CONTRIBUTION TO THE IMPROVEMENT OF THE FARMING PRATICES OF PRODUCTION OF PINEAPPLE IN BENIN: CASE OF THE MUNICIPALITY OF ALADA IN THE DEPARTMENT OF THE ATLANTIC

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Abstract

In Benin, pineapple is an important fruit crop, mainly grown in the Atlantic department. The survey in prospect to improve the production practices of pineapple in Benin took place in the municipality of Allada, in the Department of Atlantic. The objective aimed by the survey is to check off the different convenient in use by the pineapple's producers in the municipality and to make a comparative analysis of it with the scientifically advisable practices, to propose to the producers the necessary practices. To reach this objective, we used the semi-structured interview and the interview structured to collect the information, the synthesis of suitable literatures for comparison. Results indicated that the production practices were very diverse, especially regarding planting material used (slips, hapas and suckers), planting density, flowering induction, and fertilizer application. The results revealed that the application level of the technical itineraries for the production of pineapple in the municipality is weak. Indeed, the certified dismissals don't exist in Allada. All producers tell to appropriate the dismissals on their own harvests or buy them by the neighbors. Although uncertified, the dismissals are not treated before their setting in earth. Fertilization is done without previous survey of soil and without leaf diagnosis. The organic manure is not quite of the practiced and the specific

manure (NPK-S-Mg) is not of use because inaccessible. With regard to the ploughing, it is flatbed but only 40% of the producers respect the depths of advisable ploughing (30-35cm). Tackling all these constraints would help producers improve the quantity and quality of produced pineapple in this municipality.

Keywords: Pineapple, Faming practices, Analysis compared, Productivity, Allada

Introduction

The Government of Benin, in its constant concern for the well-being of people, has selected on the horizon 2015, quantitative targets for poverty reduction and development (Capo-Chichi et al., 2009). To achieve these goals, strategic and political orientations were defined. Twelve priority sectors have been identified and agreed by the Beninese Government in the "Plan Stratégique de Relance du Secteur Agricole" (PSRSA, 2006). Among these priority sectors, include that of the pineapple. The aim, expressed in this plan is to substantially increase the production of pineapples of quality and improve the implementation fresh fruit market and its derivatives in order to contribute to the diversification of exports (MAEP, 2010).

Pineapple is the second tropical fruit after bananas, concerned with world trade (Mangara et al., 2010)). The major importers are the European Union and North America (33%). The main suppliers are Latin America and the Caribbean (40%) (PMC, 2008). The contribution of Benin is estimated at 1% of world production (Tropagri, 1998 ; Tossou, 2001). It is the main fruit growing in Southern-Benin, particularly in the department of Atlantic and by approximately 70% of producers who account for about 95% of the total production of Benin (Helvetas-Benin, 2008). The better quality of the Benin pineapple, in comparison with Cameroon, Ivory Coast, Ghana bring it a real asset internationally.

Despite the multiple opportunities presented by pineapple sector in Benin, the production is largely rain-fed with inadequate use of improved technologies such as high and stable yielding crop varieties, good agricultural practices, fertilizers, and other agro-inputs. These among many other things have contributed to the observed low yields (53,56t / ha-68,31t / ha) (INSAE, 2007). It is looking solutions to increase yields we set ourselves the task of conducting a diagnostic study of cultural practices to characterize the farmers' cultural practices in the municipality of Allada, to retain weaknesses for improvement based on external experiences and existing technology package and disseminated in Benin.

Material and methods

Study area

The municipality of Allada is located in norther part of the Department Atlantic about 56 km from Cotonou, the economic capital of Benin. The climate is subequatorial with two (02) rainy season (high season from March to June and a small season from September to November interspersed with two dry seasons (July to September and from November to March). The average annual rainfall is 1200 mm, 700 to 800 mm for the first rainy season and 400 to 500 mm for the second rainy season. The monthly temperature varies between 27 °C and 31 °C. The soils are essentially characterized by the "Terre de barre". Terre de barre are red soils (2.5, 5 and 7.5YR) having a sandy-clay texture on the surface 0–40 cm. These soils are very deep (>10 m) with neither gravel nor an indurate horizon. These soils correspond respectively to Acrisols in FAO classification (FAO, 2002). There are well suited to food crops, market gardening, fruit and the cultivation of coffee and cocoa. The vegetation is characterized by a mosaic of crops and fallows and rare forest islands.

Data collection

Data for the study was based on interviews (through questionnaire administration) and focus group discussions with pineapple producers and technical supervision. Other information were collected by literature review (proposal for improvement) and the observations in pilot fields of pineapple production in order to assess the relevance of certain statements of the respondents. The survey was based on a sample covering 11 of the 12 districts in the municipality. By district, 2 villages or urban district were randomly chosen with the following criteria: significance of the presence of production and organization of producers. In each village and urban district, the questionnaire was randomly administrated to 10 producers making a total of 220 producers for the whole municipality. The sample unit was the farm household with the head of the household or the person who takes farm management decisions as the respondent. We gathered information on areas sown, recent productions (last five years), the varieties grown, the sources of pineapple planting material s, production systems, types of tillage, planting periods, struggles against weeds, formulations and dose of floral induction treatment, periods of harvest, stocking and packaging.

Data analysis

The collected data were the subject of a manual count and were processed using the Excel 2007 spreadsheet (spreadsheet was used to draw graphs or figures). The MINITAB software (v. 14) was then used for statistical analysis and the least significant difference (LSD) method at the

probability level (P) of 0.05 was used to separate mean difference. Finally, the chi-square test performed using the same statistical software has enabled us to identify practical differences between the various producers.

Results

Trend of pineapple area harvested, production and yield in the municipality of Allada

Figure 1 shows that from 2008 to 2012, the land allocated to pineapple production has gradually increased from 267.25 ha to 1381.55 ha. From 2008 to 2012, the pineapple production in this municipality has gradually and significantly ($p<0.05$) increased from 16035 tonnes (2007-2008) to 57219.6 tonnes (2011-2012) (Figure 1). Whereas yield has decreased from 60 t/ha to 41.4 t/ha (Figure 1).

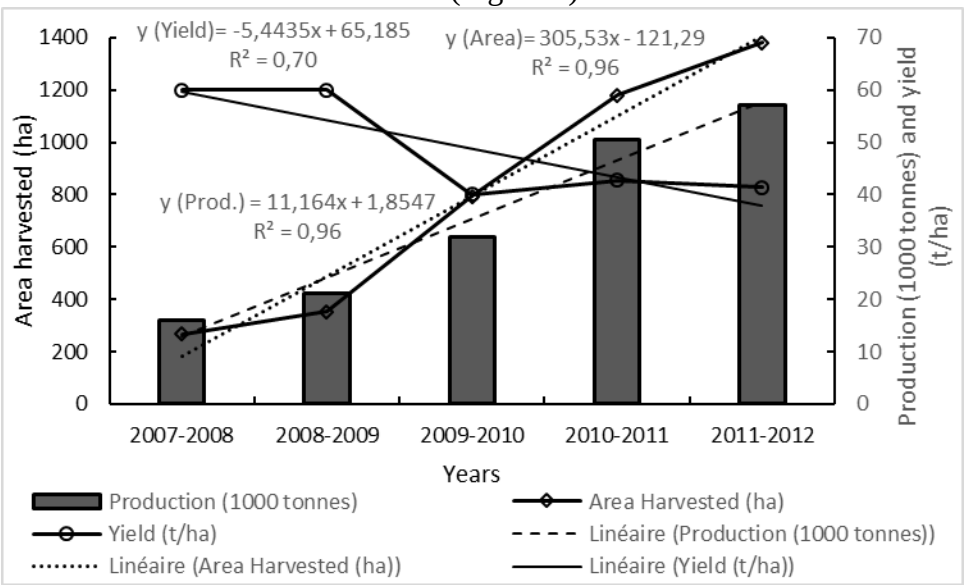

Figure 1. Land allocated to pineapple production and pineapple yield in in the municipality of Allada from 2008 to 2012

Source: Own compilation adapted from CeCPA Allada data

Cultivation practices for pineapple production in Allada agricultural sector

- **Origin of pineapple's planting material s and planting period**

There are two sources of pineapple's planting material supply in the municipality of Allada: bought from neighbors and levy on own harvest. All surveyed farmers levy pineapple's planting material on their own harvest, but 53.75% of them complete their pineapple's planting material with those purchased from the neighbors. Pineapple's planting material of "Sugarloaf" variety used by producers are those obtained from the previous season crops.

Pineapple's planting material of the "smooth Cayenne" variety are often bought from neighbors. For every producer, pineapple's planting material planting begins after the first rain but can vary according to sale expected periods.

- **Preparation of pineapple's planting material for planting**

There is a very significant difference ($p<0.01$) between the proportion of producers who treat their planting material s and those who don't treat. Indeed, surveys show that only 2.5% of producers treat pineapple's planting material s before planting (Figure 2). The treatment is done by soaking in a solution of benomyl 250g/100 L of water.

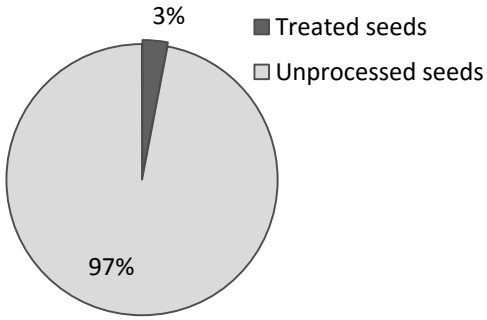

Figure 2: Pineapple's planting material treatment before the planting

- **Weeding**

There is a significant difference ($p< 0.05$) between the number of producers making two weeding preceded by a weed-killer application and those making more than three weeding, and a very significant difference ($p<0.01$) between producers making two weeding preceded by one weed-killer application and those making three weeding. Also a significant difference exist ($p<0.01$) between those two doing weeding and those making more than three weeding. Overall, 17.5%, 5%, 52.5% and 25% make respectively two (2) manual weeding preceded by weed-killer application, two (02) manual weeding, three (3) manual weeding and more than three manual weeding.

Table 1. Weeding frequency

Number of weeding	Number of respondents	% of respondents
2 weedings preceded by one weed-killer application	39	17,5
2 weedings	11	5
03 weedings	115	52,5
More than 03 weedings	55	25
Total	220	100

For weed management, some weed-killer used are summarized in Table 2.

Table 2. Weed-killer used

Trading name	Active substance
AGRIBROMA 80% WP	Bromacil 800g/kg
AGRAZINE	Atrazine 800g/kg
CHEMOVAR 80%WP	Bromacil 800g/kg
CHEMURON	Diuron 800g/Kg

- **Cultivation systems**

There is a very significant difference ($p<0.01$) between the number of producers who produced pineapple in pure culture (65%) and those who produced in mixed cropping (20%). 15% of respondents produce pineapple in both pure and mixed cropping (Figure 3).

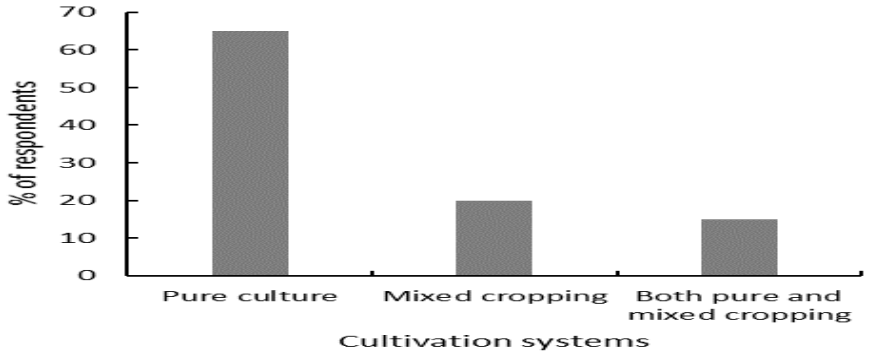

Figure 3. Cultivation systems of pineapple in Allada's agricultural sector

There is a very significant difference ($p<0.01$) between the type of association (pineapple-maize) and other the crop associated with pineapple are maize (53.57%), chilli (17.85%), tomato (10.71%), peanut (10.71%) and gboma (14%) (Figure 4).

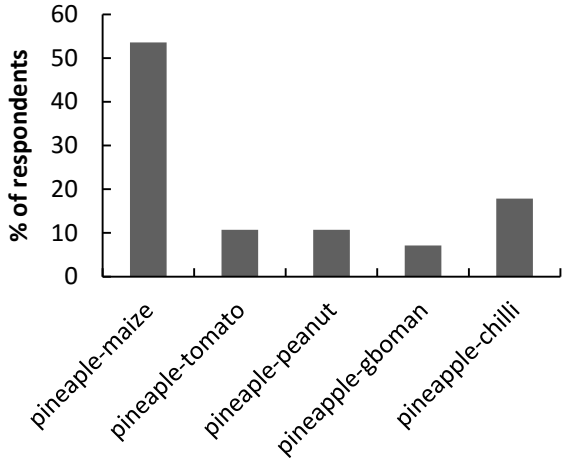

Figure 4. Types of associations

The practice of crop rotation is not at all respected by producers. They practice monoculture with a few years of fallow. There is a significant difference ($p<0.01$) between producers cultivating pineapple two consecutive growing seasons on the same plot and those producing it more than three consecutive years. Table 3 shows that in the municipality of Allada, among the investigated producers, 17.5% produce pineapples on the same plot two consecutive growing seasons, 36.25% do so three consecutive growing seasons and 46.25%, more than three consecutive years.

Table 3. Cultivation frequency of pineapple on the same parcel.

Cultivation frequency	Number of respondents	% of respondents
2 consecutive growing seasons	39	18
3 consecutive growing seasons	80	36
More than 3 consecutive growing seasons	101	46
Total	220	100

- **Ploughings and planting density**

In the municipality, all producers use the flat ploughing for the production of pineapple. There is no significant difference ($p>0.05$) between producers doing the ploughing for recommended depths (25-35 cm) and those doing at higher or lower depths. 36% of producers do their ploughing at depths below 25 cm and 24% of producers at higher depths (35cm) and 40% at 30-35cm.

Planting density varies from one producer to another and depends on planting spacing. These densities ranging from 44000 to 55000 plants per hectare.

- **Fertilization**

All respondents practice fertilization. The fertilizer used are the cotton fertilizer (NPK 14-23-14), urea (46%) and sulphate of potassium. None of the producers does not use organic manure or specific pineapple fertilizers (NPK-S-MgO).

There is a significant difference ($p<0.05$) between the proportion of producers who respect the fertilizer recommendations corresponding to 300 kg/ha of NPK, 300 kg/ha of urea and 300 kg/ha of K_2SO_4 and those who applied lower doses (Table 4).

Table 4. Respect of fertilizer recommendations

Application dose	Number of respondents	% of respondents
Recommended doses	94	42,5
Low doses	126	57,5
High doses	00	00
Total	220	100

IV- 3-9. Floral induction practice

The floral induction practice is done by all producers. It consists in spreading in the heart of the plant a chemical product to induce flowering. For floral induction, the product used is the "Carbide". It is the only product used for flower induction of pineapple. The "éthrélage" is applied by all producers when the fruit is destined for export. The product used is ethephon. The éthrélage is applied in order to turn the green fruit color to yellow-orange.

Discussion

The evolution of annual pineapple production in the last five years in the municipality of Allada shows the same trends of increasind as the area planted wheras the yield is decreased. This explains the extensive nature of this culture, character that wants producers to increase their production based on area planted rather than intensification. Many driving forces (e.g. population growth, lack of access to specific inputs by pineapple producers, the high cost of available inputs can explain the increasing production of pineapple. From a technical view point, the observed increases of production are likely associated with increases of labour and land. Yet, additional factors such as the non-mastery and poor application of cultivation practices, non-adoption of improved production technologies, soils and climate conditions are also very likely to influence positively or negatively the yield. Indeed, all producers use planting material s taken from their own harvest and 53.75% of them complement those purchased from the neighbors. This equally significant proportion may negatively influence the average yield considering all producers. Non-certified pineapple's planting material can beings sources of transmissible diseases from one producer to another. It is important to note farmers perceived that because they already have crops that were grown from certified planting material s, there is no need to procure the same seasonally, and hence they use their own planting material s from previous harvests. The farmers were of the opinion that the planting material s are safe since they are rarely attacked by pests. The farmers' perspective on source of pineapple for planting suggests the reason for the low yields of pineapple prevalent in the Municipality.

In majority, the pineapple producers do not plant on recommended dates regardless of the growing cycle of the variety. These producers claim that their planting times depend on the planning of sale, their financial means and also the availability of labor. So for these producers, the planting periods are variable from year to year and are held throughout the year. Now, according to extension services, for good and quality production of pineapple in Benin, it is recommended that pineapple's planting material s be sown before June, which is generally the wettest month, to limit the risk of disease

including phytophtora (Gbèhounou and Gbassi, 1999). Failure of these dates by the majority of producers could therefore adversely affect pineapple production in the municipality. Delaying of planting date can be also a strategy to cope with rainfall variability (Gnanglè et al., 2012; Yegbemey et al., 2013; 2014). Given the high rainfall variability, farmers usually face dry spells after the first sowing. To deal with this lack of rains, they practice a second sowing. As a result, the duration of the cropping season lasts longer than usual, posing the issue of time-inefficiency.

Weeding is a soil cleanup operation that aims to rid it of wild grass or weeds by mechanical means (Aho & Kossou, 1997). According to Tossou (2010), for a pineapple field, at least ten (10) weeding are necessary from the planting until harvest. The results of this study revealed that only 36.25% of producers practiced more than three weeding. 30% of producers used pre-emergence weed-killer (AGRIBROMA, CHEMOVAR, CHEMURON). These weed-killer with the active ingredients they contain prevent the germination of a wide range of weeds, which greatly reduces the density of weeds.

All producers practice intercropping in the majority with maize. According to Tossou (2010), this association (pineapple-maize) is not recommended because the maize pests are also those of pineapple. Crop rotation is the succession of cultures brought by the same sole, for a number of crop after which the same culture of succession is repeated in the same order (Aho and Kossou, 1997). Our study revealed that more than 40% of producers practice mono-cropping over three (03) consecutive years. So these producers do not have a crop rotation plan. Crop rotation and weed control can help to limit the population of pests such as scale insects that are vectors of virus-associated (Pineapple Mealyburg Wilt closterovirus, PMWaV), the main agent of dieback pineapple. Therefore pineapple monoculture practiced in agriculture sector of Allada is a real handicap which will direct consequence not only of land degradation but also the proliferation of pests and diseases of pineapple and thus declining agricultural yields.

The results showed that flat ploughing is practiced by all producers, which is recommended by the extension service because provides good development of roots and good compliance with planting spacing. But plowing depths are not respected by producers. Indeed, only 40% respect the recommended depth (30-35cm). According to (Gbèhounou and Gbassi, 1999), the non-obedience of ploughing depths can affect the growth and development of plants.

The inorganic fertilizers used by the respondents were mainly the cotton fertilizer (compound NPKSB) and thus their use on pineapple production was limited. Moreover, those who use fertilizers don’t respect the

dosing recommendations given to them during training by extension services. This call upon to put available the specific fertilizer for pineapple to producers. Moreover many of the producers use simple fertilizers (urea and potassium sulphate) for fertilization. According to Tossou (2010), when fertilizer is easy to use, such as urea and potassium sulfate, basal dressing is essential because the simple fertilizers do not contain all the nutrients needed for good growth of plant. The contribution of these complementary elements in the basal dressing not only contributes to good growth, but also to better management of soil, thus ensuring its preservation. The results showed that the pineapple producers of the municipality of Allada apply basal application only if they use simple fertilizers. Also, they don't make any foliar diagnosis or soil analysis before fertilization. Interviewed farmers reported that the main reason for this is a dramatic increase in fertilizer prices coupled with a lack of financial capital, which together constrain their application of inorganic fertilizers. Evidence from elsewhere in the country confirms that Beninese farmers use a low level of inorganic fertilizer per hectare (Saïdou et al., 2004). Several studies in different areas indicate that crop productivity has been affected by the increasing price of fertilizer and improved planting material (Alem et al., 2010; Spielman et al., 2010).Organic manure is therefore not at all used.

According to extension service agent, it is advised to treat pineapple planting material 24 to 48 hours before planting. The treatment is made from 50% benomyl dipping releases up to half their height, and then takes them out straight to keep the product between the sheets to prevent pests and diseases such as mealybugs, phytophtora. Only 2.5% interviewed producers practice pineapple planting material treatment before planting. Analysis of the results shows that all producers receive extension service agents training and NGOs such as HELVETAS on pineapple production techniques. This is already an asset to raise the level of production. Indeed, nowadays, insufficient training and information for any business is a real problem (Houndonougbo, 2003). Thus, bad practices and incorrect considerations that characterize the production of pineapple in Allada find their reasoning in breach of technical information and data by technical frames agents. Trends in the evolution of pineapple yields can find their explanation in all the factors above mentioned.

Conclusion and suggestion

In the municipality of Allada, there is a clear commitment to a future pineapple industry. Benin government as development NGOs are determined to bring their particular technical contribution to producers. But with all the good will, it should be noted two factors that are not likely to facilitate the development of the pineapple industry in Benin and more specifically in the

municipality of Allada: there are inaccessibility of producers of chemical inputs starting with specific fertilizers pineapple and also the unwillingness of farmers to implement the technical recommendations of the frame. For improvement of pineapple production in the municipality of Allada, we suggest the effective implementation of technical advice of agents and NGOs (e.g. effective use of organic manure, the use of specific fertilizer; respect of fertilizer recommendations, the planting material s treatment before planting).

References:

Adjahossou, N., 2006. La culture de l'ananas dans le département de l'Atlantique : formes d'accès aux intrants et leurs effets sur les systèmes de culture. Thèse d'Ingénieur Agronome UAC / FSA, Bénin.

Agbossou E.K., 2005. Proposition méthodologique pour la rénovation du système de formation agricole au Bénin. 6 p.

Aho N. et Kossou D. K., 1997. Précis d'agriculture tropicale *:* bases et éléments d'application. Les Editions du Flamboyant, Cotonou, Bénin 463 p.

Alem Y, Bezabih M, Kassie M, Zikhali P, 2010 Does fertilizer use respond to rainfall variability? Panel data evidence from Ethiopia. Agric Econ 41:165–175

Country Stat Benin, 2010. Les indicateurs clés Country stat Bénin.

FAO. 2002. Quatorzième réunion du sous-comité´ ouest et centre africain de corrélation des sols pour la mise en valeur des terres; 2000 Oct 9–13; Abomey, Bénin. Rapport sur les ressources en sols du monde, N8 98. Rome (Italy): FAO.

Gbèhounou, G. et Gbassi, P., 1999 : Guide pratique pour une production d'ananas de qualité au Bénin

Gnanglè, P.C., Yabi, J.A., Yegbemey, N.R., Glèlè Kakaï, L.R., Sokpon, N., 2012. Rentabilité économique des systèmes de production des parcs à Karité dans le contexte de l'adaptation au changement climatique du Nord-Bénin. Afr. Crop Sci. J. 20 (2), 589–602.

Helvetas-Bénin. 2008. Appui à la Filière Ananas Biologique et Équitable: Document du Projet. Helvetas-Benin. Cotonou.

Houndonougbo A., 2003. Contraintes liées à la production et à la diffusion des clones de manioc (*Manihot esculenta* CRANTZ) dans le Borgou : Cas de la commune de N'Dali. Rapport de fin de formation pour l'obtention du D.U.T. EPAC UAC. 52 p.

INSAE, 2001, Données climatologiques, Bénin.

INSAE, 2007, Données climatologiques, Bénin.

Mangara A, N'da Adopo AA, Traore K, Kehe M, Soro K, Toure M. 2010. Etude phytoécologique des adventices en cultures d'ananas. Journal of Applied Biosciences, 36: 2367- 2382.

PCM - Performances Management consulting, 2008. Stratégie d'opérationnalisation et déclinaison en plans d'investissements sectoriels de la vision Bénin 2025 : Agenda vers une économie émergente. Rapport final, 171 p.

Saïdou A, Kuyper TW, Kossou D, Tossou R, Richards P. 2004. Sustainable soil fertility management in Benin: learning from farmers. NJAS – Wag. J. Life Sci., 52: 349-369.

Spielman DJ, Byerlee D, Alemu D, Kelemework D. 2010 Policies to promote cereal intensification in Ethiopia: the search for appropriate public and private roles. Food Policy 35:185–194

Tossou CC, 2001. Impact de la culture de l'ananas sur l'environnement dans le département de l'Atlantique, Mémoire de DESS.UAC. 109 pp.

Tossou CC, 2013. Dimensions environnementale, nutritionnelle et socioéconomique des espèces fruitières cultivées sur le Plateau d'Allada au Sud Bénin. Thèse de Doct. Un. UAC. 246 pp.

TROPAGRI, 1998. Etude de la filière ananas au Bénin. Tome IV : pp1-10.

TROPICAL, 1970. Tome 25, pp. 250-543

Yegbemey, R.N., Kabir H., Awoye, O.H.R., Yabi, J.A., Paraïso A.A. 2014. Managing the agricultural calendar as coping mechanism to climate variability: A case study of maize farming in northern Benin, West Africa. Climate Risk Management 3, 13–23

Yegbemey, R.N., Yabi, J.A., Tovignan, D.S., Gantoli, G., Kokoye, S.E.H., 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 34, 168–175.