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RESEARCH ARTICLE

LOCAL KNOWLEDGE OF PRODUCERS IN A CONTEXT OF CLIMATE CHANGE FACING THE CONTROLINGCOSTS CROP PESTS AND SOIL FERTILITY IN NORTHERN BENIN AND SOUTHERN NIGER

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ABSTRACT

The objective of the study was to analyze the contribution of climate change adaptation strategies and the costs of crop pest control and soil fertility management to improving crop productivity. To do this, data relating to the socio-economic characteristics of producers, the adaptation strategies developed and production inputs and outputs were collected from 280 corn and cotton producers in North Benin and 70 millet producers in South Niger. It appears from the analyzes that the majority of producers have adapted to climate change by adopting a varied range of adaptation strategies such as: (1) crop diversification, (2) adjustment of the crop calendar and cultivation practices, (3) land use strategies and (4) other adaptations including traditional prayers and rituals, and producer migrations. These adjustments made by producers have consequences on the productivity of the farm and on the costs of controlling crop pests and soil fertility. In addition, the strategy of adjusting the agricultural calendar and farming practices seems to be the adaptation strategy most suited to the context of climate change. Therefore, research institutes and producer support structures must provide producers with technical routes better adapted to climate change, particularly drought conditions.

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INTRODUCTION

Climate change represents one of humanity's greatest challenges, compromising the food security of rural households. The physical and socio-economic characteristics of Africa, notably the fragility of its economy, predispose it more than other regions to feel the harmful effects of climate change (Niasse *et al*. 2004). Climate forecasts show a reduction in precipitation and an increase in temperatures overall. In Benin for example, Gnanglè *et al*. (2011) reported a significant increase in average temperature (more than 1 ˚C), a perceptible decrease in rainfall (- 5.5 mm/year on average) and in the average annual number of rainy days between 1960 and 2008. In addition, climate projections for 2100 predict that precipitation will remain more or less stable (0.2% variation) in the southern part of the country but will reduce by approximately 13 to 15% in the northern part (MEHU, 2011). As for Niger, Bouchard and Goudo (2009) mentioned that average monthly precipitation will increase compared to the climatological normal over the period 1961-1990 - in all stations except Tillabéri and Niamey which will face a drop in precipitation. Under these scenarios, crops established in these different highly vulnerable regions will be more affected by climate variations, resulting in significant reductions in yield which will affect the food security of agricultural populations. According to MEHU (2001) for example, the yield levels of certain crops such as corn, cassava, beans, cotton, etc., will decrease by 3 to 18% by 2025 in Northern Benin due to climate change. A reduction in the level of millet yields by 13%, groundnuts by 11% to 25%, and cowpeas by 30% by 2025 is also expected in Niger (Mohamed *et al*. 2002a, b). One of the solutions to improve the resilience of populations and consequently their productivity which determines the level of food security is adaptation. With this in mind, producers develop and implement different adaptation strategies (Deressa *et al*., 2009; Hisali *et al*., 2011; Deressa *et al*., 20 The ultimate goal of the adaptation strategies developed by producers is to maintain the level of productivity, and to a certain extent, improve it. However, in general, the analysis of adaptation strategies by considering only the level of productivity could be insufficient. Indeed, the level of productivity can be influenced by factors such as populations of crop pests – insects, parasites, weeds and diseases – and soil fertility management; factors which in turn can be influenced by the adaptation itself. Better still, climate change could influence the agro-climatic distribution of populations of crop pests – insects, weeds and diseases – with the consequence of reducing agricultural productivity (FAO, 2010). Starting from this level of knowledge, this research aims to investigate whether current adaptations to climate change allow producers to increase their level of productivity while considering the cost of combating crop pests and managing soil fertility, implying an overall positive result for food security.11; Gnanglè *et al*., 2012; Yegbemey *et al*., 2014a).

MATERIALS AND METHODS

Study area: The research was conducted in localities more vulnerable to climate change in North Benin and South Niger. The agro-ecological characteristics of these areas make them very vulnerable to the adverse effects of climate change. According to the official MEHU report (2001), North Benin is more affected by climate change than the South. In order to integrate the sub-regional aspect and to make cross-country analyzes possible, the study was extended to the South of Niger, separated from North Benin by the Niger River, and which present almost the same geomorphological, meteorological and pedological characteristics. Four (4) communes in North Benin and one (1) commune in South Niger were selected taking into account their geographical location in order to cover all regions as well as the existing agro-ecological zones; the acuteness of the climate change problem; importance in the country's agricultural production; the representativeness of socio-cultural groups; and accessibility during the study period, particularly during field work. Following these criteria, the communes of Malanville, Banikoara, Kandi and Bembèrèkè were selected in North Benin, and only the commune of Tilaberi in Niger? The only municipality chosen in Niger is the one which best responds to the same geomorphological, meteorological and pedological characteristics as Northern Benin.

Sampling and database: The research units are the producers of the study area in general. To simplify the conduct of field work and the analysis of the results, only corn and cotton producers were taken into account in the North of Benin and those of sorghum and millet in the South of Niger based on the same criteria as in the North of Benin. For each selected village, a sample of 35 producers was formed in a simple, random manner. In doing so, the study was conducted with a sample of 350 producers throughout the study area, i.e. 280 in Northern Benin and 70 in Niger. Generally speaking, the main data collected from the sampled producers are those relating to the socio-demographic characteristics of the producers, the adaptation strategies of the producers, the inputs and outputs involved in the production process, etc. Data collection was carried out through surveys in the form of structured, semi-structured and unstructured interviews. Furthermore, triangulation through focus groups was organized at the beginning and end of the study to ensure the veracity of the data collected.

Model specification: Based on the hypothesis that adaptation strategies developed in response to climate change would have effects on the cost of combating crop pests and managing soil fertility and that simultaneously all these elements combined with the socio-economic characteristics of the producer could have an effect on agricultural productivity; the study adopted an approach using simultaneous modeling of the observed phenomena. For this, control costs - in terms of time and/or money - were used as a proxy to assess the importance of pest, weed and disease populations. In relation to soil fertility management, the cost of managing said fertility was used. In this logic of analysis, then we have the following formulations:

Yi= g (CCRi, CGFi, ADAPij, Zij)
CCRi = p (ADAPij, Zij)
CGFi = t (ADAPij, Zij)

Yi is the productivity of producer i, CCRi the cost of controlling crop pest populations of producer i, CGFi the cost of managing soil fertility of producer i, ADAPij, the adaptation strategy *j* used by producer i, Zij' the sociodemographic characteristic k of producer i. g, p and t are linear functions. Subsequently, we can impose on a vector of k variables the socio-economic characteristics of the producers, a vector of j variables the adaptation strategies developed by the producers. This being said, we have ADAP as a vector of kj×1 adaptation strategies, Z as a vector of kj'×1 socio-economic characteristics, and S as a vector of kj''×1. With such characteristics, function [1] becomes a set of equations defined as follows:

$$\begin{cases} Y_i = \alpha_0 + \alpha_1 CCR_i + \alpha_2 CGF_i + \sum_j \alpha_{3j} ADAP_{ij} + \cdots + \sum_k \alpha_{nj'} Z_{ij'} + u \\ CCR_i = \beta_0 + \sum_{j'} \beta_{1j} ADAP_{ij} + \cdots + \sum_{k'} \beta_{nj'} Z_{ij'} + v \\ CGF_i = \delta_0 + \sum_{j''} \delta_{1j} ADAP_{ij} + \ldots + \sum_{k''} \delta_{nj'} Z_{i'} + w \end{cases} \quad (2)$$

The indices j and j' represent the number of adaptation strategies and sociodemographic characteristics introduced into the model of productivity, costs of controlling crop pest populations and managing soil fertility respectively; u, v and w the error terms. □i, □i and □i were estimated using the OLS (ordinary least square) method by apparently independent regression (SUR). From these coefficients and their levels of importance, the factors affecting the productivity of maize and cotton in Northern Benin and that of millet in Southern Niger were deduced. The sets of possible explanatory variables are presented in Table 1.

Table 1. Explanatory variables

Noms des variables	Types de variables	Modalités	Signes attendus
Caractéristiques socioéconomiques des enquêtés			
Secondaryactivity	D	0= No ; 1= Yes	+
Organizationmembership	D	0 = No ; 1= Yes	±
Access to credit	D	0 = No ; 1= Yes	±
Contact with Extension service	D	0 = No ; 1= Yes	±
Experience in agriculture	C	-	
Capital			
Fixed cost of production (FCFA/ha)	C	-	+
Crop Pest Control Cost	C	-	+
Cost of controlling soil fertility	C	-	+
CostOther inputs	C	-	+
Coping strategies			
Crop diversification	D	0 = Non ; 1= Oui	+
Adjustment of cultural practices and the agricultural calendar	D	0 = Non ; 1= Oui	+
Land use strategies	D	0 = Non ; 1= Oui	+
Other adaptations	D	0 = No ; 1= Yes	+

Types: D = Discontinuous variables; C = Continuous Variables
Source: Authors' specification

RESULT AND DISCUSSION

Descriptive statistics: The results of the descriptive analysis (Table 3) show that almost all of the producers surveyed in North Benin and South Niger are men due to access to productive resources and their role as head of household. More than half of the producers surveyed have a secondary activity allowing them to diversify their sources of income. Most producers, particularly in North Benin, belong to a producer organization or village group and are at the same time in contact with an extension service facilitating their access to production technologies. Furthermore, we note a small proportion of producers having access to agricultural credit in southern Niger. Likewise, producers in southern Niger have a low number of agricultural workers in their care due to millet production which is less subject to labor intensification. As for the costs of controlling crop pests, they are 3.7 and 12 times higher in cotton production than in corn and millet production respectively. On the other hand, the costs of controlling soil fertility are slightly higher in cotton production compared to corn and very lower in millet production.

Climate change adaptation strategies: All producers surveyed in South Niger perceived climate change compared to only 0.34% in North Benin who did not perceive it. From these frequencies, 96.06% and 85.71% of the producers surveyed in North Benin and South Niger respectively have adapted. The same types of adaptations (Table 2) are used by producers, namely crop diversification, adjustment of practices or the agricultural calendar, land use strategies and finally other adaptations including agricultural credit, prayers and migrations of producers. However, the adjustment of cultivation practices in North Benin and land use strategies seem to be the most adopted by producers. On the other hand, in southern Niger, land use strategies and the group of other adaptations take precedence in millet production systems.

Determinants of crop productivity adapted to climate change: The results of the regression model (tables 3; 4; 5) indicate that the variations observed in the possible explanatory variables explain 5% to 14%, 5% to 12% and 16% to 58% of the variations observed in the productivity of corn, cotton and millet respectively and the costs of

Table 2. Descriptive statistics

Areas	Nothern Benin	Southern Niger
Variables	Frequencies	
Sex	----	----
Female	7.6	7.10
Male	92.40	92.90
Access to education	27.3	28.6
Contact with an extension structure	88.10	52.90
Secondaryactivity	55.4	65.70
Access to credit	45.30	14.30
Membership of a group	88.80	70
	Moyenne (Ecart type)	Moyenne (Ecart type)
Agricultural experience	18.90 (±15.31)	25.30 (±15.01)
Agricultural Assets	9.23 (±5.44)	4.371 (±2.92)
Household size	12.99 (±7.93)	6.285 (±3.12)
Coping strategies	Frequencies	
	Maize - Cotton	Mil
Crop diversification	49.46 -18.28	40
Adjustment of agricultural practices/calendar	97.13-97.77	54.29
Land use strategies	72.04-70.97	78.57
Other adaptations	43.01-87.1	81.43
Production costs	average (stantarddeviation)	Moyenne (stantarddeviation)
Crop Pest Control Costs	Maïs 11548(±5133) Coton 43110 (±19659)	Mil 3594 (±6655)
Soilfertility control costs	Maïs 37880 (±12143) Coton 40 521(±9086)	Mil 16749 (±19126)

Results of analysis of survey data 2023

Table 3. Results of the apparently independent regression model for maize in North Benin

	Productivity		Coste of corn pest control		Cost of fertility soil control	
	Coefficient	*P > t*	*Coefficient*	*P>t*	*Coefficient*	*P > t*
Caractéristiques socio-économiques						
Secondaryactivity	0.075* (1.90)	0.057				
Contact with an extension structure	0.116* (1.90)	0.057	0.517*** (3.31)	0.001	0.104(0.78)	0.432
Organizationmembership			0.029 (0.18)	0.856		
Access to agricultural credit	0.085** (2.12)	0.034	0.086 (0.90)	0,.69	-0.192** (-2,14)	0,032
Agricultural experience	0.051* (1.94)	0 .052	--		--	
Capital						
Corn Pest Control Cost	0.023(0.94)	0.345				
Cost of controlling soil fertility	0.064** (2.35)	0.019				
Coping strategies						
Crop diversification	-0.069* (-1.75)	0.079	-0.172* (-1.80)	0,072	-0.115* (-1.30)	0.079
Adjustment of agricultural practices/calendar	0.490***(3.73)	0.000	0.404(1.28)	0,201	0.199(0.68)	0.497
Land use strategies	-0.140*** (-3.01)	0.003	-0.250** (-2.29)	0,022	0.217** (2.14)	0.032
Other adaptations	0.041(1.02)	0.308	0.045(0.47)	0,639	0.093(1.03)	0.302
Model Summary						
Constant	5.888*** (14.99)	0.000	8.531*** (25.82)	0,000	10.104** (33.68)	0.000
Comments	276 10		276 7		276 6	
Settings	0.14		0.08		0.05	
R-square	45.57 0.0000		22.65 0.0020		13.65 0.0338	

NB: values in parentheses designate standard errors; *, **, *** significant respectively at 10%, 5%, and 1%.
Source: Results of analysis of 2023 survey data

Table 4. Results of the apparently independent regression model for cotton in Northern Benin

	Productivity		**Coste of corn pest control**		**Cost of fertility soil control**	
	Coefficient	*P > t*	*Coefficient*	*P>t*	*Coefficient*	*P > t*
Caractéristiques socio-économiques						
Secondaryactivity	--		--		0.039(1,34)	0.180
Contact with an extension structure	0.151* (1.65)	0.099	0.208(1.18)	0.238	0.120** (2,44)	0.015
Organizationmembership	--		0.372***(3.41)	0.001		
Agricultural experience	--		0.085**(1.98)	0.047		
Capital						
Fixed Production Capital	6.47e-06**(2.35)	0.019				
Cost of additional inputs	0.070***(4.73)	0.000				
Cotton Pest Control Cost	0.022 (0.71)	0.477				
Cost of controlling soil fertility	0.094 (1.36)	0.174				
Coping strategies						
Crop diversification	0.043(1.02)	0.310	-0.297*** (-3.94)	0.000	0.008(022)	0.824
Adjustment of agricultural practices/calendar	0.116(1.02)	0.310	0.392** (1.77)	0.070	0.078(0.78)	0.433
Land use strategies	-0.043(-1.16)	0.248	0.091(1.25)	0.210	0.057* (1.72)	0.085
Other adaptations	0.006(0.13)	0.899	-0.015(-0.14)	0.886	0.041(0.86)	0392
Model Summary						
Constant	5.04*** (6.64)	0.000	9.603*** (40.96)	0.000	10.295***(102.31)	0.000
Comments	269 9		269 7		269 6	
Settings	0.12		0.12		0.05	
R-square	35.81 0.0000		39.31 0.0008		13.74 0.0327	

NB: values in parentheses designate standard errors; *, **, *** significant respectively at 10%, 5%, and 1%.
Source: Results of analysis of 2023 survey data

Table 5. Results of the apparently independent regression model for millet production in southern Niger

	Productivity		Cost of mil pest control		Cost of soil fertility control	
	Coefficient	*P > t*	*Coefficient*	*P>t*	*Coefficient*	*P > t*
Socio-economiccharacteristics						
Secondaryactivity	--		--		0.069 (1.34)	0.180
Contact with an extension structure	0.251* (1,65)	0.099	0.308(1.18)	0.238	0.120** (2.44)	0.015
Organizationmembership	--		0.772 (0.341)	0.001		
Agricultural experience	--		0.095 (1.98)	0.047		
Capital						
Fixed Production Capital	6.47** (2.35)	0,019				
Additional input allocation	0.070 (1.03)	0.000				
Cotton Pest Control Cost	0.022 (0.71)	0.477				
Cost of controlling soil fertility	0.094 (1.36)	0.174				
Coping strategies						
Crop diversification	0.03 (1.02)	0,310	0.297** (3.94)	0.000	0.008 (0.22)	0.824
Adjustment of agricultural practices/calendar	0.16 (1.02)	0.310	0.39* (1.77)	0.070	0.078 (0.78)	0.433
Land use strategies	-0.043 (-1,16)	0.248	0.091 (1.25)	0.210	0.07* (1.72)	0.085
Other adaptations	0.006 (0.13)	0.899	-0.015 (-0.14)	0.886	0.041 (0.86)	0.392
Model Summary						
Constant	5.04*** (6.64)	0.000	9.603*** (40.96)	0,000	10.295***(102.31)	0.000
Comments	69 9		69 7		69 6	
Settings	0.42		0.26		0.31	
R-square	58.1 0.0000		31.1 0.0008		15.74 0.0327	

NB: values in parentheses designate standard errors; *, **, *** significant respectively at 10%, 5%, and 1%.
Source: Results of analysis of 2023 survey data

controlling crop pests and soil fertility in each of the cases which determine it. Although the R squares appear to be low in the cases of corn and cotton, all models are overall and highly significant. From the results obtained, it appears that maize productivity is determined by factors such as access to credit, contact with an extension agent, secondary activity, experience in agriculture, costs of controlling soil fertility and strategies for adaptation to climate change, in particular adjustment of the crop calendar and cultivation practices. As for cotton productivity, it is explained by contact with an extension agent, experience in agriculture, membership in a producer organization and strategies for adaptation to climate change. Finally, contact with an extension agent, the producer's fixed capital and adaptation strategies to climate change are the main determinants of millet productivity. Different factors such as contact with an extension structure, access to credit and adaptation strategies affect the costs of controlling crop pests and soil fertility, depending on the case.

DISCUSSION

Given the significant negative effects that climate change has on agricultural productivity, many authors have shown that producers are developing various adaptation strategies to guarantee their means of subsistence. The adaptation strategies mentioned in the literature are the adjustment of cultural practices, the diversification of sources of income, the development of water management and soil conservation strategies, the use of early varieties, the diversification of crops, the change in land allocation, the modification of cultural operations, traditional prayers and rituals, etc. (Deressa *et al*., 2009, Gbetibouo, 2009; Yegbemey *et al*., 2013; Eakin *et al*., 2014; Nhemachena *et al*., 2014). The socio-economic and demographic characteristics of respondents have effects on both crop productivity and the costs of controlling crop pests and soil fertility. Contact with an extension service has a positive impact on farm performance through improved productivity and costs allocated to operations to control crop pests and soil fertility. Extension services are of vital importance in the production process in that they provide producers with the necessary support through agricultural technologies and advice on adaptation strategies for improving production. As an illustration, pesticides for the control of crop pests and fertilizers for the control of soil fertility used in cotton production, particularly in northern Benin, are under the control of extension services which rely on producer groups. This result is similar to those of Gbetibouo (2009) and Yegbemey *et al.* (2014a) who had already highlighted the importance of extension services in agricultural production and membership in a producer group in their work on adaptation to climate change. Other key socio-economic indicators of farm performance such as secondary activity, farming experience and access to agricultural credit play a substantial role in achieving production targets. Indeed, the diversification of activities is also a strategy for adaptation to climate change (Maddison, 2006; Gnanglè *et al*., 2012; Piya *et al*., 2013; Yegbemey *et al*., 2014a) which allows the producer to reduce the risks in the event of poor precipitation on the one hand and on the other hand allows them to have additional resources devoted to the acquisition of technologies, at hand salaried work and other activities on the farm. The same goes for access to agricultural credit allowing producers to obtain supplies of inputs necessary for controlling soil fertility and crop pests in order to increase crop productivity. As for experience in agriculture, as highlighted by Madison (2007) and Deressa (2009), it positively affects the decisions of producers in the development of adaptation options and therefore the improvement of crop productivity. A lot of effort is being made both by producers themselves and by research institutions to reduce harvest losses due to pests. Producers, based on their experiences, play on the combination of their cultivation practices to limit yield losses. Speaking of producer capital, it implies that the more the producer invests in the allocation of productive resources, the more he manages to have a good production.

Among the strategies for adapting to climate change, that of adjusting the crop calendar and farming practices seems to be the most suited to improving crop yields. Even if the effect is not yet significant for producers due to the constantly changing climate and changing adjustments, these strategies mainly contribute to obtaining high yields. We primarily note a significant impact on the costs of controlling crop pests due to the change observed at the producer level in the allocation of pesticides for the treatment of so-called cotton pests. By making changes in the use of pesticides to fight against weeds and insects which disrupt the cotton cycle, which is still vulnerable to climate change, producers in Northern Benin are able to obtain acceptable yields. As for crop diversification strategies, the positive and significant effect on all indicators has not been achieved. This result could be explained to the extent that producers do not really use varieties designed to resist drought. The strategies that they develop, for example, in corn production only concern the installation of several varieties of corn - early - late in order to guarantee an acceptable yield. This practice does not support the sustainability of production due to the changing rain cycle, they need, as mentioned by Yegbemey *et al*. (2014, b) seeds recognized as drought tolerant. As for land use strategies, the practices used by producers are mainly agroforestry, soil conservation strategies by leaching following heavy rains by installing large sandbags or directing plowing in a specific direction and changing field location, these types of strategies aim more at soil conservation and therefore contribute positively to the control of soil fertility. Finally, other strategies such as access to credit contribute positively to the control of soil fertility, the fight against crop pests and therefore the improvement of crop productivity.

CONCLUSION

Climate change, through its effects on agricultural production, jeopardizes the yields expected by producers. Strategies such as crop diversification, adjustment of the agricultural calendar and cultivation practices, land use strategies, traditional prayers and rituals, agricultural credit and migration are developed by the majority of the latter. These strategies are involved in maintaining or improving the level of productivity of cultivated crops. Subsequently, it appears that the socio-economic characteristics of producers, their agricultural capital, the costs of controlling crop pests and soil fertility and the strategies of adaptation to climate change (adjustment of the agricultural calendar and cultivation practices) determine the level of productivity of cultivated crops. It is therefore important to act on these determinants in order to improve crop productivity and therefore food security.

Conflicts of Interest: The authors of this article declare that there are no conflicts of interest in relation to this article.

REFERENCES

Bouchard, Michel A., and Dieudonné G. Goudou (2009). *Inventory of knowledge on climate resilience in Niger. Pilot Program for Climate Resilience*. Final report. Republic of Niger. 85p.

Deressa, T. T., , Hassan, R. M., Ringler C., (2011). *Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia*. Journal of Agricultural Science 149: 23-31.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., Yesuf, M., (2009). *Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia*. Global Environmental Change 19 (2009) 248–255.

Eakin, H., Tucker, C., M., Castellanos, E., Porras, R., D., Barrera, J. F., Morales, H., (2014). *Adaptation in a multi-stressor environment: perceptions and responses to climatic and economic risks by coffee growers in Mesoamerica*. Environ Dev Sustain (2014) 16:123–139 DOI 10.1007/s10668-013-9466-9

FAO (2010). "*Climate-Smart" Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation*. Report. 49 p.

Gbetibouo, G.A., (2009). *Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa*. Environment and Production Technology Division. IFPRI Discussion Paper 00849. 52 p.

Gnanglè, C. P., Glèlè, K. R., Assogbadjo, A. E., Vodounon, S., Yabi, J. A., Sokpon, N., (2011). *Past climate trends, modeling, perceptions and local adaptations in Benin.* Climatology 8: 27-40.

Gnanglè, P. C., Yabi, J. A., Yegbemey, N. R., Glèlè, K. L. R., Sokpon, N., (2012). *Economic profitability of Shea park production systems in the context of adaptation to climate change in Northern Benin.* African Crop Science Journal 20:589–602.

Hisali, E., Birungi, P., and Buyinza, F., (2011). *'Adaptation to climate change in Uganda: evidence from micro level data', Global Environmental Change*, Vol. 21, No. 4, pp.1245–1261, doi:10.1016/j.gloenvcha.2011.07.005.

Maddison, D., (2006). *The Perception of Adaptation to Climate Change in Africa*, No. 10, p.47. Available online at: http://www.ceepa.co.za/docs/CDPNo10.pdf.

MEHU, (2001). *Initial National Communication of Benin*. Ministry of the Environment, Housing and Urban Planning, Cotonou, 76 p.

MEHU, (2011). *Second National Communication of the Republic of Benin on Climate Change.* Benin, MEHU, Cotonou. 168 p.

Nhemachena, C., Hassan, R., and Chakwizira, J., (2014). *Analysis of determinants of farm-level adaptation measures to climate change in Southern Africa.* Journal of Development and Agricultural Economics. Vol.6 (5) pp.232-241, May 2014 Doi 10.589 71 JDAE 12.0441

Niasse, M., Afouda, N, A., Amani, A., (2004). *Reduce West Africa's vulnerability to climate impacts on water resources, wetlands and desertification*. IUCN, Acorn, Switzerland and Cambridge, United Kingdom. XVIII + 71 p.

Piya, L., Maharjan, K.L., Joshi, N.P., (2013). *Determinants of adaptation practices to climate change by Chepang households in the rural Mid-Hills of Nepal*. Reg Environ Change 13:437–447.

Yegbemey, R. N., Yabi, J. A., Aïhounton, D. G. B., and Kokoye, S. E. H., (2014b). *Economic valuation of maize farming profitability under climate change adaptation in Benin*, West Africa', Int. J. Agricultural Resources, Governance and Ecology,Vol.10,No.3,pp.269–280

Yegbemey, R. N., Yabi, J. A., Aïhounton, D. G. B., Paraïso, A., (2014a). *Simultaneous modeling of perception and adaptation to climate change: case of corn producers in Northern Benin (West Africa)*. CahAgric23:177-87.doi:10.1684/agr.2014.0697

Yegbemey, R.N., Yabi, J.A., Tovignan, S.D., Gantoli, G., and Kokoye, S.H.E., (2013). *Farmers' decisions to adapt to climate change under various property rights: a case study of maize farming in northern Benin (West Africa*), Land Use Policy, Vol. 34, pp.168–175, doi:10.1016/j.landusepol.2013.03.001.

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