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GIS Mapping, A Decision-Making Tool for the Co-Management of the Border Areas Aplahoue (Benin)-Tohoun (Togo)

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ABSTRACT: Despite their potential, West Africa's cross-border spaces pose management problems. This situation is perceived differently on both sides of the border. The purpose of this research is to study the possibilities for co-management of the Aplahoue (Benin)-Tohoun (Togo) transboundary area. The method used is a geographical approach based on mapping by the Geographic Information System and social surveys. The results obtained highlight both the organizational constraints of co-management and the threats to the evolution of the area under study. The determinants of co-management are human, physical and also dependent on land use. There are varying levels of land use (low 23%, medium 71% and high 6%). The mapped area presents territorial, economic and socio-political challenges (consolidation of national solidarity, rapprochement of divided peoples and regional integration) as well as solutions to infrastructure, land, security and sanitation problems that can be enhanced through the creation of a decision map. The latter makes it possible to project the cross-border study area into sub-regional integration (UEMOA). To operationalize co-management at the institutional, legislative, technical and financial levels, development poles are created with a view to their appropriation by stakeholders.

KEYWORDS: Border area, Co-management, Decision-making mapping, Aplahoue (Benin) -Tohoun (Togo).

I. INTRODUCTION

The dynamics of border areas create new forms of spatial organisation that are developing to impose on local governance the need to take into account areas beyond borders. according to Denert and Hurel (2000) [1], the emergence of border areas constitutes a project that modifies the border without, however, making it disappear. Border areas are identified with illegal cross-border flows, since ecological, wealth, tax or monetary disparities appear to be the determinants of these exchanges (Stary, 1995) [2]. The management of natural resources in these areas would benefit from being addressed in a regional context, i.e. co-management, due to the incompatibilities between political borders and ecological zones (Domingo, 2008) [3]. An example of co-management of the transboundary space is the one that already exists between Benin, Burkina-Faso and Niger called the plan for the development and management of the W border biosphere reserve (PAGRB/W). it makes it possible to distribute the prerogatives between these states with a common regional authority (ECOPAS, 2005) [4].

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In Benin, border areas play a pivotal role in regional integration because they represent places of cultural mixing, exchange and interconnection between countries and populations of West Africa (DAT, 2012)[5]. In this context, development actions are initiated across borders as spontaneous initiatives to strengthen the socio-economic integration of these territories (CDRI and Enda Diapol, 2007; Renard, 2010)[6;7].

The Benin-Togolese border has not been the subject of much work, if not specifically in terms of spatial analysis. This situation shows the interest of this article which lies in the possibilities of illustrating the significant aspects of migration and spatial recompositing. In view of the artificial division resulting from colonisation, border areas should be recognised as priority development areas. They could become a place of solidarity between States. But unfortunately, for a long time they were considered as national peripheries poorly equipped with the equipment essential to the well-being of the populations (lack of drinking water, electricity, roads, schools and hospitals). According to Igué, 2006[8], this neglect makes border populations vulnerable and, at any time, they can renounce their origin and become floating populations. The Aplahoue-Tohoun cross-border area targeted by this study is characterized by its distance from the national capitals where modernization processes are concentrated and then a feeling of being on the periphery or abandoned (Igué, 1989)[9]. But only a convincing and well-argued cartographic document can provide a better knowledge of these border areas (Igué, 2006)[8]. The Geographical Information System (GIS) and cartography are often used to represent space and assist decision-making using a participatory approach (Bedard et al., 2006)[10], and both tools introduce a method of reflection and analysis, thus co-managing the relationships between facts, phenomena and their dynamics on border areas in order to meet emerging social demands that are particularly strong in underdeveloped countries. The objective of this study is to study the possibilities of co-management of the Aplahoue (Benin)-Tohoun (Togo) border area. The results obtained will be based on a prospective mapping that will make it possible to co-manage the cross-border area and integrate border communities in a local manner.This area of interest, the focus of this study, links the commune of Aplahoue (Benin) with the Prefecture ofMoyen-Mono (Togo). It is located between 6°48' and 7°33' north latitude, 1°24' and 1°54' east longitude and covers a total area of 159400 hectares. Figure 1 provides details on the geographical and administrative location of the study area.

The Aplahoue-Tohoun border area is partly elongated between the Mono and Couffo rivers. The neighbouring administrative units are the communes of Djakotomey, Klouekanme, Djidja east of Benin and the prefectures of Ogou and Haho west of Togo (Fig.1).

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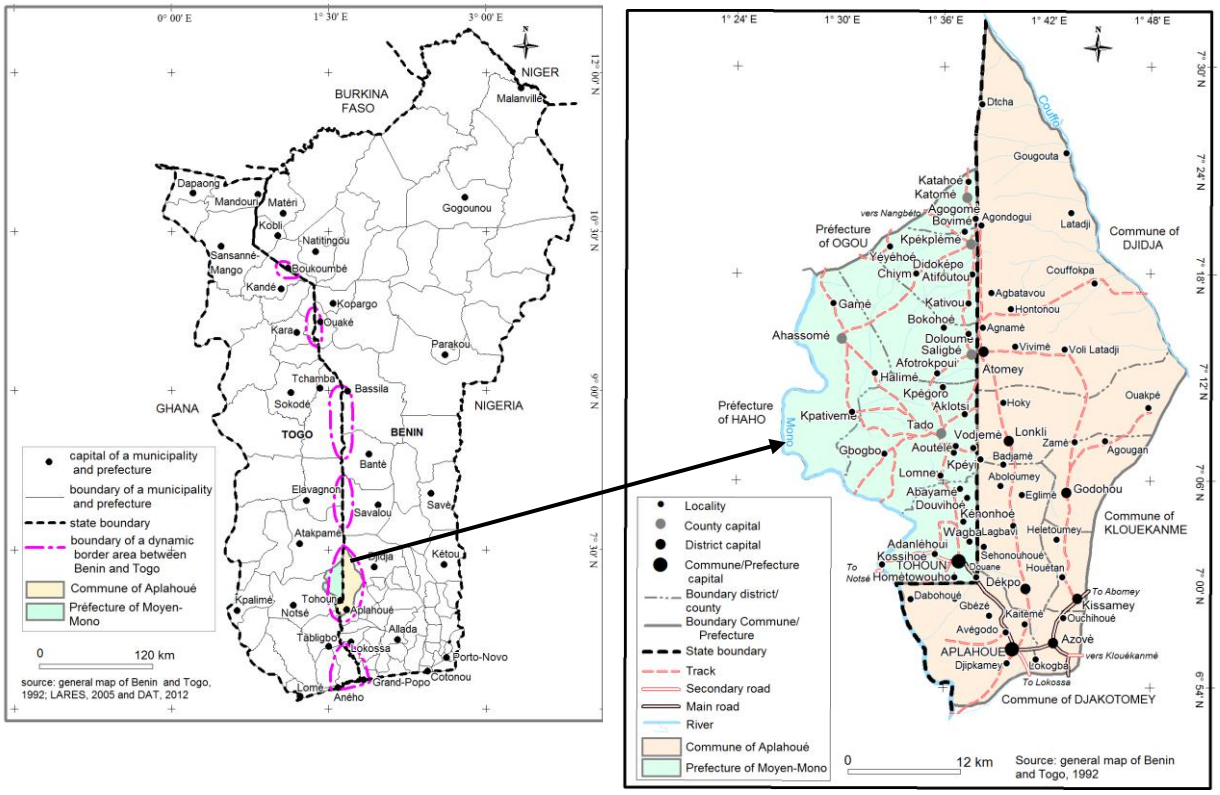

Fig. 1 Geographical and administrative locations of the Aplahoue-Tohoun border area

II.LITERATURE REVIEW

Cross-border cooperation is a complex integration process that can be broken down into three dimensions: the analysis of the potential for cooperation in border regions, the current structure of cross-border governance networks and the vision of policy makers on cross-border cooperation. Several authors have focused on the cross-border potential of West African countries. For example, a study on Africa used a mapping analysis of seven political and socio-economic indicators (population potential, water resources, agricultural and pastoral resources, languages, border status, political stability and poverty) to examine to what extent the existence of social, economic and political disparities constitute a source of synergies for cross-border cooperation or, on the contrary, a barrier to cross-border initiatives(Walther, 2017) [11]. The results obtained revealed significant disparities between regions divided by a land border in West and North Africa. Reading the map shows that the Sahel-Saharan areas are generally those with the lowest potential for cooperation, while the Sahel is generally characterized by high potential for cooperation, as in Southern Senegambia, on the borders of Burkina Faso and between Niger and Nigeria. The border regions of the Gulf of Guinea are more heterogeneous. While many border segments in Sierra Leone, Guinea and Liberia appear to be unfavourable to cross-border cooperation. Some regions have very high values, such as between Ghana, Togo and Benin. The Accra-Lagos conurbation is particularly favourable to cross-border cooperation in this respect.

Another study on Border & Community Management in the Sahel countries (Burkina Faso, Chad, Mauritania, Mali and Niger) showed that ethnic homogeneity allows communities to exchange across borders, thus promoting the porous nature of borders and making it difficult for states to control them (UNDP, 2003) [12]. According to the

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African Union Border Programme, carried out by the Department of Peace and Security of the African Union Commission for the Development of a Cross-border Basic Service Infrastructure (PFUA, 2013) [13], border populations generally have secular, socio-cultural and economic links. In Africa, they are generally characterized by isolation, lack of basic social services (health, drinking water, education, etc.) and unconcerned management of natural resources. In border areas, people share and live from the exploitation of the same natural resources that extend on both sides of the border. Economic and environmental pressures in recent decades can lead to border disputes over the exploitation of natural resources between these border communities (PFUA, 2013) [13]. Unfortunately, these aspects are not fully taken into account in the sectoral programmes of most countries. However, in May 2013, the African Union (AU) developed a specific continental strategy to improve border management and serve as a user guide for Regional Economic Commissions (RECs) and countries (UNDP, 2003) [12]. However, the delimitation and demarcation of borders generally follows the lines inherited from colonial division and does not take sufficient account of the traditional use that people make of natural resources (fields, pastures, forests, water points, fishing grounds, quarries, etc.). This factor can aggravate conflicts. Cross-border cooperation then provides solutions to these problems by proposing a peaceful and coordinated development of border territories.

The analysis of trade poles and channels in West Africa has shown that West African trade is organized around five poles designated as sub-areas (Cacid, 2012) [14]. The southern conurbation zone comprising southern Nigeria, Benin, Togo and Ghana, which extends into Côte d'Ivoire and is called the "co-prosperity zone", covers the study area where several countries have significant socio-cultural relations and economic exchanges with Benin.

Several examples of cross-border cooperation between Benin and other countries in the West African sub-region already exist. Of particular note is the Plan for the Development and Management of the W Border Biosphere Reserve (PAGRB/W) between Benin, Burkina Faso and Niger. This project (PAGRB/W) confirms the shared will of these three States, fifty years after the decree.

III. MATERIALS AND PROPOSED METHODOLOGY

III.1DATA USED

The data used in this study are planimetric, demographic and socio-economic. The first collect SENTINEL 2A images from December 2015 (sources: IGN Benin 2000, earthexplorer.usgs.gov and sentinels.copernicus.eu/web/sentinel/sentinel-data-access downloaded on 20 November 2018). They have made it possible to map the land use of the cross-border area. The second concerns the population size in the study area (INSAE, 1979 and 2013; DGSCN, 1981 and 2013) [22; 23]. They made it possible to analyse the distribution of the population in the border area and to assess its population growth. The third provides information on socio-cultural groups, territorial administration, facilities and infrastructure, socio-economic activities, cross-border mobility, spatial structuring have been collected. The agricultural data used consist mainly of statistics on the production and area of the main crops grown in the Aplahoue-Tohoun border area during the period 2002-2012. Other data on existing and/or planned developments, the regulatory framework related to border area management and the border alignment were also used. All these data made it possible to analyse socio-economic and spatial dynamics as well as the economic development outlook of the study sector for the production of the decision map.

III.2METHODS

III.2.1 DOCUMENTARY RESEARCH AND FIELD WORK

The methods used are a geographical approach based on documentary research, field work, data processing and analysis of the possibility of co-management of space. The documentary research made it possible to assess the state of knowledge on the subject. To this end, several documentation centres were visited in the municipality of Aplahoue and the prefecture of Moyen-Mono as well as specialized websites. Also, documents in the Ministries in charge of decentralization and land use planning, agriculture and foreign affairs of Benin and Togo as well as the structures in charge of border management of the two countries (ABeGIEF and DGCAF) were consulted.

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Fieldwork brings together investigations and inquiries. The first allowed direct GPS field surveys to be carried out to take geographical coordinates of socio-community equipment and infrastructure. The latter consist of socio-economic surveys conducted through direct interviews, semi-structured interviews and sampling. To this end, individual questionnaires were sent to the administrative authorities, socio-professional groups (craftsmen, farmers, etc.) NGOs (GRAIB, PAGLOC, etc.) involved in the study sector, institutions in charge of border issues, a reasoned choice survey was carried out to select border localities and groups directly involved in spatial management. The investigation unit is the border locality. This includes any location within 10 km of the border taken horizontally and as the crow flies (Nassa, 2005; Fusco and Scarella, 2007; Ruffray et al., 2011) [15;16;17]. But places beyond 10 km were also chosen by chance to check the border effect boundary. To determine the sample size of the respondents, the formula of Schwarz (1995) [18] was used. It is expressed as follows:

Thus, if N denotes the sample size, we have:
$N = (za^2 \times pq/i^2)$; N = Sample size, z = 2 = Cluster effect, i = 10% = Desired accuracy, a = Constant from the normal distribution at a 95% confidence level or standard deviation is 1.96 and corresponds to 5%,
P = frequency of the event estimated in this study at 3.5%. A total of 264 people surveyed

III.2.2METHODSOF PROCESSING THE COLLECTED DATA AND ANALYSIS OF THE POSSIBILITY OF CO-MANAGEMENT OF THE BORDER AREA APLAHOUE (BENIN)-TOHOUN (TOGO)

The processing of the collected data consisted in examining their qualitative and quantitative attributes in order to provide answers to the questions raised by the subject. GPS data processing is done with Excel and Mapsource software. The analysis of the possibility of co-management is done using mapping by the Geographic Information System. For this purpose, the GIS software MapInfo and ArcGIS were used. This choice is guided by the accessibility of the available computer tools and their processing, spatial and multi-criteria analysis capabilities for the co-management of the border area. The storage formats of this last software offer the possibility to use a Database Management System (DBMS) in Excel/Access format and script files (.txt).
To better achieve co-management, the analysis of current management methods for Aplahoue-Tohoun border areas was carried out. The constraints to the prospective management of the border area are analysed through the SWOT model (Diarrab, 2002, Basse, 2011)[19; 20]. This model was used to identify and analyse the constraints and threats essential for a strategic diagnosis and from the perspective of co-management of this area (Fig. 2).

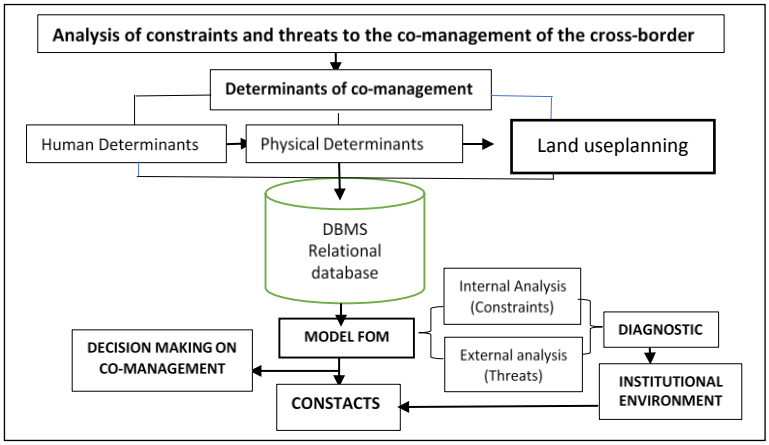

Fig. 2 Methodological diagram for analysing constraints and threats to co-management of the border area
Source: Adapted from Agbon, 2015 [21]

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III.2.3 DECISIONAL MAPPING FOR THE CO-MANAGEMENT OF THE APLAHOUE-TOHOUN CROSS -BORDER AREA BY 2025

The decision-making map is produced in a participatory approach and in accordance with the mental representation that local authorities and populations have of the management of the border area. It is based on eight phases (Figure 3).

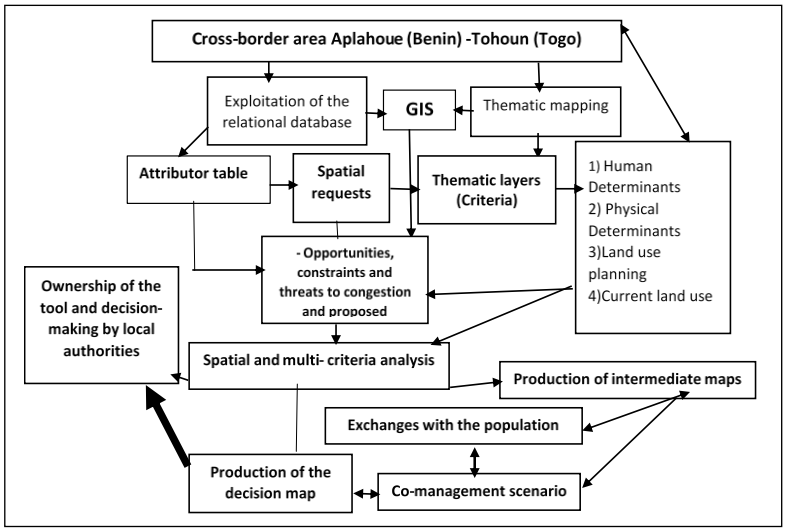

Fig. 3 Participatory approach to decision mapping
Source: Adapted from Agbon, 2015[21]

IV. EXPERIMENTAL RESULTS

From the perspective of co-management of the border area at the local level, several aspects were analysed: population growth, the determinants of co-management of the cross-border area, land use, constraints and threats to cross-border development and decision-making mapping.

IV.1 DETERMINANTS OF CO-MANAGEMENT

IV.1.1 HUMAN DETERMINANTS

Population potential in the localities surveyed in the Aplahoue-Tohoun cross-border area is estimated at approximately 76358 inhabitants (INSAE, 1979 and DGSCN, 1981)[22; 24]. This population increased to 244020 inhabitants in 2012 with an average growth rate of 2.84% in Togo and 3.5% in Benin (INSAE, 2013 and DGSCN, 2012)[23; 25]. The analysis in Figure 4 shows that, from 1980 to 2012, the population of the border area almost tripled. The population size is higher in Aplahoue, Azove and Kissamey. The Aplahoue-Azove complex is the largest urban centre in the border area with the potential to develop the road network. On the other hand, the highest inter-censual growth rates are observed in rural areas: Katome (12.91%e), Ahassome (12.53%), Kpekpleme (5.15%) and Godohou (4.8%). These rates are explained by the increase in natural growth rates in the study area, which are relatively very high compared to Benin (2.81%) and Togo (2.72%). The population is fairly well distributed. A concentration of villages is noted around the border. The sample size generally varies from 4 to 5 people in the localities mentioned above. The border effect 10 km on either side of the border is greater in the south around the towns of Azondogahoue, Douane and Kissame and in the north around the towns of Kpekpleme and Agondogui (Fig. 5).

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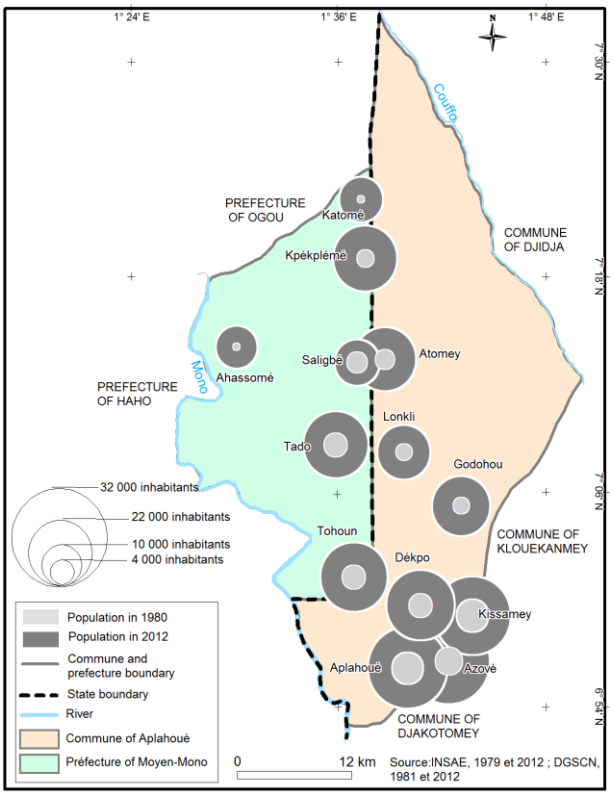

Fig.4 Population growth

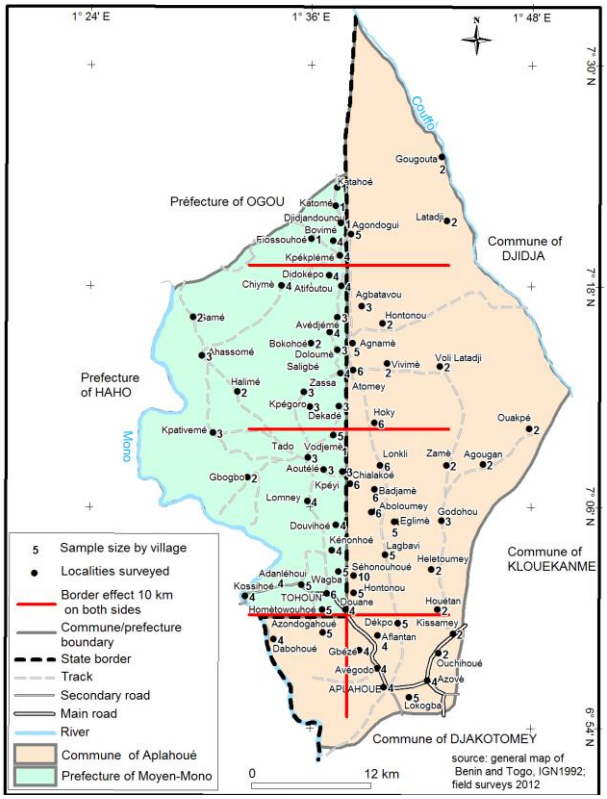

Fig. 5 Sampling of the villages surveyed

At the infrastructure level, there are facilities to road infrastructure, tourism and land potential, and socio-cultural groups on both sides of the border. The Adja socio-cultural group is the most represented in the study area. Social and commercial relations at the grassroots (between villages) are real and strong enough for cross-border cooperation and co-management. The highest density is observed in Azove, Kissamey and Katome. Economic activities are relatively concentrated in the South. Its timid extension towards the centre and north can be observed with the presence of several markets and the development of their network (Figure 4). At the physical level, the geomorphology, climate and vegetation dynamics determine the type of development to be put in place for co-management of the Aplahoue-Tohoun transboundary area. The relatively flat topography shows steep slopes located on the Dahomeyen and Continental Terminal units. The relatively small difference in elevation is unevenly distributed around the border. Endoreic drainage of the study area is provided by several intermittent streams that flow into major watercourses such as Mono and Couffo. The distribution of rainfall increases from south-east to north-west. Land use shows anthropogenic pressure on natural resources in general and forest resources in particular (Figure 6).The border area has a road network (339.25 km) that facilitates trade and the movement of people. This is RNIE 4 (2546 km) which links Aplahoue-Tohoun to other Beninese localities: Lokossa, Cotonou and Abomey and Togolese: Noste, Atakpame and Lomé. Tracks also facilitate circulation within the studied area. The majority of the population lives in towns and villages along the main roads. The latter are those of Tetetou-Tohoun, Aplahoue-Tohoun-Tado and its extensions towards Kpekpleme in the north and Ahassome in the northwest, Aplahoue-Azove-Djakotomey, Aplahoue-Azove-Abomey and Aplahoue-Azove-Klouekanme-Toviklin. The roads are relayed by a network of rural tracks that open up the border villages. The elements of cross-border trade in Aplahoue-Tohoun are presented in Fig. 7.

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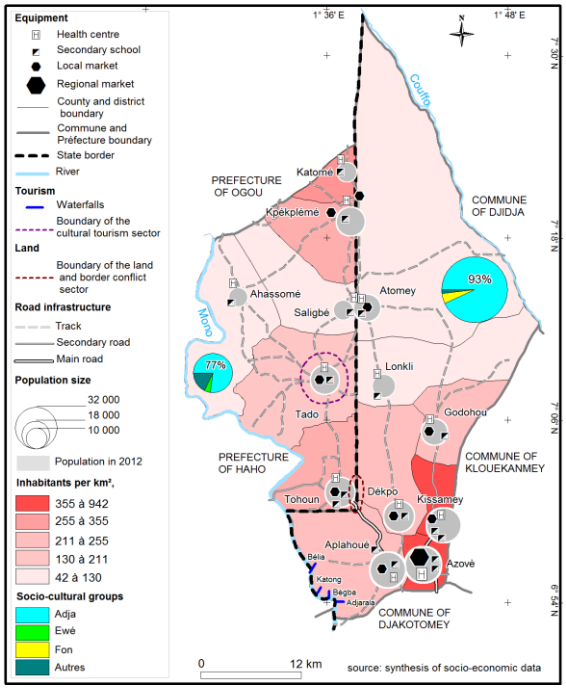

Fig. 6 Infrastructure and Equipment

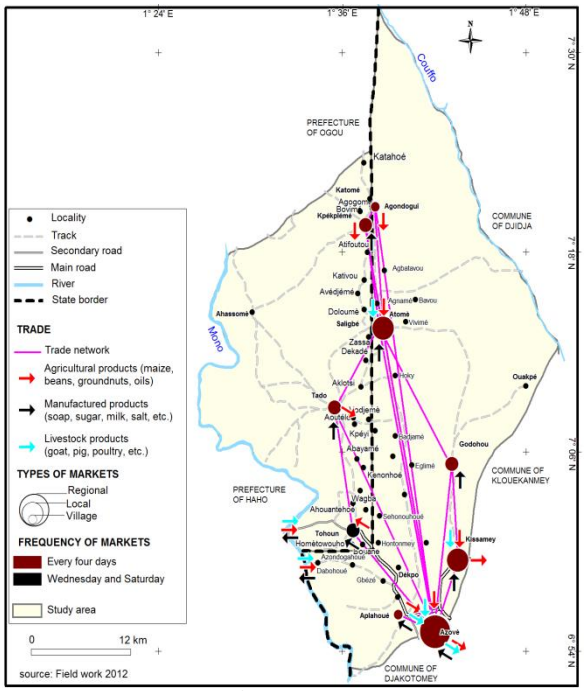

Fig.7Trade flows and exchanges

In the study area, the important markets are Azove, Kpekpleme, Tohoun, Tado, Atome, Kissamey, and play a very important role. These exchange centres are meeting places for Adja populations shared between Benin and Togo by the border. The use of these markets allows border populations to have permanent contacts. They thus fulfil a function of maintaining social cohesion. The high number of visitors to the various markets appears to be a factor in bringing border populations closer together. These border markets support the local economy and are the points of exchange for the rural world. The organization of the network of these markets is quite complex. They are held every four days and are animated as follows, taking the Azove market as a reference point. Indeed, those who frequent the markets of this border area start the cycle with the Azove market, to go to Atome the next day, to Tado the next day and finally to Kpekpleme. This market network organization allows sellers and customers to operate in three or four of the five markets each week. Apart from these five markets, there are other small markets, the most important of which are Agondogui and Godohou. Storage warehouses lead to a spread of the market across border localities. The intensification of the storage function benefits the emergence of trade networks based on the clandestine nature of trade and contributes to the dynamics of border localities. They are important in terms of border trade in the study area. Warehouses are not necessarily set up for the purpose of smuggling. In addition to the traditional warehouses set up to ensure the illicit traffic of certain goods, other warehouses are being set up to ensure that neighbouring border populations consume the products they lack. The localities that serve as warehouses are Tohoun, Donoume and Dabohour.

IV.1.2 PHYSICAL DETERMINANTS

At the physical level, the geomorphology, relief, climate and vegetation dynamics determine the type of development to be put in place for co-management of the Aplahoue-Tohoun transboundary area(Fig.8 and Fig. 9).

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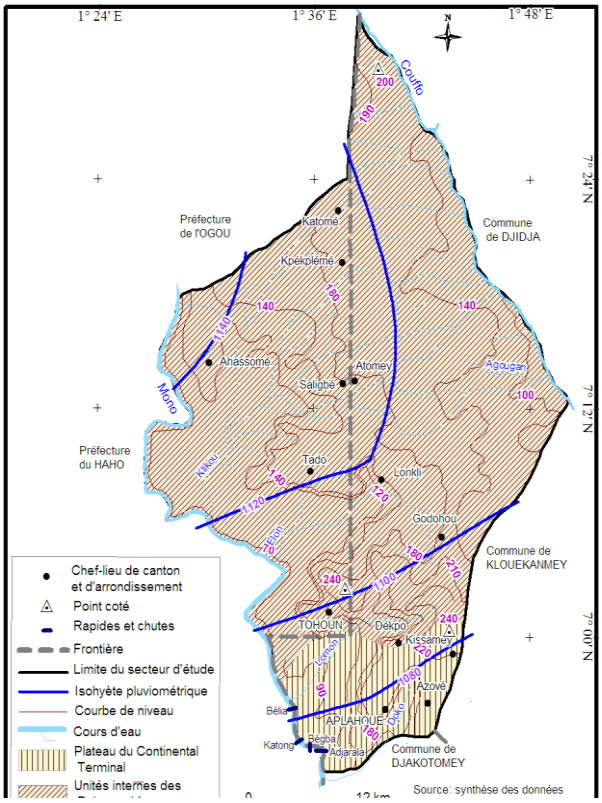
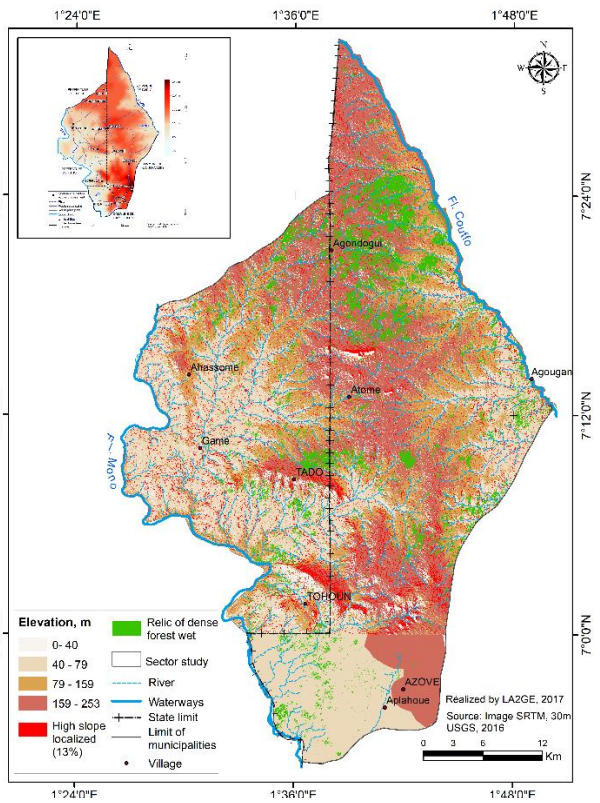


Figure 8: Geomorphology and climate



9: Topographic relief

The relatively flat topography shows steep slopes located in the South of border on the Dahomeyen and Continental Terminal units. The relatively small difference in elevation is unevenly distributed around the border. Endoreic drainage of the study area is provided by several intermittent streams that flow into major watercourses such as Mono and Couffo. The distribution of rainfall increases from south-east to north-west. Land use shows anthropogenic pressure on natural resources in general and forest resources in particular.

IV.1.3LANDUSE PLANNING

Landuse shows a downward trend in forest resources indicated by the linear equation y=-1.1366x + 16.251. The landscape is characterized by a dominance of the mosaic of fields and fallows (38.41%) whose presence is mainly noticed around peripheral localities such as Ahassome, Game, Tohoun, Djikpame, etc. and a co-dominance of gallery forest (15.06%) and tree and shrub savannah (14.88%). The dense humid forest occupies (8.01%). Only the open forest and wooded savannah contrast with the landscape with a low representation in the occupation (2.73%). Wetlands are relatively large west of the study area along the Mono River and occupy about 6.34%. The built areas are mainly concentrated in the southeast of the study area with a network of communication routes around Tohoun, Azove and Aplahoue (Figure 10). They generally occupy 5.03% of the total study area. Bare soils represent 3.79%.

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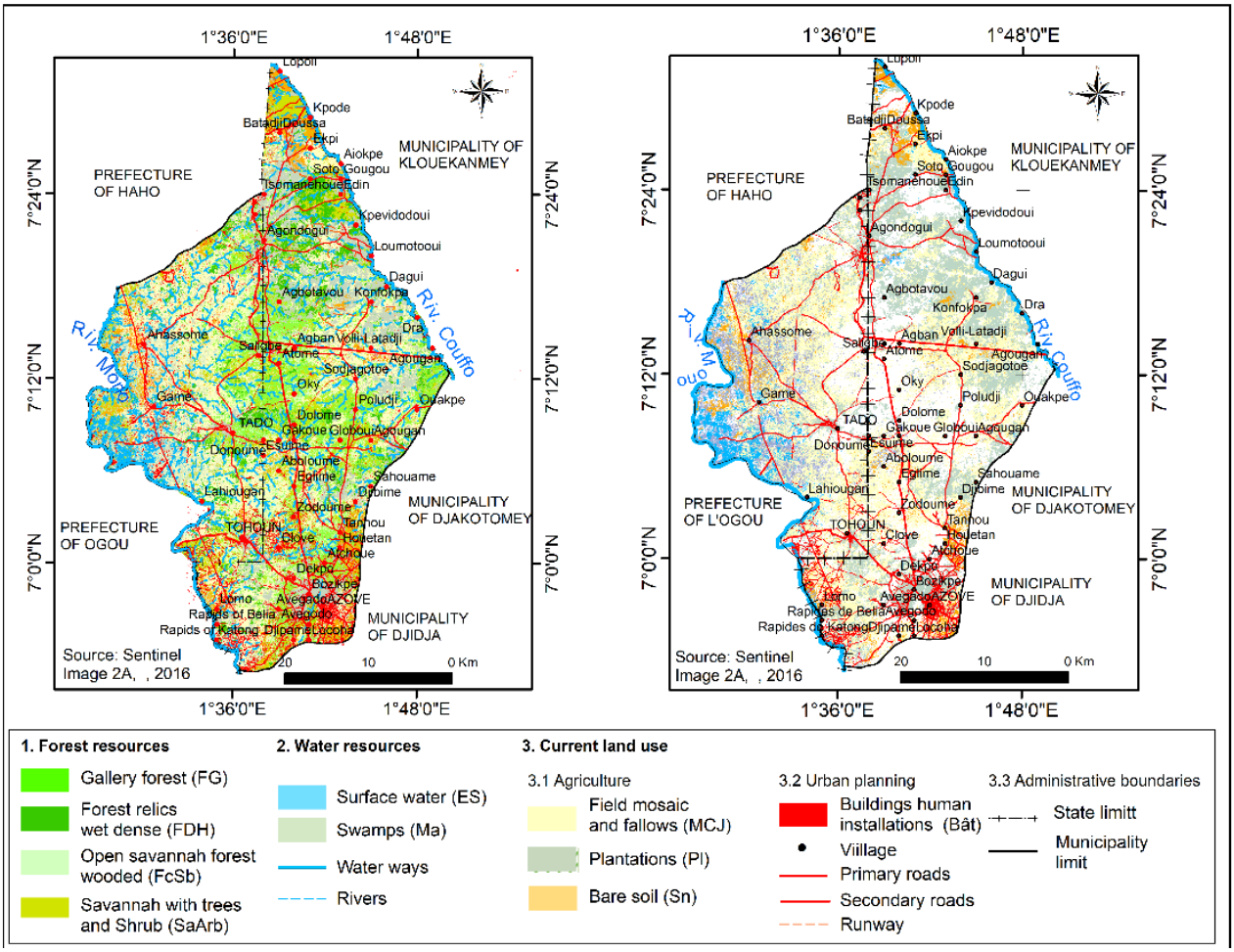

Fig.10 Land use planning and Current land use in 2016

In total, the landscape of the study area is composed of 40.68% forest resources, 8.95% water resources, 45.34% agricultural resources and 5.03% human settlement to be exploited.Current land use occupies only 50.37%. (Fig.11).

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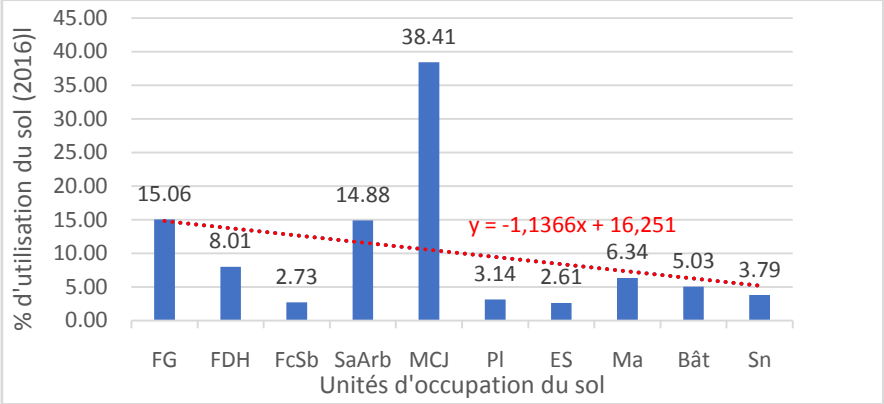

Fig.11 Histogram of the rates of the different land use units
Source: Statistical processing of mapping results, 2019

IV.1.4 CONSTRAINTS AND MENACE ON LAND USE

Threats are the difficulties that the border area could face, namely: erosion risks, climatic hazards, lack of a regulatory and operational framework for cross-border planning, environmental destruction, scarcity of economic resources and politicization of the administration. In this group, water erosion is particularly noticeable. In the valleys, it is highly intense on multi-linked river channels and medium on single-linked river channels. This situation, which is also perceived on the interfluve, shows that the strong erosion is mainly identified around the steeply sloping escarpments located on the border and relatively dispersed in the other parts of the study area. The average risk is also unevenly distributed in the study area with pockets of low risk. Some parts of the study area do not present an erosion risk. This situation is the source of this water filling (Fig.12). The commitment of the actors in the cross-border area to take measures to deal with constraints and threats may give it a better life expectancy. To do this, it is necessary to design an integrated co-management decision support tool for the prospective management of the Aplahoue -Tohoun border area in a participatory approach with the grassroots populations and local authorities. The majority of the local and regional actors met (including public actors) are in favour of developing all these exchanges. Political relations between States are also good and confident enough (if we refer to the socio-linguistic fabric that exists between the Aplahoue and Moyen-Mono administrations) that the border does not constitute an obstacle to the cross-border actions observed.

The first constraint of land use is the unequal distribution of the study area on both sides of the border with a large area in Benin and less in Togo. It extends 41 km wide and 73 km long on the interlude between the Mono and Couffo rivers (Fig. 13). The second is the geographical position of the border, which does not facilitate the co-management of space. Indeed, the latter is erected on a steeply sloping terrain, which explains the disparities in land use. They are expressed in three sub-areas: low-use space (23%), medium-use space (71%) and high-use space (6%). The first one stands out in the Centre and in the north of the study area in Benin, while the second one dominates the study area in Togo. The third area is visible in the South - East of the Benin border area and in the North - West of the same area in Togo. These disparities can be corrected with the installation of infrastructure such as markets, high schools and hospitals, without any difficulty, especially in areas of low use but with difficulties in road construction. To this end, concerted planning and environmental impact studies must be carried out by the two administrative districts together. But in the meantime, the answer to the challenges of spatial management is the implementation of equipment programmes in the border areas of Aplahoue and Moyen-Mono, and this separately.

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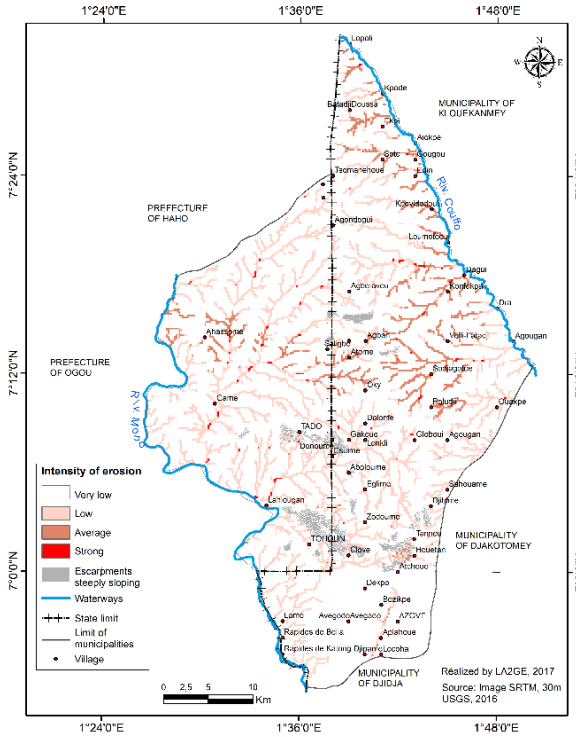

Fig.12 Erosion risk

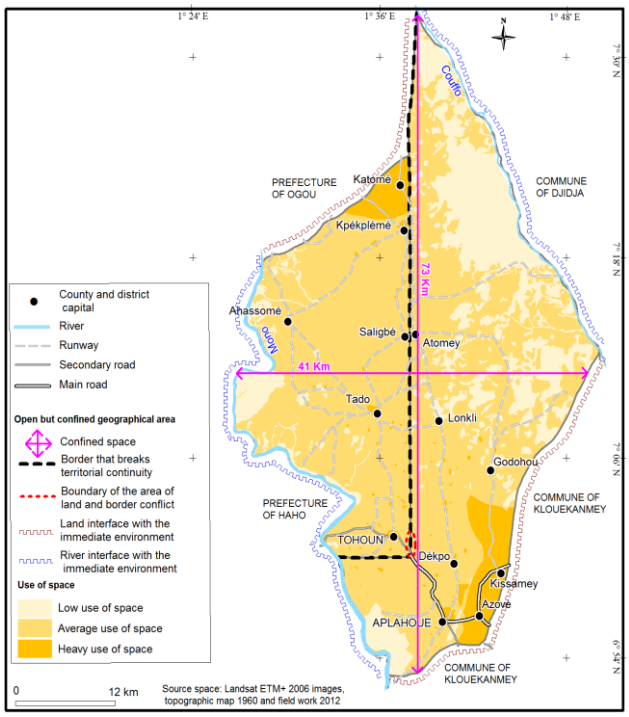

Fig.13 Land use level

IV.1.5 FUTURELAND USE AND DECISION MAP

Future land use must be carried out in localities such as Ahassome, Tado, part of Tohoun, Dekpo, Kissamey and Aplahou and the alluvial plain of the Doko River (not suitable for human settlement). It also indicates that the area affected by the land dispute between Tohoun Township and Dekpo Borough will be used. It also provides for the strengthening of cross-border public services, such as the Aplahoue zone hospital in Benin and the construction of a new one in Tohoun. The co-management of the cross-border area requires the strengthening of the Aplahoue-Atome road, which divides the study area into almost two parts and thus constitutes the backbone of the entire road network. The development of this one will consist in improving its layout, width and surface. On the flow map, it can be seen that this route gives a better chance to enhance the population's production and is the most effective framework for the economic development of the Aplahoue - Tohoun area. Cross-border movement implies the need to develop the north-south link, as well as east-west transport corridors by improving existing border crossing points. The existence of economic poles is essential for the growth of sectors of activity such as the markets in Azove, Aplahoue and Atomeyin Benin and Tohoun, Tado and Kpekpleme in Togo. Indeed, Azove and Kpekpleme constitute the economic poles and Aplahoue and Tohoun the administrative poles. Tado is considered as the Adja cultural tourist centre and the Saligbe-Atome rural doublet as an agricultural centre. In addition, the influence and attraction of the city of Azove is very important throughout the area. So, if nothing is done, Azove will concentrate all the possible advantages, although it is also necessary to develop this city. Tourism development will focus on the development of reception facilities. The border area shares the same cultural and historical heritage (Tado), which must be developed jointly by the two administrative districts and allow the creation of a cross-border label. Under these conditions, tourism activities can promote the conversion of certain rural sectors while developing employment, transport and accommodation infrastructures. Such a cross-border approach will make it possible to affirm the cultural identity of the Aplahoue-Tohoun border area. The development of river traffic is to be expected on the Mono River to improve the development

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of trade. Better co-management of water resources and waste dumps is also needed. This requires organizing people locally by informing them about what is being done to safeguard the environment and the development prospects of their localities.

IV.1.6SCENARIOSFOR CO-MANAGEMENT OF THE CROSS-BORDER AREA AND VALIDATION OF THE DECISION MAP

The assessment of the measures of co-management of the border area by stakeholders (local authorities and socio-professional groups) reveals that some stakeholders interviewed by this study accept several scenarios for the implementation of co-management and the production of the decision map. Several scenarios have been supported by the population and local authorities. The most enthusiastic are: co-management of forest resources, water, sanitation and concerted land use; co-management of household waste and water erosion as a source of water fill and joint environmental impact assessments; co-management for the establishment of commercial, safety and health infrastructure on both sides of the border; and the definition of a legislative and regulatory framework to discuss the problems that co-management of the cross-border space could raise. On the basis of these conciliabulas, the decision-making map was produced and adopted by the stakeholders. However, it should be stressed that at the level of some phases of its implementation, a small proportion of these actors considered that some of the actions of the tool are "not applicable" or "partially applicable". Even if it is a negligible segment of the population that has made these assessments, it is important to take these assessments into account to ensure the successful implementation of the tool. The actions that received favourable ratings were mainly the clean-up, road and equipment infrastructure development, implementation and operationalization of the map. The actions of planned human settlement, land conflict resolution and the establishment of a regulatory framework for land use definition, land conflict and the development of the regulatory framework for co-management of the border area are announced as actions whose application may cause difficulties. The reservations expressed at the level of the decision map can be corrected by informing, training and raising awareness among all stakeholders (Fig.14).

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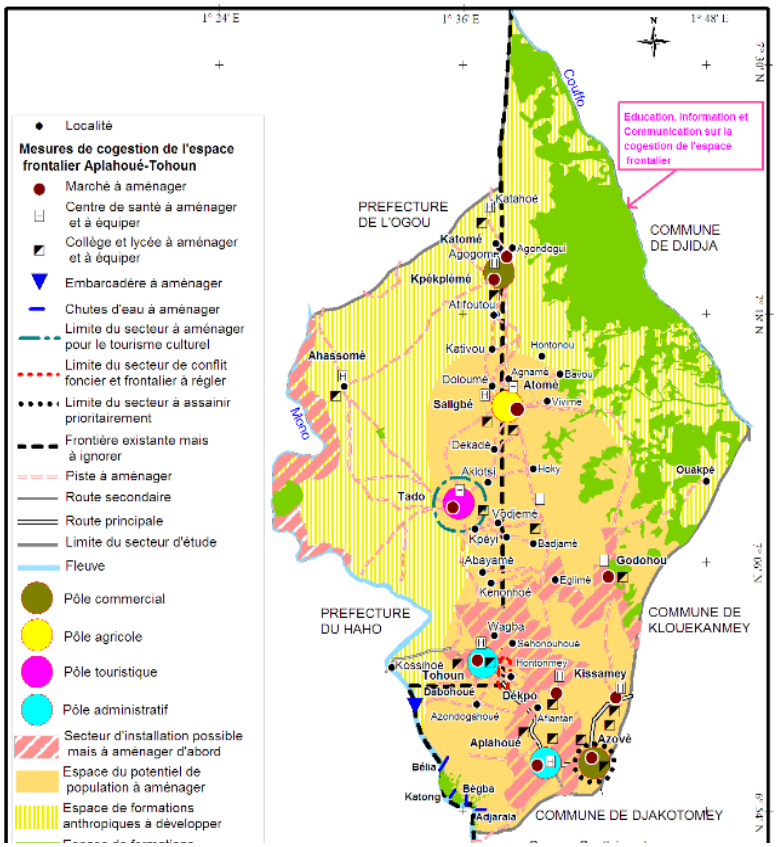

Fig. 14: Decision-making map for the co-management of the cross-border area

IV.DISCUSSION

The delineation of borders has not taken into account the ethno-demographic continuum (Hallaire, 1989; Fall, 2004; Nassa, 2005)[26; 27;15]. Ethnic groups are often cross-border and socio-cultural ties connect people on both sides of the border (Stary, 1995; da Cruz, 2009)[2;28]. According to the African Union Border Programme (PFUA, 2013)[13], border populations generally have secular, socio-cultural and economic links. In Africa, they are generally characterized by isolation, lack of basic social services (health, drinking water, education, etc.) and unconcerned management of natural resources. Domingo, 2008[3] demonstrated that the management of natural resources in these border areas would benefit from being addressed in a regional context, i.e. co-management due to incompatibilities between political borders and ecological zones. The Geographic Information System (GIS) and mapping are often used to represent space and support participatory decision-making (Bedard et al., 2006)[10]. Thus, several authors have shown that mapping the potential for cooperation highlights significant disparities between regions divided by a land border in West and North Africa. Some regions have very high values, such as between Ghana, Togo and Benin (Walther, 2017; PFUA, 2013; UNDP, 2003) [18]. In border areas, people share and live from the exploitation of the same natural resources that extend on both sides of the border. Africa's international borders encompass stae entities that have been invented, created from scratch by European powers on the basis of treaties promptly signed on the basis of uncertain maps (Bennafla, 1999). Improving the lives of people at the borders requires better integration and taking into account the specific needs of these areas (SWAC, 2010). This reality is confirmed by the importance of the Adja socio-cultural group on both sides of the Aplahoué border (Benin-Tohoun (Togo) and shows that the boundaries of the

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political borders between Benin and Togo are similar to two corridors crossed by powerful and dynamic structures organizing solidarity and cleavages that transcend these borders (Antheaume and Arreghini, 1995). The results obtained made it possible to illustrate the significant aspects of migration and spatial recomposition in the study area through the decision map, which forecasts future land use.

The delineation of borders has not taken into account the ethno-demographic continuum (Hallaire, 1989; Lavergne, 1996; Fall, 2004; Nassa, 2005). Ethnic groups are often cross-border and socio-cultural ties connect people on both sides of the border (Stary, 1995; da Cruz, 2009). According to the African Union Border Programme (PFUA, 2013), border populations generally have secular, socio-cultural and economic links. In Africa, they are generally characterized by isolation, lack of basic social services (health, drinking water, education, etc.) and unconcerned management of natural resources. Domingo, 2008 demonstrated that the management of natural resources in these border areas would benefit from being addressed in a regional context, i.e. co-management due to incompatibilities between political borders and ecological zones. The Geographic Information System (GIS) and mapping are often used to represent space and support participatory decision-making (Bedard et al., 2006)[10]. Thus, several authors have shown that mapping the potential for cooperation highlights significant disparities between regions divided by a land border in West and North Africa. Some regions have very high values, such as between Ghana, Togo and Benin (Walther, 2017; PFUA, 2013; UNDP, 2003)[11;13; 12]. In border areas, people share and live from the exploitation of the same natural resources that extend on both sides of the border. Africa's international borders encompass state entities that have been invented, created from scratch by European powers on the basis of treaties promptly signed on the basis of uncertain maps (Bennafla, 1999) [29]. Improving the lives of people at the borders requires better integration and taking into account the specific needs of these areas (CSAO, 2010)[30]. This reality is confirmed by the importance of the Adja socio-cultural group on both sides of the Aplahoue border (Benin-Tohoun (Togo) and shows that the boundaries of the political borders between Benin and Togo are similar to two corridors crossed by powerful and dynamic structures organizing solidarity and cleavages that transcend these borders (Antheaume and Arreghini, 1995)[31]. The results obtained made it possible to illustrate the significant aspects of migration and spatial recomposition in the study area through the decision map, which forecasts future land use.

V.CONCLUSION

GIS mapping has made it possible to study the potential for co-management of the Aplahoue (Benin) -Tohoun (Togo) transboundary area. The results obtained showed that co-management is possible. The importance of the Adjja socio-cultural group on both sides of the border is an opportunity for co-management. The latter must not only be based on available resources but must also take into account the constraints and threats, namely: the non-existence of the operational regulatory framework for cross-border development, climatic hazards and risks of erosion, the destruction of the environment, the scarcity of economic resources and the politicization of the administration. The commitment of the actors in the cross-border area to take measures to deal with constraints and threats may give it a better life expectancy. To do this, it is necessary to design an integrated co-management decision support tool for the prospective management of the Aplahoue-Tohoun border area in a participatory approach with the grassroots populations and local authorities. The majority of the local and regional actors met (including public actors) are in favour of developing all these exchanges. Political relations between states are also good and confident enough that the border does not constitute an obstacle to the cross-border actions observed.

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