

Individual perceptions on rainfall variations versus metric precipitation trends in two contrasted neighbourhoods in Abidjan, Côte d'Ivoire.

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1. Introduction

Global climate projections show that the increasing trends in extreme precipitation will very probably contribute to the resurgence of the risk of flooding in the cities in the course of the coming century [1,2]. Worldwide, an overall increase in very wet days has been observed in countries situated in intermediate latitudes of the northern hemisphere and in Australia [3]. Nevertheless, if the simulated precipitation models of the last century show a greater intensity of precipitation compared to the mean annual precipitation in several regions of the world [4], these simulations remain very uncertain in the tropical and subtropical regions [5].

In parallel with this uncertainty regarding knowledge of the physical reality of the climate in sub-Saharan Africa, the populations may have their own perception of the variability of precipitation. These perceptions, which subsequently give rise to actions, are constructed on the basis of frameworks of comprehension (also referred to as frameworks of reference or by the sociologist Erving Goffman [6] experience frameworks), in which are developed the perceptions of occurrence fact or an event.

The literature thus reveals that a decline in precipitation over the past 30 years would appear to be the most widely documented opinion for West Africa [7], in particular on the basis of surveys carried out in Burkina Faso [7,8], Benin [9,10] and Ghana [11,12]. In parallel with this perception of a decline in precipitation, the populations surveyed perceive an intensification of precipitation [13,14], in addition to the idea that the rainy season is different today compared to the last decades, with the rainy season starting later, ending sooner and of shorter duration [7,12].

The present study therefore seeks to determine the similarities and the divergences between the perceptions of individuals surveyed regarding the variability of precipitation and the trends observed in the meteorological data at Agbekoi and Palmeraie. To this end, we have analysed the results of a survey based on a questionnaire which we have considered in parallel with analyses on the trends observed in the metric indices of precipitation.

2. Methodology

2.1. Collection of data for the survey

In the framework of the Evidence¹ project, this research has been carried out at two contrasting neighbourhoods (disadvantaged and residential) of the district of Abidjan, the economic capital of Côte d'Ivoire: Agbekoi, in the municipality of Abobo, and Palmeraie in the municipality of Cocody. In total 503 individuals surveyed responded to a questionnaire related to various themes linked to flooding, and recording the socio-demographic and economic characteristics of the households. The questions concerning the perception of the characteristics of the rain over the past ten years reflect the individual perception of the person responding to the questionnaire regarding the beginning, the end and the duration of the rains, the rainiest year, the quantity of rain, the intensity of the precipitation and extreme rainfall episodes.

¹ EVIDENCE 'Évènements pluvieux extrêmes, vulnérabilité aux inondations et à la contamination des eaux' (Extreme rainy events, vulnerability to flooding and to the contamination of water) is a project based at Abidjan of which the main aim is to contribute to the mitigation of risks associated with extreme rainfall impacting the living conditions of urban populations (<http://www.evidence-ci.org/>).

2.2. Meteorological data

In the absence of meteorological data from ground observation in the two neighbourhoods, we used CHIRPS (Climate Hazards Group Infrared Precipitation) satellite data². This product developed by experts from the Climate Hazards Group provides estimations of precipitation at a spatial resolution of 0.05°*0.05° (or ≈ 25 km²) based on records from synoptic meteorological stations and measurements from infrared observations of clouds[15].

2.3. Statistical analyses

2.3.1. Calculation of the climate indices trends

Indices of climate variability for precipitation, established by the Expert Team on Climate Change Detection and Indices (ETCCDI)[16], were calculated and used for comparison with the perception of individuals. These climate variability indices were calculated using the package 'climdex.pcic' under R[17]. The climate indicator trends were determined using the test of Mann-Kendall[18]. This test was applied using the package 'trend' under R[19].

3. Results

3.1. Similarities and divergences between individual perceptions and metric precipitation trends

The results evidence a divergence between the perceptions of individuals surveyed regarding the end of the long rainy season and the precipitation data trends in the Agbekoi neighbourhood. In fact 76 % of individuals surveyed (Figure 1.b) in this neighbourhood report a later end which is in contradiction with the negative trend in the meteorological data which reflects an earlier end to the long rainy season. Similarly, in the same neighbourhood, 66 % of individuals (Figure 1.c) report a longer duration of the long rainy season. Yet the trend in the precipitation data shows a shorter duration of the long rainy season.

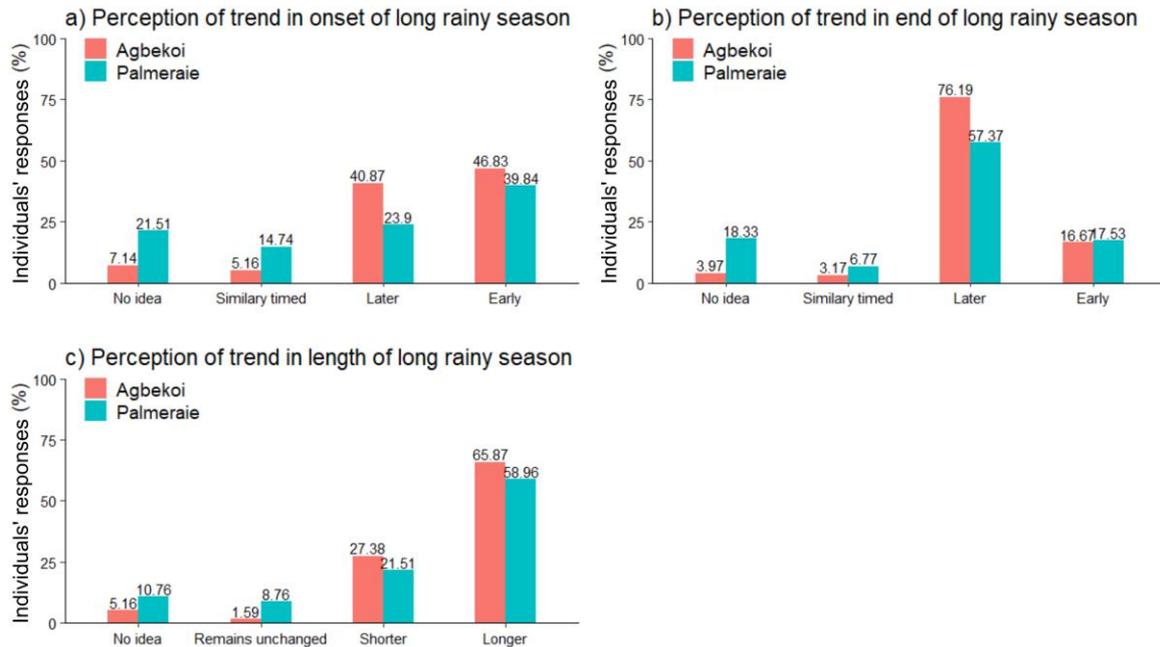


Figure 1 : perception of individuals regarding the variation of the long rainy season in their neighbourhood

Regarding the intensity of precipitation, the individuals surveyed perceive an increase in the rainfall intensity in the case of most of them at Agbekoi (73 %) and at Palmeraie (93 %) (Figure 2.b). This perception converges with the trend in the intensity indicator (SDII) which is significant in the Palmeraie

² <https://www.chc.ucsb.edu/data/chirps>

neighbourhood with a slope of 23%. This slope reflects the increase in intensity of precipitation greater than 20% at Agbekoi and would appear to be convergent with the perception of individuals surveyed. Furthermore, the trend in R50mm confirms a significant increase at Agbekoi. The perception of individuals surveyed regarding the quantity of precipitation is thus more consistent with the number of days of extreme rainfall.

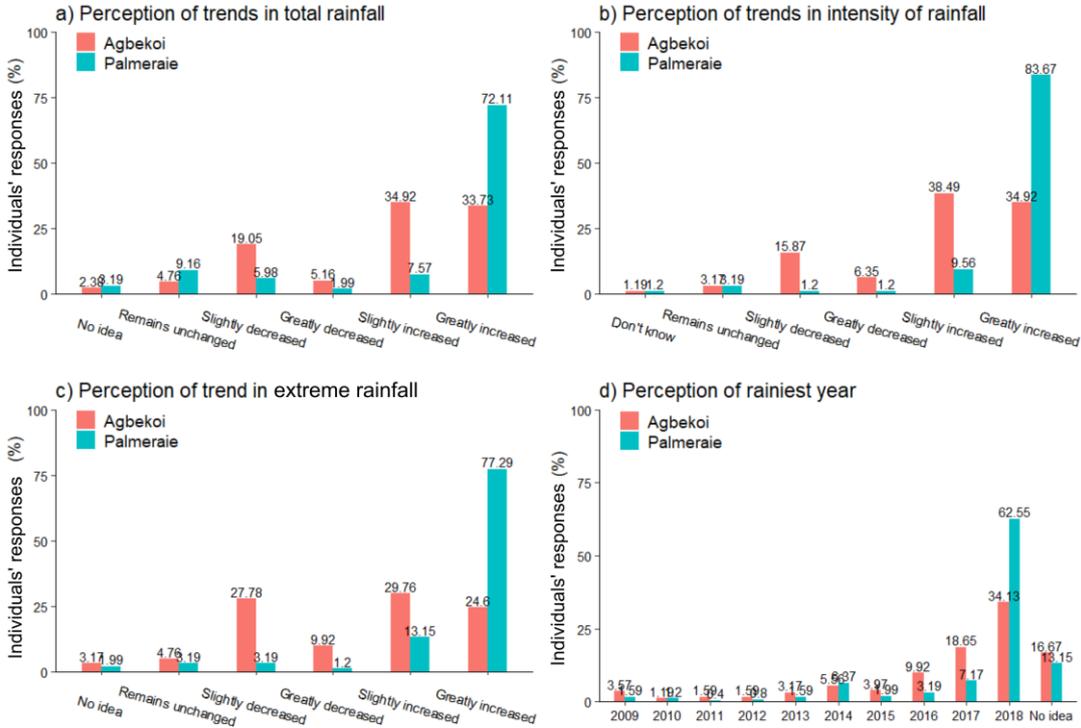


Figure 2 : perception of individuals on the variation of precipitation in their neighbourhood.

4. Discussion

This study has revealed certain points of divergence and other points of convergence between the perceptions of those surveyed and the pluviometric measurements. Firstly, there is a divergence between the perception of individuals surveyed concerning the variations in the beginning and end and the duration of the long rainy season and the meteorological data. The individuals perceive a later end and a longer duration of the long rainy season in the period 2009 to 2018, whereas the measured trends show an earlier end and a shorter duration of the long rainy season. According to Kouassi et al., [20], the variability of these dates, calculated on the basis of meteorological data, of the onset and the end of the long rainy season is high. This might explain the difficulty for individuals surveyed to perceive exactly the changes in the dates of the beginning and end of the long rainy season.

The perception of an increase in the intensity of heavy rainfall is largely shared by other individuals in West African countries [21,22]. The people questioned in our survey also perceive an increase in days with rainfall higher than 50 mm and the intensity of precipitation in the period 2009 to 2018. Furthermore, the trends in measured climate indicators show similarities with the perception of individuals surveyed on these questions at Agbekoi and at Palmeraie. Daily rainfall higher than 50 mm is considered as heavy rainfall and is likely one of the factors causing flooding in the district of Abidjan [23].

5. Conclusion

The results of this study show that individuals surveyed have a perception of change in the variability of the long rainy season, a perception which goes beyond the trends in the meteorological data. The precise dates of the beginning and end of the long rainy season are difficult for residents of an urban environment to remember. In contrast, individuals surveyed perceive certain intensive precipitation events, in particular days of rainfall higher than 50 mm and the intensity of precipitation, climatic

variables associated with the risk of flooding in the Abidjan district. The perception of these intensive events is divergent between the individuals surveyed affected and those not affected by the floods or runoff in the Agbekoi neighbourhood.

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