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Reasons for adoption and non-adoption of agricultural innovations for adaptation to climate change in the Sudano-Sahelian zone of Cameroon

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Abstract: This article addresses the issue of the adoption and non-adoption of agricultural innovations in the Sahelian regions of Africa. The objective is to identify the main reasons why farmers adopt or do not adopt innovations disseminated by researchers and developers, in the light of Rogers Everett's Theory of Diffusion and Adoption of Innovations. Following interviews with key informants and focus groups conducted in ten (10) villages, data were collected from six hundred (600) farms households' heads using a mixed-method survey questionnaire. The SPSS statistical software tools of were used to analyze the data, specifically the percentages for adaptation strategies, and the Kendall's test of agreement to rank the main reasons for adoption and non-adoption. The results show that the primary factors guiding farmers' decisions are the comparative advantage of innovations and their compatibility with the farmers' values (customs) and practices. Therefore, to further improve farmers' adaptation to climate change in the region, it is important for researchers and developers to focus on innovations that provide them with comparative advantages (yield, production, cost, earliness, resistance to drought or heat…etc.) and that are compatible with their local values (customs) and practices.

Keywords: adoption, innovations, agriculture, adaptation strategies, climate change.

Résumé: Le présent article traite de la problématique de l'adoption et de la non-adoption des innovations agricoles dans les régions sahéliennes africaines. L'objectif du travail consiste à identifier les principales raisons pour lesquelles les agriculteurs adoptent ou n'adoptent pas les innovations diffusées par les chercheurs et les développeurs, à la lumière de la Théorie de la diffusion et d'adoption des innovations de Rogers Everett. Après des entretiens avec quelques personnes ressources, et conduite de focus-groups dans quelques villages, les données ont été collectées auprès de six cents (600) chefs d'Exploitations Agricoles Familiales (EAF) à l'aide d'un questionnaire d'enquête mixte. Les outils du logiciel statistique SPSS ont été utilisés pour analyser ces données, en l'occurrence les pourcentages pour les stratégies d'adaptation, et le Test de concordance de Kendall pour le classement des principales raisons de l'adoption et de la non-adoption. Il ressort que les facteurs primordiaux qui guident les choix ou décisions des agriculteurs sont constitués par l'avantage comparatif des innovations et la compatibilité de ces innovations avec leurs valeurs (coutumes) et leurs pratiques. Dans le but donc d'améliorer davantage l'adaptation de ces agriculteurs au changement climatique dans la région, il serait important que les chercheurs et les développeurs se focalisent beaucoup sur les innovations qui leurs procurent des avantages comparatifs (rendement, production, coût, précocité…etc) et qui sont compatibles avec leurs valeurs (coutumes) et leurs pratiques endogènes.

Mots clés: adoption, innovations, agriculture, stratégies adaptation, changement climatique.

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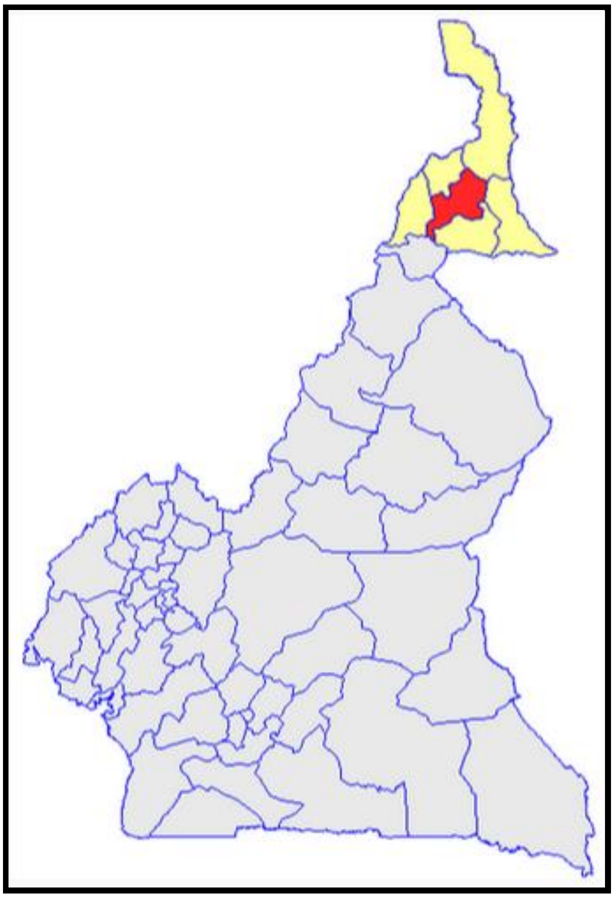
1. Introduction

The theme addressed in this article concerns the analysis of the reasons for the adoption and non-adoption of agricultural innovations for climate change adaptation. The Diamaré division (Figure 1) is located in the Sudanian-Sahelian zone of Cameroon, a region where socioeconomic activities, particularly agriculture, are heavily impacted by climate change (Abou, Ali, and Wakponou, 2024). In this region, climate change, through the frequent droughts and floods, constitutes the major obstacle to the sustainable development of agriculture (Berger, 2013). In order to differentiate between farmers who adapt and those who do not, Batterbury & Mortimore (2013), and then Ngigi (2009) differentiate climate change adaptation strategies between "coping strategies," generally short-term, and ‘’adaptation strategies’’, which constitute a change in response to changing climate parameters. A great variety of agricultural innovations have been disseminated by researchers and developers in the area, but adoption rates remain low (GIEC, 2007) for many reasons that are linked depending on the Rogers’ theory of diffusion and adoption of innovations, to three categories of factors (the characteristics of the products or services, the characteristics of the consumers, and the profiles of the different categories of adopters). Furthermore, among the characteristics of innovations that facilitate their adoption, Rogers identified five (5): their comparative advantage, compatibility with current values and practices, simplicity and ease of use, ease of evaluation (testing), and the immediate availability of results. Several studies have examined the reasons for the adoption of these innovations (Alcouffe, 2014; Jouve, 2010; Mapfumo et al., 2008), but those focusing on one hand on the reasons for their non-adoption, and on the other hand on their own characteristics are few (Zhou, 2010). Data were collected through a semi-closed survey questionnaire administered to six hundred (600) farms household heads selected randomly from twenty (20) villages using a stratified sampling method. The overall objective of this study is to identify the main reasons for the adoption and non-adoption of agricultural innovations for climate change adaptation that have been disseminated to farmers in the region.



Source: Thomas Brinkhoff (2022)

Figure 1: Study area

2. Materials and methods

2.1. Selection of the area, study sites, and sample

The choice of the Diamaré division (Figure 1) as the study area was primarily guided by the fact that it constitutes the largest sorghum-producing basin (sorghum being the staple food of the population) in the Far North region of Cameroon.

The sample selection process, which began at the outset of the site selection, was carried out using stratified random sampling due to the heterogeneity of the survey population (Loubet Del Bayle, 2000).

The selection of the main cereal production sites constitutes the first stratification, while the random selection of study sites from among the identified potential sites represents the second stratification in the sample selection process. In the third phase of the process, which is the actual sample selection, for each site, and according to the crop of interest (rainfed sorghum, dry season sorghum), we compiled a comprehensive list of all farms household heads primarily producing this crop, with the help of villages and neighborhoods' chiefs, assisted by the heads of agricultural stations. From each list, we randomly selected thirty (30) farms household heads to whom we administered the survey questionnaire. This yielded a total of three hundred (300) farms household heads per crop, for a total sample of six hundred (600) farms household heads for both crops.

2.2. Data collection and analysis

Following interviews with key informants and focus groups conducted in ten villages, a mixed-method survey questionnaire, partially semi-closed and partially closed, was administered to the six hundred (600) farms household heads.

The collected data were analyzed using SPSS statistical software version 20. The various adaptation strategies were evaluated using frequencies and percentages, while the innovations' preference ranking was assessed using Kendall's test of agreement.

3. Results

3.1. Climate change adaptation strategies used by farmers

Table 1 below presents the various adaptation strategies used by sorghum farmers (rainfed, dry season) to cope with the impacts of climate change in their area.

Table 1: Adaptation strategies used by sorghum farmers in response to the impacts of climate change

Adaptation strategies	Rainy season sorghum		Dry season sorghum	
	Total	(%)	Total	(%)
Sowing early matured varieties	131	43,67	175	**58,33**
Sowing or transplanting early	178	**59,33**	139	**46,33**
Sowing of drought resistant crops varieties	178	**59,33**	194	**64,67**
Diversification of crops varieties	94	31,33	182	**60,67**
Changing of crops or crops' varieties	105	35	25	08,33
Labor of plots and mounding of plants	234	**78**	96	32
Temporary or permanent transfer of crops	170	**56,67**	30	10
Making of racks or bunds	103	34,33	203	**67,67**
Nursery organic or inorganic fertilizer input	271	**90,33**	82	27,33
Diversification of income-generating activities	195	65	141	47
Crops diversification	268	**89,33**	272	**90,67**
Multiplication of weeding	123	41	20	06,67
Sowing of molten seed holes or dried plants	166	**55,33**	05	01,67
Rocky bunds	05	01,67	-	-
Late transplanting	-	-	125	**41,67**
Deepening piles	-	-	129	43
Purchase or request of nurseries	-	-	104	34,67
Scaling of nurseries over the time	-	-	203	**67,67**

Organic or inorganic fertilization of nurseries	-	-	107	35,67
Cleaning and deepening of ponds	-	-	131	**60,33**
Water research over long distances	-	-	95	31,67
Fertilization of transplanting water	-	-	06	02

Table 1 shows that farmers in the area use a wide variety of

Table 2 below details the different reasons for the adoption of adaptation strategies used by sorghum producers, as well as their respective rankings.

Table 2: Order of importance of reasons for adopting adaptation strategies

Reasons	**Rainy season sorghum**		**Dry season sorghum**	
	Mean Rank	Rank	Mean Rank	Rank
Low costs	4.96	5	3.80	**1**
Habits or inheritance (parents)	4.57	**3**	3.88	**2**
Effectiveness of adaptation strategies	4.77	**4**	4.12	**3**
Strategies adapted to the area (physical environment)	3.26	**1**	4,58	**4**
Lack of other alternatives	5.58	7	4.91	5
Ease of use	5.11	6	5.09	6
Influence of the social environment	6.36	9	6.09	7
Workforce availability	6.10	8	6.11	8
Animal availability	4.31	**2**	6.42	9
	N	300	N	300
	Kendall[a] W test	.168	Kendall[a] W test	.190
	Khi^2	402.963	Khi^2	456.852
	Df	8	Df	8
	Sig.	.000	Sig.	.000

Analysis of the four (4) main reasons for farmers' adoption of innovations, in accordance with Rogers Everett's theory, shows that the first and third reasons relate to their comparative advantages (low cost, efficiency), while the second and fourth reasons relate to compatibility with local values (customs) and current practices in the area.

Table 3 below details the reasons for the non-adoption of adaptation strategies used in the area by sorghum farmers.

Table 3: Order of importance of reasons for non-adoption of adaptation strategies

	Rainy Season sorghum		**Dry Season sorghum**	
Reasons	Mean Rank	Rank	Mean Rank	Rank
Strategies not adapted to the area	2.18	**1**	2.41	**1**
Binding strategies	3.73	**2**	3.56	**3**
Costly strategies	4,01	**3**	2.96	**2**
Labor-intensive strategies	4.14	4	5.11	6
Unprofitable or ineffective strategies	4.37	5	4.08	4
Strategies with harmful consequences	4.58	6	5.24	7
Unknown strategies	5.00	7	4.65	5
	N	300	N	300
	Kendall[a] W test	.213	Kendall[a] W test	.306
	Khi-deux	384.007	Khi^2	550.354
	Df	6	Df	6
	Sig.	.000	Sig.	.000

The analysis of the four (04) main reasons for the non-adoption of innovations by farmers in accordance with the theory of Rogers Everett shows that the first reason relates to compatibility with their local values (customs) and current practices in the area (practice not adapted to the area), the second reason relates to the ease and simplicity of use (restrictive strategies), and the third and fourth reasons relate to their comparative advantage (costly strategies, labor-intensive strategies).

4. Discusion

The adaptation strategies or innovations to cope with the impacts of climate change are largely traditional; and moreover, their adoption rates are low (≤ 70%).

This result corroborates those obtained by Berger (2013) in the same region of Cameroon, as well as by Yesuf et al. (2008) in East Africa, and by Leary, Kulkarmi, and Seipt (2007), according to whom all case studies conducted in developing countries have observed a serious adaptation deficit among farmers. Overall, there is a lack of adoption of the best adaptation strategies because some analysts believe that the best adaptation strategies are not those based on past climate variability, but rather those guided by knowledge of the future, i.e., information on forecasts (Pittock 2007), but also the integration of a proactive approach (advance preparation), technological efforts (large and small scale), the mixing of traditional and modern technologies, medium and long-term planning, and the dissemination of knowledge and information (Chavez-Tafur et al. 2008). For greater effectiveness, it will be necessary to combine traditional knowledge and climate forecasts, but also to adopt an integrated, multidimensional and multisectoral approach (Gehendra and Dinanath 2008).

The analysis of the reasons for the adoption and non-adoption of climate change adaptation strategies by farmers shows that, as a priority, farmers adopt innovations that provide a certain comparative advantage over those they use (yield, production, cost, etc.), and those that are compatible with their local values (customs) and current practices in their area.

This result corroborates the work of Perrot, Gonne, and Mathieu (2005), and Raimond (2005) for whom comparative advantage is an important factor, as well as that of Barnaud (2007), for whom compatibility with values and practices is paramount. In contrast to these findings, the work conducted by Berger (2013) in the Cameroonian Sahel showed that farmers' failure to adopt adaptation strategies is primarily attributed to a lack of access to innovations (meteorological information), a lack of appropriate skills for using this information, and limited access to new agricultural technologies. Mapfumo et al. (2008) support this idea, suggesting that this limitation can also be explained by the fact that farmers struggle to adopt medium and long-term adaptation strategies due to a lack of information and knowledge about the effects of future climate change. Even worse, most government and NGO initiatives supporting farmers affected by climate change are more relief-oriented and short-term. Fabre (2010), and later Mapfumo et al. (2008), argue that in addition to access to information and technologies, the sustainable adaptation of African farmers in general, and Sahelian farmers in particular, must also involve addressing their socioeconomic vulnerabilities, specifically by combating poverty.

Conclusion

An analysis of the reasons for the adoption and non-adoption of climate change adaptation strategies by farmers in the Cameroonian Sahel, based on Rogers Everett's theory of diffusion and adoption of innovations, showed that the primary factors guiding their choices are the comparative advantage of the innovations and their compatibility with farmers’ local values (customs) and practices. Therefore, to further improve these farmers' adaptation to climate change, it is crucial that researchers and developers focus on innovations that provide them with comparative advantages (yield, production, cost, earliness, etc.) and that are compatible with their values (customs) and local practices.

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