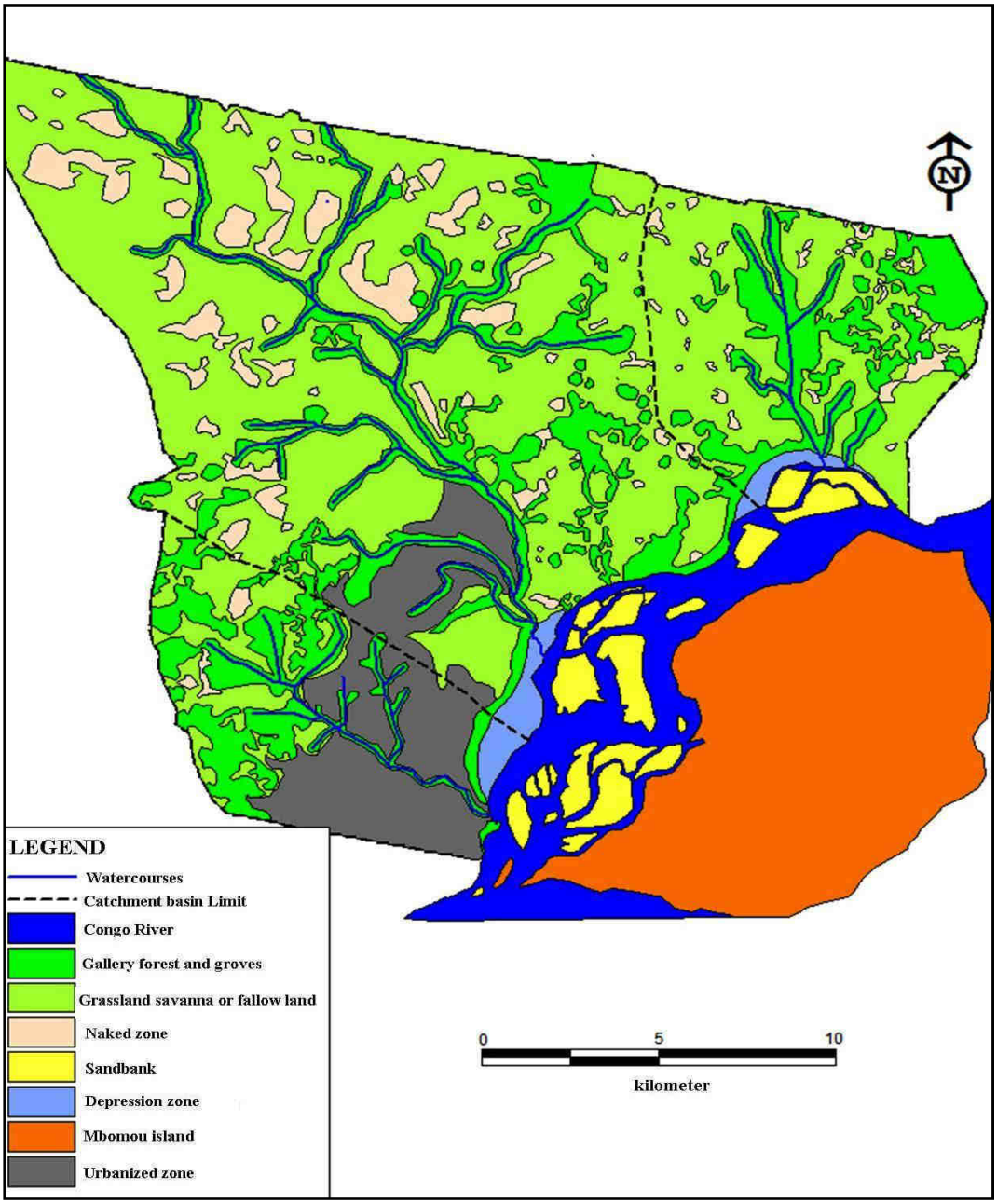

Fig. 2.1: State of land occupation in the Pool in 2001
(Image Source : Landsat 2001)

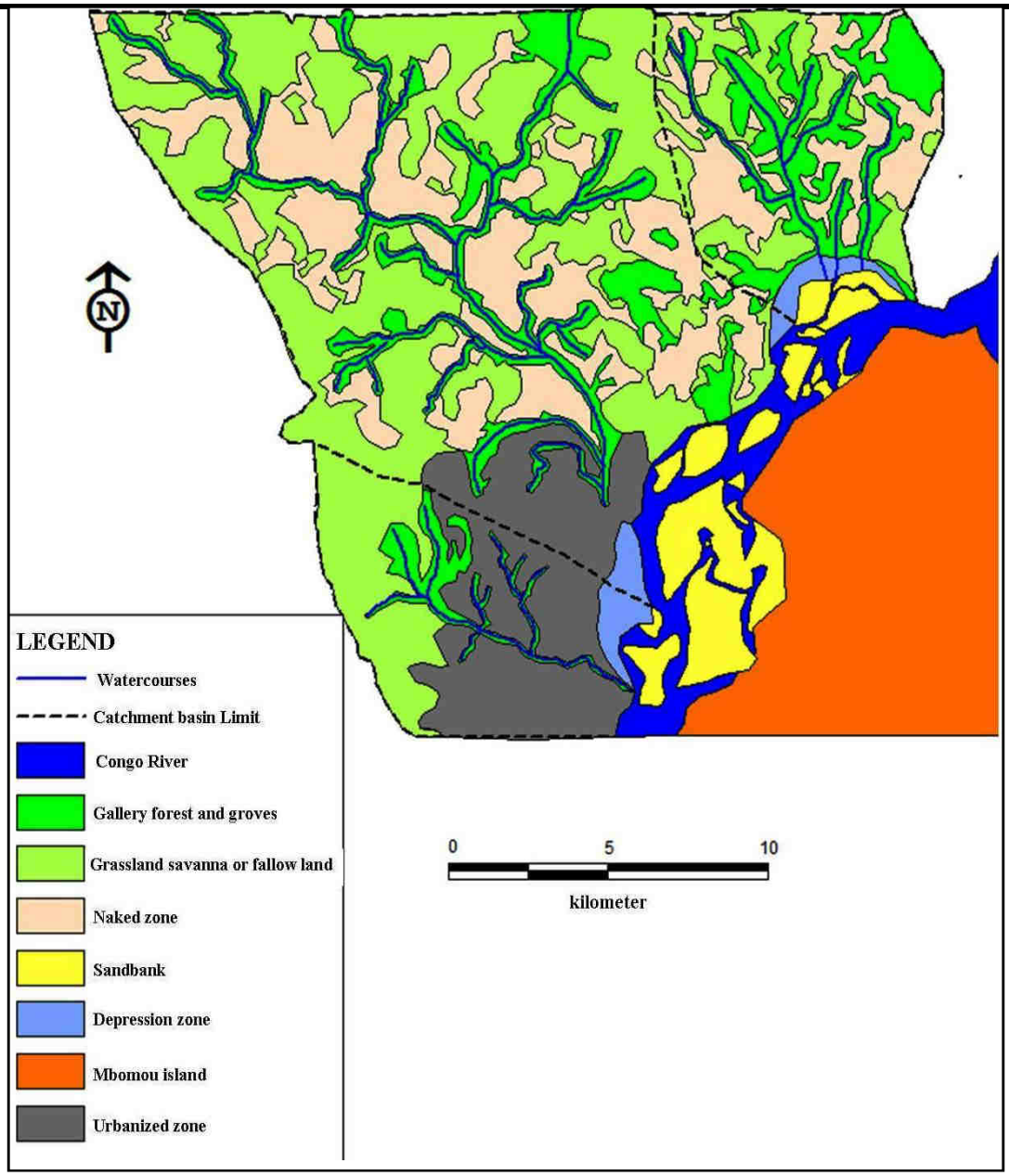

Fig. 2.2: State of land occupation in the Pool in 2005
(Image Source : Google earth)

2.2. Types of land occupation

Stanley Pool site also shows no significant evolution than 1970 (Table 2.1). Mangrove vegetation that grows free of land occupation, nevertheless subjected to the related influences the growth of the Pool region and to that of its port traffic [5].

Table 2.1: Types of land occupation in 2001 and 2005

Land occupation (Km^2)	2001	2005
Grassland savanna or fallow land	379,8	253
Gallery forest and groves	167,8	146,8
Urbanized zone	66,81	58,15
Naked zone	48,97	166,7

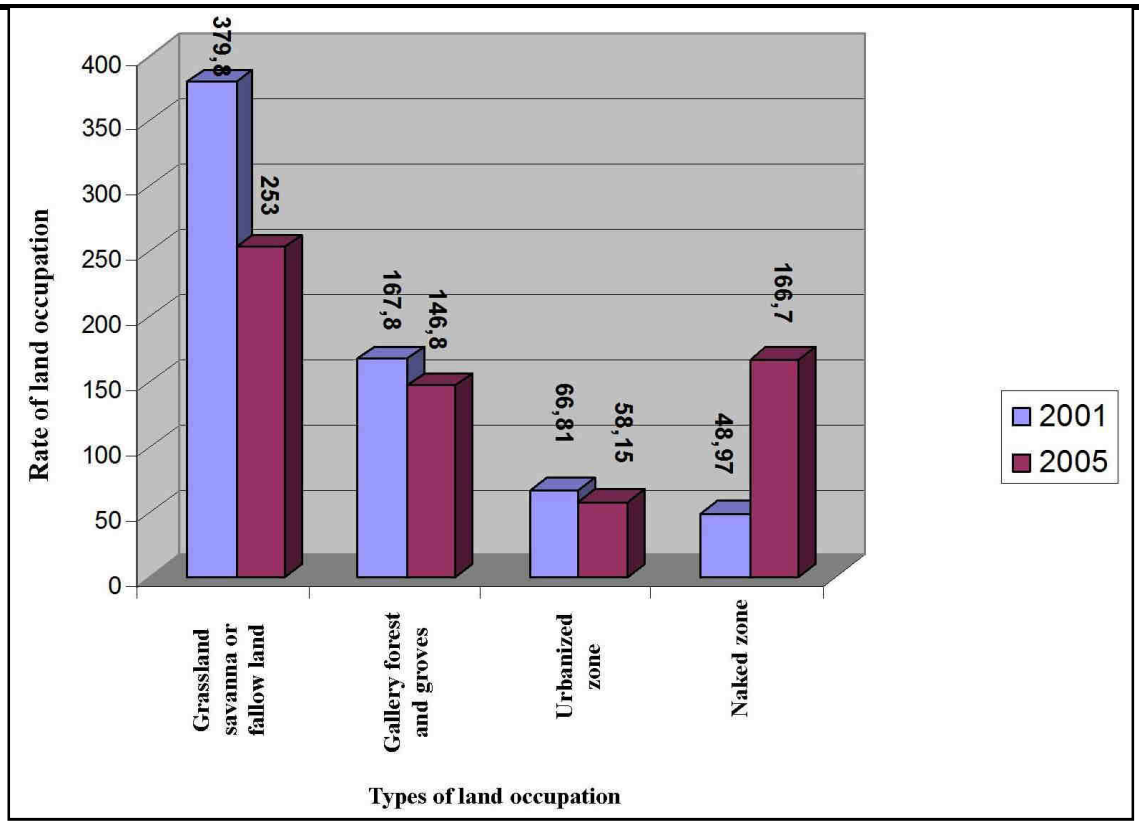

Fig.2.3. Land occupation in Stanley-Pool (2001-2005)

III. RESULT

Between 2001 and 2005, Stanley-Pool's sub basins have undergone important changes. The size of the urbanized area reduces from 66.81 km ^{2} to 58.15 km ^{2,} this does not mean that urbanization has slowed, but the population has moved more to the west of the basin Tsiémé hoping to have plots lands that will be protected from erosion. The statistical results showed that the vegetation cover especially the gallery forest has disintegrates to the benefit of grassland savanna. While the increase in the denuded zone which has tripled is certainly linked with the developments to the very active ravines in the Stanley Pool.

This analysis shows that the naked zone occupy approximately 166.7 km^2 of the Pool region in 2005 resulting in increase acreage that tripled within four years. Thus there is pockets degradation, which, for some, is cicatrize from one year to another whereas others are created elsewhere; is the spatial and temporal mobility of the transformation of environment related to the anarchic occupation of land.

IV. INTERPRETATION AND DISCUSSION

Land occupation in the sub basins of Stanley Pool, recorded between 2001 and 2005 may have two causes that might likely played together: natural causes and anthropogenic causes.

The natural cause is due to rain action that causes erosion, which is frequent in Brazzaville, confirmed by the work of [6, 7]. Elements of this action are apparent on the 2005 satellite image with a dominant percentage of naked zones.

The second cause is anthropogenic. Indeed, during 1970, there was expansion of the city, an increase of the surface of the urbanized zone. This excessive overcrowding, which continues also has destabilized the sediment balance. This change of the relief in the sub basins and sediment transfer was accelerated in these zones to meet the Port of Brazzaville [8].

Based on the results obtained, it is found that the accuracy of information on the dynamics of land occupation by the diachronic method depends heavily to reference period between the acquisition dates of the documents on which it is based. The average trend of the dynamics of land occupation is all the more representative when the period is long. Changes in land occupation under the impact of exceptional events, such as decadal rainfall, are not so observable, which amounts to neglect of land occupation recovery time [9, 10]. The loss of information on the dynamics of land occupation, hydrosedimentary processes and forcing who are causing, could lead to misinterpretation this shows that the rate of evolution of land occupation is not constant and therefore allows a

better analysis of the factors controlling the dynamics of land occupation in the autonomous port of Brazzaville.

V. CONCLUSION

In conclusion, diachronic study based on the missions of Landsat satellite images in 2001 and Google Earth in 2005 has allowed the quantification of different types of land occupation in the sub basins of Stanley Pool over a period of four years. Thus, the examination of the 2005 images shows an exceptional advanced land occupation which affected the whole of the autonomous port of Brazzaville.

VI. ACKNOWLEDGEMENT

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REFERENCES

[1] Bravart J.P.1994. L'incision des lits fluviaux, du phénomène morphodynamique naturel et irréversibles aux impacts réversibles : Revue de Géographie de Lyon, 69/1, P 5-10ois

[2] Delorme F –(1994)- Les changements de la morphodynamique fluviale sur l'Ecozone du Forez, mémoire de DEA Géographie, Lyon III, 125p.

[3] Crepet. F.1997. L'artificialisation des écoulements : application au bassin de l'Allier et de la Loire amont, Thèse de Géographie, Université de Cergy-Pont

[4] Puech C.1993. Détermination des états de surfaces par télédétection pour caractériser les écoulements des petits bassins versants. Application a des versants en zone méditerranéenne et en zone tropicale sèche. Thèse de doctorat, Université Joseph-Fournier(Grenoble1), Grenoble, 213p.

[5] Kinga-Mouzeo.1986. Transport particulaire actuel du fleuve Congo et de quelques affluents ; enregistrement quaternaire. Thèse de doctorat de géologie, Université de Strasbourg, 246p

[6] Bardénet G.1987. Télédétection, environnement et urbanisation : de l'image globale aux objets géographiques, application de l'urbanisation sur les paysages en Afrique et en Chine. Thèse de doctorat d'état es lettre et Sciences Humaines, Université de Paris IV, volume 1p12-146.

[7] Lagro D.2001.Dynamique de l'érosion continentale aux grandes échelles de temps et d'espace ; mobilisation expérimentale, numérique et théorique. Thèse Sciences de la terre, Université de Rennes 1. 152p

[8] Zaguy-Guerembo. R .2009. Etude morphodynamique de l'ensablement du port autonome de Brazzaville dans le Stanley-Pool (Congo), Université de Bangui, 243p.

[9] Khouma M, Bock L, Mathieu L, Engels P.1996. Système d'information géographique et gestion des données de sol, In surveillance des sols dans l'environnement par télédétection et SIG. Ed ORSTOM, pp 35-52.

[10] Guis H.2004. Caractérisation par télédétection de l'environnement favorable aux culicoi des vecteurs de la forme catarrhale dans le bassin méditerranéen : cas de la Corse, 38p.