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Impact of Climate Variability on Water Requirements of Lowland Rice Farming in South Sudanian Climate Region

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Abstract

Rice farming in south sudanian climate region is mainly rain-fed, subject to drought or flood which can wreck the harvesting hopes of small holder farmers. So, this study was aimed to mitigate the effect of these droughts on yield. Surveys have been done during August 2017 in three lowlands and at the extension services of the Ministry of Agriculture. Climatic data for the last 30 years have been analyzed by using Franquin method versus rice water need in Houet lowland area, Burkina Faso. The results show, that small holder farmers use five improved varieties with cropping cycle varies from 95 to 120 days. The sowing period is between mid-June to mid-July. And Yields in this lowland have depended strongly by rainfall. Analyse of climate data versus rice water's need show that, 97 % over this period, rice water needs were not met at 100%. To mitigate the effects of drought on the productivity of lowland rice, for direct seeding, the periods of 20 to 25 June and 20 to 25 July are suitable for rice varieties with 120 day and 90 days of cropping cycle respectively.

Keywords : climate variability, water need, lowland rice farming, rainfall, crop calendar

1. Introduction:

Today, the world is facing to food security challenge. Climate change, which is a major threat to food security (Gerald C. Nelson et al., 2009) would make this situation worse. Currently, more than 63% of the African population depends on rainfed agriculture for their livelihood (World Bank, 2015). However, in this climate change context, the lowlands due to their water potential, seems to be the privileged place for secure rice farming (OUATTARA, 2009, Africa-Rice2014). Indeed, rice yields in rainfed are best in lowlands compared to the upland (MARHASA EPA 2011). However, in the same lowland, yield varies from year to year depending on the climate (Philippine Rice Research Institute, 2011). Thus, farm surveys done by (Enquête FAO/EUFF région nord, 2015) in three lowlands in Burkina Faso over the period 2011 to 2014, showed that the average paddy yield in t/ha was 1.028 ; 2.296 ; 1.303 and 0.992 under a rainfall of 505 mm, 964 mm, 713mm,and 767 mm (Direction générale de la météorologie 2014). Productivity in these lowlands is therefore highly dependent on rainfall variability (Fujisaka (1990, (Meertens et al, 1999, FAO, 2007, OXFAM, 2011) that are increase in frequency, intensity, and duration of extreme events such as droughts, floods, changes in the intensity, timing and spatial distribution of rainfall (Philippine Rice Research Institute, 2011). Increasing rice's productivity in these lowlands can fight against food insecurity because lowland rice represent 71% of the rice areas in Burkina Faso and contribute for 57% of the national rice production (Task Force, 2014). The sustainability of lowland rice farming would require the lowland water management ((Rosegrant et Cline, 2003) and mastery of cropping's parameters such as sowing dates in order to mitigate the impact of climate variability. Indeed, often there is no harvest in this lowland when there is no rain during the late season as was the case 2017 in many lowlands in Burkina Faso (Sidibé, 2018). That is why, the main objective of this work was to study the impact of rain variability on lowland rice farming in south sudanian climatic zone in order to propose the best sowing period.

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2. Material and method:

2.1. Presentation of study area:

Houet province, located in the west of Burkina Faso, covers an area of 11582 km² (IGB, 1998) (figure 1) and is in the south sudanian climatic zone, with an average rainfall of 1200 mm per year (Guinko 1984). The climate is characterized by the alternation of dry and wet season.

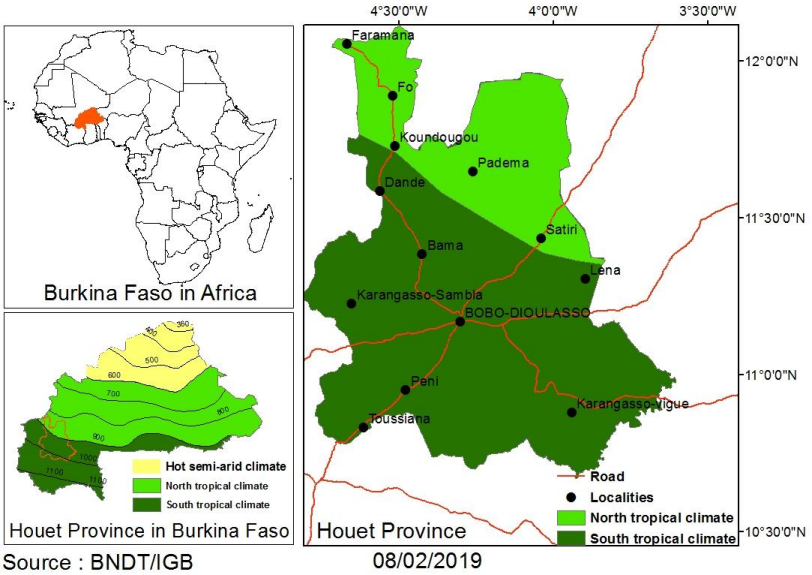

Figure 1: Map of Stady area

2.2 Rainfall series processing and analysis

The climate data collected at the airport of Bobo Dioulasso, is the series of 30 years (1987-2016). Lamb's method (1982) was used to calculate the rainfall index. Daily rice water need (ET rice) was estimated using Penman-Montieth method (Allen et al., 1998) and crop factor (Kc). We took 80% of the rain as effective. The position of precipitation and the ETo was located by using the agro-climatic analysis method of the water balance in the tropical region developed by Franquin (1969).

2.3 Characterization of lowland rice cultivation in Houet

These surveys have been done during August month 2017 in three lowlands (Kimini, Padema and Soma-Madinakoura) and at the extension services of the Ministry of Agriculture.

3. Results and discussion

3.1 Rice farming in Houet province

Houet province is one of the most important rice farming area in Burkina Faso. According to (Sié ,1982), small holder farmers produce rice in lowland with or without bunds. In 2016, Houet province has 54 lowlands with bunds on area of 3155 ha. 92.9% of these lowlands have been farmed on rice. As seed, they use local and four improved varieties (table 1). The cultural calendar is spread over an average 5 months from June to October. The sowing dates are very variable (between mid-June and mid-July) and the harvest from September to October. Finally, average rice yield in these rainfed lowlands is strongly dependent on the rainfall (figure 2**), (**Afouda ,1990; Langlois,2006).

Table 1: improved varieties use in Houet lowlands

Variété	Cycle
FKR 62N	118 jours
FKR 64 ou TS2	120 jours
FKR45	95 jours
FKR 19	95 jours
Orilyx 6	100 jours

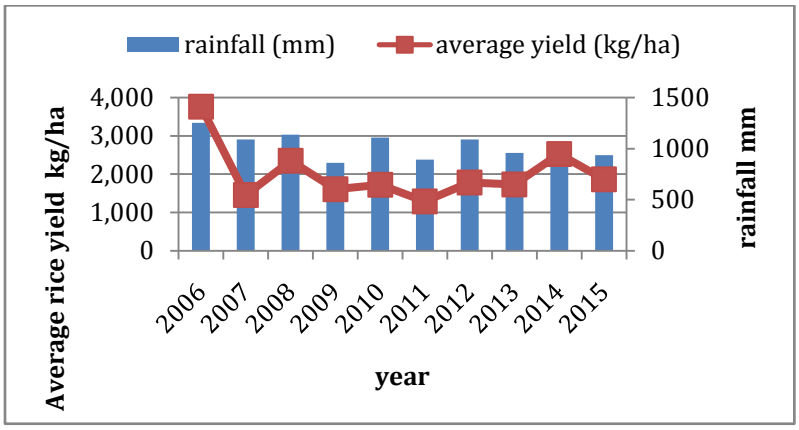

Figure 2: average rice yield in rainfed lowlands versus rainfall from 2006 to 2015 in the province of Houet

3.2 Impact of rainfall variability on rice production and it mitigation

Rainfall index is characterized by a high alternation of deficit (53% of years) and surplus rainy (47% of years) which have brought about upheavals of the crop calendars (figure 3). These results are consistent with those of (Djohy et al., 2015, Beavogui, 2012).

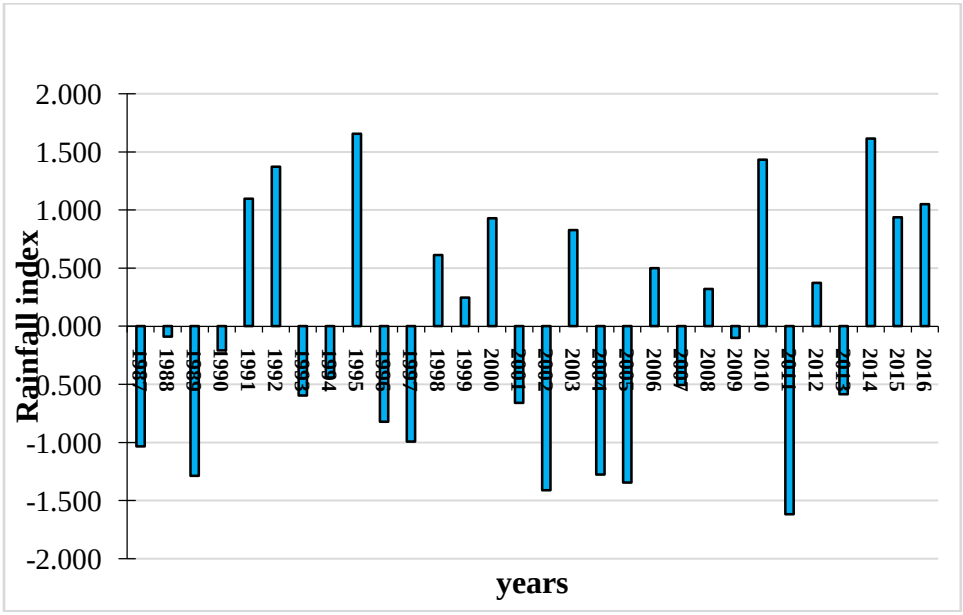

Figure 3: variability of rainfall index during the period 1987-2016 in Houet province

Annual useful rainfall is some years lower than rice water need (figure 4), which allow to emphasis the climatic risk in lowland rice farming in this area.

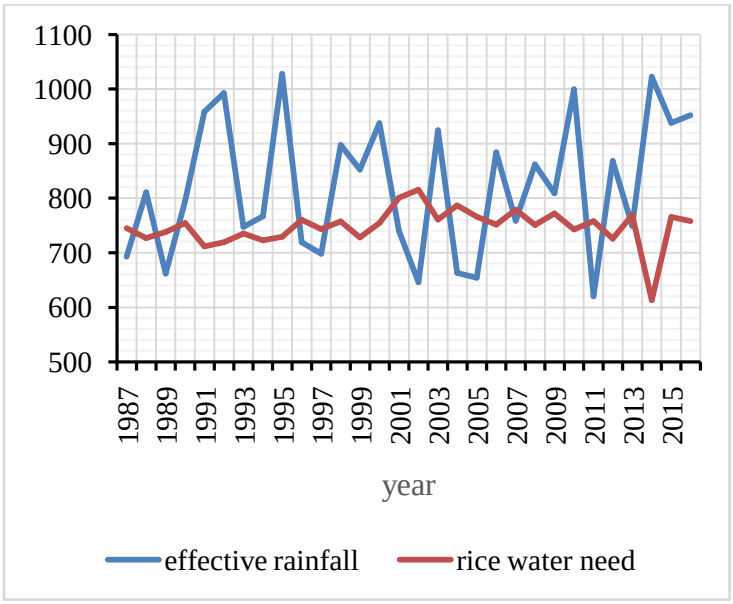

Figure 4: Comparison between rice water need and effective rainfall

Franquin method (Figure 5), allows to split the rainy season in the province of Houet, in three period: the pre-wet: May 1 to June 8, the wet: June 8 to September 14 and post-wet: September 14 to October. In fact, to mitigate the effects of rainfall variability on the productivity of lowland rice, for direct seeding, the periods of 20-25 June and 20-25 July are suitable for rice varieties of cropping cycle of 120 days and 90 days. These dates are in agreement with the results of Kambou (2008) and APRAO (2011).

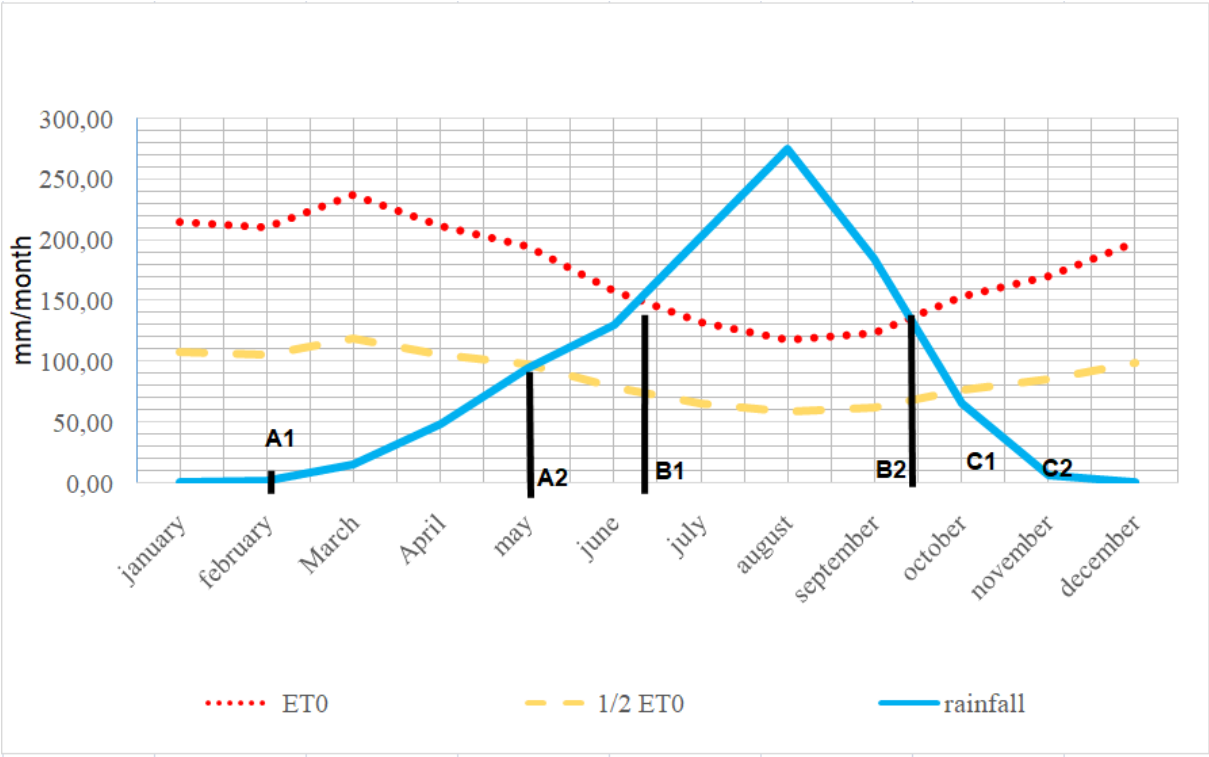

Figure 5: Average monthly rainfall regime, 1987-2016

4. Conclusion

This study showed that in Houet Province in Burkina Faso, small holder farmers produce rice in lowland with or without bunds. In 2016 rainy season, 3155 ha of lowland have been developed and 93 % farmed. Small holder farmers use five improved varieties with cropping cycle varies from 95 to 120 days.

The sowing period is between mid-junes to mid-July. And Yields in this lowland have depended strongly by rainfall hence rainfed rice farming is not made secure in the south sudanian climate region. As a result, to mitigate the effects of drought on the productivity of lowland rice, for direct seeding, the periods of 20 to 25 June and 20 to 25 July are suitable for rice varieties with 120 day and 90 days of cropping cycle respectively.

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