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Raising adaptive capacities through agrometeorological learning - lessons from Burkina Faso and Senegal

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Abstract

Climate change poses significant challenges to farmers worldwide, impacting crop yields and exacerbating food insecurity. To address these challenges, enhancing agricultural resilience is crucial. One effective approach is empowering farmers with tools for informed decision-making, such as local weather observation and agrometeorological learning. A three-year collaborative research project, part of the NUTRiGREEN initiative supported by the European Research Area Network Cofund (ERA-NET) Food Systems and Climate (FOSC), examined the feasibility and impact of such initiatives in Senegal and Burkina Faso.
Data on daily maximum and minimum temperatures and rainfall in seven rural villages located in semi-arid climatic zones were collected and analysed from 2022 to 2023. This data, collected by trained observers, facilitated by NGOs, and analysed by student assistants, was compared to long-term averages. The results were fed back to the local weather observers on a quarterly basis in combination with focus group discussions for evaluation. For the analysis of historical weather data, re-analysed open-source weather data provided by the World Bank was used. Results of ombrothermal diagrams showed decreased rainfall and increased maximum temperatures, with variations among villages and years compared to the long-term average from 1991 to 2020. Rainfall occurred mainly in July and August, while the other months of the rainy season - June, September and October - were comparatively dry. The number of rainy days varied widely between villages and years, with the largest difference in Razoutenga village of Burkina Faso being 21 days in 2022 and 40 days in 2023.
Despite challenges, such as poverty, food insecurity, illiteracy, and logistical issues, the experiment had positive outcomes. Communities expressed a strong demand for improved rainfall information, and observers were empowered to read and interpret climate data, bridging the knowledge gap between scientist and rural farmers. This study underscores the importance of localized climate information and community engagement in building agricultural resilience. However, to maximize benefits, agro-meteorological learning should be further integrated with support for agro-ecological farming practices, directly impacting food security and smallholder incomes.

Keywords: Agroecology, agrometeorology, Burkina Faso, climate change, climate information, Senegal, weather observer

Introduction

Climate change is part of the reason that food insecurity and undernourishment are increasingly affecting the semi-arid climatic zones of Burkina Faso and Senegal. The proportion of the population affected by severe food insecurity increased from 10% in the years 2014 – 2016 to 21% for 2020 – 2022 in Burkina Faso (FAO et al., 2023). In Senegal, this value increased from 8% to 11% in the same time frame. Furthermore, the total number of undernourished people in Burkina Faso increased from 2.8 million between 2000 and 2002 to 3.6 million between 2020 and 2022, representing 23% and 16% of the total population (FAO et al., 2023). Notably, the total number and its percentage of the population was decreasing until the time frame of 2009 – 2011 (2.3 million) but increased ever since. In Senegal the total number of undernourished people decreased from 2.4 million in 2000 – 2002 (25% of the population) to 1 million in 2017 – 2019 where it stagnated until 2020 – 2022 (6%) showing that the trend can be stopped, although it remains at a high level (FAO et al., 2023; Röhrig et al., 2021; Tomalka et al., 2022).
One of many possibilities to counter this development is the enhancement of climate resilient farming, which is what the NUTRiGREEN project endeavours to achieve. Within the work package presented in this article, the project aims to empower farmers with tools for informed decision-making through local weather observation and agrometeorological learning. This is achieved through collecting local weather data which is then related to long-term averages. Furthermore, the feasibility and impact of such initiatives in Senegal and Burkina Faso is examined.

Methods

In cooperation with the partner NGOs "Association Koassanga" in Burkina Faso and "Association pour la Promotion de l'Agroforesterie et de la Foresterie" (APAF) in Senegal, eleven villages participated in the agrometeorological learning field lab since October 2021. In two villages (crossed in figure 2) the project supported school and nutrition gardens, but didn't set up the agrometeorology instruments, as the villages joined in later. Therefore, only seven villages in Burkina Faso and two in Senegal participated (figures 2 and 1).

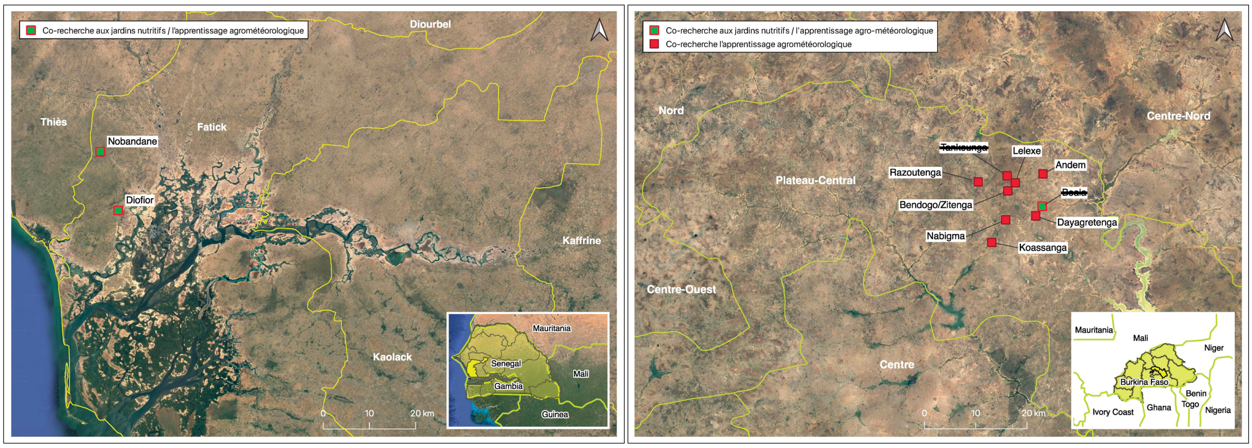

Figure 1, 2: Participating villages in Senegal (1) and Burkina Faso (2).

Between 2022 and 2023, the local weather observers engaged in collecting data in the nine participating villages. To ensure that the project is self-sustaining, the observers received pre-training, follow-up meetings, but worked on a voluntary basis. Using the thermometers (TFA Dostmann analogue mini-max thermometer) and rain gauges (TFA Dostmann analogue) provided by the project, they manually collected daily data on the maximum and minimum temperatures (in °C), and rainfall (in mm). The weather observers recorded their observation in notebooks and the NGO took pictures of their monthly recordings. The data was then analysed and compared to long-

term averages by APAF for Senegal and by student assistants of Humboldt-University Berlin for Burkina Faso. Following, the processed data was fed back to the local weather observers where it was then evaluated in focus group discussions biannually.
The data used for the long-term averages was taken from the World Bank (2024a, 2024b), as several attempts to obtain the historical daily weather data from the public meteorological services ANAM in Burkina Faso and ANACIM in Senegal were unsuccessful. As the World Bank database doesn't provide information on the number of rainy days, it was not possible to compare this data with the long-term average. Also, the values on rainfall and temperature refer to the average data for the years 1991 to 2020 of the countries' capitals, meaning they were collected approximately 50 - 70 km from the project sites in Burkina Faso and around 100 km from the sites in Senegal.

Results and Discussion

The chosen method empowered the local weather observers to read and interpret the collected climate data. The processed data, in the form of climate diagrams, is now available to the participating local communities who have expressed a particular need for the local measured rainfall data.
For each participating village, ombrothermal diagrams as shown in figure 3 have been produced for both 2022 and 2023. The example displayed for Koassanga village shows that both the maximum and minimum temperatures in 2023 are higher than the long-term average. It also shows that the rainfall for April to June and August to October is well below average, resulting in the annual precipitation being only half (56%) of the average.

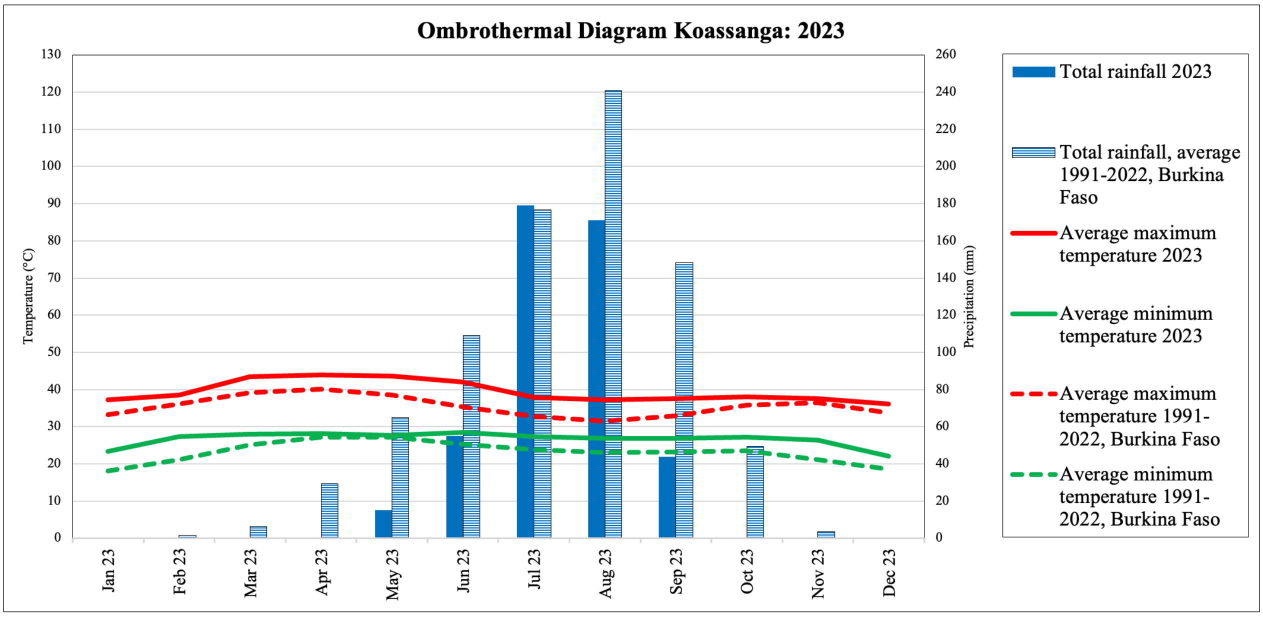

Figure 3: Example of ombrothermal diagram based on collected and average data.

The diagram of Koassanga presents a stark but illustrative example of the data collected in the other villages. As illustrated in figure 5, it can be observed that the rainfall levels recorded at all project sites were below the long-term average for both 2022 and 2023. Furthermore, it is notable that most project sites, except for Nabingma and Razoutenga, experienced a reduction in rainfall during 2023 in comparison to the previous year. Additionally, figure 4 illustrates that while precipitation levels were higher in 2022 than in 2023, there were more days of heavy rain (37 mm or more per day) in 2022 than in 2023. This observation is in line with climate projections for all parts of Burkina Faso that show a significant increase in rainfall per day or per five days in all scenarios (Sawadogo et al., 2024). Heavy rainfall events lead to higher erosion rates and flooding, which in turn is making agriculture less productive, despite the potential benefits of increased rainfall.

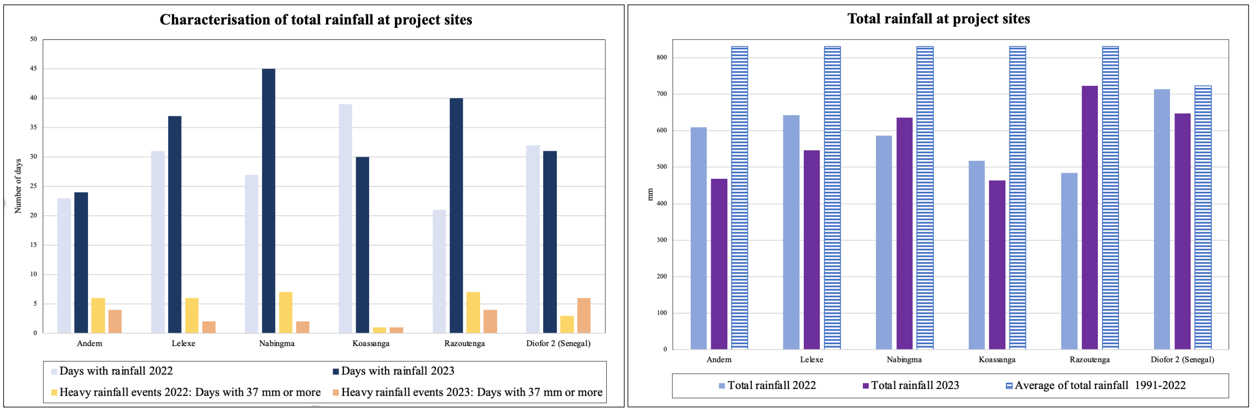

Figure 4, 5: Characterization of rainfall (4) and amount of total rainfall (5) in participating villages.

Conclusion and Outlook

In summing up the quality of the discussed data, it is important to note that the described inconvenience of the imprecise long-term data is due to the difficult access to official long-term weather data from national weather services. Furthermore, some farmers who took part as weather observers on a voluntary basis were not able to collect complete datasets. Only three out of seven villages collected complete datasets, the rest failed to report consistent data for the project period. This can partly be explained by the effort involved in daily data collection. Furthermore, it has shown that the gender of the weather observers might also have an influence on the completeness of the data, as two out of the three most reliable village data were collected by women. Also, illiteracy was a challenge, as were logistical and technical issues. Weather observers reported problems with the thermometers, some of them had stopped functioning due to the liquid separating inside. As a result, and to avoid the time-consuming daily observation, weather observers suggested measuring rainfall only during the rainy season.

Nevertheless, the agrometeorological learning process had a strong impact on the farming communities: At the beginning of the project, most participants had their first contact with thermometers and rain gauges. After two years of data collection and analysis, weather observers reported that they are were finally able to read, understand and explain the weather charts. Official weather diagrams displayed in the municipality, previously largely ignored, were suddenly a point of interest and discussion in the community. It became clear that rainfall is the limiting factor for most farmers, who seem to be more interested in measuring rainfall than in measuring temperature. In Burkina Faso, it was reported that also villagers are very interested in rainfall data as they like to visit the weather observers after rain events and ask how much rainfall was measured. The Senegal team concluded that learning about agrometeorology should be closely linked to training in agroecology to ensure greater relevance for participating farmers. Similarly, Tarchiani et al. (2021) piloted climate and weather services in Burkina Faso on larger scale with the meteorological service and has demonstrated the impact on higher profitability of sorghum production through increased yield, reduced production costs, and labour-saving farming.

This case study shows that establishing the infrastructure to enable agrometeorological learning can be challenging, but the method is proving to be a way of bridging the knowledge gap between scientists and farmers. This empowering method also generates valuable local data in the learning process. It gives the participating rural communities the chance to quantify the impacts of climate change, to speak more informed about weather, and thus builds climate resilience.

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