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Influence of Sorghum Farmers 'Access to Communication Channels on Their Access to Climate Variability Adaptation Strategies in the Semi-Arid Zone of Cameroon

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Abstract: This article addresses the problem of the performance of communication channels in influencing farmers' perception of climate variability and their access to climate variability adaptation strategies. It aims to compare the influence of sorghum farmers' access to ICTs and interpersonal channels on their climate variability perception and their access to adaptation strategies, in order to make recommendations for improving their resilience to climate variability. The stratified random sampling method was used to select study sites, which consist of twenty (20) villages, and the sample, which consists of six hundred (600) family farms households' heads. Primary data were collected using a mixed survey questionnaire (closed and semi-open). Descriptive statistics (frequency, percentage) were used to analyze the sorghum farmers' climate variability perception and their access to adaptation strategies. The correlations between sorghum farmers' access to communication channels (ICTs, interpersonal channels) and the their climate variability perception, the correlations between the sorghum farmers' climate variability perception and their access to adaptation strategies, as well as that correlations between the sorghum farmers' access to communication channels and their access to the adaptation strategies were analyzed using the chi-square test. It appears that the access rate of sorghum farmers to a communication channel is not proportional to its influence on their climate variability perception and their access to the adaptation strategies; and the access of sorghum farmers to ICTs plays a more important role than their access to interpersonal channels in their climate variability perception, whereas their access to interpersonal channels plays a more important role than their access to ICTs (especially radio and television) in their access to the adaptation strategies. Improving the resilience of sorghum farmers to climate variability requires the proper use of each channel, but the telephone is in fact the ICT on which agricultural extension must henceforth rely most for effective improvement of the climate variability perception by sorghum farmers and their access to adaptation strategies.

Keywords: adaptation strategies, climate variability, communication channels, semi-arid zone, sorghum farmers.

I. INTRODUCTION

This article discusses the influence of sorghum farmers' access to communication channels (ICT, interpersonal channels) on their access to climate variability adaptation strategies. The analysis of this influence is justified by the fact that according to [1], in sub-Saharan Africa, less than 10% of farmers have access to innovations mainly because of the exclusive deployment of public extension services in the field, which, according to [2], then [3], use extension methods and interpersonal communication channels, characterized by a multitude of failures. This theme is also important as [4] believe that a better understanding of farmers' perceptions of climate variability, current adaptation strategies, as well as their determinants, is essential to inform policy makers about sustainable adaptation of the agricultural sector. However, the works on the determinants of the farmers' climate variability perception are numerous, but those relating to the correlations between this farmers' perception and their access to agricultural information through ICTs are almost non-

existent. [5] is one of the few scientists to have shown that farmers' perceptions, and their choice and adoption of improved technologies, depend on the success of the information, education, and communication strategies employed, and in the way these technologies were packaged and delivered to farmers, without specifying the nature of the communication channels. [5], [6] and then [7], have also shown that the farmers' climate variability perception is an important determinant of the adoption of agricultural innovations. Similarly, [8] has shown that farmers' access to ICTs has strongly influenced their massive adoption of adaptation strategies diffused by agricultural research. That said, several scientific works have focused either on the determinants of the farmers' perception of climate variability, or on the determinants of the adoption of agricultural innovations, but rarely on the correlations between the farmers' perception of climate variability, their access to agricultural innovations, and their access to ICTs as determinants of these parameters. That is why we decided to carry out this research work of which the overall objective is to compare the influence of sorghum farmers' access to communication channels (ICT, interpersonal channels) on their access to climate variability adaptation strategies. For this, we assume that if the climate variability perception by sorghum farmers influences their access to adaptation strategies, and if their access to ICTs influences more than their access to interpersonal channels on this climate variability perception, that means logically transitivity-based, that their access to ICTs influences more than their access to interpersonal channels on their access to the adaptation strategies.

In order to carry out this work, we relied on a set of three hypotheses:

H1: The climate variability perception by sorghum farmers influences their access to climate variability adaptation strategies.

H2: The access of sorghum farmers to ICTs influences more than their access to interpersonal communication channels on their climate variability perception.

H3: Sorghum farmers access to ICTs influences more than their access to interpersonal channels on their access to climate variability adaptation strategies.

II. MATERIALS AND METHODS

2.1. Choice of study area and sites, and sample

The choice of the Diamaré division (Figure 1) as study area was guided mainly by the fact that it constitutes one of the largest basins (if not the largest basin) of sorghum production (rainfed, dry season) in the Far North region of Cameroon.

The selection of the sample, which was initiated from the beginning of the sites' choice, was made following the "stratified random sampling method", because of the heterogeneity of the survey universe containing the target population ([9]).

The identification of the mainly cultivated cereals, and the choice of these cereals' main production sites, constitute the first stratification, while the random selection of the study sites among the identified potential ones, materializes the second stratification in the process of the sample choice. In the third phase of the process, which is the selection of the sample itself, for each of the sites, and depending on the speculation of interest (rainfed or dry season sorghum), we have drawn up an exhaustive list of all the farms' households heads that are producing in priority the speculation, with the help of the villages and neighborhoods' chiefs, assisted by the agricultural posts' heads. In each list we randomly drew thirty farms' households' heads to whom we submitted the survey questionnaire. This gives a total of three hundred (300) farms' households' heads per speculation, and a total sample of six hundred (600) farms' households' heads for the two speculations.

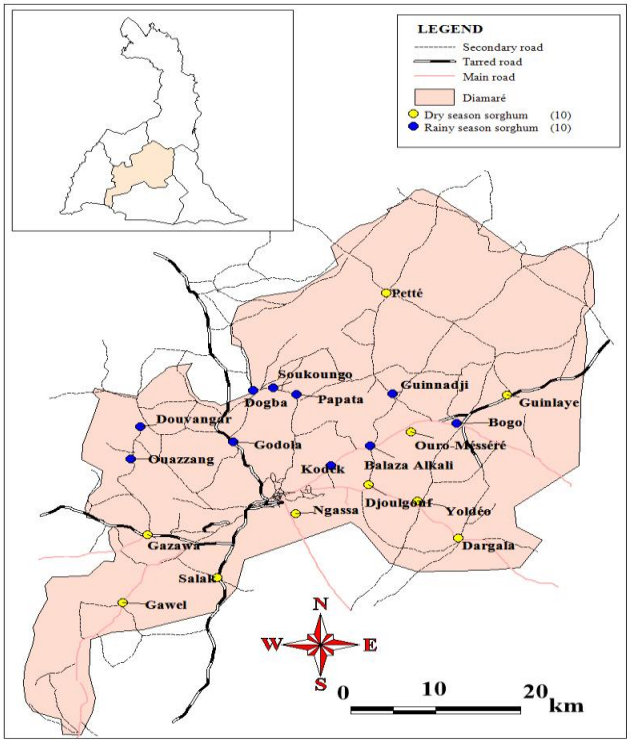

Figure 1: Study area and sites (rainy season sorghum sites in blue, dry season sorghum sites in yellow)

2.2. Data collection and analysis

After interviews with a few resource persons and focus-groups in ten villages, five of them by speculation, a mixed survey questionnaire, both partially semi-closed and closed, was submitted to the six hundred (600) farms households' heads. SPSS statistical software was used to analyze the collected data. The ICTs we are interested in are radio, telephone and agricultural magazines.

The farmers' climate variability perception, that means their simultaneous perception of rising temperatures and decreasing precipitations, was obtained using cross-tabulations on the basis of frequencies and percentages. The analysis of sorghum farmers' access to ICTs was based on an analysis of their access rate to each of these ICTs using frequencies and percentages. Correlations between farmers' perception of climate variability and their access to the adaptation strategies, the correlations between sorghum farmers' access to communication channels (ICTs, interpersonal channels) and their perception of climate variability, and the correlations between the sorghum farmers' access to communication channels and their access to the adaptation strategies were analyzed using the chi-square test.

III. RESULTS AND DISCUSIONS

3.1. A sorghum farmers' climate variability perception that influences their access to climate variability adaptation strategies

The following figure 2 gives us an idea of the different frequencies of the farmers' perception of the decline, the rise and the stability of precipitations and temperatures.

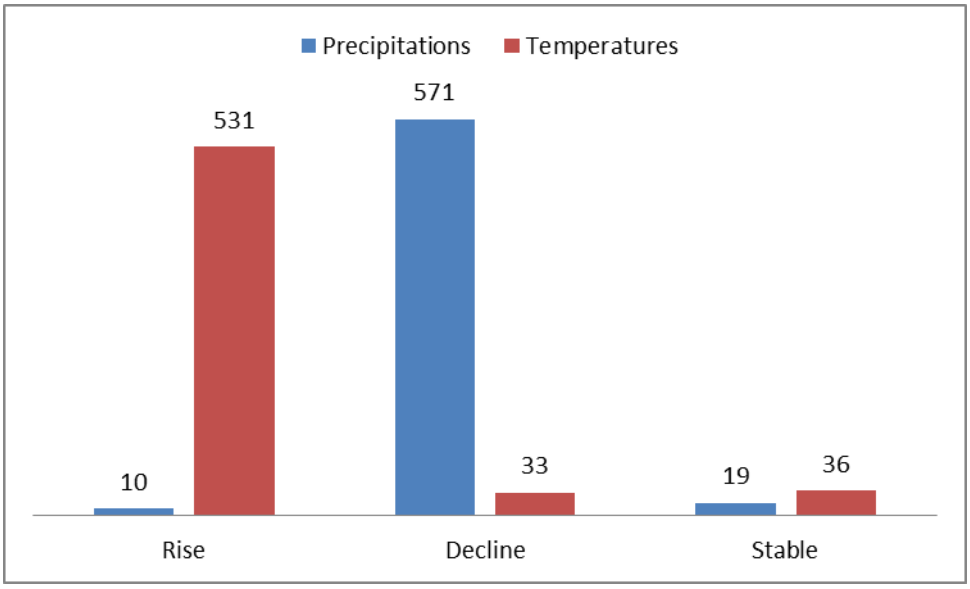

Figure 2: Sorghum farmers' perception of precipitations and temperatures' evolution (rise, increase, stability)

The results in figure 2 indicate that most of the sorghum farmers perceive higher temperatures and lower precipitations. This result corroborates those obtained by [10], then [7].

Nevertheless, the decrease in precipitation seems to be more perceived than the rise in temperatures, in accordance with the results of the work of [10], which is not consistent with the scientific characterization of the climate variability ; on the other hand, in accordance with this scientific characterization of the climate variability, [11], [12] and then [13], find that the farmers perceive the rise of the temperatures more than the decrease of the precipitations.

It also appears that just as in the case of climate variability's scientific characterization, farmers' perception of climate variability is diverse and varies according to individuals; because whatever the parameter or the group of parameters on which one relies to evaluate it, it always appears a diversity of farmers' perceptions. Similarly, the fact that there is a (marginal) number of sorghum farmers who perceive contrary phenomena, that means stable temperatures or precipitations, then increasing precipitations and lowering temperatures, once more again reflects the diversity of this farmers' perception.

The following table 1, which shows the different modalities of the farmers' perception of the simultaneous evolution of precipitations and temperatures, allowed us to have an idea of the objective farmers' perception of climate variability. Objective farmers' perception of climate variability is the simultaneous perception of rising temperatures and decreasing precipitations, which is an objective perception of climate variability, because it corroborates the scientific characterization of the climate variability.

Table 1: Sorghum farmers' simultaneous perceptions of precipitations and temperatures' trends

Precipitations	**Temperatures**		
	Rise	**Decline**	**Stable**
Rise	04 (0,67 %)	03 (05 %)	03 (05%)
Decline	**516 (86 %)**	30 (05 %)	25 (04,17 %)
Stable	11 (01,83 %)	00 (00,00%)	08 (01,33 %)

The results in this table 1 show that 86% of sorghum farmers' simultaneously perceive rising temperatures and decreasing precipitations. Since climate variability in the Sudano-Sahelian zone of Cameroon is scientifically characterized by a decrease in precipitations and an increase in temperatures, it is therefore the case that an overwhelming majority of sorghum farmers actually perceive this climate variability; these results corroborate those ones obtained by [10], [14], and [11].

The results of the influence of this sorghum farmers' perception of climate variability on their access to the various adaptation strategies are shown in the following Table 2.

Table 2: Results of correlations between sorghum farmers' perception of climate variability and their access to the adaptation strategies

Stratégies d'adaptation	Khi-Square	df	p-value
Sowing of early maturing ecotypes or varieties	**4,331**	**1**	**0,037****
Early sowing or transplanting	0,390	1	0,532
Making of lockers or bunds	0,442	1	0,506
Diversification of crops' varieties	0,507	1	0,477
Multiplication of weeding	**2,688**	**1**	**0,121***
Plowing plots and / or ridging of plants	**9,818**	**1**	**0,002*****
Changing of crops or crops' varieties	**2,620**	**1**	**0,106***
Diversification of crops	0,173	1	0,678
Re-sowing / transplanting of melted or dried seedlings	0,501	1	0,479
Temporary or permanent relocation of crops	1,773	1	0,183
Sowing of drought resistant ecotypes or varieties	**12,677**	**1**	**0,000*****
Diversification of income-generating activities	**9,952**	**1**	**0,002*****
Use of organic manure or mineral fertilization	**2,103**	**1**	**0,147***

Seuils de significativité : < 1 % (***), 5% (**), 15% (*).

The results obtained in table 2 indicate that the farmers' perception of climate variability has significantly influenced their access to several adaptation strategies, among which:

-sowing of drought resistant ecotypes or varieties, Plowing plots and/or ridging of plants, and diversification of income-generating activities, at a threshold of 1% (***);

-sowing of early maturing ecotypes or varieties, at a threshold of 5% (**);

-changing of crops or crops' varieties, use of organic manure or mineral fertilization, and multiplication of weeding, at a threshold of 15% (*).

In this case, we could say that the existence of significant correlations between the farmers' perception of climate variability and some adaptation strategies indeed confirms that this farmers' perception of climate variability influences their access to these adaptation, strategies. but we cannot speak at this stage of adaptation strategies' adoption. This result is consistent with those obtained by [6] and then [7], according to which the main determinants of farmers' adaptation to climate variability are the variables of perception.

At the end of these analyzes, one could say that our specific hypothesis H1 which states that "the sorghum farmers' perception of the climate variability influences on their access to the climate variability adaptation strategies" is verified, and thus accepted.

In the next section, we tried to evaluate the influence of the sorghum farmers' access to the communication channels (ICT, interpersonal channels) on their climate variability perception.

3.2. Sorghum farmers' access to ICTs influences their climate variability perception more than their access to interpersonal communication channels

The following table 3 indicates the nature and identity of the ICTs we have been interested in, and which are accessible to the sorghum farmers, in particular radio, telephone and agricultural magazines.

Table 3: Nature and identities of ICTs of interest to sorghum producers

Nature of ICTs		
Radio stations	**Mobile phone networks**	**Agricultural magazines**
-FM Maroua -FM Yaoundé -FM Yagoua -Dana community Radio -Meskine community radio -Mora community radio	-CAMTEL (CT Phone) -MTN -ORANGE -NEXTELL	-La voix du paysan -Infos CNPC -Bulletin agricole du CDD -Bulletin d'informations agricoles INADES

A total of six radio stations, four telephone networks and four agricultural magazines were identified.

Of the radio stations, three are public (FM Maroua, FM Yaoundé, FM Yagoua), while the other three are parastatal or private (Dana community Radio, Meskine community Radio, Mora community Radio). While rural radio stations, which are generally used for agropastoral purposes, mainly broadcast agropastoral information, public FM radio stations broadcast a very limited number of agropastoral programs to farmers, often with the financial support of public, parastatal or private sectors. In this case, the nature or content of the information disseminated therefore depends essentially on the objectives of the sponsors (climate, agricultural inputs, pesticides, food prices, markets' information, etc.).

Agricultural magazines, on the other hand, generally belong to private structures (SAILD, CDD, INADES) or parastatal organizations (SODECOTON), and mainly disseminate agropastoral information to farmers, with content that is most often of concern to farmers.

For the telephone, contrary to the southern region of the country or to some African regions (East, South, West) where there are farmers' organizations that receive information related to their agricultural activities in the form of SMS messages (climate, markets, prices, damages) following contracts signed with mobile operators, in the Far-north Cameroon region, dissemination or access to agricultural information through the telephone is still a personal initiative.

Figure 3 below gives an idea of the nature of sorghum farmers' channels of access to agricultural information as well as their different access rates to these communication channels.

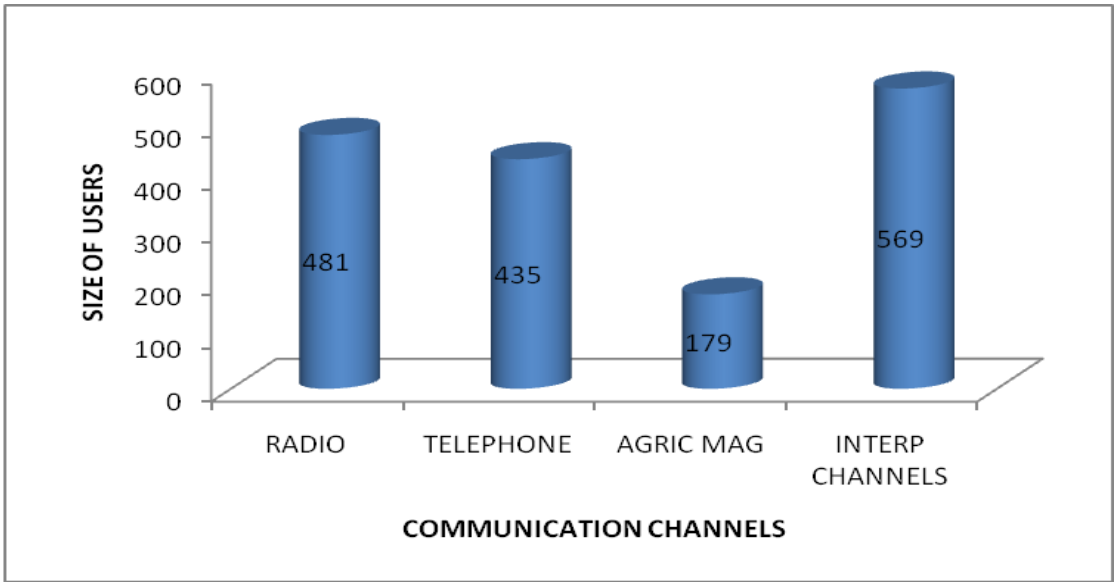

Figure 3: Nature of communication channels and access rates of sorghum farmers

The figure 3 shows that, overall, the interpersonal channels remain the most used communication channel by sorghum farmers, far ahead of each individual ICT. These interpersonal communication channels have as a whole vectors and following the zones, other farmers (parents, brothers, friends, neighbors), community leaders, seeds multipliers and sellers, extension agents (public, private) who use demonstrations fields, farmers' fields tests, and field visits ... etc. The work done by [5] in Malawi confirms this result and points out that among the interpersonal communication channels, it is the community networks (neighbors, family, markets, farmers' organizations) that constitute the main source of information for smallholder farms.

Among ICTs, radio appears to be the main ICT in terms of the overall access rate of sorghum farmers, followed by the telephone, and finally the agricultural magazines. This result is consistent with that obtained by [15] and then [16], according to which, in order of importance of farmers' access, radio, telephone, and then television appear respectively as the most used ICTs.

However, in terms of the overall access rate of sorghum farmers to communication channels, interpersonal channels remain the most used channels; while among ICTs, radio appears to be the most used ICT for these sorghum farmers, followed by the telephone and then the agricultural magazines.

Table 4 below gives the results of the correlations between the sorghum farmers' perception of climate variability (dependent variable) and their access to the ICTs (independent variables).

Table 4: Results of correlations between the sorghum farmers' perception of climate variability and their access to ICTs

Independent variables	Khi-Square	df	p-value
Access to radio	6,700	2	**,035*** **
Access to telephone	5,543	1	**,019*** **
Access to agricultural magazines	4,801	1	**,028*** **
Access to interpersonal communication channels	,155	1	,694

1% (****), 5% (***), 10% (**) et 15% (*).

Analysis of the results in Table 4 on the basis of correlations' significance levels indicates that the sorghum farmers' access to ICTs in general has a significant influence on their climate variability perception. That means the more access of sorghum farmers to ICTs, the better their climate variability perception. This result corroborates those of [17] conducted in Nigeria, and those of [8] conducted in Benin, which showed that access to agricultural information through ICTs, and the number of accessible ICTs positively influence the amount of knowledge acquired.

Nevertheless, despite the fact that sorghum farmers' access to the radio is greater than their access to telephone, which in itself is greater than their access to agricultural magazines, their access to the telephone and the agricultural magazines influence more than their access to the radio, their climate variability perception. It means that in the Diamaré division, the telephone and the agricultural magazines give sorghum farmers more access than radio to information on climate variability.

Similarly, there is no correlation between sorghum farmers' access to interpersonal communication channels and their perception of climate variability. This means that the access of sorghum farmers to ICTs influences more than their access to interpersonal communication channels, on their climate variability perception. That said, while Figure 3 shows that interpersonal communication channels are more used by sorghum farmers than ICTs, it appears that access to these ICTs influences more than their access to interpersonal channels, on their climate variability perception. Logically, therefore, it could be said that the use of ICTs by sorghum farmers in general, allows them to access more than their use of interpersonal communication channels to information on climate variability.

From the synthesis of these two previous results, one could simply conclude that the fact that a communication channel is accessible to a large mass of sorghum farmers is not synonymous with the importance of its contribution to their perception of climate variability; it depends on the nature and content of the information disseminated or exchanged through these communication channels. Indeed, according to the work of [3], although radio is currently more used than television by farmers, they believe that television broadcasts innovations much more useful than radio.

At the end of these analyzes, it could be said that our specific hypothesis H2 that states that "Sorghum farmers access to ICTs influences more than their access to interpersonal communication channels on their climate variability perception ", is verified, and therefore accepted.

Since we have just demonstrated in § 3.2 that the sorghum farmers access to ICTs influences more than their access to interpersonal channels on their climate variability perception, and that we have demonstrated in § 3.1 that the climate variability perception by sorghum farmers influences on their access to adaptation strategies, it will be necessary to seek to verify whether their access to ICTs influences more than their access to interpersonal communication channels on their access to the adaptation strategies.

3.3. Sorghum farmers' access to interpersonal channels influences more than their access to ICTs on their access to climate variability adaptation strategies

Table 5 below shows the results of the correlations between the sorghum farmers access to interpersonal channels and their access to the adaptation strategies.

Table 5: Results of correlations between the sorghum farmers' access to the interpersonal channels and the climate variability adaptation strategies

Dependent variables	Khi-Square	df	p-value
Sowing of early maturing ecotypes or varieties	**15,149**	**1**	**,000*** **
Early sowing or transplanting	¿902	1	,342
Making of lockers or bunds	**20,226**	**1**	**,000*** **
Diversification of crops' varieties	**5,274**	**1**	**,022** **
Multiplication of weeding	**4,164**	**1**	**,041** **
Plowing plots and / or ridging of plants	**13,136**	**1**	**,000*** **
Changing of crops or crops' varieties	**7,734**	**1**	**,005*** **
Diversification of crops	,000	1	,985
Re-sowing /transplanting of melted or dried seedlings	**9,042**	**1**	**,003*** **
Temporary or permanent relocation of crops	1,553	1	,213
Sowing of drought resistant ecotypes or varieties	**10,247**	**1**	**,001*** **
Diversification of income-generating activities	2,698	1	,100
Use of organic manure or mineral fertilization	**10,630**	**1**	**,001*** **

The analysis of the results in table 5 shows that sorghum farmers' access to the interpersonal communication channels significantly influenced between 1% and 5% threshold on their access to nine (9) adaptation strategies over thirteen (13).

Table 6 below shows the results of the correlations between sorghum farmers' access to the ICTs and their access to the climate variability adaptation strategies used.

Table 6: Correlations between sorghum farmers' access to ICTs and climate variability adaptation strategies

Independent variables	Dependent variables	Khi-Square	df	p-value
Access to radio	Sowing of early maturing ecotypes or varieties	**6,012**	**2**	**,049** **
	Early sowing or transplanting	6,874	2	,032
	Making of lockers or bunds	1,118	2	,572
	Diversification of crops' varieties	2,702	2	,259
	Multiplication of weeding	3,444	2	,179
	Plowing plots and / or ridging of plants	**13,560**	**2**	**,001*** **
	Changing of crops or crops' varieties	,287	2	,867
	Diversification of crops	**9,740**	**2**	**,008*** **
	Re-sowing /transplanting of melted or dried seedlings	**10,100**	**2**	**,006*** **
	Temporary or permanent relocation of crops	**7,802**	**2**	**,020** **
	Sowing of drought resistant ecotypes or varieties	2,763	2	,251
	Diversification of income-generating activities	**44,673**	**2**	**,000*** **
	Use of organic manure or mineral fertilization	**37,139**	**2**	**,000*** **
Access to telephone	Sowing of early maturing ecotypes or varieties	,913	1	,339
	Early sowing or transplanting	2,997	1	,083
	Making of lockers or bunds	,024	1	,876
	Diversification of crops' varieties	1,958	1	,162
	Multiplication of weeding	**4,224**	**1**	**,040** **
	Plowing plots and / or ridging of plants	**20,690**	**1**	**,000*** **
	Changing of crops or crops' varieties	**4,682**	**1**	**,030** **
	Diversification of crops	1,570	1	,210
	Re-sowing /transplanting of melted or dried seedlings	**5,932**	**1**	**,015** **
	Temporary or permanent relocation of crops	**8,464**	**1**	**,004*** **

	Sowing of drought resistant ecotypes or varieties	1,432	1	,231
	Diversification of income-generating activities	**66,524**	**1**	**,000*** **
	Use of organic manure or mineral fertilization	**45,936**	**1**	**,000*** **
Access to agricultural magazines	Sowing of early maturing ecotypes or varieties	**65,174**	**1**	**,000*** **
	Early sowing or transplanting	**6,677**	**1**	**,010** **
	Making of lockers or bunds	**34,903**	**1**	**,000*** **
	Diversification of crops' varieties	**44,085**	**1**	**,000*** **
	Multiplication of weeding	,894	1	,344
	Plowing plots and / or ridging of plants	**19,140**	**1**	**,000*** **
	Changing of crops or crops' varieties	**10,039**	**1**	**,002*** **
	Diversification of crops	**7,078**	**1**	**,008*** **
	Re-sowing /transplanting of melted or dried seedlings	**25,523**	**1**	**,000*** **
	Temporary or permanent relocation of crops	**22,239**	**1**	**,000*** **
	Sowing of drought resistant ecotypes or varieties	**27,852**	**1**	**,000*** **
	Diversification of income-generating activities	3,475	1	,062
	Use of organic manure or mineral fertilization	**13,658**	**1**	**,000*** **

The analysis of the results in this table 6 indicates for threshold significance levels between 1% and 5% that:

-the access of sorghum farmers to the radio significantly influences their access to seven (7) adaptation strategies;

-the access of sorghum farmers to the telephone significantly influences their access to seven (7) adaptation strategies;

-the access of sorghum farmers to agricultural magazines significantly influences their access to eleven (11) adaptation strategies.

The comparison between the influence of sorghum farmers' access to ICTs and the influence of their access to interpersonal canals leads us to the following observations:

-the access of sorghum farmers to interpersonal channels influences more than their access to radio and telephone on their access to the adaptation strategies;

-only sorghum farmers' access to agricultural magazines influences their access to the adaptation strategies more than their access to interpersonal channels.

In this case, it could be said that although sorghum farmers' access to ICTs, (especially radio and telephone), influence on their climate variability perception more than their access to interpersonal channels, their access to these interpersonal channels influences more than their access to ICTs on their access to the climate variability adaptation strategies.

With regard to comparisons between ICTs, it is apparent that although it is demonstrated in § 3.2 that the access rate of sorghum farmers to radio is greater than their access rate to telephone, which is also more important than their access rate to agricultural magazines, it is still apparent in § 3.2 that their access to telephone and agricultural journals influences their climate variability perception more than their access to radio; similarly, it is apparent in § 3.3 that their access to agricultural magazines and radio respectively influences more than their access to telephone on their access to climate variability adaptation strategies. These results corroborate that obtained by [3].

On the basis of the synthesis of the results obtained in this § 3.3, the following table 7 gives an idea of the order of importance of the ICTs according to their influence on certain sorghum farmers' characteristic parameters.

Table 7: Order of importance of ICTs according to their influence on some sorghum farmers' characteristic parameters

Estimated characteristic parameters	**Order of importance**		
	1	**2**	**3**
Sorghum farmers' access rate to the ICTs	Radio	Telephone	Agricultural magazines
Influence of the sorghum farmers' access rate to ICTs on the climate variability perception	Telephone	Agricultural magazines	Radio
Influence of the sorghum farmers' access rate to ICTs on their access to climate variability adaptation strategies	Agricultural magazines	Radio	Telephone

From the analysis of the results of tables 5, 6, and 7, the following important conclusions could be drawn:

-While the sorghum farmers' access to communication channels (ICT, interpersonal channels) influences their climate variability perception, the importance of their influence on the climate variability perception is not proportional to their access rate to this communication channels; for example, radio is more accessible to sorghum farmers than telephone and agricultural magazines, but their access to telephone and agricultural magazines influences more than their access to radio on their perception of climate variability;

-though the sorghum farmers' perception of climate variability influences their access to the adaptation strategies, the importance of the influence of their access to a communication channel on their climate variability perception is not proportional to the importance of the influence of their access to this communication channel on their access to the adaptation strategies; for example, sorghum farmers' access to the telephone influences their climate variability perception more than their access to radio, but their access to radio influences more than their access to the telephone onr their access to the adaptation strategies.

This discrepancy in the importance of correlations between sorghum farmers' access rate to communication channels, its influence on their climate variability perception, and its influence on their access to adaptation strategies, could be explained simply by the fact that not all of these communication channels are used to exchange or disseminate information on climate variability and climate variability adaptation strategies.

At the end of these analyzes, it could be said that our hypothesis H3 which states that "Sorghum farmers' access to ICTs influences more than their access to interpersonal channels on their access to climate variability adaptation strategies " is not verified, and is therefore rejected.

Overall, sorghum farmers' access to ICTs may be more influencing than their access to interpersonal channels in their climate variability perception, and their access to interpersonal channels is more influencing than their access to ICTs (except the telephone) in their access to the adaptation strategies. Similarly, the telephone is the only ICT that plays a more important role than interpersonal channels in both the sorghum farmers' climate variability perception and their access to adaptation strategies. This result could be justified by the fact that the telephone constitutes an ICT which is accessible to sorghum farmers with a higher frequency than the other ICTs. It is in fact the ICT that agricultural extension is most likely to rely on in the future.

In order to further improve the resilience of these sorghum farmers to climate variability, it is imperative that the following actions are taken and implemented by the government:

-to disseminate more information on climate variability and adaptation strategies through radio, which is the most accessible ICT for farmers, especially in local languages;

-to formalize the dissemination of information on climate variability and adaptation strategies through the telephone, by using both calls and SMS, especially by relying on educated farmers who will relay the information;

-to take concrete steps to improve school enrollment rates in the area (especially in rural areas), so that a critical majority of farmers can access information on climate variability and adaptation strategies through agricultural magazines.

Finally, the telephone is in fact the ICT on which agricultural extension must henceforth rely most for an effective improvement of the perception of the climatic variability by sorghum farmers' their access to the adaptation strategies.

III. Conclusion

We could say that there are significant correlations between the access of sorghum farmers' to communication channels, its influence on their climate variability perception, and its influence on their access to the adaptation strategies; but these correlations are not proportional to each other for a given communication channel.

In addition, sorghum farmers' access to ICTs plays a more important role than their access to interpersonal channels in their climate variability perception, whereas their access to interpersonal channels plays a greater role than their access to ICTs (especially radio and agricultural journals) in their access to the adaptation strategies.

While a real improvement in the resilience of sorghum farmers to climate variability through the diffusion of agricultural innovations must certainly take into account the advantages offered by each of the communication channels, the telephone remains the appropriate channel on which agricultural extension must rely on mostly in the future.

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REFERENCES

[1.] Y. Zhou, *Reinventing agricultural extension to smallholders* (Beijing, China: Syngenta Foundation for Sustainable Agriculture, 2010)..

[2.] PD. Kaboré, *Analyse des mécanismes de diffusion des technologies agricoles améliorées et innovations dans l'espace CEDEAO* (Dakar, Sénégal : CORAF 2011).

[3.] J. Mirza, S. Khalid, and A. Sakhwat, Role of communication in diffusion and adoption of agricultural innovations, *Gomal University Journal of Research, 27 (1),* 2011, 111-118.

[4.] C. Nhemachena, and R. Hassan, *Micro-level analysis of farmers' adaptation to climate change in southern Africa* (Washington, USA: IFPRI, 2007).

[5.] AM. Kabuli, *Soil and water innovations to address food security in Africa: role of knowledge management systems in improving adoption* (Lilongwe, Malawi: WASW-World Association of Soil and Water Conservation, 2014).

[6.] M. Ouédraogo, Y. Dembélé, and L. Soné, Perceptions et stratégies d'adaptation aux changements des précipitations : cas des paysans du Burkina Faso, *Sécheresse, 21(2),* 2010, 87-96.

[7.] M. Yesuf, S. Di Falco, T. Deressa, C. Ringler, and G. Kohlin, *The impact of Climate Change and Adaptation on Food Production in Low-income Countries: Evidence from the Nile Basin-Ethiopia* (Addis Ababa,Ethiopia: IFPRI, 2008).

[8.] UA. Arodokoun, *Impact socioéconomique de l'usage des NTIC dans les stratégies d'adaptation aux changements climatiques en milieu rural : cas des producteurs de coton du Centre-Bénin*, Thèse pour l'obtention du diplôme d'Ingénieur Agronome, Université d'Abomey-Calavi, Abomey, Bénin, 2011.

[9.] JL Loubet del Bayle, *Initiation aux méthodes des sciences sociales* (Paris, France : Les classiques universitaires, 2000).

[10.] F. Chédé, *Vulnérabilité et stratégies d'adaptation au changement climatique des paysans du Département des Collines au Bénin : cas de la Commune de Savè*, Mémoire de Mastère en Changement climatique et développement durable, Centre Regional AGRHYMET, Niamey, Niger, 2012.

[11.] PC. Gnanglé, J. Egah, MN. Baco, CDSJ. Gbemavo, RG. Kakai, and N. Sokpon, Perceptions locales du changement climatique et mesures d'adaptation dans la gestion des parcs à karité au Nord-Benin, *Intl. J. Biol. Chem. Sci., 6 (1),* 2012, 136-149.

[12.] R. Dimon, *Adaptation aux changements climatiques : perceptions, savoirs locaux et stratégies d'adaptation développées par les producteurs de Kandi et de Banikoara, au Nord Bénin*, Mémoire d'Ingénieur Agronome, Université d'Abomey-Calavi, Cotonou, Bénin, 2008.

[13.] PSS. Houssou-Goe, *Agriculture et changements climatiques au Bénin : Risques climatiques, vulnérabilité et stratégies d'adaptation des populations rurales du département de Couffo*, Mémoire d'ingénieur agronome, Université d'Abomey-Calavi, Cotonou, Bénin, 2008.

[14.] D.S.M. Agossou, C.R. Tossou, V.P. Vissoh, and K.E. Agbossou, Perception des perturbations climatiques, savoirs locaux et stratégies d'adaptation des producteurs agricoles béninois, *African Crop Science Journal, 20 (2),* 2012, 565-588.

[15.] A. Maru, and V. Pesce, *Adoption of Information and Communication Technologies in Agricultural Research for Development* (Rome, Italy: GFAR, 2013).

[16.] R. Don, *Les TIC transforment-elles la vulgarisation agricole ?* (Wageningen, Pays-Bas: CTA, 2006.

[17.] AK. Ango, AI. Illo, AN. Abdullahi, MA. Maikasuwa, and A. Amina, Role of Farm-radio Agricultural Programmes in Disseminating Agricultural Technology to Rural Farmers for Agricultural Development in Zaria, Kaduna State, Nigeria, *Asian Journal of Agricultural Extension, Economics and Sociology, 2(1),* 2013, 54-68.