93. Pearl millet yields and climate evolution across the last 20 years in central Senegal. A yield gap study

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The study focuses on the evolution of yield of pearl millet in central Senegal between the early 1990s (P1) and present time (P2). Mean air temperature and total annual rainfall both increased between P1 and P2. To avoid confounding effects due to these differences in climate with other possible causes, yields measured in farmers' fields (Ya) in the two periods were compared with estimates of potential (Yp) and water-limited (Yw) yields obtained using a crop model. Ya were extremely variable across fields whatever the period (100 to 1937 $Kg.ha^{-1}$) and much lower than simulated Yw (1343 to 3251 $Kg.ha^{-1}$). Resulting from interactions between changes in sowing dates, the photoperiod sensitive nature of the cultivars used, and the distribution of changes in temperature across the rainy season (increasing in June and July, and decreasing in August and September), cycle durations were slightly but significantly increased between P1 and P2, whereas solar radiation decreased concomitantly with the increase in rainfall (from 377 to 614 mm). This provoked a decrease in Yp (3076±14 $Kg.ha^{-1}$ in P1 against 2843±37 $Kg.ha^{-1}$ in P2), whereas Yw increased (1959±92 $Kg.ha^{-1}$ in P1 against 2571±72 $Kg.ha^{-1}$ in P2). With the change in Ya, passing from 835±105 $Kg.ha^{-1}$ for P1 to 525±43 $Kg.ha^{-1}$ for P2, the resulting yield gap Yw-Ya significantly increased (1124±140 $Kg.ha^{-1}$ in P1 against 2045±77 $Kg.ha^{-1}$ in P2). Field management did not significantly change between P1 and P2. It is concluded that the low yields and their stability across climate variations were due to the non-intensive nature of the cropping system. The impact of climate change on agricultural systems of the region should be studied accounting for complex interactions between rainfall, temperature, and radiation and for possible changes in cropping systems in response to changes in the economic environment of farms, that would likely change the crop's sensitivity to climate variables.