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Climate change and dynamic of lands occupation at the hippopotamus pond biosphere reserve in Burkina Faso

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Abstract— *In Africa, forest cover and timber resources experienced a sharp decline, especially in the last thirty years. Burkina Faso has experienced major droughts, especially from1965-1966to 1991-1992 and 1994 – 1995 with serious impact on agriculture, water resources and natural vegetation as well as the indirect consequences on health, economy and institutions.*

The forests are located in areas dominated by subsistence production agricultural and many herds of cattle. The growing needs for firewood leads to anarchic cuts causing the deterioration of forest genetic resources. The Biosphere Reserve of "Mare aux hippopotames (RBMH)" although its International statute knows these phenomena. The study aims generally to contribute to an assessment of the impacts of climate change on the lands occupation of the Biosphere reserve. The specific objectives are: i) understand the perception of the people on climate change and its effects; (ii) study the dynamics of lands occupation in the RBMH and iii) Identify the causes of decline of ecosystems. The approach consisted in a diachronic analysis to assess the dynamics of lands occupation and semi structured interviews to collect the effects and manifestations of climate change with60 men and 40 women from 10 villages of the RBMH.A list of 29 climate resiliencehas beencited by all the villages. The incidence of disease is the largest followed by the lack of drinking water and drought; floods, overload work and drought are the most severe.

Our results could contribute to take actions coping with climate change and variability.

Keywords— Climate shock, Impact, Land exploitation, Vulnerability, Severity.

I. INTRODUCTION

In Africa, forest cover and timber resources experienced a sharp decline, especially in the last thirty years. According to [17], studies on the evolution of the climatic zones in Burkina Faso show that over 40 years, the Sahelian zone extends while the Sudanian zone is reduced. Indeed, Burkina Faso had major droughts, especially in 1965-1966, 1972, 1974, 1981 to 1984, in 1986-1987, 1991-1992 and 1994 - 1995 [6]. The result is a severe direct impact on agriculture, water resources and natural vegetation as well as the indirect consequences on health, economy and institutions.

Accordingly, population, migration and climate pressures resulted in an intense desertification and over-exploitation of natural resources, threatening protected areas. In the classified areas hunting activities farming and agriculture and other human activities are prohibited or regulated, and the country conducted strategy of conservation of biodiversity, from 1926 to 1937., In general, this classification has been done without the participation of the populations, causing frustrations and various hostilities such (poaching, bush fires, agricultural clearings, pastures). Thus, the classified forest of the Hippopotamus pond was created in 1937 by the Decree No. 836 SE of March 26, 1937, like various other forests in Burkina Faso. This forest got the statute of Biosphere Reserve by decision of the MAB International coordination in 1987, then as Ramsar site in 1990.

According to [10] the forests are located in areas dominated by a subsistence agricultural production and by many herds of cattle. The growing needs for fires wood of populations and particularly in large urban areas, lead to anarchic cuts which are one of the main causes of the deterioration of forest genetic resources.

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The Hippopotamus pond Biosphere Reserve is not in secure of certain phenomena which may bring into question its status as International Biosphere reserve. Biosphere reserves have objectives to serve research, education and training in the field of ecology [20].

The overall objective of our study is to contribute to an assessment of the impacts of climate change on vegetation formations of the Hippopotamus pond Biosphere Reserve (RBMH)of Burkina Faso..

.The specific objectives are to i) understand the perception of local communities on climate change, ii) to study the dynamics of the occupation of the lands of the RBMH and the impact on ecosystems and iii) to identify with local people the causes of regression of some vegetation formations.

II. MATERIALS AND METHOD

2.1. Presentation of study site

2.1.1 Localization of the study site

Hippopotamus pond Biosphere Reserve is located between 11°30' and 11°45' N and 04°05'and 04°12'O at South-west of Burkina Faso.It covers 19 200 hawith a permanent river of 660 ha.

This forest is surrounded by a dozen of villages including Bala, Sokourani, Tierako. "Fig 1". The name of the forest derives from the pond it hosts and where Hippopotamus live permanently[18]. The RBMH is located in south-soudanian phytogeographic sector and in the south-soudanian climatic domain according to [11]. The strictosensu Biosphere Reserve is concerning 16354 ha according to [1]

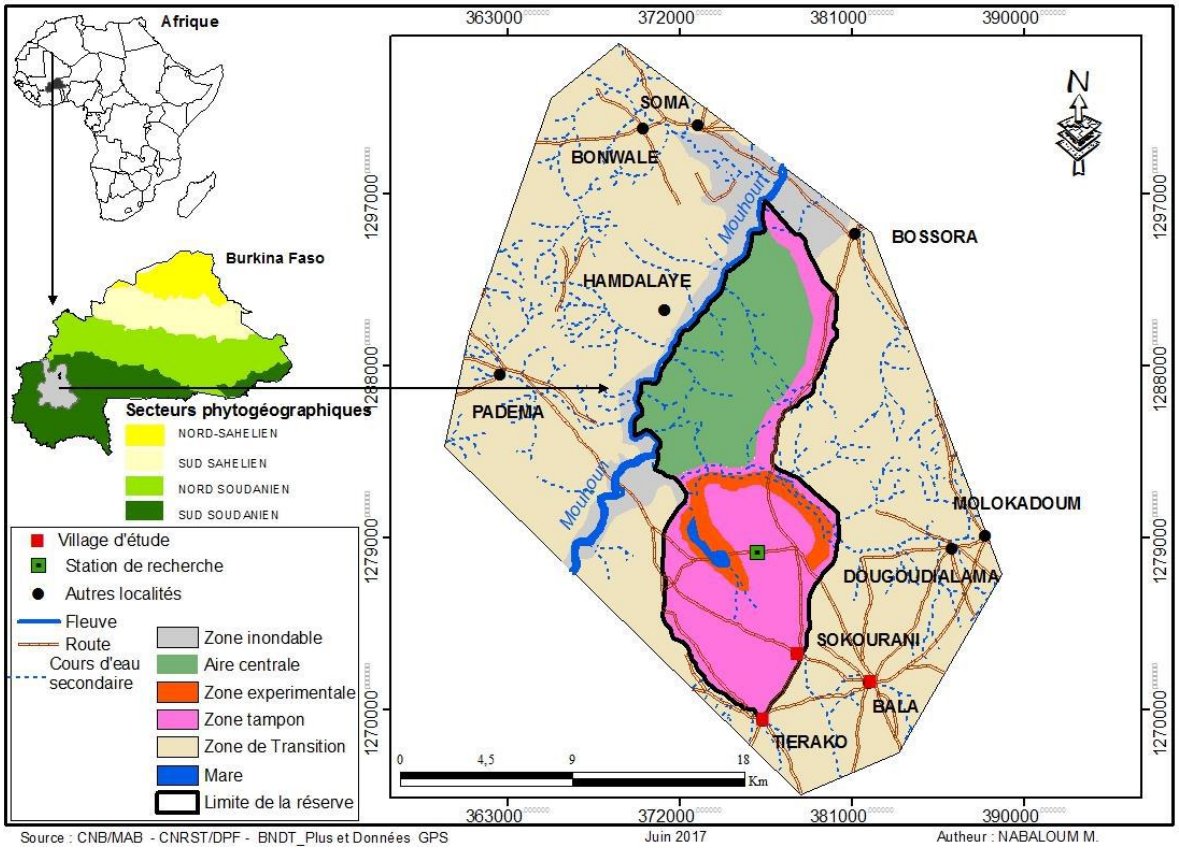

Fig: n°1: Localization of Hippopotamus pond Biosphere Reserve

2.1.2. Climate of RBMH area

The south-sudanian climate of RBMH is characterized by a dry season which runs from November to April and a rainy season or winter from May to October. The average rainfall over the period 1986 to 2015 is about1080 mm/year. The evolution of rainfall during this period indicates a very strong inter annual variability with an upward trend. The monthly mean temperatures are relatively weak between 25 and 31°C. "Fig2".Some droughts, particularly severe have been registered as those of 1972-73 and then from 1983-84, which have had dramatic consequences for the agro-forest-pastoral productions[6]. One of the direct consequences of the reduction of rains and their variability is the increase in the frequency of dried years, with an acceleration of desertification and silting of waterways, accentuated by the decline in density of the vegetation, the ageing of stands and the threat of extinction of some species.

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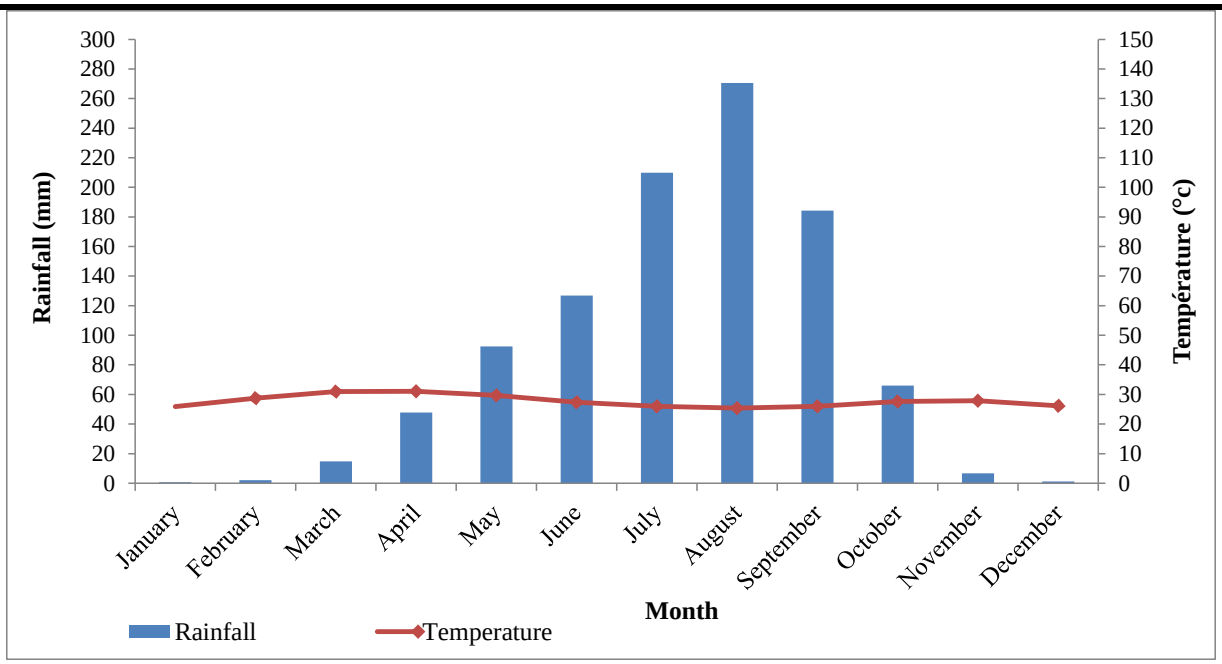

Fig.n°2 :Ombro-thermic diagram of the station of BoboDioulasso (1986-2015)

The annual height of rainfall reported in "Fig. 3" do not meet certain species of Combretaceae rainfall needs such *Combretumglutinosum, Pteleopsissuberosa, Terminaliamacroptera*, etc. [12].

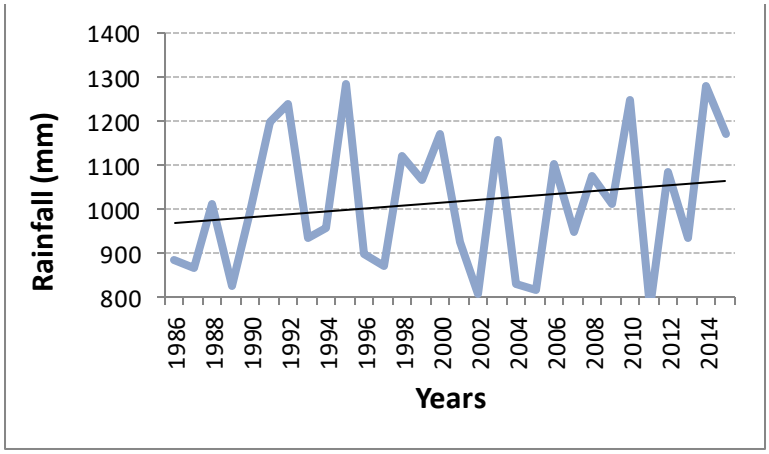

Fig. n° 3 : Rainfall High at the station of BoboDioulasso from 1986 to 2014

2.1.2. Relief and Soils

The relief of the Biosphere Reserve and the surrounding villages is relatively flat with an average altitude ranging between 280 and 320 meters.

Four types of soils are distinguished at the level of the reserve area according to [1] :

- soils on battleship made up of ferruginous soils truncated;
-tropical ferruginous soil leached;
-alluvial soils including mineral soils to "Gleyoxydated" along the temporary streams and on the alluvial strip of Mouhoun.
-hydromorphic soils at the level of the flood plains.

2.1.3.Hydrographyof RBMH area

The Mouhounriver, main watercourse with permanent flow, with its tributaries as the Wolo, the Tinamou and the Leyessa, irrigate the reserve and the villages in the South and central parts [1]. The pond is a lake lying N/NW-S/SE of about 2.6 km long and 700 m wide. In times of flood, water runs and floods the East Coast and West, favouring thus the displacement of the hippopotames from the flooded area to any backwater or pocket of water[18], [20].Floodings of the pond are highly dependent on those of the Mouhoun.

2.2. Study method

2.2.1. The mapping

The method of production of the maps of the lands occupation at the RBMH in 1992, 2002 and 2013 is

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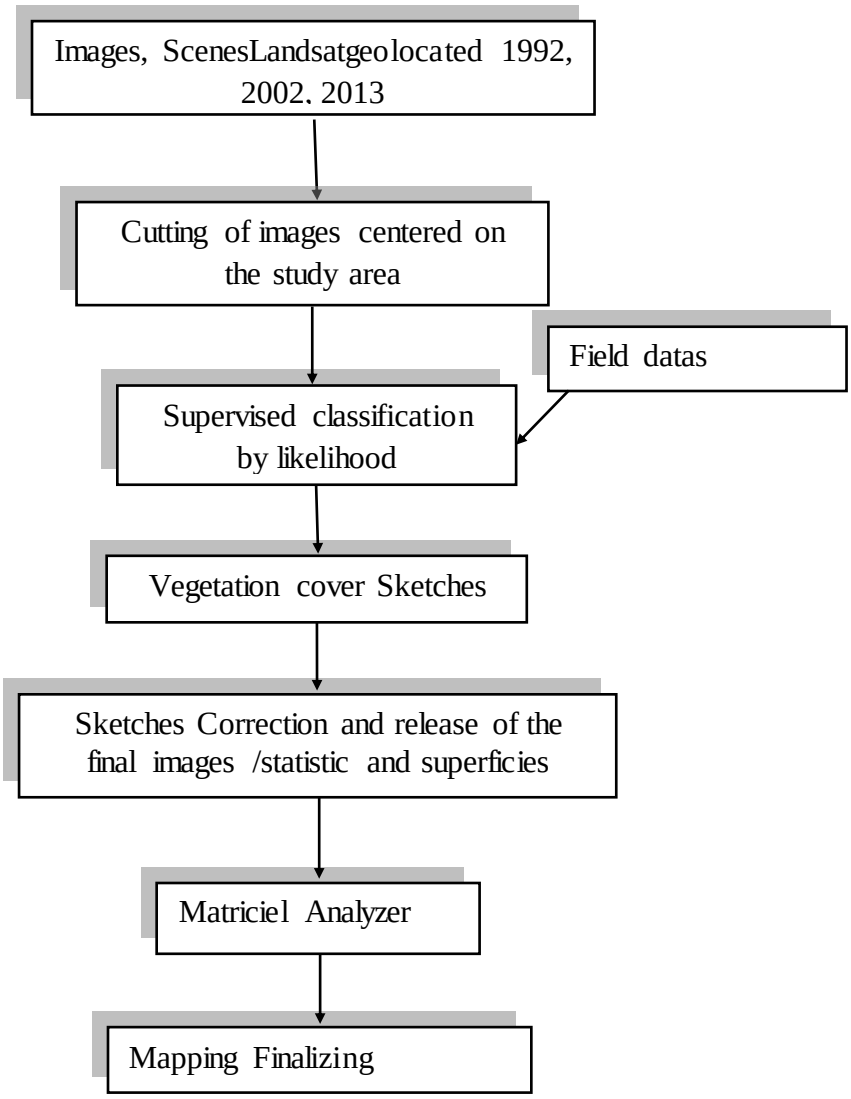
summarized in "Fig.4" below. It required the exploitation of data and their treatment. The images used are type Landsat imagesTM, ETM, ETM+ for the years 1992, (L4B10_19921016196050S), 2002 (L7B50_20021028196052), 2013 (LC8_1960522013 3 07LGN00_8bit). The vector datas used are those of the national topographic database (BNDT) of IGB. ENVI 4.5 for the treatment and classification of satellite images (phase 1).



Source: the authors
Fig.n°4: Methodological Scheme of Maps production

2.2.3.The inquiries

Investigations consisting to collect the perception of each group on climate change effects, feelings and coping strategies. A questionnaire guide used helped identifying all felt shock and adaptation strategies. Once the shocks are listed in each group, we did a harmonization of the terms. Then, the populations have themselves hierarchized the shocks according to their importance. Adaptation strategies developed by people to deal with the multifaceted climate shocks have been recorded with a focus on adaptation in relation to the vegetation according to the perception of men and women.

Analyzing the severity of the climate gave a resulting list of shocks. This list was used then for the calculation of the impact, of the severity and Risk Index (Ij). From the impact and the severity, the severity map of a village, the group of men or women can be established. In the analysis of the map, a strong value translated a significant impact of the shock. However, great severity is associated with a low value.

Risk indices were calculated in a participatory manner according to the method cited by [17] and [19].Thus, the equations below have been applied:

: Index of severity Sj (1-2) :1 + (r-1) /(n-1)

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r = rank of the threat (by order of importance according to the participant)
n = total number of threats listed by the participant;
Then we calculate the average for all participants who have listed a certain threat to get the average severity**, Sj :**
Impact Ij= listed type of threat x-time / number of participants
Risk Index (0-1) :Rj :Ij/Sj

III. RESULTS AND DISCUSSION

3.1. Description of vegetation of RBMH

This description indicates that the reserve is the clear,field of woodlands, treed and shrubby savannas and forest galleries.

3.1.1. Forests Gallery and clear Forests

Forests Gallery are found on the banks of the Black Volta River and its tributaries, and are characterized by*Berliniagrandiflora*, *Vitexdoniana*, *Cola cordifolia*, *Khayasenegalensis*, *Erythrophleumguineensis* and *Diospyrosmespiliformis*.

The clear forests of RBMH are composed of *Prosopisafricana*, *Danielliaoliveri*, *Ostryoderrisstuhlmannii* and treed savannas constituted by a treed strata with *Pterocarpuserinaceus*, *Prosopisafricana*, *Danielliaoliveri*, *Xeroderrisstuhlmannii* and *Anogeissusleiocarpus*. The big characteristic of these two vegetation kinds is the existence of herbaceous stratum made up of perennial grasses dominated by *Andropogontectorum*[1], [8].

3.1.2.The treed savannas

In the RBMH, the treed savannas have a medium coverage. The floristic composition is composed of*Isoberliniadoka*, *Terminaliaspp*, *Danielliaoliveri* and *Vitellariaparadoxa*[1],[9],[20].

3.1.3.The shrubby Savannah:

It covers large areas in the biosphere reserve. The shrub stratum is composed mainly of *Detariummicrocarpum*, *Combretumcollinum* and *Crossopteryxfebrifuga*. The herbaceous stratum is made up of perennial grasses [1], [8].

3.1.4. The bushes:

They thrive on the micro reliefs such areas attacking in the Biosphere Reserve. This type of vegetation contributes to the maintenance of these micro reliefs by contributions of plant debris and by promoting the installation of the mounds [20]. Thicket vegetation is composed of shrubs of *Combretumglutinosum*, *Combretumghazalense*, *Capparissepiaria*, *Leptadeniaangolensis*, *Gardenia sokotensis*, *Acaciamacrostachya*. andcreepers as *Saba senegalensis*, *Baisseamultiflora*,and *Acacia penneta*.

3.1.5. Wetland Vegetation

It is found in the Biosphere Reserve because of the permanent presence of water in the pond and the Mouhoun River. The aquatic and/or semi-aquatic vegetation are developed around the pond as well as the floodplains of Mouhoun[1],[9],[20].Thus, from the pond to the outside, there isprogressively : i) a floating vegetation or water meadow with a belt around the pond consisting of species likes *Pistiastratiotes*, *Trapanatans*, *Azollaafricana*a,ii) a dense thicket hardly penetrable composed of *Ficustrichopoda*, iii)a treedsavannah with *Mitragynainermis* and *Vetiverianigritana*.

3.1.6. The parklands

They occupy more than 80% of the Burkina national territory. The trees of the field or parklands have been so preserved because of the products and services they provide to local communities [5], [22].The fields of the RBMHRiverside villages are dominated by woody species with in majority *Vitellariaparadoxa*, *Parkiabiglobosa*, *Tamarindusindica*, with some companions species such as *Terminaliamacroptera*, *Ficusgnapalocarpa*, *Lanneamicrocarpa*. *Sclerocaryabirrea*, *Bombaxcostatum* and *Khayasenegalensis*.

3.1.7. The sacred wood

The sacred woods are islands of vegetation located near villages, often presented as relics of natural forest, preserved of human action in respect to traditions and to fear the criminals minds that they host. They are forest fragments associated with a spirit, a divinity or a temple. These are traditional protected areas, directly managed by the local population for cultural purposes[21]. The component speciesof these areas in the RBMH include *Afzeliaafricana*, *Annonasenegalensis*, *Cordiamyxa*, *Diospyrosmespiliformis*, *Gardenia erubescens* and *Securidacalondepedunculata*.

3.1.8. The fields

In houses fields are cultivated cereals like millet, sorghum and maize which are the main food of the population. A little further away from the houses are villages' fields where speculations like peanuts, cotton and tobacco are grown in addition to grain. Several kilometers of the course, households cultivate in Bush's. fields[22]. .

3.1.9. Bare areas

They correspond to two facies, one hydromorphic and the other gravillonnaire. The hydromorphicfacies appears

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onthe hollower, with a compact slab on the microtopographies. The gravillonnaire layer, although very little deep (about 10 cm), is not flush; the 'termite mushrooms' are particularly numerous. The vegetation, which is very poor, is composed of some annual grasses like *Loudetiatogoensis* and *Andropogonpseudapricus*, with a perennial feature at very low recovery *And ropogonascinodis*. The gravillonnairefacies is an intermediate microtopography little affected by the hydromorphy.

3.1.10. Water, aquatic areas and flood plans

These facies of vegetation are observed around the pond itself as well as in the areas of overflow of Mouhounriver. According to [12],from the pond to the outskirts, there are several landscape units whose the aquatic grassland. Woody riparian vegetation or Gallery of the pond and treed savannah with *Mitragynainermis* and *Vetivernianigritana*.

The aquatic grassland of the flooded area includes two strata. The first, submerged and the water or floating, includes species such as *Ceratophyllumdemersum, Trapanatans, Pistiastratiotes, Azollaafricana* and *Utriculariainfexa var. infexa*. [3]. The second, about a meter high contains the following set *Apodostigmapallens, Ipomoea rubens, Neptuniaoleracea, Oxycaryumcubense, Vossiacuspidata, Echinochloastagnina, Pycreusmundtii, Ludwigiaadscendens, Ludwigiastenoraphe, Cyclosorusstriatus, Leersiahexandra and* diverses Polygalaceae.. Woody riparian Vegetation encircling the water meadow has two levels: a stratum of shrub with*Ficuscongensis, Canthiumcornelia, Alchorneahirtella, Trichiliaemetica, Phyllanthusreticulatus* and *Mimosa pigra*a treed stratum with *Morelia senegalensis, Syzygiumguineense* covered with *Ipomoea rubens* and *Pterocarpussantalinoides*[4]. [5].

3.2. Dynamic of lands occupation at RBMH from 1992 to 2013

The "Table1"defines each unit and its evolution in the time and in the space.

Table.I: Dynamic of lands occupation at RBMH

lands occupation	1992 (ha)	% 1992	2002 (ha)	% 2002	2013 (ha)	% 2013	Tendancy (1992-2013)
Galleryforest	1179,79	6,9	1179,79	6,9	1424,67	8,4	progression
Clear Forest claire	11640,37	68,6	9265,93	54,6	9636,92	56,8	regression
ShrubbySavannah	1864,13	11	4129,28	24,33	4520,25	26,6	progression
*Parklands*territories	0,0022	0,13	0,0022	0,13	252,04	1,5	progression
Field	339,74	2,13	449,31	2,73	826,79	4.9	progression
Water	1039,11	6,12	1039,11	6,12	55,33	0,32	regression
Aquatic grassland	683,88	4,03	683,59	4,02	447,60	2,6	regression
Bare grounds	200,22	1,18	200,22	1,18	58,11	0,34	regression

In the RBMH, the clear forest being the largest land unit went from 68.6% in 1992 to 56.8% in 2013. The second unit is the shrubby Savannah who went from 11% to 26.6% between 1992 and 2013. The gallery forest grew from 1179,79 ha to 1424,67 ha from 1992 until 2013, causing a reduction of 245 ha. It remains the vegetation having the lowest area. The fields and parklands territories are on the rise in the reserve. They move from 2 to 4.9% and 0.13 to 1.5 during the same period. These have increased at the expense of the natural wooded formations. The increase in very close crops of the RBMH vegetation formations against natural one is another cause of the destruction of the vegetation according to [13]. The following map shows the land occupation at RBMH from 1992 to 2013

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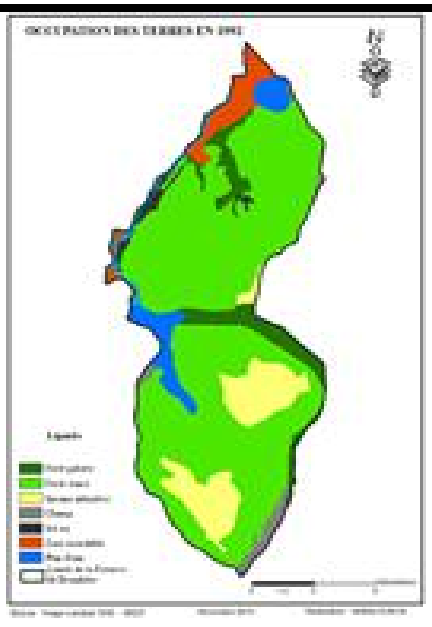
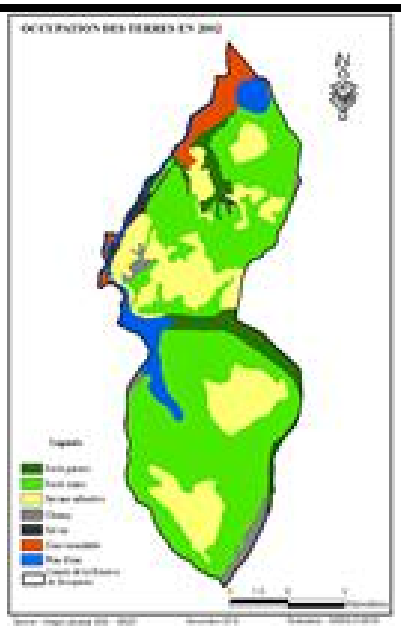
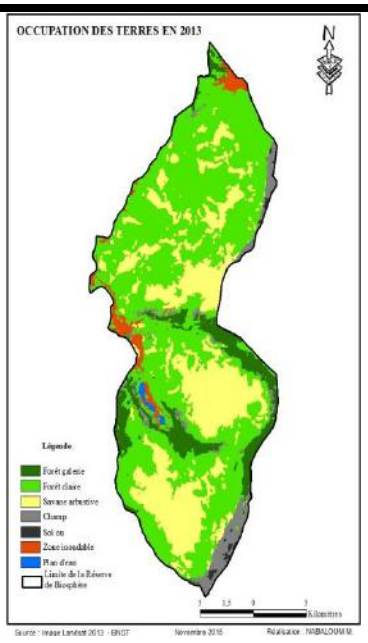

Land occupation in1992


Land occupation in2002



Land occupation in2013

Fig. n°5: Land occupation Map of RBMH from 1992 to 2013

After seven years survey, [1] has clearly shown that there is also a tendency to the disappearance of many species within the forest galleries of the RBMH. However, this study showed no evidence that the decline is directly linked to the actions of local residents (removal, Bush fires). Indeed, the causes of this degradation are also at the level of climate change (precipitation down) but also in facilities designed around these environments (dams, track,...)[11]..

A general observation of the environment of Burkina Faso shows a degradation of natural resources (soil, water, biomass and biodiversity resources) because of multiple factors[7], [10].These factors are, among others, the pressure on natural resources due to the increase of the population, access to bit secure land, low productivity of farming systems and livestock, a weak implementation of the legislative framework. Low ownership of the management of natural resources and a lack of development of biodiversity.

Of course, it was impossible for [3]to definitively identify the specific reasons for the decline in quality of these areas of great ecological interest "Fig 5". But this study may confirm that certain practices can be modified to slow down, or even to counter the impoverishment of middle in terms of diversity of woody according to [15],[16],

3.3. Climate Change and people vulnerability according to gender

3.3.1. Climate Change impact according to gender

The observation of the population indicates a significant increase in temperatures and a decline in rainfall. "Table 2" shows 29 shocks listed by all of the surveyed population. Among these shocks, diseases are the most important with an incidence of 0.6, followed by the lack of drinking water and the drought with respectively 0.5. Low impact shocks include deforestation, fruit reduction, and poverty, with a value of 0.4. population growth, degradation of soils, the disappearance of wildlife, the disappearance of fishing, the Hunger (0;3); the disappearance of medicinal plants, high temperatures (0.25); unemployment, Exodus, lack of wood, agricultural mechanization, human mortality, the land problem, work overload and the drying up of River (0.2). Eight very low impact shocks were given: the lack of fodder, Guinea worm, the winds, the livestock mortality, floods. the disappearance of market gardening, the abandonment of customs.

Table n°2 :Impact values in the whole villages according to gender

N°	**Shocks of all men and women**	**Impact**		
		W, M	**W**	**M**
1	Abandonment of customs	0,1		0,1
2	Unemployment	0,2	0,3	0,1
3	Demographicgrouth	0,3		0,3

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4	Deforestation	0,4	0,4	0,3
5	SoilsDegradation	0,3	0,3	0,3
6	Diminution of fruits plants	0,4	0,4	0,3
7	Disappearance of medicinal plants	0,25	0,25	
8	Disappearance ofwildlife	0,3	0,3	0,2
9	Disappearance of market gardening	0,1	0,1	0,1
10	Disappearanceof fishering	0,3	0,25	0,2
11	Animal divagation	0,1		0,1
12	Exodus	0,2		0,2
13	Hunger	0,3	0,2	0,2
14	High temperatures	0,25	0,25	
15	Floodings	0,1		0,1
16	**Diseases**	**0,6**	0,6	0,5
17	Lack of wood	0,2	0,3	0,1
18	**Lack of water**	**0,5**	0,5	0,4
19	Lack of Fodder	0,1	0,1	
20	agricultural mechanization	0,2	0,2	0,2
21	Lifestockmortality	0,1	0,1	
22	Humanmortality	0,2	0,2	0,1
23	Poverty	0,4	0,6	0,2
24	Bussiness land problem	0,2	0,2	0,2
25	**Drought**	**0,5**	0,3	0,7
26	Overloadwork	0,2	0,2	
27	River drying	0,2		0,2
28	Violent winds	0,1	0,1	0,1
29	Guinea worm	0,1		0,1
			22	24

3.3.1.1. According to women

The data of "table 2" show that 24 shocks have been identified by the women. The highest incidence (0.6) is given by poverty, disease and lack of water. Seventeen shocks have a low impact and are as follows: 2 with impact = 0, 4 (fruit reduction, deforestation); for 6 shocks impact is 0.3 (drought, degradation of land, unemployment, hunger, endangered wildlife and lack of wood);. We noted 3 shockswith impact = 0.25 (high temperatures, endangered medicinal plants, and endangered fishing); and 6 shocks with impact = 0.2 (land problem, famine, lack of wood, lack of agricultural equipment, human mortality and work overload). Four shocks have a very low incidence (0.1): lack of fodder, disappearance gardening, winds and livestock mortality.

3.3.1.2. According to the men

On a total of 22 given shocks, drought emerges as the first shock with high incidence (0.7). Diseases have an incidence of 0.5. Low impact shocks are the lack of water (0.4); degradation of soils, deforestation, fruit reduction, population growth (0,3); poverty, land problem, agricultural mechanization, hunger, endangered wildlife, endangered fishing and exodus (0.2); floods, abandonment of customs, Guinea worm, straying of animals, human mortality, violent winds disappearance gardening and unemployment (0.1).

3.3.2. Severity in all the study villages according to gender

Concerning the severity of shocks (ranging from 1 to 2), a low value means great severity. For this purpose, the floods, overload work and drought are the most severe with respectively 1, 1 and 1.1. Five shocks have a severity equal to 1.4: abandonment of customs, unemployment, population growth, lack of water and drying up of rivers. A single shock has a medium severity (1.5) the hunger. Low severity impacts include respectively the hunger (2), exodus (1.9), and six shocks with severity = 1.8 as: high temperatures, lack of wood, soil degradation, lack of fodder, human mortality and straying of animals. Three shocks with severity = 1.7 are: gardening, agricultural mechanization, and cattle mortality. Seven shocks with severity = 1.6 are: diseases, fruit drop, loss of medicinal plants, poverty, land problem, violent winds and Guinea

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worm. From all, the drought seems to be the most indicative shock of the climate change.

Table n°3: Severity values in all the study villages according to gender

N°	Shocks of all men and women	Sévérité		
		W,M	W	M
1	Abandonment of custums	1,4		1,4
2	Unemployment	1,4	1,4	1,5
3	Dmographicgrougth	1,4		1,4
4	Deforestation	1,3	1,5	1,2
5	SoilDegradation	1,8	1,6	1,9
6	Diminution of fruits trees	1,6	1,6	1,7
7	Disapearanceof medicinal plants s	1,6	1,6	
8	Disapearanceof wildlife	2	1,9	2,1
9	Disapearanceof gardenmarket	1,7	1,5	2,0
10	Fisheringdisapearance	1,5	1,5	1,4
11	Animalsstraying	1,8		1,8
12	Exodus	1,9		1,9
13	Hunger	1,5	1,4	1,4
14	Hightemperatures	1,8	1,8	
15	Floodings	1		1,0
16	**Deseases**	1,6	1,4	1,8
17	Lack of wood	1,8	1,6	1,6
18	**Lack of water**	1,4		1,7
19	Lack of fodder	1,8	1,8	
20	Agricultural Mechanization	1,7	1,8	1,7
21	Cattlemortality	1,7	1,7	
22	Humanmortality	1,8	1,8	2,0
23	Poverty	1,6	1,5	1,7
24	Land problems	1,6	1,9	1,3
25	**Drought**	1,1	1,1	1,2
26	Overloadwork	1	1,0	
27	Riverdrying	1,4		1,4
28	Violent winds	1,6	1,2	2,0
29	Guineaworm	1,6		1,6

3.3.2.1. According to women

In terms of the severity of each of these 24 shocks, overwork has maximum severity (1). Then successively follow the drought (1,1), lack of water, winds (1,2), disease, unemployment, and hunger (1,4). 5 shocks have a medium severity = 1, 5 (poverty, deforestation, gardening disappearance, hunger and fishing disappearance). The less severe shocks are represented by the degradation of the soil, fruit reduction, lack of wood, endangered medicinal plants (1.6); cattle mortality (1.7); lack of agricultural equipment, lack of fodder, human mortality and high temperatures, (1.8); then the land problem, endangered wildlife and lack of wood (1.9). Women severity S map "Fig. 6" shows that water scarcity and drought stand out among the shocks with to strong impact and average severity.

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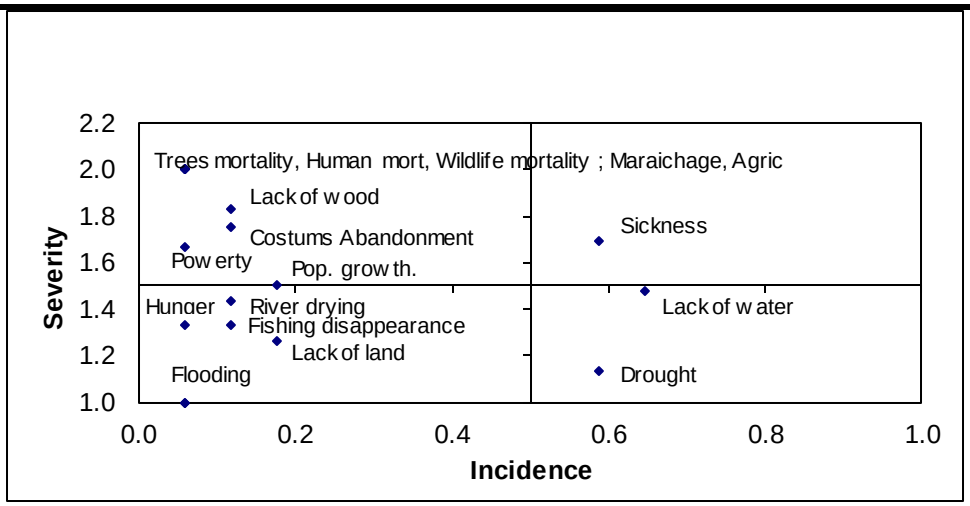

Fig n°6: Women severity S map

The surveyed women are unanimous in recognizing that the flooding, lack of land, the Hunger and the drying up of the pond are the main causes of degradation of natural resources.

3.3.2.2. According to men

Respectively the severity of shocks is dominated by the floods with a maximum severity (1), drought and deforestation (1,2), the property issue (1,3), hunger, endangered fishing, population growth, dry river,. customs abandonment (1,4). Unemployment has amedium severity. Then follow in last position, Guinea worm, lack of wood (1.6), poverty, lack of water, agricultural mechanization, fruit decrease (1.7), diseases, river drying (1.8) exodus, degradation of soils (1.9). 3 shocks have zero severity (winds, human mortality, and disappearance gardening).

3.3.2.3.Men Severity Card

Map of severity of shocks "Fig 7" listed by men let see shocks groups emerging: shock with impact and high severity (drought), shock with impact and medium severity (lack of water), shock with high incidence and low severity (diseases). Shock with low impact and maximum severity (flood), the rest of the shocks are divided among groups of shock with impact and low severity and shocks with low impact and high severity.

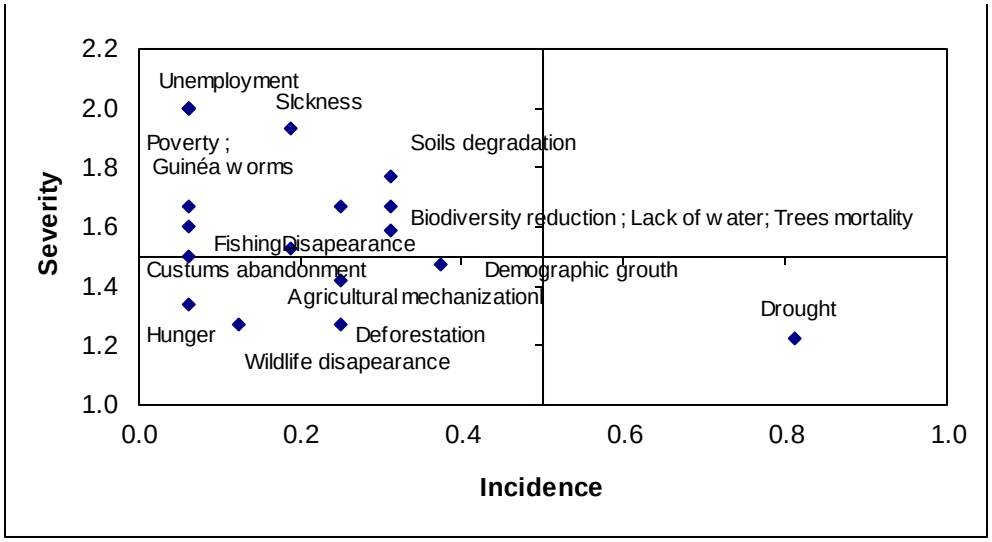

Fig. n°7 : Severity Map S of Men

For men, deforestation is the first cause of natural resources degradation in all the villages. Then come the hunger, agricultural mechanization and population growth which have greatly contributed to a deep and accelerated degradation of natural resources in the region

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3.4. Adaptation practices of populations to climate change

Studies of vulnerability to climate change in Burkina Faso [6] have shown the difficulties to separate the effects of the variability of the anthropogenic factors. Despite the efforts to combat desertification, recurrent droughts are only exacerbating environmental imbalances [17]. Shocks listed in this study as the disappearance of wildlife, soil degradation, the rural exodus, the lack of forage are more important than those cited in the southwest of the Burkina [17], [14] showed that the lack of rain has the value of the highest incidence while the poor quality of the seeds and the straying of cattle present as much severity. In the face of climate change, populations have initiated a set of adjustments or adaptation in natural resource systems: extension of the area under cultivation, crop intensification; introduction of animal culture, the culture of cotton (annuity), techniques of conservation of water and defense and restoration; operation of the shallows and the lowlands, etc. In terms of our study area, mapping noted a regression of the natural formations in favor of fields and agroforestry parks. This was confirmed by investigations which also showed dynamism in the formation of farmer organizations in the area. These often mixed professional organizations specialized in specific production sectors such as cotton and oilseeds and for the monitoring of forest or pasture, etc. The adaptation of people living along the RBMH to climate change is reflected on the different sectors of activity. At the farm level, it was noted among other things, the increase in area planted; diversification of operating systems (culture attached, irrigation techniques to techniques of conservation of water and defense and restoration) the intensification of crops (seeds, fertilizer and manure); cash crops (cotton, Cowpea) and market gardening.

IV. CONCLUSION

The populations of the Biosphere Reserve of the Hippopotamus pond perceive climate change and variability. Awareness of the effects of climate change by the people has occurred especially in the elderly. The youngest, because of their short existence in time, less perceive the effects of climate change. Awareness would have occurred from the years 1975-1980, following a significant decline in rainfall over several agricultural seasons. This study showed that climate change has a negative impact on 4 sectors as agriculture, livestock, forests, and water resources. In agriculture, cultivated areas are increased; pastures are more degraded by livestock; water resources present an irregularity in their distribution of a pool to the other. This is noticeable as well by the mapping study by local people.... Also, local people are developing various adaptation strategies to mitigate or even curb the impacts and effects of climate change. It is apparent that the increase in the cultivated areas at the expense of the natural formations is a form of adaptation to climate change.

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