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Perception of Dew by Cereal Growers in Semi-Arid Climate (Guéné, North Benin)

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Abstract: *West Africa is one of the regions the more impacted by climate change, concerning in particular droughts and lack of fresh water. In this context was carried out a study of the sociological perception of dew as alternate source of water by cereal's growers in Guéné (semi-arid region, north Benin). Ten data collectors were formed to fill out questionnaires, addressed to 100 cultivators in 2014. Data analysis takes into account respondents' gender, their ages and the type of cereal they cultivate. Close to 80% of the growers experienced dew assistance when sowing cereals. During rain shortage, 44% of the farmers rely on dew occurrence to compensate for lack of rain water. Among farmers, 80% account for dew before and during cereals growth. For 99% of growers, dew plays an important role for cereal growth, as stated in scientific literature. However, 17% point out a possible negative role of dew, favoring dissemination of plant diseases. Farmers (87%) are open to any technology capable of collecting enough dew water for agriculture, but they remain skeptical about such discoveries. Responses only slightly vary when considering the gender and the ages of the farmers but they vary strongly when considering the type of cereal.*

Keywords: *Dew, Survey, Cereal Growers, Semi-Arid Area, Guéné, Northern Benin*

1. INTRODUCTION

Nowadays, extreme climate variability leads to severe human consequences, notably concerning droughts in arid and semi-arid regions where water availability is already low under normal conditions [1]. West Africa is recognized to be one of the regions in the world the most vulnerable to extreme climate variability [1]. Population is indeed mostly rural with agriculture as the main source of income. This is especially true in the extreme northern part of Benin, where water is often scarce. In these regions, growers are said to produce several varieties of cereals every year (maize, sorghum and millet) thanks to a traditional knowledge in dew water management, even though the yields are low. Unfortunately, these traditional methods of agricultural and water management are often lacking of scientific knowledge and never cited.

Dew is an ubiquitous phenomenon in which water vapor condenses on various types of natural or artificial surfaces, such as grass, crops, roofs or vehicles. Dew occurs at night when humid air condenses on surfaces as its temperature falls below the dew point temperature of the surrounding atmosphere. Substrate cooling is ensured by the nocturnal radiative deficit with atmosphere. Low wind speed and clear skies are favorable to dew events. Dew formation has been the object of scientific researches over many years [2]. There is abundant literature reporting that, even though dew amount is small, it can be beneficial to humans [3]. Dew water can be used as fresh water and can give additional water to plants and desert animals, not only in arid and semi-arid areas, but also in humid regions where drought can suddenly occur for more than weeks or months during the rainy seasons. Dew, however, can cause plants diseases through stagnant dew water on their surfaces. Dew can indeed promote the development of pathogenic gems and increasing disease frequency in crops [4].

To our knowledge, no sociological studies have been conducted so far to explore the use of dew water in agriculture. It is thus worth looking more closely at these aspects of human adaptation as far as dew water is concerned. Extreme weather and climate events have major negative impacts on food security and economy income. These realities illustrate the need to understand the sociological knowledge of dew in relation with cereal growth in view of its possible utilization as alternate or adaptive technology for improving agriculture and mitigate climate extreme impacts. As a matter of fact, since the 1990's, experimental studies have been conducted on dew collection throughout Benin, using efficient conical dew condensers [5, 6].

The following is thus concerned with the perception of dew by the grower's rural population through a statistical investigation at Guéné, a typical village in a semi-arid region of northern Benin. The objective of this study is to highlight the understanding of cereal's growers in Guéné concerning the significance of dew in their daily agricultural activities. In particular, correlation analyses are performed between (i) the responses and the respondent gender, (ii) the responses and the respondent ages and (iii) the responses and the type of sown cereals.

2. MATERIALS AND METHODS

2.1. Site Description

The survey was performed in the village of Guéné (~1,560 km^2), located in West Africa in the northern part of Benin. Guéné is located within about 750 km from the economical capital city Cotonou, at 11˚20'-12˚ latitude north and 2˚5'-3˚05' longitude east (Fig. 1). The elevation is about 250 m a.s.l. Guéné is characterized by a north Sudanian climate with two different seasons per year [7]. The rainy season period often lasts from May to September; it is followed by a long and dry season from October to April. Harmattan is a dry and dusty wind, which blows north-east, from the Sahara desert and frequently reaches Guéné between November and February [7]. Guéné is at about 30 km from the south Niger River. The climate is semi-arid and the area's precipitations highly vary in both volume and spatial distribution from year to year. Alike certain western African countries, the Guéné area suffers from unpredictable extreme weather conditions, heavy floods and droughts. Mean annual rain amount and temperature are respectively ~750 mm and ~30.6°C. December is the coldest month (~20.3°C) and April is the hottest month (~42.1°C).

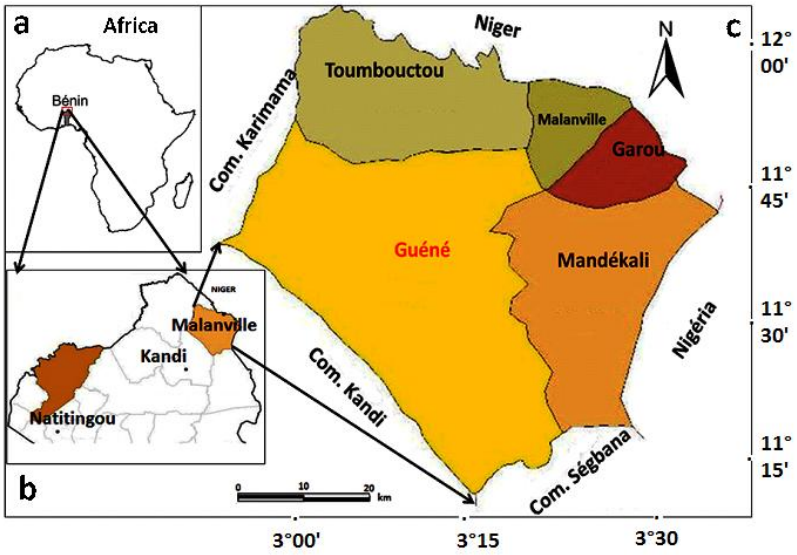

Fig1.*(a) Location of Benin in West Africa, (b) Location of the Malanville region in Northern Benin, (c) Location of the Guéné area in the Malanville region*

2.2. Data Collection and Analysis Methods

Data are collected during an investigation carried out in Guéné from July 19, 2014 to July 26, 2014. For this investigation, 10 data collectors, natives of Guéné, assisted in filling out the questionnaires after talking with the respondents. The main reasons for using natives of Guéné are the following. (i) Facilitate the immersion of the investigators in the population, (ii) ensure confidence between the growers and the interviewers, a necessary condition to maintain credibility of their information and

(iii) guarantee that the collectors will rapidly master the questionnaires thanks to their good education level.

The interview is based on "face-to-face" conversations, using the language chosen by the farmers (French or Dendi, a local language). The main indicators or information that the questionnaires aim to collect are organized in four main aspects. (1) Demographic information about the growers, particularly their name, gender, age, level of education, the type of cereals sown, their experience as producer of cereals, etc. Their ages were divided in three intervals: [19 - 35[years (G1), [35 - 55[years (G2) and [55 - 70] years (G3), as frequently appeared in the sample. (2) Specific information from the respondents regarding climatic parameters that often influence the production yield. (3) Information concerning dew knowledge (regarding the utility of dew and their experience of dew water contribution in agriculture). (4) Information on grower attitudes concerning the adoption of new technologies for dew harvesting.

After the collection and quality-control, the respondent's data were transferred to a database in a saving system "Census and Survey Processing System (CSPro 5.0)". A double entry was done in order to correct the eventual data entry mistakes. Then the tabulations and the statistical analyses were performed simultaneously with SPSS for Windows (SPSS Inc., Chicago, Standard version 17.0) and STATA statistical software. Descriptive analysis in terms of frequency and percentage were performed on questionnaires data.

2.3. Samples Presentation

The investigated sample is constituted of 100 representative producers of cereals in which 97 growers are mainly from Guéné and 3 other growers from neighboring villages. The sample counts 93 men and 7 women. Unfortunately, only 7 women had accepted to answer the questionnaires. The majority of the interviews were carried out in Dendi language (94%), since nearly 78% of the growers had a level of instruction that does not exceed the primary level. Table 1 presents the characteristics of the sample.

Table1. *Summary of demographic and farming characteristics*

Variables		*Mean or percentage (%)*
Gender	Male	93
	Female	7
Instruction level	None	53
	Primary	27
	Secondary	15
	University	5
Cereals	Sorghum	76
	Millet	58
	Maize	99
	Fonio	1
Economy	Missing	3
	Subsistence	24
	Sale	9
	Sale & subsistence	64
Seasons	Rainy	100
	Dry	0
	Rainy and dry	0
Age	Mean	37.31
	Min	19
	Max	70
Year of experience	Mean	20.61
	Min	2
	Max	60
Cultivated surface (ha)	Mean	7.21
	Min	1
	Max	60

The mean age of the growers is ~37 years, with an average of 20 years in agriculture practice. The mean surface allocated to cereals growth in the sample is 7.2 ha, with a minimum area of 1ha and a maximum area of 60 ha. The sample represents well the diversity of main cereal tendencies in the region. Among the respondents, maize is cultivated by 99%, Sorghum by 76% and millet by 58%. Only 1% of the farmers produce "fonio", a regional cereal. All producers report that they cultivate the cereals in the rainy season. Only 9% of the growers produce cereals for sale, 24 % cultivate for subsistence while 64% of the farmers produce cereals for both trade and subsistence. The results are presented, analyzed and discussed in the sections below.

3. RESULTS

Results are analyzed regarding the following four main points: (i) knowledge of seasons, rain and wind; (ii) farmers experience of dew process in their environment, its utility and utilization; (iii) attitudes towards adoption of new technologies (dew harvesting) and (iv) analysis of answers in view of respondents' gender, ages and type of cereals they cultivate.

3.1. Farmers Knowledge of Seasons, Rain and Wind

Water is an important factor that determines the success of agriculture in general and cereals production in particular. In order to facilitate the dialogue, some of the questions were intentionally very basic.

It is obvious that most of the farmers master the rainy and dry seasons of the study area because they are native of the village and have lived there for long. However, different answers are obtained when it is asked «in which months does each of the seasons usually start or end? » The majority agrees that the rainy season usually begins in May (86%) and ends in October (74%). The dry seasons often starts in November (51%) and ends in April (62%).

To the question whether rain is often sufficient for cereals growth, farmers answer that rain is not always sufficient (73%). A majority of the growers (99%) declares that their cereals are often victim of rain shortages during the rainy season, which can last up to 23 days on average. In this case, to compensate for the lack of water, 44% declare that they rely on dew occurrence in their fields. Otherwise, for wind regimes, the growers believe that wind is more abundant in the morning (48%) and during night (46%).

Farmers have thus a good knowledge of their environment. What they know about dew is discussed below.

3.2. Dew: Knowledge, Utility and Various Utilizations

All the growers (100%) have their own idea of what dew is, because they observe it for a longtime. They try accordingly to give a definition of dew. For instance, most of them think that «dew is water, or drops of rain fallen down from the sky and usually observed in the early morning on objects such as vegetables, canopy, plants leaves, shrubs, etc.». Interestingly, they also notice (81%) that dew is different from fog.

When one asks in which month dew is mostly observed, different responses are given. According to 45% of the investigated people, dew is abundant during August, 83% declare that dew is most abundant in September and 66% declare that October is the month in which dew is the most abundant in Guéné. In addition, 80% of the growers declare that dew can be observed in the morning; in contrast 46% of them declare that dew is usually observed during the night. Growers also say that the substrates on which they often observe dew are: leaves of plants (100%), roofs of the houses (44%), soil (25%) and vehicles (19%). In addition, the growers highlight factors inhibiting dew formation. For example, they cite a hot soil temperature during night (44%), cloud cover (34%) and large wind speed (31%). They also indicate that dew formation can vary dependently from the season (42%).

From the survey, regarding the utility of dew for cereals growth, respondents' opinion is almost unanimous (99%) in saying that dew plays an important role for cereals growth. Some declarations were mentioned: «after dew events, cereals plants or vegetables that greatly need little water come back to life», «dew helps plants by wetting them, bringing them water through soil and humidity when rain is lacking or in period of long drought», «dew can help certain plants to grow, even when there is a lack of rain», «dew helps plants in difficult growing times», «it contributes to reinforce

plant's roots», «dew permits several cereals' leaves to become green», «dew helps the survival and the growth of plants», «dew helps plants to finish their vegetative growth», etc.

Otherwise, when one asks the farmers in which phase dew is most useful, regarding the six main stages of cereals growth, 64% declare that dew is more useful for cereals during the *maturation phase* (called physiological maturity phase), 52% think that dew is more useful during the *stage of flowering*, 32% think that dew is more important in the *raised up phase*, 10% think that dew is most important for the *germination phase*. For 2% of the growers, dew is of benefit for cereals during the *stages of harvest* (tasseling) and the stage of *senescence* (1%).

In contrast to the positive perceived benefits of dew, some growers declare that dew could be harmful for cereals (17%). For example, some of them say that dew is especially harmful for the «abandoned harvests», «it is harmful for fruits especially when they fall down» and «dew can also contribute to turn black certain cereals seedlings, such as millet and sorghum». In addition, when one asks them about the particular stage of cereals growth in which dew could be harmful, the growers believe that dew is more harmful in the *harvest stage* (11% of the sample or 65% of those who declared that dew could be harmful to plants). Finally, dew is thought to have also harmful effects on cereals in the *stage of maturation* (4%, or about 24% of those who declared that dew could be harmful to the growth of cereals).

Concerning dew utilization, 80% of the growers declare that they account for dew before and during the growth of their cereals. Close to 80% of the growers affirm that, in their own experience, dew has assisted their cereals growth. Most growers illustrate the role of dew by affirming that «dew helps cereals in the periods of drought or during rain shortage», «it brings humidity to the plants», «dew impact is especially great after the last weeding toward the end of the rainy season», «dew improves cereals good maturation», «it comes in support to the cereals, two or three days after a rainy day», «dew contributes to the growth of cereals as sorghum, millet, maize in period of rainy break».

When one asks them what source of water they substitute for rain when lacking or not sufficient, 56% of growers declare to use water from wells for irrigation, 44% declare to count on dew. They gather wild grasses around cereals plants, dew condensed from the leaves into the gathered grasses and reach the roots of the plants. They also think that plants absorb dew from atmosphere directly.

3.3. Attitudes towards Adoption of New Technology for Dew Water

A number of questions were asked to the growers in view of the promotion of a new technology that could help to collect and store dew water for utilization in agriculture. It was asked «whether they think possible to collect dew water?», «would they agree to adopt a technology that would permit them to collect dew water and in what conditions could they use dew water?». Only 15% of the respondents believe that it is possible to collect dew water using materials. They proposed many ways to collect it. Among the possibilities of dew harvesting, they answered that «bowls» or «calabashes» can be deposited for recovering dew at night or early morning. They also mentioned «enter in the moistened shrubs and let their cloths absorb dew that may be squeezed from cloths», «utilize cloths to collect dew from roofs or plant's leaves». Moreover, 87% say that they can adopt new technology that could help them to collect dew, at least if it is feasible and unexpensive. However, they remain doubtful regarding the efficiency of any method for collecting a sufficient amount of dew.

3.4. Analysis of Responses Regarding Ages, Gender and the Kind of Cultivated Cereals

Table 2 presents the results of the survey taking into account the way that farmers respond in the three different groups of ages (G1, G2 and G3) and the gender (male or female). Several points are concerned from the table. Maize is the cereal most sown regardless the group of ages (100% G1, 98% G2 and 99% G3) and the gender (98% male, 100% female) of the respondents. However, regarding the sufficiency of rain to cereals growth, 75.3% and 42.9% of males and females, respectively, agree, no matter what age they are (80.5% G1, 63.7% G and 71.4% G3), that rain is insufficient. So 98.9% and 100% respectively of males and females, regardless the ages (100%, 98%, 100%) are aware of rain interruptions during the rainy seasons. Furthermore, in order to compensate the lack of water during those rain interruptions, most of the elders (71.4% G3,) believe that dew is mostly used by cereals to mitigate water scarcity. However, 71.4 % of females of the same group of age have opposite opinion.

Table2. *Results of the survey taking into account farmers knowledge of: seasons, dew role in cereals growth, factors affecting dew amounts and farmers attitude of adapting any dew harvesting technology*

Rain season start month	**Number**	**Percentage**	**Valid Percentage**
April	1	1	1.0
May	**86**	**86**	**86.0**
June	12	12	12.0
Rain season end month	**Number**	**Percentage**	**Valid Percentage**
June	1	1	1.0
September	20	20	20.0
October	**74**	**74**	**74.0**
November	4	4	4.0
Dry season start month	**Number**	**Percentage**	**Valid Percentage**
September	6	6	6.0
October	34	34	34.0
November	**51**	**51**	**51.0**
December	7	7	7.0
Dry season end month	**Number**	**Percentage**	**Valid Percentage**
February	1	1	1.0
March	12	12	12.0
April	**62**	**62**	**62.0**
May	20	20	20.0
June	3	3	3.0
Rain sufficiency during rainy seasons			
	Number	**Percentage**	**Valid Percentage**
Yes	27	27	27.0
No	**73**	**73**	**73.0**
Cereals are victims of shortage during rain season			
	Number	**Percentage**	**Valid Percentage**
Yes	**99**	**99**	**99.0**
No	1	10	1.0
Source of water during shortage in rainy season			
	Number	**Percentage**	**Valid Percentage**
Backwater No	100	100	100.0
Yes	0	0	0.0
Well Yes	2	2	2.0
No	98	98	98
Dew **Yes**		**44**	**44.0**
No		56	56.0
Wind occurrence period			
None period Yes	2	2	2.0
No	98	98	98.0
Morning **Yes**	**48**	**48**	**48.0**
No	52	52	52.0
Evening Yes	20	20	20.0
No	80	80	80.0
Night Yes	**46**	**46**	**46.0**
No	54	54	54.0
Dew is helpful for cereals **Yes**	**99**	**99**	**99.0**
No	**1**	**1**	**1.0**
Dew is the same to fog Yes	14	14	14.0
No	**81**	**81**	**81.0**
Dew highest amount months			
June Yes	4	4	4.0
No	**96**	**96**	**96.0**
July Yes	26	26	26.0
No	**74**	**74**	**74.0**
August Yes	45	45	45.0
No	**55**	**55**	**55.0**
September Yes	83	83	83.0
No	**17**	**17**	**17.0**

October Yes	66	66	66.0
No	**34**	**34**	**34.0**
November Yes	15	15	15.0
No	**85**	**85**	**85.0**
December Yes	1	1	1.0
No	**99**	**99**	**99.0**
Daytime of high dew amount			
Morning Yes	80	80	80.0
No	20	20	20.0
Evening Yes	3	3	3.0
No	97	97	97.0
Nigh Yes	46	46	46.0
No	54	54	54.0
Support on which dew is often observed			
Grass Yes	100	100	100.0
No	0	0	0.0
Glass Yes	100	100	100.0
No	0	0	0.0
Roofs Yes	44	44	44.0
No	56	56	56.0
Soil Yes	25	25	25.0
No	75	75	75.0
Factors affecting dew amount on support			
Wind Yes	31	31	31.0
No	69	69	69.0
Cloud Cover Yes	34	34	34.0
No	66	66	66.0
Soil Temp Yes	44	44	44.0
No	56	56	56.0
Season Yes	42	42	42.0
No	58	58	58.0
State of growth in which dew is helpful			
Germination Yes	10	10	10.0
No	89	89	89.0
Initial state Yes	32	32	32.0
No	67	67	67.0
Flowering state Yes	52	52	52.0
No	47	47	47.0
Maturation state Yes	64	64	64.0
No	35	35	35.0
SenescenceYes	1	1	01.0
No	98	98	98.0
Harvest Yes	2	2	02.0
No	97	97	97.0
State of growth in which dew is harmful			
Germination Yes	00	00	00.0
No	18	18	18.0
None Applicable	82	82	82.0
Initial State Yes	00	00	00.0
No	18	18	18.0
None Applicable	82	82	82.0
Flowering state Yes	1	1	01.0
No	17	17	17.0
None Applicable	82	82	82.0
Maturation state Yes	4	4	4.0
No	14	14	14.0
	82	82	82.0
Senescence state Yes	1	1	1.0
No	17	17	17.0
None Applicable	82	82	82.0
Harvest State Yes	11	11	11.0

No	7	7	07.0
None Applicable	82	82	82.0
Dew is forecasting in cereals growth			
Yes	80	80	80.0
No	19	19	19.0
Dew is ever experienced			
Yes	80	80	80.0
No	19	19	19.0
State of growth at which dew is experienced			
Germination Yes	6	6	06.0
No	74	74	74.0
None Applicable	20	20	20.0
Initial state Yes	25	25	25.0
No	55	55	55.0
None Applicable	20	20	20.0
Flowering state Yes	39	39	39.0
No	41	41	41.0
None Applicable	20	20	20.0
Maturation state Yes	50	50	50.0
No	30	30	30.0
None Applicable	20	20	20.0
Senescence Yes	3	3	03.0
No	77	77	77.0
None Applicable	20	20	20.0
Harvest State Yes	1	1	01.0
No	79	79	79.0
None Applicable	20	20	20.0
Dew technology Adaption			
Yes	87	87	87.0
No	11	11	11.0
None Applicable	2	2	02.0
Total	**100**	**100**	**100.0**

Even if a significant proportion of females (100%) and males (79.6%) think that dew is different from fog, female (42.9%) think that dew is not abundant in early mornings against males (82.8%) regardless their ages, respectively 80.5% in G1, 83.7% in G2 and 71.4% in G3. However, females (100%) believe that dew is abundant at night time**.**

All the respondents (100%) believe that dew can form on grasses. Coming to the identification of the main factors affecting dew occurrence: wind, cloud cover, soil temperature and seasons, respectively, 33.3%, 34.3%, 46.2% and 38.7, answer that these factors affect dew formation. Both females (100%) and males (78.5%), respectively, estimates that dew occurrence is one of the main source of water during the seeding seasons for cereals, no matter in which group of age they are (82.9% G1, 75.5% G2 and 85.7 G3).79.6% of male and 85.7 of female agree that dew helps cereal's growth.

Concerning the responds regarding the type of cereal the farmers grow, one can find that farmers in Guéné do not sow other cereals out of sorghum, millet, maize or fonio. The statistics show that the majority of the farmers sow maize (99%) and sorghum (58%), indicating that there is less influence of the farmers who sow millet (58%) and fonio (1%) in the responses. The respondents (80%) who cultivate maize plan a probable contribution of dew before they sow their cereals and those (87%) who sow sorghum agree to adopt any technology of dew collection in their farm. But 49% of maize and sorghum sowers require an efficient technology. 99% of the two cereal sowers claim that dew contribution is spontaneous in plant growth especially at the *ripening* (64%) and *flowering* (52%) stages of growth. However 69% think that dew can be harmful. The answers from this category of investigation indicate that 100% of the farmers sowing both maize and sorghum know dew and fog and 76% of them indicate that the two phenomena are different. On the other hand, 66% think that dew can be used for irrigation.

Even if the percentage can somewhat vary from a group of age or the gender to another, all the answers to the main questions concord when the analyses are performed taking into account the ages and the gender of the respondents. However, the correlation of the responses from the farmers who sow sorghum and millet indicate that the answers depend on these sowers.

Table3. *Results of the survey taking into account the gender and the ages of the respondents*

	Gender (%)				*Ages (%)*					
	Male		Female		19-35 Years		35-55 Years		55-70 Years	
Parameters	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Cultivated Cereals										
Sorghum	75.3	24.7	85.7	14.3	75.6	24.4	71.4	28.6	100.0	0.0
Millet	59.1	40.9	42.9	57.1	41.5	58.5	65.3	34.7	85.7	14.3
Maize	98.9	1.1	100.0	0.0	100.0	0.0	98.0	2.0	99.0	1.0
Fonio	1.1	98.9	0.0	100.0	2.4	97.6	0.0	100.0	0.0	100.0
Others	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Rain sufficiency to cereal's grow										
	24.7	75.3	57.1	42.9	19.5	80.5	32.7	67.3	28.6	71.4
Rain breaks during rainy seasons										
	98.9	1.1	100.0	0.0	100.0	0.0	98.0	2.0	100.0	0.0
Water used to compensate rain break										
Rivers	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Wells	2.2	97.8	0.0	100.0	0.0	100.0	4.0	95.9	2.1	97.9
Dew	45.2	54.8	28.6	71.4	43.9	56.1	42.9	57.1	71.4	28.6
Others	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Dew is the same as rain										
	15.1	79.6	0.0	100.0	12.2	85.4	14.3	77.6	28.6	71.4
Period of intense dew										
None	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Mornings	82.8	17.2	42.9	57.1	80.5	19.5	83.7	16.3	71.4	28.6
Noons	3.2	96.8	0.0	100.0	2.4	97.6	2.0	98.0	14.3	85.7
Nights	41.9	58.1	100.0	0.0	36.6	63.4	46.9	53.1	71.4	28.6
Materials on which dew is observed										
None	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
Grass	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Pane	20.4	79.6	0.0	100.0	24.4	75.6	18.4	81.6	0.0	100.0
roofs	44.1	55.9	42.9	57.1	43.9	56.1	38.8	61.2	67.1	42.9
Naked soil	26.9	73.1	0.0	100.0	26.8	73.2	28.6	71.4	0.0	100.0
Factors affecting dew occurence										
Wind	33.3	66.7	0.0	100.0	22.0	78.0	36.7	63.3	57.1	42.9
Cloud cover	34.3	65.6	28.6	71.4	39.0	61.0	32.7	67.3	28.6	71.4
Soil temperature	46.2	53.8	14.3	85.7	39.0	61.0	46.9	53.1	42.9	57.1
Seasons	38.7	61.3	85.7	14.3	43.9	56.1	61.2	41.9	42.3	57.7
Others	8.6	91.4	0.0	100.0	12.2	87.8	4.1	95.9	14.3	85.7
Forecast dew during cereal growth										
	78.5	20.4	100.0	0.0	82.9	14.6	75.5	24.5	85.7	14.3
Dew helps your cereal's growth										
	79.6	19.4	85.7	14.3	87.8	9.8	73.5	26.5	71.4	28.6

4. CONCLUDING REMARKS

The recognition of rain shortage constitutes a core knowledge that makes growers sow their cereals at the best moment of the rainy season to prevent unpredictable rain shortages (99% of the respondents are victim of rain shortage). For that purpose, they rely on dew as an alternate source of water for their cereals, suggesting that dew directly influences water management for cereals growth: 99% of the respondents agree that dew water is beneficial to cereals growth. These responses suppose that the majority of farmers, in their experience for agriculture, notice the diminution of water resources and also relate meteorological parameters (wind, rain, temperature) to dew formation. The high percentage regarding the questions related to the seasons is in agreement with scientific literature data [7] concerning the region.

The definitions and justifications that growers give to illustrate how they understand the dew process contain the main scientific terms to build a real definition of what is dew. They mention words like "high air humidity", "night time", "and early morning", "clear sky, leaves"," plants "," dew substrates and air temperature". Even if they do not mention the dew point temperature (the temperature at

which water vapor reaches 100% relative humidity and can condense into liquid), the terms that they use, in trying to give dew definition, are mainly used to build an exact scientific definition of dew. Growers also differentiate dew from fog, using the same wording as in literature [8]. But they mistake dewfall as rain droplets falling from the sky. This is presumably because they usually observe abundant dew in September (83%), a transition month between the end of rainy season and the beginning of dry season. Confusion could be made between rain droplets and dew drops condensed on plant's leaves, on which 100% declare to often observe dew. Also the confusion could be explained by their low academic instruction level, which may make them misunderstand the questions to indicate exactly the difference between rain and dew. Nevertheless, respondents affirm that dew is not fog, as declared by 81% of them regardless of their gender or ages (Table 3). But when one considers the responses they give in view of the sown cereals, the growers responses depend mainly on maize (99%) and sorghum (58%) sowers. The answers indicate that 100% of the farmers sowing both maize and sorghum know dew and fog, which are two different phenomena. On the other hand, they think that dew can be used for irrigation. In addition, farmers indicate that cloud cover and high wind speed inhibit dew formation, as noted in literature [2, 9]. They also report that the period from August to October is beneficial to dew formation. Meteorological observations in Guéné [7] show that this period coincides with the transition period from rainy to dry season. Hence, the crops that are delayed because of lack of rain can benefit from dew season to finish their growth cycle and ripen.

Based on their experience, most of the growers thus confirm that dew contributes in cereal growth, particularly in *flowering* and *maturation stage* (52% and 64%, respectively), where a lack of water is critical for fruit formation. While they do not precisely know the process by which dew forms from humid air and is utilized by plants, farmers utilize dew for cereals by enhancing it accumulation around plant's roots. The majority of farmers declare to forecast (80%) and integrate dew periods in their annual agricultural activities. Growers think that dew and humidity around cereals allow their leaves to be green thanks to the contribution of dew to plant photosynthetic activities. Dew is said to be a major factor affecting water use efficiency in the water-stressed regime, in agreement with literature [9]. Growers also claim that dew is an important source of moisture in the air in semi-arid areas (like Guéné) and creates the best conditions for plants growth on early morning for two to three hours after sunrise. It is why 80% experienced farmers take account of dew before and during cereals growth. This practical knowledge of dew formation and dew effects on plants is important for agriculture in general and for cereals in particular at Guéné. On the other hand, some growers also indicate that dew can be harmful for plants and cereals seedling, in accordance with literature [2, 4]. Growers highlight the interest of having a technology for dew collection but are uncertain about the water amount that could be collected.

Eventually, the study concludes that farmers' perceptions of dew mirror the scientific literature, though their perceptions are based on practical experience. The grower's opinion indeed reflects their life and agricultural work conditions, characterized by a keen knowledge of meteorological environment and poverty of means and life conditions. One notes that the responses to the main questions are not related to gender and ages as shown in Table 3. All the farmers respond to the different questions in the same way, however the responds vary dependently from the sown cereals.

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