

CONTRIBUTION OF MULTI-SOURCE DATA TO THE KNOWLEDGE OF THE HYDROGRAPHIC NETWORK OF THE N'ZI WATERSHED (IVORY COAST)

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ABSTRACT

The analysis of the hydrographic network supplies several informations that one must know for better watershed management. The N'zi watershed is located in Ivory Coast between longitudes 3°49' and 5°22' West and latitudes 6°00' and 9°26' North. It extends to 35,500 km² and its main river is the N'zi of a length of 725 km which is fed by many tributaries. Two different and complementary approaches are used to characterize the hydrographic network of the N'zi watershed.

The first approach refers to the development of a methodology of Landsat 7 ETM+ image processing in order to highlight the basic drainage patterns of the N'zi watershed (**Figure 3**). First, Landsat 7 ETM+ images undergo preliminary treatment (mosaic of the 6 scenes of Landsat 7 ETM+, windows and extraction of the N'zi watershed). Then, resulting images are submitted to the digital processing (various operations of enhancement, combinations of bands, filtering specifically that carried out by the 7×7 matrix of Sobel). Finally, transformed images undergo a visual analysis for the morphological identification of the hydrographic network (**Figures 1 and 2**) of the N'zi watershed.

The second approach refers to the global hydrographic network processing extracted of the topographical map and which constitutes a reliable source of validated information of grounds. This one is used as network of reference for the recognition of the tracing of the rivers on the images. The hydrographic network is used for the statistical analysis and for mapping the drainage density and also the functioning zones of the N'zi watershed.

The hydrographic network is firstly discretized in regular meshes of 5 km side using Linwin 2.0

software. In each mesh, the total number of drains and the cumulated lengths of the drains are determined. These two parameters are compiled in a circular histogram in order to discriminate them on the basis of their orientation. A correlation is determined between the number of drains and the cumulated lengths of the drains. From the cumulated lengths of the drains by mesh, an interpolation by kriging of these values is carried out under ArcGis 10 to generate the drainage density map.

The global hydrographic network of the N'zi watershed is organized into a hierarchy according to the convention of STRAHLER (1968) because of its geomorphological significance. A counting of all the drains according to their order is also carried out. A graph showing the number of drains according to the orders of the rivers is established in order to highlight the mathematical law governing the distribution of the drains.

Finally, the hierarchical hydrographic network is used for the establishment of the iso-orders curves. The junctions of the drains which have the same order (1, 2, ..., n) on the N'zi watershed are joined by the curves of respective iso-orders 1, 2, ..., n. On the basis of geomorphological analysis of the N'zi watershed, relatively three distinct functioning zones are mapped.

The analysis of the satellite images and the interpretation of the hydrographic network allowed to highlight the basic drainage patterns: dendritic, subdendritic, parallel and radial (**Plate 2, Figures 4 to 7**).

The compared analysis of the drains in number and cumulated lengths shows that major directional class N90-100 is the longest (**Figure 8**). The number of drains is moderately correlated with the cumulated

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lengths of the drains of the N'zi watershed. The essential of the drainage of the N'zi watershed is assured by tributaries of small orders (1 and 2) with the order 1 which accounts for 77%. The drains of the hydrographic network fit better to the exponential law (**Plate 3**).

The drainage density is variable on the N'zi watershed (**Plate 4**). The N'zi watershed is order 6. Five iso-orders curves are highlighted on this one. It is possible to map three distinct functioning zones on the N'zi watershed (**Plate 6**).

- the recharge zone: it corresponds to geographical place occupied generally by the rivers of order 1 and 2. It is generally the zone of plateau where the principal rivers and their tributaries begin.
- the zone with potential flow: it is occupied by rivers of order 3 and 4 and represents the sloping ground of the watershed. Water is very turbulent there.

- the zone of fluvial flood risk is the area of rivers of order 5 and 6 and the confluence zones from which they result. It is a zone of reception and accumulation of waters draining the watershed. Indeed, the contribution in water of the tributaries of the N'zi is not negligible and contributes to an increase in the flow of this one in the confluence zones. Thus, these areas are more susceptible to flood risks.

The mapping of the flood area is an essential tool not only for the prevention of the flood risks, but also for the management, planning and management of hydro-systems and for the future programming of the intervention areas.

KEYWORDS

Hydrographic network, Landsat 7 ETM+, drainage pattern, exponential law, fluvial flood, N'zi watershed, Ivory Coast.

LIST OF TABLES, FIGURES AND PLATES

Table

Table 1 : Enumeration by order of the streams of the N'zi watershed

Figures

Figure 1 : Descriptive classification : basic types of the hydrographic network (HOWARD, 1967 in DEFFONTAINES, 1990)

Figure 2 : Descriptive classification : modified types of hydrographic network (HOWARD, 1967 in DEFFONTAINES, 1990)

Figure 3 : Methodology of extraction of the drainage patterns of the N'zi watershed

Figure 4 : First principal component $ACP1_{54}$ enhancing the granites, schists and N'zi river of N-S direction (KOUDOU *and al.*, 2010)

Figure 5 : First principal component $ACP1_{57}$ illustrates the dendritic network

Figure 6 : ETM+4/ETM+7 enhances hydrographic network architecture of the N'zi watershed (sub-dendritic network to parallel network)

Figure 7 : Filtered picture by the matrix 7×7 of Sobel of NW-SE direction putting in evidence the sub-dendritic network architecture and structures of NE-SW direction (KOUDOU *and al.*, 2010)

Figure 8 : Circular histogramms of the streams.

Figure 9 : Correlation between the number of streams and the cumulated lengths of streams.

Figure 10 : Proportion of the rivers orders of the N'zi watershed.

Plates

Plate 1 : Location of the hydrographic network of the N'zi watershed.

Plate 2 : Coloured composition Hue Saturation Value (HSV) highlights the parallel and radial tributaries of the N'zi stream.

Plate 3 : Distribution of the streams of the N'zi watershed according to the exponential law.

Plate 4 : Drainage density of the N'zi watershed by mesh of 5×5 km².

Plate 5 : Map of hierarchical organization of the N'zi watershed according to STRAHLER (1968) method.

Plate 6 : Mapping of the zones of operation of the N'zi watershed.

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