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Impact of climate smart agriculture adoption on food security: The case of urban market gardeners in the city of Réo, Burkina Faso

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Abstract

Climate change is affecting Burkina Faso's cities. This situation is forcing urban dwellers to take innovative measures to adapt. Several smart strategies have been implemented in urban market gardening to cope with recent rainfall variability over the period 2001-2021. The main objective of the study is to analyze the changes in rainfall in the area, the smart strategies used and the consequences in terms of food security of the strategies promoted in urban market gardening in Réo. To achieve this, a methodology combining secondary and primary data was required. Descriptive statistics, linear and logistic regression and the rainfall concentration index (PCI) were used to process the data collected. The study showed that the area has a high variability, with a PCI >20, reflecting a high variability and concentration of rainfall over a few months. In addition, the cumulative annual rainfall is increasing over the decade 2001-2021. This situation forces farmers to adopt a number of intelligent strategies to deal with the situation. This has led to leafy vegetable production, multi-species integration in vegetable plots and the introduction of short-cycle vegetables. These strategies have led to an increase in dietary diversity and a high level of food consumption, which has had an impact on the food security of market gardeners. The level of food insecurity is also low. This shows that the smart strategies promoted in the garden plots lead to high levels of food security for the market gardeners.

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Introduction

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, occurrence of extremes) of the climate on all time scales (IPCC, 2022). It affects every continent in the world and Africa is no exception (IPCC, 2021). In West Africa, changes in precipitation are long-run trends (Lüning *et al.*, 2018; Zhang *et al.*, 2021). In the Sahelian zone of West Africa, the Sahelian rainfall regime is characterised by a persistent deficit in the number of rainy days. At the same time, the frequency of extreme rainfall events has increased between 1970 and 2010 (Panthou *et al.*, 2014). The proportion of annual precipitation associated with extreme precipitation increased from 17 % in 1970 to 1990, to 18.9 % in 1991 to 2000, and to 21 % in 2001 to 2010 (Panthou *et al.*, 2014).

Sylla *et al.* (2016) suggest that West Africa will experience shorter rainy seasons, widespread arid and semi-arid conditions, longer dry spells and more intense extreme precipitation. In the face of this situation, smart agriculture has been identified by international organizations as a solution (Finizola *et al.*, 2024). This is because it is a key strategy to ensure the sustainability of agricultural systems and to guarantee food security and nutrition in the context of a changing climate (Antwi and Antwi-Agyei, 2023). Consequently, the issue is the subject of research in many countries around the world. Studies have been conducted in India (Kaur *et al.*, 2023; Agarwal *et al.*, 2022), Indonesia (Luckyardi *et al.*, 2022) and Bangladesh (Hasn *et al.*, 2018). In Africa, the majority of studies on climate-smart strategies have focused on East Africa. Studies focus on the drivers of smart agriculture adoption in Malawi (Shani *et al.*, 2024), Ethiopia (Zeleke *et al.*, 2024) and Kenya (Ndung'u *et al.*, 2023). Other studies explore the impact of smart strategies on livelihoods (Tilahun *et al.*, 20/23) and food security in South Africa (Abegunde *et al.*, 2022).

However, there are few studies in the Sahel region of West Africa, such as in Burkina Faso. Several studies in the north and south-west (Yanogo and Yaméogo, 2023), in the Mouhoun loop (Rouamba *et al.*, 2023) and in the west (Sougoué *et al.*, 2023) show an increase in extreme rainfall between 1980 and 2020. In urban areas, however, the situation will be critical, as extreme precipitation trends will increase over the period 2020-2040 (Yaméogo, 2024). The integration of smart strategies has become an important necessity for urban dwellers. In Burkina Faso's cities, people are opting to change their socio-economic activities, as in the city of Réo, in the province of Sanguié, in the centre-west of Burkina Faso. The town is criss-crossed by many low-lying areas. The inhabitants take advantage of these natural conditions to grow vegetables in the town. However, the variability of rainfall forces them to reorganize the cultivation systems on their plots (Yanogo, 2023). In order to cope with the current rainfall conditions, this situation forces the gardeners to adopt a variety of smart strategies in the garden plots. The main objective of the study is therefore to analyze the changes in rainfall in the area, the smart strategies used and the consequences in terms of food security of the strategies promoted in urban market gardening in Réo.

Materials and methods

Presentation of the study area

The commune of Réo covers an area of approximately 432 km². It is subdivided into nine (09) sectors (Fig. 1).

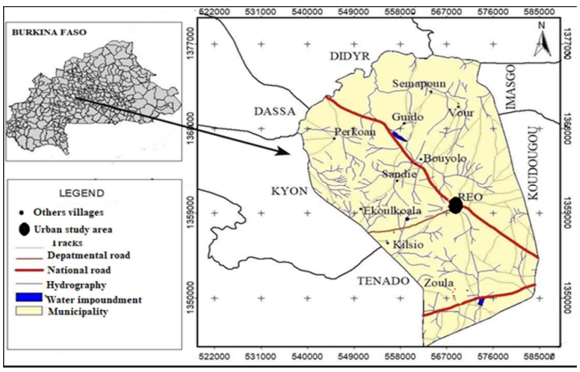

Fig. 1. Geographical location of the study area

The town of Réo is part of the Réo district. It is a town with a population of about 33,894 distributed over 9 sectors and several villages. The study area is located in sector 9 of Réo, with more than 30,000 inhabitants in 2019, including 7,676 in sector 9, the study area.

Data from the study

There are secondary and primary data. The secondary data come from the rainfall records of the Réo station in the province of Boulkiemdé, in the Centre-West region. They cover the period 2001-2021. They were obtained from the National Meteorological Agency of Burkina Faso. This period was chosen because there are no rainfall records from the Réo station. There are other stations, but they are not close to where we want to study. There are other stations, but they are not close to the study area and their inclusion could distort the results, hence the choice of the only station that allows an adequate assessment of the climatic situation in the area.

The primary data were obtained using the survey method. Purposive sampling is the sampling technique used in this study. The survey form was distributed to market gardeners in sector 9 of Réo. The size of the household to be interviewed was determined using Fisher's formula as follows:

$$N = \frac{t^2 . p(1-p)}{e^2} \quad (1)$$

Where,

N= represents the target population to be studied;

t: 95% confidence level (standard value 1.96);

p: is the proportion of market gardeners in the town of Réo. It is estimated at 14.6%.

e: the margin of error at 5% (standard value 0.05).

The application of the formula gives N = 192.08, i.e. N = 192 market gardeners to be interviewed. The survey forms were drawn up for the surveys carried out in sector 9 of Réo between December 2023 and February 2024, i.e. three (03) months.

Methods of data processing and analysis

These are based on secondary data from precipitation data and primary data from field surveys. The secondary data processing and analysis methods are based on SPI, linear regression and precipitation concentration index to characterize precipitation in the study area.

Standardized precipitation index (SPI)

This is used to quantify precipitation deficit on different time scales (Balram and Fanai, 2020) (Table 1).

$$\mathrm{SPI} = \frac{1}{\mathrm{N}} \sum_{\mathrm{j=i}}^{\mathrm{Ni}} \left(\frac{\mathrm{p_j^i} - \mathrm{P_j^-}}{\sigma_\mathrm{j}} \right) \quad (2)$$

Where, Pji is the rainfall in year i at station j, Pj the interannual mean rainfall at station j, σj the standard deviation of the seasonal cumulative series at station j, and Ni the number of stations in year i.

Table 1. Interpretation of drought level

Valeur SPI	Level of dryness
SPI ≥ 2,0	Extremely wet
1,5 ≤ SPI < 2,0	Very wet
1,0 ≤ SPI < 1,5	Moderate humidity
− 1,0 ≤ SPI < 1,0	Normal
− 1,5 ≤ SPI < − 1,0	Moderate drought
− 2,0 ≤ SPI < − 1,5	Severe drought
− 2,0 ≤ SPI	Extreme drought

Source: McKee *et al.*, 1993

Linear regression method

It is a parametric test that determines the relationship between two or more dependent and independent variables that have a causal relationship (Atılgan *et al.*, 2017). The hypothesis assumes that there is a linear relationship between the dependent and independent variables, so linear regression is defined as follows (El-Geziry, 2022; Yaméogo and sawadogo, 2024):

$$Y = \alpha + bX \quad (3)$$

Where, Y indicates a dependent variable, X indicates an independent variable, and a is the slope of the line and b is the y-intercept constant.

Precipitation concentration index (PCI)

This is an indicator of annual and seasonal trends in precipitation (Rawat *et al.*, 2021). An unbalanced distribution of precipitation can lead to periods of excessive rainfall or drought, making it difficult for plants and crops to grow (Michiels *et al.*, 1992). According to De Luis *et al.* (2011), the ICP is calculated as follows:

$$PCI = 100 * \frac{\sum_{i=1}^{12} p_i^2}{\left(\sum_{i=1}^{12} p_i\right)^2} \quad (4)$$

Where, i=1,....,12 is the month (January, February,) ; pi is the amount of rain in the ith month. It is interpreted in Table 2 below.

Table 2. Precipitation concentration index and interpretation

PCI values	Interpretation
PCI<10	Uniform distribution of monthly rainfall over the year
10 ≤PCI<16	Moderate distribution of monthly rainfall over the year
16 ≤PCI<20	Irregular distribution of monthly rainfall over the year
PCI>20	Distributions showing monthly rainfall variability over the year

Source: Michiels *et al.*, 1992

The primary data were analysed by looking at the frequency of gardeners' statements about smart strategies for coping with rainfall conditions and the food security status of gardeners in the study area. Commonly used methods to assess household food security status such as the Food Consumption Score (FCS), Dietary Diversity Score (DDS) and Food Insecurity Experience Scale (FIES) were used in this study. Several other similar studies have been conducted in Ethiopia (Roba *et al.*, 2019; Ali *et al.*, 2022), Lesotho (Nkoko *et al.*, 2024) and Burma (Hanley *et al.*, 2021) using the same indices.

Dietary diversity score determination

The dietary diversity index is a qualitative measure of food consumption that provides an indication of the access of the household/individual to different types of foods and the nutritional adequacy of the household diet (FAO, 2011). The composition of the different food groups is shown in Table 3.

Table 3. The food groups considered

Food groups	Foods in the group
Food group 1 (G1)	Cereals, roots and tubers, pulses
Food group 2 (G2)	Milk and dairy products
Food group 3 (G3)	Oils and fats
Food group 4 (G4)	Meat, fish, eggs and egg products
Food group 5 (G5)	Fruit and vegetables

Source: Hongbete *et al.*, 2017

The Dietary Diversity Score (DDS) is calculated by adding up the different foods consumed. The calculation involves assigning a score of 1 for consumption of a food group and 0 for no consumption of a food group. The dietary diversity scale is thus as follows (Abegunde *et al.*, 2022): DDS is low if the score is 1, then DDS is medium if the score is between 4 and 6, and finally DDS is high if the score is 7. In the study, the Dietary Diversity Score (DDS) is considered low if the score is 1, medium if the score is 2 and high if the score is between 4 and 5.

Determination of the food consumption score (FCS)

This is a measure of food security based on three criteria: diversity, food frequency and relative nutritional importance of various food groups (Ndiaye, 2014). The household food consumption score (FCS) was calculated using the following formula (Ndiaye, 2014, Agalati and Yabi, 2017):

$$FCS = A\ \text{Cereals} \times X\ \text{Cereals} + A\ \text{dried vegetables} \times X\ \text{dried vegetables} + A\ \text{vegetables} \times X\ l\text{vegetable} + A fruits \times X fruits + A\ \text{milk} \times X\ \text{milk} + A\ animal \times X animal + A\ \text{sugar} \times X\text{sugar} + A\ \text{oils} \times X\ \text{oils} \quad (5)$$

Where:

Ai = the weight assigned to the food group.

Xi = the number of days of consumption for each food group (≤ 7 days).

Table 4 shows the interpretation of the FCS.

Table 4. FCS values and interpretations

FCS values	Interpretation
FCS < 21	The household's food consumption is poor
21 ≤ FCS <35	Household food consumption is borderline
35 ≤ FCS <45	Household food consumption is moderately acceptable
FCS ≥ 45	Consumption is acceptable

Source: Ndiaye, 2014

Experience of food insecurity scale

This is a measure based on self-reported perceptions or experiences of access to food at the individual or household level (Coates *et al.*, 2007). It has been used successfully in Nigeria (Ajani *et al.*, 2006) and Australia (Nolan *et al.*, 2006). In this study, it was measured on the basis of nine (09) questions and their frequency of occurrence over a one-month period, as in (Coates *et al.*, 2007):

1. Have you ever worried that your household didn't have enough food?

2. Have you or any member of your household been unable to eat the types of food you prefer because of a lack of resources?
3. Did you or any member of your household eat a limited variety of foods due to lack of resources?
4. Did you or any member of your household eat food that you did not want to eat because you did not have the resources to get other types of food?
5. Have you or any member of your household eaten a smaller meal than you would have liked because there was not enough food?
6. Did you or any member of your household eat fewer meals a day because there wasn't enough food?
7. Has the household ever gone without food completely because there was no money to buy it?
8. Have you or any member of your household ever gone to bed hungry because there wasn't enough food to eat?
9. Have you or any member of your household ever gone a whole day or night without eating because there was not enough food?

Experience of food insecurity was measured on a scale defined as rarely, sometimes, often and never (Table 5).

Table 5. Level of food insecurity assessment

Number	Scale	Food insecurity level
1	Often	
2	Sometimes	
3	Rarely	
4	Never	

Source: Coates *et al.*, 2007

Binary logistic regression

The logistic model is used to model the relationshSPI between a dichotomous dependent variable and one or more independent variables, which may be continuous or binary (Rusliyadi *et al.*, 2023). In this context, therefore, the choice of each of the intelligent strategies used by the gardeners is a binary decision (0 or 1). The dependent variable is the adoption of smart strategies, with two modalities: adoption of smart strategies = 1 and non-adoption of smart strategies = 2. Thus, Yi is defined in the following way:

$$Y_i = \begin{cases} 1 \text{ if the ith producer has adopted a smart strategy} \\ 2 \text{ if producers have not adopted a sart strategy} \end{cases} \quad (6)$$

The hypothesis adopted in this study is that the choice of different smart strategies is influenced by the explanatory variables presented in Table 6.

Table 6. Explanatory variables and terms and conditions

Explanatory variables	Frequency	Modality	Expected sign
Age	Young=180 Old=12	1=Young 2=Old	+/-
Gender	Woman=73 Male=119	1=Woman 2=Male	+/-
Income level	Low income (0-300,000 fcfa/year) =100 High income (more than 2,000,000 fcfa/year) =92	1=Low income (0-300,000 fcfa/year) 2=High income (more than 2.000.000 fcfa/year)	+/-
Experience	Short experience (0-5 years) =62 Long experience (5-20 years) = 130	1= Short experience (0-5 years) ; 2= Long experience (5-20 years)	+/-
Level of information about climate	Low level=52 High income=140	1=Low level 2=High level	+/-
Household size	Small (0-4 people) =103 Large (5-16 people) =89	1= Small size (0-4 people) 2=Tall (5-16 people)	+/-
Production area	Groundwater outcrops=150 Water table not at surface=42	1=Groundwater table outcrops 2=No groundwater outcrops	+/-

The relationship between the dependent variable and the independent or explanatory variables is expressed in Eq. (5) as:

$$Ln = \left(\frac{P_i}{(1-p)}\right) = \alpha + \beta_1 LnAge + \beta_2 LnGender + \beta_3 LnIncome\ level + \beta_4 LnExperiance + \beta_5 Ln\ Level\ of\ information\ about\ climate + \beta_6 LnHousehold\ size + \beta_7 LnProduction\ area \quad (7)$$

Where, LnY=adoption of smart strategies (1=adopted, 2=not adopted).

α=constant

β1=regression coefficient (i=1, 2,..,5)

LnAge=age

LnGenre=gender

Lnexperience=experience

LnIncome level=income level

LnClimate information level=climate information

LnHousehold size=household size

Ln production area=production area.

Results and discussion

Characterization of rainfall variability in the study area

Fig. 2 below shows the variability of the annual precipitation totals, with an increasing trend over the period 1991-2021.The variability of cumulative precipitation is associated with a trend of alternating wet and dry periods over the period 2001-2021 (Fig. 3). However, the wet phase is more prolonged from 2005 to 2021. This phase is also highly variable.

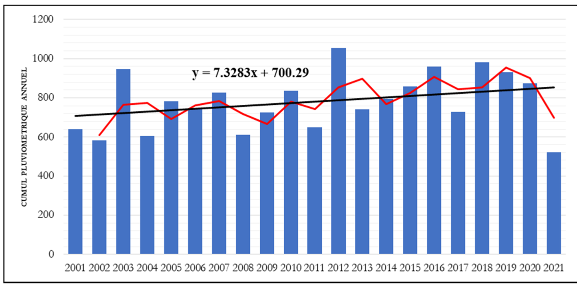

Fig. 2. Variability and upward trend of the cumulative precipitation

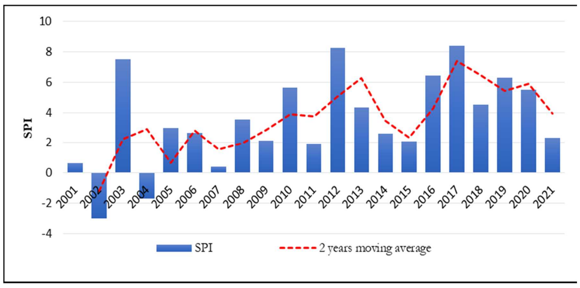

Fig. 3. Dominance of the wet phase over the period 2001-2021

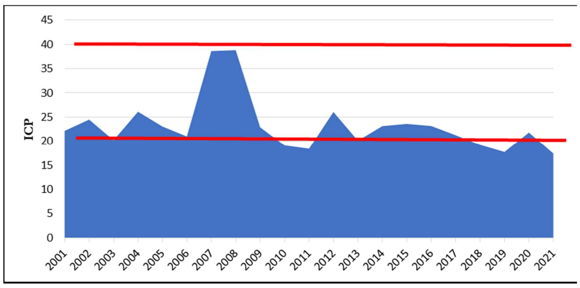

Fig. 4. Irregular distribution and high concentration of rainfall between 2001 and 2021.

The precipitation concentration index fluctuates during this period (Fig. 4). This confirms the results of Fig. 2 and 3. However, the PCIs are above 20 and sometimes even above 35 in the period 2006-2009. This means that the distribution of precipitation is irregular and concentrated in a few months of the year. This situation leads to an increase in extreme precipitation events (floods, droughts).

Climatic variability is a reality in the study area. This variability is exacerbated by a high concentration of precipitation. This situation can lead to more frequent droughts and floods. This has already been observed in other cities in Burkina Faso, such as Bobo-Dioulasso, Boromo, Koudougou, Ouahigouya and Gaoua (Yanogo and Yaméogo, 2023; Yaméogo, 2024). Several other authors, such as Yaméogo and Rouamba, 2023, and Koala *et al.*, 2023 in Burkina Faso, agree with the above authors. They add that this trend in variability and the increase in extreme precipitation will continue until 2050.

Smart strategies in vegetable production and food security

The current rainfall pattern, which is variable, irregular and concentrated over a few months, makes vegetable production very difficult. This forces farmers to adapt to the characteristics of rainfall. This is why intelligent systems have been introduced in all the vegetable plots in sector 9 of Réo. Will these intelligent strategies have an impact on the farmers' food situation?

Range of smart strategies used by market gardeners in market garden plots

Faced with the change in rainfall patterns, market gardeners have opted for several smart strategies to adapt to this new climatic situation, using strategies such as growing leafy vegetables, adopting short-cycle vegetables and combining several species with vegetables in market garden plots.

Growing leafy vegetables

Celery, mint and parsley production has become the main production system on 70% of the plots in sector

9 of Réo (Fig. 5). This is due to the unusual drop in groundwater levels in the region over the last ten years. Leafy vegetables require less water than onions and tomatoes. The option for these vegetables is to make rational use of groundwater resources.

Fig. 5. Plots of celery and parsley in sector 9 of Réo (shot: Yaméogo, December 2023)

Celery associated with mango trees in January 2024 in sector 9 of Réo | Mint combined with parsley and maize in December 2023 in sector 9 of the town of Réo

Fig. 6. Associations of maize, celery and mint with vegetables in the two study areas

Growing short-cycle vegetables

Vegetable production is affected by rainfall conditions in the region. Growers are also turning to short-cycle seeds for vegetable production. For example, 50% of them use short-cycle onion seed to adapt to the reduced number of rainy days during the rainy season.

Multi-species planting combinations in market garden plots

Rainfall is associated with high wind speeds. Market gardeners therefore plant citrus, papaya and mango trees to reduce wind speeds in their plots (Fig. 6).

Several other species are introduced by market gardeners and their number varies according to the size of the market garden plots (Table 7). The table shows that *Mangifera indica* dominates the plots (52.10%), followed by *Carica papaya* (20.83%) and *Zea mays* (15.62%). Species such as *Citrus limon*, *Musa x paradisiaca* and *Bombax costatum* are not very present in the plots.

Table 7. Main species present in market garden plots

	Types of species in the plot	Plot size	f	%
Sector 9 of the town of Réo	*Zea mays*	0.5ha	30	15.62 %
	Carica papaya	0.75ha	40	20.83 %
	Musa × paradisiaca	0.75ha	10	5.21 %
	Citrus limon	1.25ha	10	5.21 %
	Mangifera indica	1.5ha	100	52.10 %
	Bombax costatum	0.25ha	2	1.04 %

f =Frequency, %= Percentage

Source: Field surveys, December 2023-February 2024

Table 8. Significant influence of explanatory variables on the adoption of different smart strategies

	B	E.S	Wald	ddl	Sig.	Exp(B)
Growing leafy vegetables						
Age	-1.001	0.370	7.339	1	0.007	0.367
Gender	-1.724	0.527	10.697	1	0.001	0.178
Level of education	-0.372	0.898	0.171	1	0.679	0.689
Size of household	-0.003	0.533	.000	1	0.995	0.997
Experience	0.600	0.352	2.908	1	0.088	1.822
Income earned	-1.466	0.461	10.102	1	0.001	0.231
Constant	5.743	1.750	10.776	1	0.001	312.015
Combining several species in market garden plots						
	B	E. S	Wald	ddl	Sig.	Exp(B)
Age	-0.771	.429	3.221	1	0.073	0.463
Gender	2.484	.658	14.244	1	0.000	11.987
Level of education	-1.824	1.308	1.944	1	0.163	0.161
Size of household	-1.331	.671	3.931	1	0.047	0.264
Experience	-0.309	.466	0.439	1	0.508	0.734
Income earned	-2.961	0.541	29.937	1	0.000	0.052
Production area	-1.086	.458	5.619	1	0.018	0.338
The adoption of short-cycle vegetables						
	B	E.S	Wald	ddl	Sig.	Exp(B)
Age	0.460	0.353	1.698	1	0.193	1.584
Gender	1.607	0.556	8.360	1	0.004	4.986
Level of education	-.949	0.932	1.038	1	0.308	.387
Size of household	0.348	0.560	0.387	1	0.534	1.417

Experience	-1.810	0.504	12.919	1	0.000	0.164
Income earned	-.059	0.370	0.025	1	0.874	0.943
Production area	0.980	0.400	5.993	1	0.014	2.665
Constant	0.009	1.878	.000	1	0.996	1.009

Source: Field surveys, December 2023-February 2024

Gardeners in sector 9 of the town of Réo have mobilised various intelligent strategies to deal with the climate. In the peri-urban area of Nidialpoun, in the commune of Réo, Burkina Faso, market gardeners also use a number of strategies, such as increasing the number of wells to cope with the recurrence of droughts, using compost to fertilise the soil, and integrating other species such as lemons and especially papaya into market garden plots (Yaméogo *et al.*, 2022). In Ethiopia, several other strategies such as crop diversification, irrigation, drought-tolerant and early-maturing crop varieties, integrated soil fertility management and integrated pest management have been used as practices to improve crop productivity (Erekalo *et al.*, 2023).

Factors influencing the adoption of different smart strategies in the city of Réo

The regression of the two variables showed that explanatory variables such as gender, income level, production zone and experience had a different influence on the adoption of smart strategies in the zone (Table 8).

This table shows that gender, income and experience influence the decision to grow leafy vegetables (celery, mint and parsley). More men than women grow vegetable crops. This means that few women adopt the strategies as they play a supporting role to their husbands. This has led to a differentiated adoption of the strategies. The level of income also has an impact on the adoption of strategies, as these people lose a lot of financial resources as a result of losses caused by droughts, high temperatures and floods. As a result, they are more likely to adopt strategies to avoid financial losses, in contrast to those who grow for subsistence. The experience of market gardeners also motivates them to adopt smart strategies, as they have already experienced climatic and economic problems. They are proactive rather than passive. They anticipate potential difficulties in vegetable production. The strategy of intercropping in vegetable plots is influenced by gender, household size, income level and production area. In fact, men are the landowners in the study area and therefore the only ones with the right to plant fruit species. However, women cannot necessarily plant them on their plots. This may lead to a difference in the use of this strategy. The adoption of short-cycle vegetables is also influenced by gender, experience and production area.

These results are also in line with those of Anuga *et al.* 2022 in Ghana. The latter found that farmers' willingness to adopt smart strategies was driven by the climate crisis as well as other factors such as increased yield/productivity, technical knowledge and understanding of practices, risk aversion, fear and gender. Ogisi *et al.*, 2023 note that the adoption of climate-smart strategies is multi-factorial (climate, agricultural and economic factors, socio-psychological factors, institutional factors).

Impact of smart strategies on food security for market garden producers

Smart strategies and dietary diversity for market gardeners

The introduction of smart strategies to cope with rainfall variability has brought benefits in terms of dietary diversity (Fig. 7). Dietary diversity is high for 86% of the gardeners because they eat leafy vegetables (parsley, mint), flowers (red kapok flowers) especially during the holidays, and cereals, especially maize, and fruits (papaya, mango, lemon) throughout the year. The dietary diversity score for the five (05) food groups is 4 (Table 9).

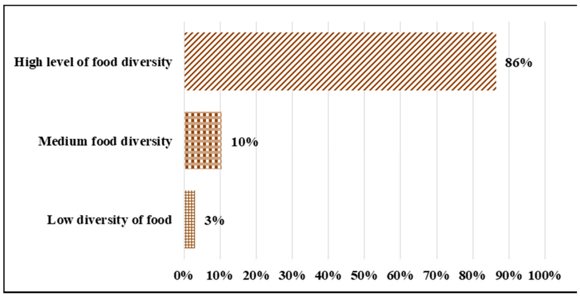

Fig. 7. Diversité alimentaire élevé chez les maraichers urbains

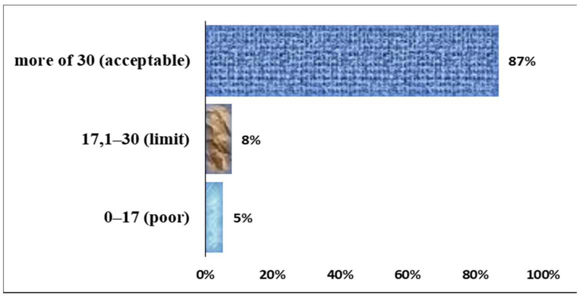

Fig. 8. High level of food consumption among market gardeners

Table 9. The main types of food consumed by market gardeners

Food groups	Foods in the group	Consumed by market gardeners	Frequency of consumption (%)	Score
Food group 1 (G1)	Cereals, roots and tubers, pulses	Maize, rice	90	1
		Beans	40	
Food group 2 (G2)	Milk and dairy products	-	0	0
Food group 3 (G3)	Oils and fats	Oil	70	1
Food group 4 (G4)	Meat, fish, eggs and egg products	Pork meat	60	1
		Mutton	40	
		Fish	70	
Food group 5 (G5)	Fruit and vegetables	Mango	90	1
		Papaya	50	
		Lemon	90	
		Banana	40	
		Aubergine	80	
		Onion	90	
		Tomato	90	
		Cabbage	60	
		Parsley	40	
		Mint	50	
Total				4

Source: field surveys, 2023-2024

Table 10. High level of food consumption by market gardeners

Food	Food consumed by market gardeners and their families	Food groups	Weighting (A)	Number of days consumed in the last 7 days (B)	Score (A*B)
Sorghum, rice, maize, millet	Sorghum, rice, maize, millet	Cereals and tubers	2	7	14
Cassava, potatoes and sweet potatoes	-				
beans, peas, groundnuts	Beans, groundnuts	Dried vegetables	3	4	12
Vegetables, condiments, leafy vegetables	Eggplant, mint, parsley, onion, tomato, cabbage	Vegetables	1	7	7
fruit	Mango, papaya, limon, banana	Fruit	5	4	8
Beef, goat, poultry, eggs, pork and fish	Pork meat, fish	Meat and fish	7	3	12
Milk, yoghurt and other dairy products	-	Milk	4	0	0
Sugar and sweet products	Honey and sugar	Sugar	0,5	3	1,5
Oil/fats	Shea butter and oil sold in shops	Oil	0,5	7	3,5
FCS					79

Source: Source: Field surveys, December 2023

Table 11. Low level of food insecurity among market gardeners

	Often	Sometimes	Rarely	Never
1. Have you ever worried that your household didn't have enough food?	5 2.60%	6 3.13%	100 52.08%	81 42.19%
2. Have you or any member of your household been unable to eat the types of food you prefer because of a lack of resources?	8 4.17%	10 5.21%	90 46.88%	84 43.75%
3. Did you or any member of your household eat a limited variety of foods due to lack of resources?	4 2.08%	15 7.81%	73 38.02%	100 52.08%
4. Did you or any member of your household eat food that you did not want to eat because you did not have the resources to get other types of food?	2.00 1.04%	10.00 5.21%	95.00 49.48%	85.00 44.27%
5. Have you or any member of your household eaten a smaller meal than you would have liked because there was not enough food?	4 2.08%	6 3.13%	82 42.71%	100 52.08%
6. Did you or any member of your household eat fewer meals per day because there wasn't enough food?	0 0%	8 4.17%	70 36.46%	114 59.38%
7. Has the household ever gone without food completely because there was no money to buy it?	0 0%	0 0%	100 52.08%	92 47.92%
8. Have you or any member of your household ever gone to bed hungry because there wasn't enough food to eat?	0 0%	1 0.52%	70 36.46%	121 63.02%
9. Have you or any member of your household ever gone a whole day or night without eating because there was not enough food?	0 0%	0 0%	57 29.69%	135 70.31%

Source: Field surveys, December 2023-February 2024

Smart strategies and food consumption for market gardeners

Gardeners produce several species on their plots, which gives them a variety of food options. This situation has led to an increase in the FCS of market gardeners (Fig. 8).

Fig. 8 shows that 87% of market gardeners have acceptable food security, as they and their families consume a wide range of foods (Table 10). This situation shows that the smart strategies adopted by the gardeners enable them to consume food on a regular basis. Table 10 shows the food consumption of the market gardeners and their families over the course of a week to give a better idea of the frequency of food consumption.

The results on the improvement of the food situation of market gardeners in sector 9 of the town of Réo are in line with the work of other authors using the same methods to assess food security. In fact, farmers in West Africa, particularly in Benin, Mali and Nigeria, who mobilised several strategies increased their food consumption score, in contrast to those who used one smart strategy (Tabe-Ojong *et al.*, 2023). The same observations were made by Belay *et al.* 2023 and Huluka *et al.,* 2019 in Ethiopia, and Abegunde *et al.,* 2022 in South Africa. In fact, households that adopt smart strategies have richer diets than those that do not.

Smart strategies and food insecurity at the level of market gardeners

The Food Insecurity Access Scale was used to assess levels of food insecurity. More than 80% of market gardener households reported that all 9 questions had rarely or never been asked (Table 11). This means that more than 80% of market gardeners are food security.

Conclusion

Rainfall variability has forced market gardeners to implement intelligent strategies to adapt to the new climatic situation. This has led to the production of leafy vegetables, the combination of several species in the plots and the introduction of short-cycle vegetables such as onions. These different strategies, used simultaneously by market gardeners, have increased the food security of market gardeners in the town of Réo. It is therefore important that the authorities in the town of Réo encourage gardeners by training them in the use of natural compost, and providing micro-credits to gardeners could also help to spread smart strategies, especially among women.

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