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Impact of Climate Change on Agriculture in Taigbé, Sub-Prefecture of Kamsar (Republic of Guinea)

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Abstract: Climate change remains one of the threats to sustainable development. In the Republic of Guinea, agriculture is largely dominated by family farms, which constitute almost all village agricultural activity units. The agricultural sector is the most affected by the effects of climate change. Agriculture plays an important role in the economy with 20% of the state budget. It is in order to understand how agriculture is influenced by climate change in Taigbé that we chose to work on "The Impact of Climate Change on Agriculture in Taigbé, Kamsar Sub-Prefecture". For this work, we set ourselves two objectives (i) to characterize endogenous practices of adaptation to climate change in Ta ẅgbé, in the Kamsar Sub-Prefecture and (ii) to establish the change map. To process this work, survey and mapping methods were used in addition to the collection of statistical and climatic data. The results obtained show that farmers on the island of Ta ẅgbé have developed some endogenous practices to cope with climate change, including market gardening (27%), fishing (26%), salt production (12%), small trade (8%) and other activities (27%). The study also reveals a loss of 208,883 ha of land, an increase in mangrove plains to 91,421 ha. In addition, in the area, there is a late start and early end of the rains. Most respondents (69%) identified the flooding of their fields as an impact of climate change in their locality. This study helped to understand that the major impact of rising sea levels is the loss of agricultural land due to flooding.

Key words: Agriculture, adaptation, climate change, incidence, Ta ẅgbé

1. Introduction

Climate change due to human activities is one of the major environmental problems of our planet because it causes disturbances in nature and affects the lives of billions of people around the world, despite efforts to reduce the risks. These impacts are noticeable on land, with an increase of temperature measured at about 1.1 ℃ more accompanied by precipitation regimes, extreme weather events with heat waves and intense drought in many regions [1]. According to the results of the sixth report of the IPCC (Intergovernmental Panel on Climate Change) published in 2021, it states that by the year 2025 the value of 1.5 ℃ of the warming limit set by the Paris Agreement could be reached [2]. This could significantly reduce by 10% on average the precipitation rate in Africa in general and in particular, in southern Africa which could be a major cause of reduction in agricultural yield in several areas of the continent. The same report indicates that hundreds of millions of people in semi-arid regions and regions of Africa could fall into extreme poverty due to the climate crisis [3, 4]. The WB (Banque Mondiale), underlines in its report on poverty in 2022, that sub-Saharan Africa is home to 60% of the people in extreme poverty in the world, or 389 million people [5]. This part of the African continent thus has the highest poverty rate in the world,

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with around 35%. Some authors, go further in their study, by emphasizing that seven of the ten countries with the largest number of poor people living in rural areas are located in sub-Saharan Africa [6]. This means that climate change is already having a very strong impact on this part of the continent with extreme weather events. It is important to note that in most African countries (e.g. Togo, Benin, Ivory Coast, Guinea, etc.), these influences are manifested by floods, droughts, changes in the agricultural calendar, heat waves, low productivity but also soil degradation, coastal erosion, deforestation, and reduced yields, etc. [7-10]. Faced with these climatic disturbances, several studies have focused on farmers' perceptions of these events and the local strategies developed to deal with them. Thus, in Benin, in the study on typologies and adaptation strategies, the authors show that approximately 44.5% of rice farmers surveyed noticed a delay in the start of the rains, followed by flooding noted by 16.7% of producers. Most rice farmers believe that climate change has a negative effect on the production of rainfed rice [11]. To adapt to perceived changes in the climate, producers interviewed in certain areas in Africa such as Ivory Coast and Senegal, mostly affirmed the change in calendar and agricultural techniques that they applied in order to adapt to climate change, followed by the diversification of crops [12, 13]. In the Republic of Guinea, agriculture is largely dominated by family-type farms, which constitute almost all village agricultural activity units. These farms concern approximately 60% of the national population and occupy approximately 95% of the agricultural land or areas cultivated annually in the country. This type of farm, generally of modest size (0.30 to 0.50 ha), actually takes very varied forms, determined by their agricultural situation and the availability of production factors [14]. Studies on the impact of climate change on priority sectors show that rice yields will decrease by 5.63% to 14.66% in 2025 and by 11.52% to 22.51% in 2050 in all rice production areas [15]. This decrease in yields will be more felt in the northern part of the country in Labé (14.66% to 22.51%) for rice while the small reductions will be observed in the South-West and North-West zones in Boké and Forécariah. In Guinea, socio-economic activities are largely based on food production which depends heavily on the country's climatic conditions. Consequently, the multiplication of extreme weather events (floods, storms, strong winds, swells and very high tides, heat waves especially in the north of Guinea, variations in the spatiotemporal distribution of precipitation, etc.), will have negative impacts on the population's way of life [16]. Despite some efforts by the population of Taïgbé in the rehabilitation of existing protection infrastructures, the plains are increasingly exposed to saline intrusion. Rice cultivation practiced by thousands of farmers in these plains, made them one of the rice granaries of the sub-prefecture of Kamsar and will disappear if urgent measures are not taken. In view of the above, the following research question arises: how does climate change influence agriculture in Taigbé? To answer this concern, we propose the objective of studying the impact of climate change on agriculture in Taigbé (Republic of Guinea).

2. Materials and Methods

2.1 Presentation of the Study Area

Taigbé is a small island, located in the coastal area of the Republic of Guinea, to the north of the sub-prefecture of Kamsar, itself under the supervision of the prefecture of Boké, to the south by the island of Kouffin and the island of Binary, to the west by the Atlantic Ocean and to the east by Kawass. The main activity of the population is agriculture (rice growing, fishing and market gardening). The total population of Taïgbé in red on the (Fig. 1) with its boundaries, was 6,765 inhabitants (RGPH3).

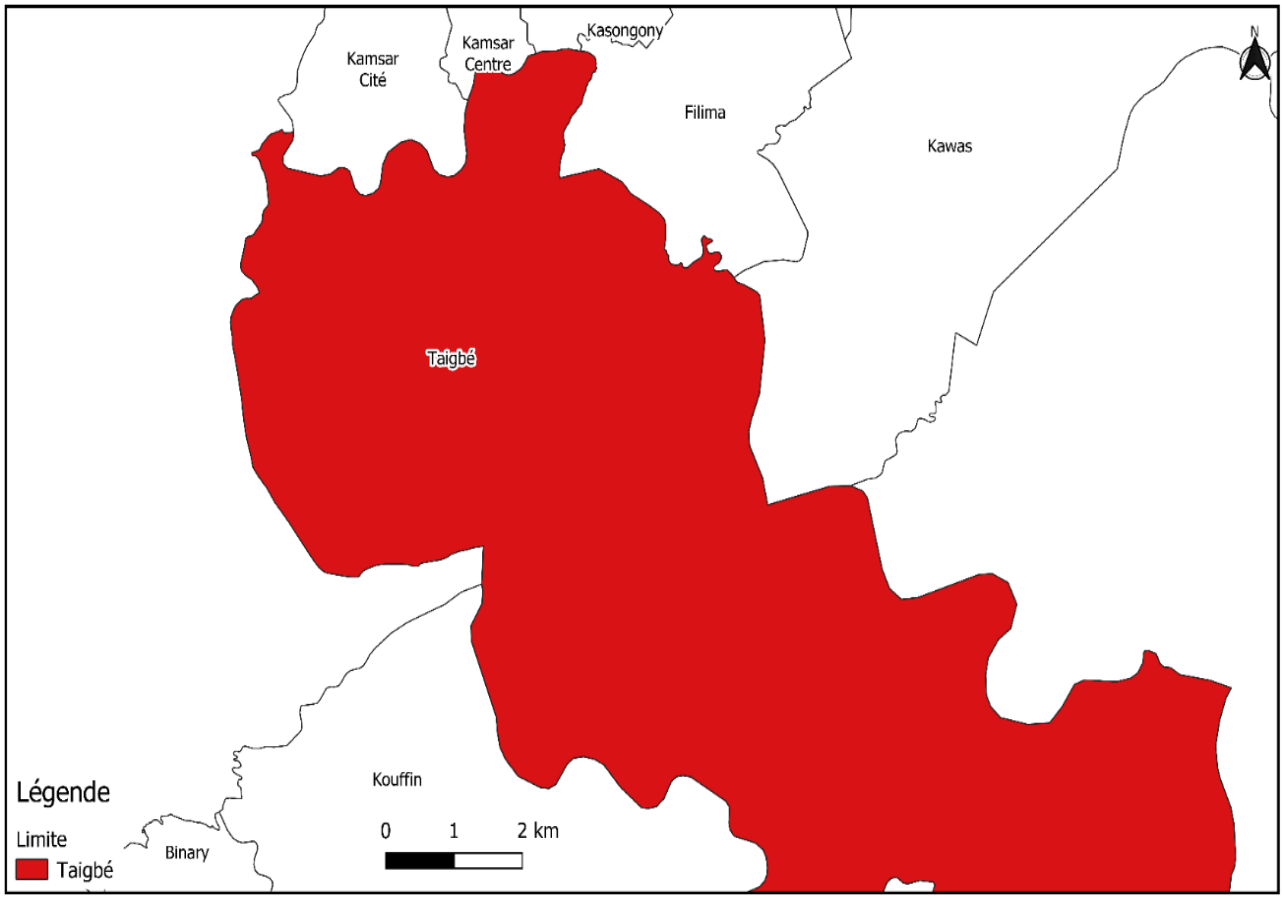


Fig. 1 Location of the area.

2.2 Study Framework

The CERE (Center for Environmental Studies and Research) of Gamal Abdel Nasser University in Conakry served as the framework for the study of this work.

2.3 Surveys, Field Observation and Statistical Analysis of Collected Data

To study the impact of climate change on agriculture in Taigbé, we first characterized endogenous practices and then we established a change map to show the changes that occurred in land use in Taigbé. Through a quantitative approach, the survey method through questionnaire and observation was used, followed by the cartographic method with image processing and statistical data (descriptive statistics) and climatic data (temperatures and rainfall). The survey involved 150 people including 36 women (125 farmers, 15 fishermen and 10 people from the public administration). In addition, to establish the change map, satellite images of the Spot heritage and Sentinel type, with a resolution of 10 m, were used. These images from 1986 for the Spot and 2022 for the sentinel images were used to produce a diachronic map (1986 and 2022) of land use dynamics, in order to highlight the changes that have occurred in crop fields over time (36 years). For the processing of satellite data, we used the CAIP (Computer-Aided Photo Interpretation) classification method. Image processing was carried out on QGIS 3.10 software.

Figs. 2 and 3 indicate some of these points visited and surveyed.

Fig. 2 Showing the condition of a drought-stricken rice field.

Fig. 3 Showing the survey activities.

2.4 Materials Used

For this work, we used survey sheets and statistical and climatic data records; the Garmin 64 GPS (Global Positioning System) for the collection of cartographic data, Sentinel and Landsat data for satellite images.

3. Results and Discussion

3.1 Characterization of Endogenous Adaptation Practices

Based on the results of the survey, among the endogenous practices of adaptation to climate change, the population of the district of Ta ǧb é mainly use market gardening, fishing, salt production, trade, the use of short-cycle varieties adapted to new climatic constraints, etc..

3.1.1 Fishing

The results of the survey reveal that 37% of respondents are turning to artisanal fishing as a solution to their declining production. Most farmers in the area are also fishermen.

3.1.2 Market Gardening

To adapt to the effects of climate change, 30% of the people surveyed (mostly women) opt for market gardening and the use of short-cycle varieties. Our results corroborate with those found in the study in the Upper Niger Valley in Dabola, Republic of Guinea, which notes that to cope with climate change, as adaptation measures, market gardening is increasingly practiced, short-cycle varieties, and the experimentation of new crops (soybeans, for example) [17].

3.1.3 Salt Production

In Ta ̈gb é, women produce very large quantities of solar salt: 2-3 bags of 50 kg/woman/day for three (3) months: February, March and April. Almost all women practice this activity, although it is slowed down at times by the submersion of the salt traps due to the saline rise.

3.1.4 Change of Socio-Professional Activities

Most of the surveys (70%) claim to have changed their profession. Indeed, this change of profession is explained by the fact that rice yields have decreased due to the recurrent saline intrusion of their fields. Some may work as laborers in the surrounding mining companies (CBG and GAG). This state of affairs is also an alternative solution, which the inhabitants of Taigb é use.

3.1.5 Youth Mobility

Due to financial difficulties, 15% of the people surveyed have already migrated to cities or other countries to protect themselves against the effects of climate change, which indicates the financial precariousness of the communities in the Ta ̈gb é district. Our results corroborate the study in Mali and Senegal, which shows that seasonal and temporary migration is widely used as an adaptation strategy to climatic conditions [18].

3.1.6 Change in Eating Habits

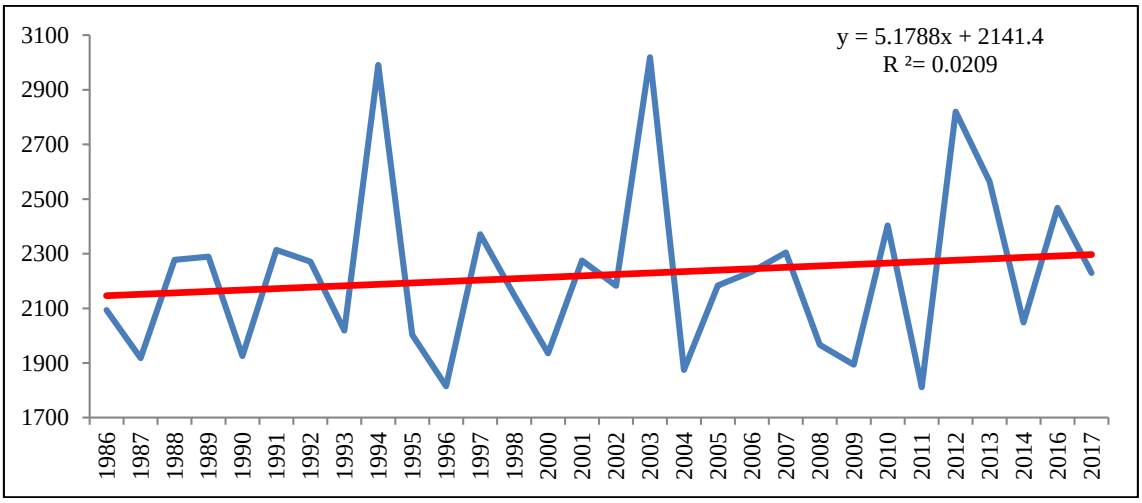
The change in eating habits is partly due to the effects of climate change on rice cultivation. Among the respondents, 60% claim to have changed their eating habits. They now consume imported rice instead of the parboiled (local) rice they previously consumed.

3.1.7 Trade

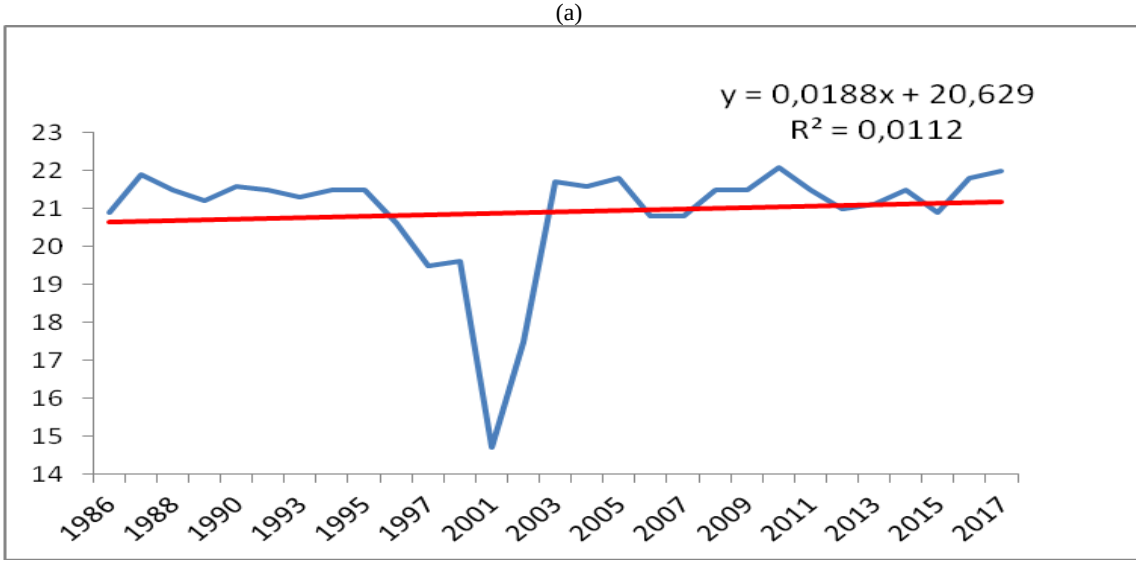
To meet family needs and to adapt to the adverse effects of climate change following the loss of agricultural land, some farmers have become traders. Thus, products such as salt, fish and palm oil are sold in Kamsar. In addition to these alternative solutions, the respondents also mention that fraternity, mutual aid and solidarity between farmers allow them to support farmers who are victims of disasters (flooding of fields, loss of production, income, etc.). To better understand why the population has opted for the endogenous practices mentioned above, we looked at temperature and rainfall records to show the facts underlying them. Through the data obtained from the National Directorate of Meteorology, the year 2003 recorded more than 3,019.1 mm^3 of water with monthly rainfall marked by a very low quantity between the month of June (293.5 mm^3) and the month of November (48.7 mm^3). The period of 1984 (1,791.5 mm^3) and 2011 (1,811.4 mm^3) recorded the lowest interannual rainfall. Thus, the rainfall data show a downward trend (Fig. 4a).

The rainfall in the area is characterized by very high interannual variability, which makes any planning policy difficult and exacerbates the vulnerability of agriculture, considered a central pillar of Guinea's economic development. The area is witnessing an increase in extreme events (floods, strong winds). According to the people surveyed, among the reference dates for climatic events, the district recorded the highest rainfall in 1998, which caused flooding and loss of life. The surveys showed that farmers in Ta ̈gb é are experiencing enormous difficulties. The results reveal that 98% of farmers note a scarcity of rain. This result is similar to that found in the study on the impact of climate change on phylogenetic resources where producers also observe a scarcity of rain [19]. Furthermore, the months of February, March and April of 1998 were the hottest months of the last 30 years in the sub-prefecture of Kamsar (Figs. 4b and 4c).

The meteorological data from the Kamsar sub-prefecture and the comments collected from the people surveyed show that the start of the rainy season is becoming later and later, the rainy season is becoming shorter and shorter, with an early end to the rains. This result corroborates that of the Burkinagb é team [20], which states that generally for both provinces, the increasingly late start of the rainy season has attracted the greatest attention, coming in first place as the most mentioned rainfall characteristic.



(a)



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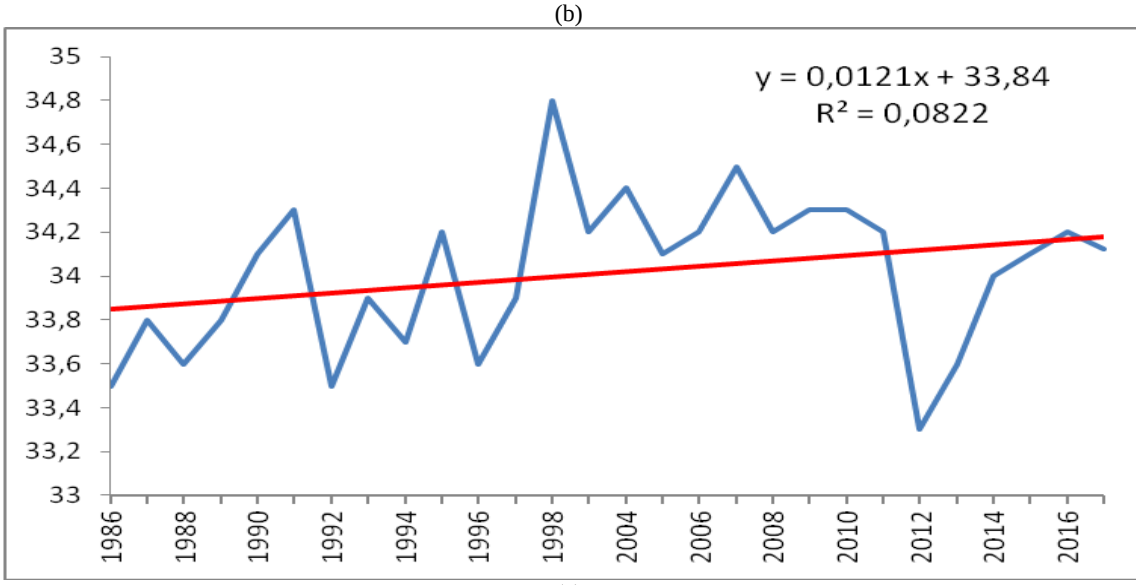

(c)

Fig. 4 (a) Annual rainfall (National Weather Directorate); (b) Minimum temperature (National Weather Service); (c) Maximum temperature (National Weather Service).

3.2 Change Card (1986-2022)

Two maps from 1986 and 2022 were developed and compared. This comparison highlighted the dynamics of change in land loss but also the decrease or decline in the area of the mangrove from 3,197.427 ha, or 38.80% (1986) to 2,988.544 ha, or 36.26% in 2022. We extracted the change map to show the areas of change. The examination of the occupation dynamics showed that the mangrove ecosystem was heavily encroached upon by the population over these three decades in Ta ğb é following the salinization of crop fields. From 1986 to 2022, most of the respondents (69%) lost their crop areas, more than 200 ha, which sufficiently proves that the rise in sea level has destroyed the arable land in the study area. This could lead to a reduction in agricultural production and later lead to a change in socio-professional activity (Figs. 5-7).

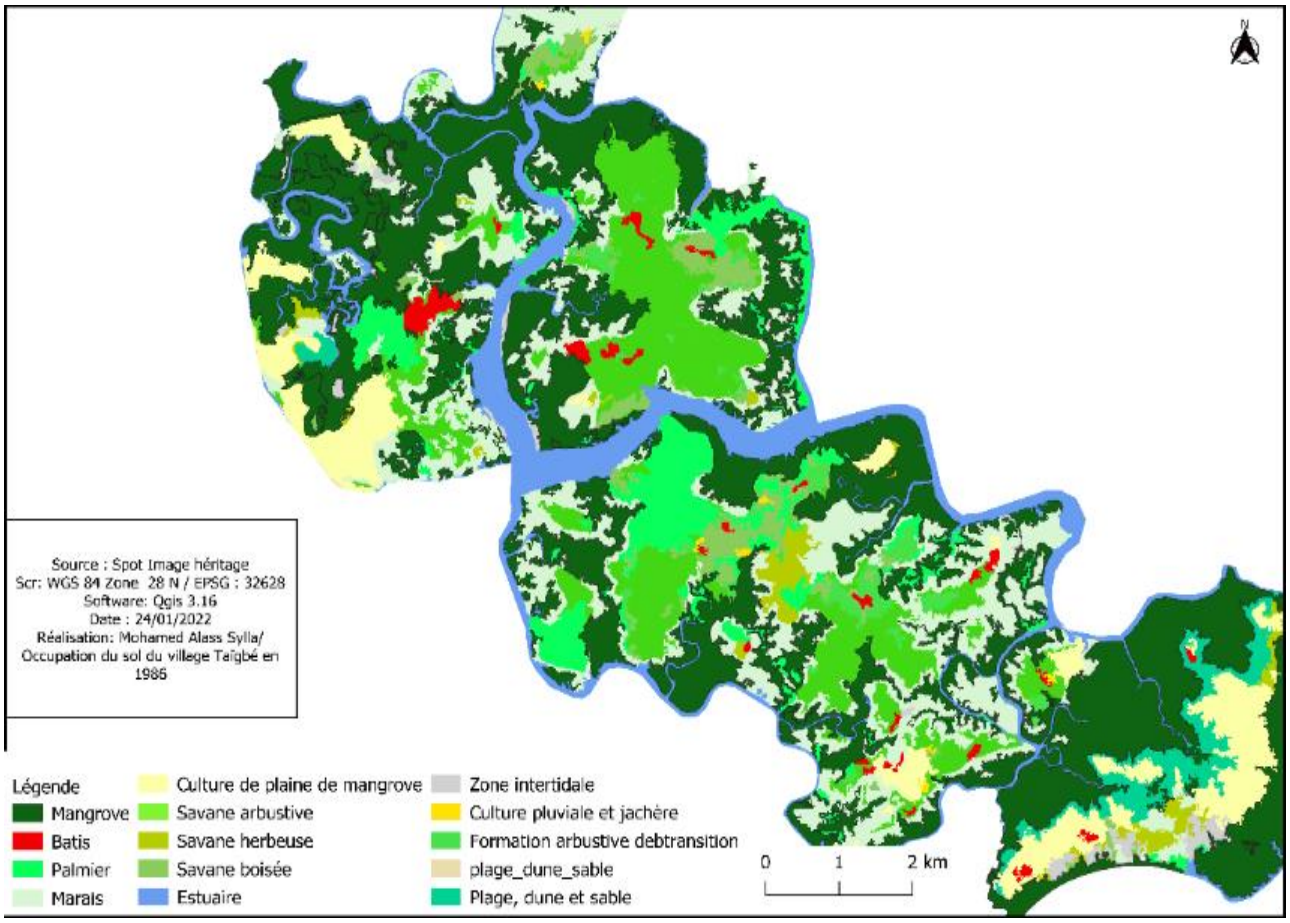

Fig. 5 Land use map (1986).

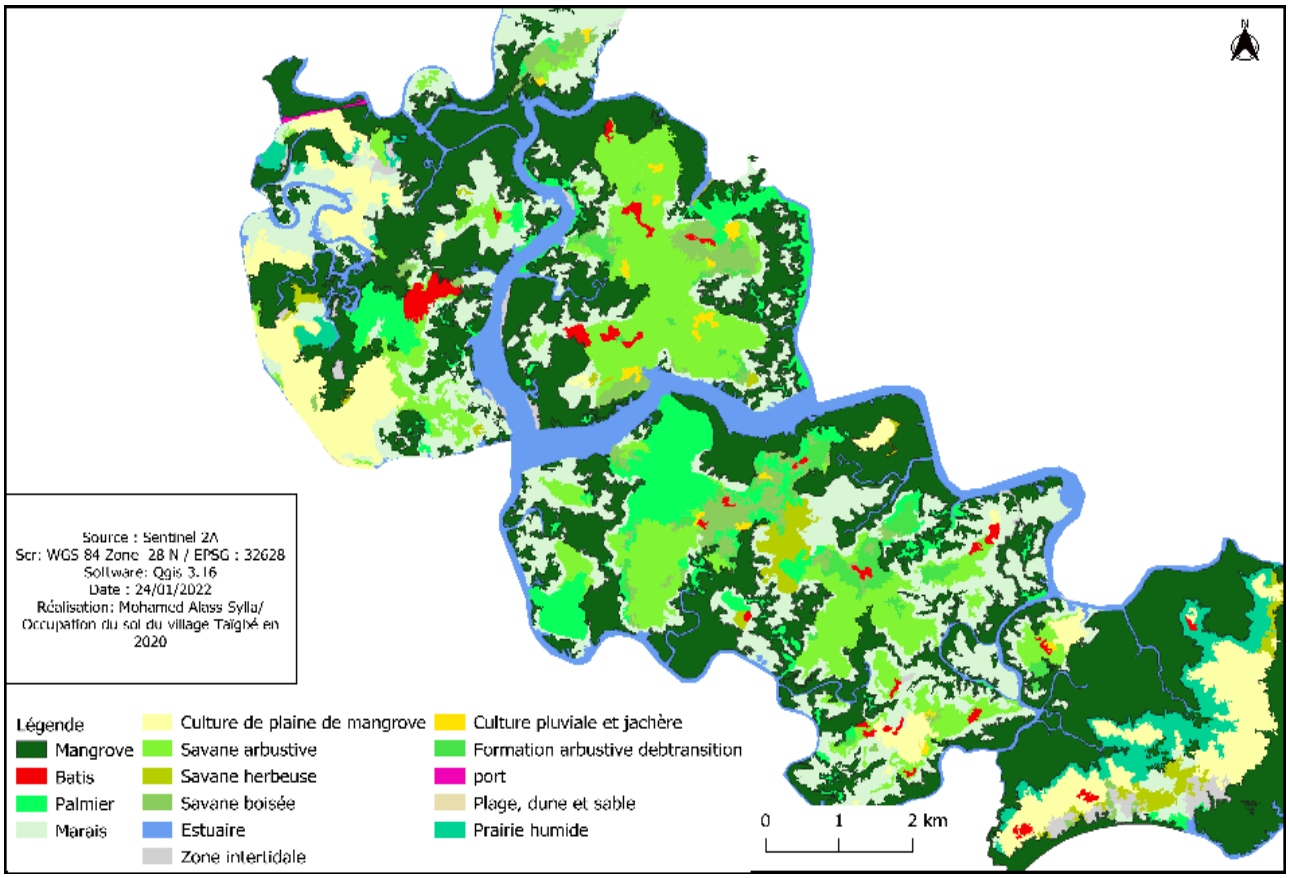

Fig. 6 Land use map (2022).

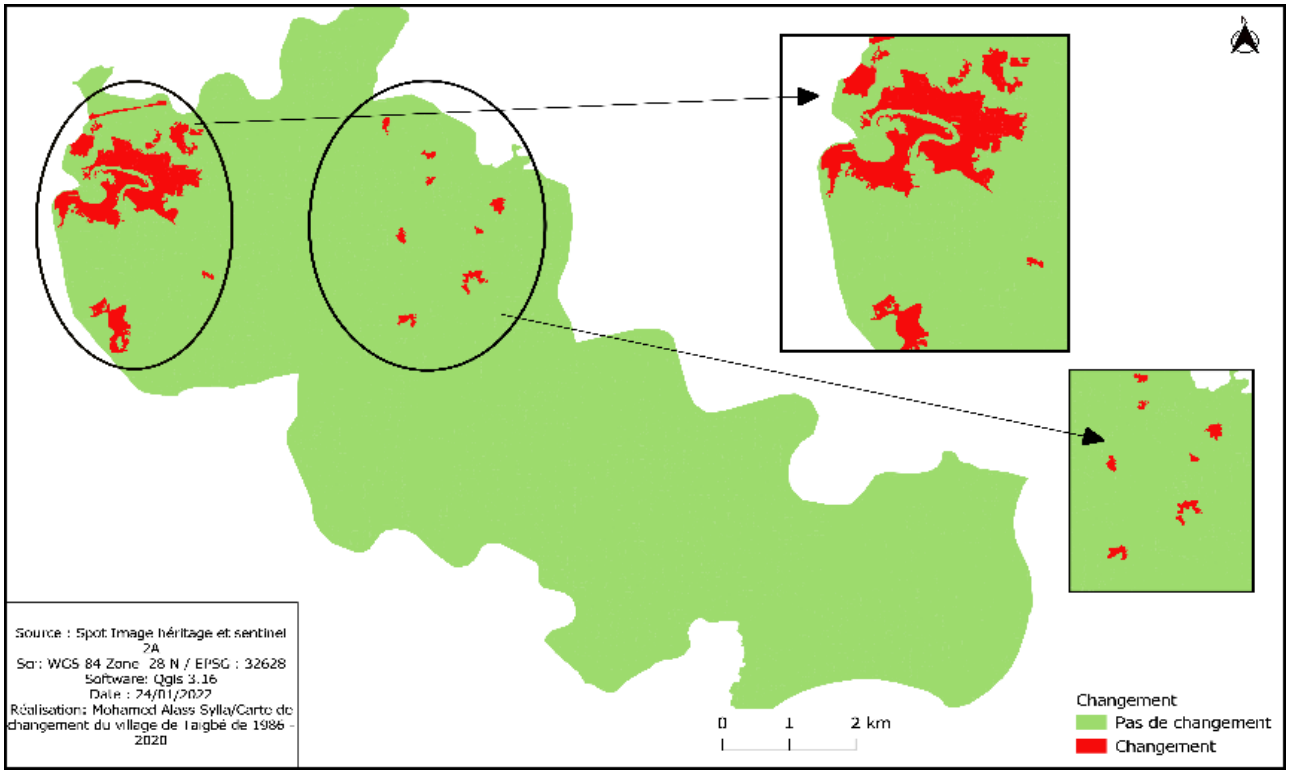

Fig. 7 Land use map (1986-2022).

4. Conclusion

This study helped to understand the impact of climate change on agriculture in Taigbé. Through the characterization of climate change adaptation options in Taigbé, we understand that the population is aware of the problem and is acting with the means at its disposal. Mainly, the study helped to confirm the climate trends described for the area by 2050, including a shortening, a late start and an early end of the rainy season. This is confirmed by surveys and rainfall records. Also to cope with climate change, the population, beyond rice growing, practices fishing, market gardening, small-scale trade and change of activities among others, as an endogenous solution to the problem of climate change. Finally, the change map clearly showed the loss of land. The rise in sea level which is the manifestation of climate change in coastal areas leads to the loss of land by salt rise leading to flooding. Taigbé being an island, if nothing is done, there will be no more arable land, which is why at the end of this study we recommend: strengthening the capacity of agricultural stakeholders and technical services on climate change, strengthening awareness of the phenomenon of climate change for greater awareness, carrying out crossing works between Kamsar and Taïgbé and building protective dikes to protect crop fields, continuing other research in the field and developing an agricultural insurance mechanism to relieve farmers in the event of a poor harvest.

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