

DETERMINANTS OF AGRICULTURAL ACTIVITIES SELECTIONS AND ADOPTIONS OF RURAL HOUSEHOLDS IN THE COTTON BASIN OF BENIN

Abstract

The aim of this paper is to identify the determinants of the various agricultural activities selected and adopted by producers in the cotton zones of Benin. With a multilogit estimation, a sample of 702 producers of different agricultural activities is extracted in a random way. Results of the estimation show that several factors inhibit the agricultural growth in the cotton zones of Benin. These factors are organizational, institutional, political and sociocultural order. The constant implication to decision-makers and producers in the implementation of sustainable agricultural growth have to be operated by, grouping farmers' organizations in each agricultural sector, base training, complete distribution of new innovations. The structures of vulgarization have to integrate the perception or producers expectations and question about reluctances of producers to fully integrate recommendations relative to practices for improving durably productivity of production systems through agricultural activities selections and adoptions.

Keywords- Selection – adoption - agricultural activities - selection models -

JEL Classification - D13, O15

1. Introduction

Although agriculture occupies about 80 %¹ of the working population of Benin, it still unable to feed the whole population. This non-performance is not only due to the socioeconomic and climatic conditions. In the cotton zones of Benin, producers seem to be agro-pastoral type with crops production in predominance (MAEP, 2014). The cultural system belongs, according to the typology of various cotton zones agro-ecological potentialities, to the cereal system based on cotton. Indeed, cereal and tubers (maize, sorghum, millet, manioc and yam) occupy less than 45 % of tilled surfaces in the cotton zones. The cultural sequences are characterized by the systematic alternation of cotton with cereal and tubers, with frequently the rotations cotton /maize; cotton/ yam; cotton/mil; cotton / manioc The maize is the most cultivated cereal in all cotton zones, marketed toward the south of Benin and the bordering countries, but it is not consumable in these zones. The Other cereals and tubers (yam, manioc, and millet) are partially intended for subsistence farming, but also marketed. Systems of selection and adoptions of agricultural activities became some strategies for producers to increase their productions and productivity, their agricultural income and especially in the optics to guarantee their food security and welfare. The cotton is the main culture in the North - Benin. This culture benefits supports from a national structure which intervenes in the campaign organization since the production until the marketing. The structure made available credits inputs for producers. A big part of the cotton production is exported towards Europe and Asia.

Cereals constitute the main base of the daily food ration of Beninese. The notion of cereal balance sheet is used in Benin to estimate the cover of the country's food needs. Today, although the notion of food security cannot be appreciated in terms of cereal balance sheet but in terms of quantity of calories and micronutrients consumed, it is opportune that we consider as base of calculation the essential component of the daily food ration. Thiombiano (1992) indicates that cereals constitute the main component of the daily food ration in rural areas (70 to 80 %). In spite of the important role of cereal in the daily food ration, the general trend of the cotton production growth in departments of North Benin is in full evolution. The cotton production in this zone has increased during the campaign 2011-2012, from 130 000 tons for the last campaign to about 300 000 tons for this campaign MAEP (2013). The cotton, due to its importance for the economy of Benin, is the sector which continues to benefit of some particular attentions for its upturn. The campaign 2011-2012 was the object of a quite particular attention of the government and which was lead to the inputs subsidy and the improvement of the purchase prices of cotton seeds for producers. During

¹ INSAE (2014).

50 this agricultural campaign of 2011-2012, the government of Benin decided, among others, to
51 satisfy the request of producers to reduce from 240 to 220 CFA francs (1 US dollars = 499 CFA
52 francs) the kilogram, or from 12.000 CFA francs to 11.000 CFA francs the 50 kg bag selling price
53 of fertilizers to cotton producers, and to pay to producers the first choice of cotton seed at 250 /
54 KG against 200 CFA francs in 2010-2011 and 190 CFA francs during campaigns 2008-2009 and
55 2009-2010 and second choice at 200 CFA francs / KG against 140 CFA francs / KG for the
56 campaign 2009-2010 and 160 CFA francs /kg for the campaign 2010-2011 (MAEP, 2013).

57 This cotton growth poses a problem of selection and adoption between the cotton and the food
58 productions. Selections and adoptions of agricultural activities continue to occupy an important
59 place in the strategies of agriculture boosting as the base of the economy of Benin. The population
60 growth with an average of 3, 25 % between 2002 and 2008; 3.73 % in 2011; 4. 78 % in 2013
61 seems to be very strong compared with agricultural development indications estimated to 2.5 % in
62 2011; 2.4 % in 2012 and 3.6 % for 2013 (MAEP, 2014). Some agricultural product such as maize,
63 manioc and niebe are marketed in informal way towards Niger, Nigeria, Burkina Faso and Togo
64 where the demands are very high (ONASA, 2014). The high demands of these speculations in
65 these bordering countries infer the increase of the food goods prices in Benin. Nigeria, only
66 absorbs more than 45 % of the informal marketing of these food productions (ONASA, 2014). This
67 sector characterized by a weak growth due to numerous necks of structural, organizational,
68 institutional and political order. The cotton basin produces more than 78 % of the “white gold” in
69 Benin (MAEP, 2015). This basin covers, except the sub prefecture of Gogounou, the sub-
70 prefectures of Ségbana, Banikoara, the Urban District of Kandi in the department of Borgou and
71 the sub-prefecture of Kérou in the department of Atacora. The basin named ZAE ² is estimated at
72 20.930 km² (that is, 18 % of the national territory) among which approximately 56 % of arable
73 land. It is bounded at East by the Federal republic of Nigeria, at North by the sub-prefectures of
74 Malanville, Karimama and by the Republic of Burkina Faso; at South by the sub-prefectures of
75 Kalalé, Bembéréké, Silence, Péhunco and Kouandé; and at West by the sub-prefecture of
76 Tanguéta. The agricultural activity in the ZAE2 was only limited to subsistence crops such as
77 sorghum, yam, millet, peanut, maize, niebe, manioc, sesame, sweet potato, etc. The rice is known
78 and practised in the village since the beginning of the 50s with French Company for Textiles
79 Development ((Compagnie française pour le Développement des Textiles (CFDT)). The cotton
80 production seems from now on associated with subsistence crops as maize, manioc, sorghum, rice,
81 etc. The ZAE2 is characterized by two seasons: a rainy season spread over 6 months from April to
82 October and which would grow shorter more and more. It really settles down from May in the best
83 case, and a dry season which begins in October and finish in March. The annual average rainfall
84 oscillates between 800 and 1200 mm. The period of vegetative growth varies between 140 and 180
85 days. In the ZAE 2 the pluviometry is very irregular and this shows itself in several ways: early,
86 late starting up; rough interruption; premature or late end; etc. From the beginning of 2013, we
87 note that the annual height of water exceeds hardly 1000 mm while for the previous period this
88 height was reached more frequently. Besides, rains were distributed on a number of higher days
89 before 1980; it often rained during more than 80 days a year against approximately hardly 70 days
90 during the last two decades. The dominant vegetation is a grassy raised savanna strongly degraded
91 by the anthropological influence, so evolving towards the shrubby savanna. We distinguish three
92 types of grounds: the argilo-muddy grounds: they are very convenient to the agriculture, in
93 particular to the culture of yam, and meet in the slums and forest galleries; the sandy grounds: they
94 are generally little fertile and quickly dry out. The monopoly of cotton exportation is granted to a
95 public company named SONAPRA (Société Nationale pour la Promotion Agricole) which is the
96 only one to take care on the collection's organization to farmers and shelling. In the ZAE 2,
97 between 1995 and 2012, the intensity of selection and adoption passed from 28,5 % to 42,3 % for
98 maize, from 24 % to 29 % for niebe, from 64 % to 100% for peanut and 74 % for cotton , MAEP
99 (2013). What are thus the socio-economic determinants of agricultural activities' selections and
100 adoptions in the cotton zones of Benin? We hoped this article contribute to the sustainable
101 development of agricultural research in Benin. After a literature review in second section, the third
102 section exposes first of all the model and the econometric options. It describes then the data and
103 specifies variables. The fourth section presents results and discussions, and the fifth proposes the
104 conclusion.

²Agro-ecologique Zone 2

In theory, the contribution of selections and adoptions of the agricultural production activities to the agricultural, industrial and commercial sectors development is known. It imposes agricultural productions strategies centred on optimizations of the agricultural income and the economic efficiency. These selections and adoptions infer some demanding operations in energy as the ground works, improve the performances of operations needing technicality as sowing and hoeing, allows to increase the cultivated surfaces and to value the human work for less painful or more productive tasks. At the level of farms, these improvements are estimated by the increase of the production and the productivity (lands, labor) and the reduction of production cost. Selections and adoption of the agricultural activities are inevitably oriented on the producer theory of well-being. For that, Easterlin (2001) confirms that there is a weak and positive relation between agricultural income and happiness when we compare at a given instant, persons having different incomes, but no relation when we make a comparison in time. These works also underline the existence of important differences in satisfactions declared by producers from the point of view of their economic development. The research for new evaluation tools for the individual well-being and for the social choice took in short, two different ways: i) the feed-back on the hedonist conception of utility and ii) the adoption of more objective definitions of life quality. The happiness felt by producers is the only component of the well-being, why not to conceive indicators which allow to measure it directly with the concerned? The economy of happiness³, which was developed in the 1990s, is characterized by the feed-back on the hedonist conception of utility. In another hand, empirical confirmation of the importance of adaptation phenomenon gives all its relevance to the criticism of the welfarist frame and to the approaches which suggest estimating the people position and comparing it with other types of data than those supplied by subjective indications of the well-being. The Social situation of a producer can be measured, for example, based on resources, by the detention of goods in a rank of premium goods⁴ or by life quality's objective indicators such as the life expectancy, the level of nutrition, the level of qualifications, according to Sen (1991). In these approaches, the components of the well-being are not only defined in reference to producer's preferences. The "list" of the well-being factors can be elaborated by ethical criteria that defines the quality of life. The theory of the capability of Sen (1985) constitutes at this time one of the most important alternative metrics of welfarism. The welfare components, named functioning by Sen, indicate social or physical activities or states of the existence. In the approach of Sen (1985), the situation of people is not estimated by the result really reached in terms of realizations but by the set of selections accessible to people that Sen called capabilities. For the physiocrats, the procurement of the remunerative price by farmers is a central objective and will become the sign of the kingdom prosperity. «It is necessary to consider as a sacred principle, that what constitutes the state of Empire prosperity, is the competition of the big population, the abundance and the good productions price. François Quesnay had insisted on the fact that "such is the market value, such is the income." Not only has the good price favored the agriculture progress, added Quesnay: but it is in the good price that consist the wealth which it gets. Unproductiveness with the abundance is not wealth; the high price with shortage is poverty; the abundance with high price is wealthiness. Numerous authors of this stream of thought such Lewis (1955), Hirschman (1958) and Mellor (1966) dedicated many important papers.

The agricultural activity selection and adoption are consecutives, with a certain delays for apprehension, because certain agricultural producers need to be convinced of the profit expected by the agricultural activities selection and adoption, whereas others will need time to mobilize their financial and human resources. In this perspective, certain empirical works such as those of Adéoti and al (2002), show that the highest rates of adoption were recorded with the improved varieties; more than 95 % in Ghana and in Burkina Faso. The low rates of adoption of improved varieties were observed in Senegal and in Benin, 20 - 30 %. Likewise, Ntsama et al (2008) explains that the

³ The term "economy of happiness" is used in a common way since its entrance to New Palgrave Dictionary of Economics with Carol Graham's article "The Economics of Happiness". For a general presentation of this stream see for example Bernard M. S Van Praag, «Perspectives from the Happiness Literature and the Role of New Instruments for Policy Analysis», Iza, Discussion Paper, 2568, January, 2007.

⁴ Rawls (1987)

determinants factors of selections and adoptions of new varieties of maize (CMS, 8704) are: the academic level, the membership in a peasant organization and the commercial orientation. On the other hand, the age, the surface, the sex and the risk seem to have no effect on the adoption of the improved variety. In the same perspective, Morel (1998) explains that the high climate change determines the agricultural activities' selections and adoptions. Paturel and al (1995) shows that changes of agricultural activities selection and adoption are rather oriented on an environment degradation which is indicated by the decrease of the farming yields. Thirtle and al (2003) shows that an increase of 1 % of the agricultural productivity in Africa, reduces the poverty of about 0,6 %, and the increase of 1 % of the production drops of 6 million the number of people living with less than 1 US dollar a day.

3. Data, model regression and econometrics option

3.1. Data collection

Several methods are used by the "Centre d'Action Régional Pour le Développement Rural (CARDER)" of Borgou-Alibori (Parakou) and Atacora-Donga(Natitingou) under the direction of the "Ministère de l'Agriculture de l'Elevage et de la Pêche (MAEP)" for data collection. The first category of technics is the Accelerated Method of Participative Research (AMPR). This is oriented on the works of Ghirotti(1994) and Nianogo (1994). The advantage of this method, is that it generates quite soon, information which are analyzed with producers' cooperation. The application of AMPR requires a high quality of communicative and sensibility, WaterBayer and Bayer (1995).Results supply a first understanding of the potentialities and constraints of the agricultural activities selection and adoption systems. This method thus allows to identify the various selections and adoptions of generative agricultural activities income, the various techniques associated with strategies of selection and adoption operated by producers. It also allows producers to explain the choice of new technologies proposed by the technical supervisions. The information collected in 2013 2014 during the sessions of the AMPR concerns the objectives of selections and adoptions of such agricultural activities of productions (strategies of productions) and their level of realization. The use of internal inputs and / or externals relative to their agricultural production selection and adoption strategy, the cultural varieties and animal species, the evolution of the physical performances of selected and adopted agricultural activities, the relative explanations and the corrective strategies brought between producers and agricultural supervision agents. Information on a number of parameters and factors are also collected such as, the practice of non-agricultural activities; the academic and educational level; the uncertainties and risks perception; the agroecological potentialities of cultivated surfaces; the health annual expenses, the annual children's educational and accommodation expenses; the inputs and cash credits access and the agricultural income delay and the membership in an agricultural cooperative. The second method of data collection uses at first the agricultural production evaluation slip from selections and adoptions operated by producers; from the agricultural, breeding and nonagricultural activities association. A survey in two passages concerning more than one thirds of producers is led in each of cotton zone. The socio-demographic characteristics, the vegetable and animal speculations operated by producers, the grounds and cattle food fertilization techniques, the uses of products and of agricultural and non-agricultural income are collected. The constraints and the potentialities of the agricultural and non-agricultural activities are questioned. At all, on 750 agricultural rural households, 702 gave reliable responses compared with the first passage, that is the rate of pertinence and reliability is 93.6 % of collected information. The choice of agricultural producers is in a random way and without focus group. The number of agricultural producers selected in every zone varies according to the density and its agro-ecological potentiality.

3.2. Variables specification and model regression

- X_i (actagrc) the explanatory variable identifying the selected and adopted agricultural activities by producers in the cotton zones. With $i = 1 \dots 6$. Where
- actcton: the variable unique cotton agricultural activity (actcton m=1) i
with $S_1 = 1 \dots 122$ on 702 of the sample;
- actcma (m =2) : the variable cotton production activity associated with maize, $iS_2 = 1 \dots 184$ on 702 of the sample;

- 208 ▪ actctomil (m = 3) : the variable cotton production activity associated with millet, I
209 with $S_3 = 1.....113$ on 702 of the sample ;
- 210 ▪ actctomac (m =4) : the variable cotton production activity associated with manioc, I with
211 $S_4 = 1.....105$ on 702 of the sample ;
- 212 ▪ actctontrs (m=5): the variable cotton production activity associated with the others
213 variables not considered in this article, i with $S_5 = 1.. 51$ on 702 of the sample;
- 214 ▪ Actctoigme (m=6): the variable cotton production activity associated with yam, I avec $S_6 =$
215 $1... ..127$ on 702 of the sample ;
- 216 ▪ assv: the variable assistance of agricultural technical vulgarization.it is a dummy , with u =
217 0 and 1. Where 0 corresponds in no access and 1 access to the technical vulgarization
218 assistance. 502 (71.51 %) producers don't have access, against 200 (28.49 %) which have
219 access to the assistance of technical vulgarization;
- 220 ▪ mbrec: the variable , be a member of a cooperative or an agricultural or peasant
221 organization. It is a dummy, with h = 0 and 1. Where 0 corresponds to not be membership
222 and 1 to be a membership in an agricultural cooperative. 403 (57.41 %) producers are not
223 a member of an agricultural or peasant cooperative, against
224 299 (42.59) who are a membership of an agricultural or peasant cooperative;
- 225 ▪ Access: the variable access to the cash credits of the microfinance institutions. It is a
226 dummy, with t = 0 and 1. Where 0 corresponds no access to cash credits and 1 access to
227 cash credits. 424 (60.40 %) producers don't have access to cash credits against 278 (39.60
228 %) which have access to the cash credits;
- 229 ▪ acesint: the variable access to inputs credits. It is a dummy, with q=0 and 1. Where 0
230 corresponds no access to credits inputs and 1 access to credits inputs. 378 (53.77 %)
231 producers don't have access to the credits inputs, against 325 (46.2 %) producers who
232 have access to inputs credits;
- 233 ▪ Elvag: the variable association between agriculture and breeding. It is a dummy with n = 0
234 and 1. Where 0 corresponds to the dissociation between agriculture and breeding and 1
235 association between the agriculture and breeding. 483 (68.80 %) separate the agriculture
236 and breeding, against 219 (31.20 %) which associate the breeding with the agriculture;
- 237 ▪ Delay: the variable delay in payment of the agricultural income. It is a dummy with v= 0
238 and 1. Where 0 corresponds to the delays in the agricultural income payment and 1
239 absence of delay in the agricultural income payment. 437 (62.25 %) producers give
240 evidence of the delays in agricultural income payment, against 265 (37.75 %) which is not
241 agree with the delays in agricultural income payment;
- 242 ▪ Assurance: the variable subscription to agricultural insurance. It is a dummy with r = 0 and
243 1. Where 0 corresponds to no subscription to agricultural insurance and 1 for subscription
244 to agricultural insurance. 460 (65.53 %) producers do not insure their productions and
245 their goods against 242 (34.47 %) producers who insure their productions and the goods;
- 246 ▪ desteinsc: the variable debt of the producers toward credits structures and other micro-
247 credits institutions . It is a dummy with k = 0 and 1. Where 0 corresponds to the debtor
248 producers and 1 to the solvent producers. 461 (65.67 %) producers are debtor of the
249 micro-credits structures and 241 (34.33 %) are solvent of these micro-credits structures;
- 250 ▪ level: the variable producers' education and instruction level . It is a dummy with l= 0 and
251 1. Where 0 indicate the producers having no education and instruction level and 1 those
252 having the primary, secondary or upper level and other practical trainings levels in the
253 agricultural domain. 493 (70.23 %) producers have no education and instruction level,
254 against 209 (29.77 %) producers having an education and instruction level or practical
255 trainings;
- 256 ▪ Lpricotb: the variable price of cotton expressed in CFA francs. It is quantitative and
257 measures the purchase price of a kilogram (kg) of cotton quantity sold by the producers.
258 This average price is 240 FCFA between 2013 and 2014 in the cotton zones;

- Lprixmais: the variable price of maize expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg of maize) sold by producers in south Benin and in the bordering countries. This average price is 310 FCFA between 2013 and 2014 in the cotton zones;
- Lprixigme: the variable price of yam expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg) of yam sold by producers. This average price is 1 2000 FCFA between 2013 and 2014 in the cotton zones;
- Lprixman: the variable price of the manioc expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg) of the quantity of the manioc sold by producers. This average price is 310 FCFA between 2013 and 2014 in the cotton zones;
- Lprixigme: the variable price of the yam expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg) of yam sold by the producers. This average price is 12000 FCFA between 2013 and 2014 in the cotton zones;
- Lprixman: the variable price of the manioc expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg) of the quantity of the manioc sold by the producers. This average price is 540 FCFA between 2013 and 2014 in the cotton zones;
- Lprixmil: the variable price of the millet expressed in CFA francs. It is quantitative and measures the purchase price of a kilogram (kg) of the quantity of the millet sold by the producers. This average price is 640 FCFA between 2013 and 2014 in the cotton zones;
- Lages: the variable age of the producers expressed in the years. It is quantitative, the average age of the producer is of 35 years, the maximal age is of 64 years and the minimal age is of 20 years;
- Lndepeducat: the variable producers' children educational expense expressed in CFA francs. It is quantitative and this average expense is 35 000 FCFA between 2013 and 2014 in the cotton zones of Benin. Its biggest value is 54 600 FCFA and its minimal value is 15 000 FCFA;
- Lndépsanté: the variable dedicated to the producers' family health expense expressed in CFA francs. It is quantitative and this average expense is 15 000 FCFA between 2013 and 2014 in the cotton zones of Benin. Its biggest value is 24 000 FCFA and its minimal value is 7 000 FCFA.
- Lndéplogmt: the variable producers' accommodation expense expressed in CFA francs. It is quantitative and this average expense is 385 000 FCFA between 2013 and 2014 in the cotton zones of Benin. Its biggest value is 554 600 FCFA and its minimal value is 90 000 FCFA.

Several studies assessed the impact of various socio-economic, cultural, institutional and political factor on the willingness of farmers to adopt new activities (Ayinde et al,2010; Akinola et al, 2009; Feder and Zibermann,1985) . In most adoption studies, the dependent variable takes value between 0 and 1 and the models used were exponential functions while univariate and multivariate logit and probit models including their modified forms have been used extensively to study the adoption behavior of respondents. In this paper a multivariate logit model is used due to the several selections' modalities of ours variables (Maddala (1985) et Long (1997). The selection and the adoption of an agricultural activity method can be considered as the realization of a latent variable U_m^* (unobservable) indicating certain level of satisfaction or utility withdrawn from this selection and adoption and depending linearly of a set of variables vector of observable determinants X_i ($i = 1,.....,k$). As this relation is not only determinist, an error term is introduced into the relation and its law of distribution defines the estimation model of the probability of the alternative occurrence. If J choice and adoption are possible, the followings is the probability of selection and adoption:

$$Prob(Y = m) = Prob(U_m^* > U_j^* \quad \forall \quad j \neq m) \quad \text{with} \quad U_m^* = X_i\beta + \varepsilon \quad (1)$$

In this paper several possible alternatives are defined, without predefined or pre-established rank, it is advisable to estimate jointly the probability of every alternative compared with an alternative taken as reference. The required econometric model is then a logit or probit multinomial in accordance of distribution law of the error terms, Maddala (1985) and Long (1997). The multinomial model allows to estimate the probability of five (5) modalities with regard to a modality taken as reference. We suggest to estimate the probability of the modalities 1, 3, 4, 5, 6 in reference to the modality 2.

$$Prob_m = Prob(Y = m/X) = \frac{\exp(X\beta_{m/2})}{1 + \sum_{j=1}^6 \exp(X\beta_{j/2})} \quad j \neq 2 \quad \text{for } m = 1, 3, 4, 5 \text{ and } 6. \quad (2)$$

In relation with the probability of reference alternative 2

$$Prob_2 = Prob(Y = 2/X) = \frac{1}{1 + \sum_{j=1}^6 \exp(X\beta_{j/2})} \quad j \neq 2$$

With $\sum_{m=1}^6 Prob_m = 1$, X_i a vector of K explanatory variables common to all alternatives of agricultural activities selection and adoption in the cotton zones of North Benin and $\beta_{m/2}$ the vector of parameters estimated for the modality m (m = 1, 3, 4, 5, 6) compared with the reference modality 2, with $\beta_{2/2} = 0$. As the estimated coefficients β of the logistic models is not directly interpretable, it is easy to present results directly like " odds " (noted Ω); or more exactly, like " odds ratio " (noted OR) that apply "exponent " to the coefficients estimated to observe how an increment unity (marginal effect) of the explanatory variable modifies the relationship of such probability. In the case of binary logistic model, the interpretation of the "OR" is relatively easy because this relationship returns to the occurrence probability of the studied event on the opposite event probability:

$$\text{Odds}(X) = \Omega(X) = \frac{P_1}{1-P} = \frac{Prob(Y=1/X)}{1-Prob(Y=1/X)} = \exp(X_i\beta) \quad (4)$$

$$\text{OR}(X_k/X) = \frac{Prob(Y=1/X_k+1,X)/(1-Prob(Y=1/X_k+1,X))}{Prob(Y=1/X_k,X)/(1-Prob(Y=1/X_k,X))} \quad (5)$$

With a multinomial logistic model, the analysis is more complex because several events are considered. From that, the probability ratio of every modality of the event compared with the reference modality do not correspond directly to an "odds" which indicates, a probability ratio of an event with its opposite. We thus prefer to use «conditionals odds ratio» (noted COR), also indicated under the term of «ratio of relative risk» (noted rrr), which correspond to the ratio of every probability with regard to the probability taken in reference (here the modality 2: associated cotton and maize production):

$$\text{Conditional Odds}_m(X) = \Omega_{m/2}(X) = \frac{P_m}{P_2} = \frac{Prob(Y=m/X)}{Prob(Y=2/X)} = \exp(X\beta_{m/2}) \quad (6)$$

For m = 1, 3, 4, 5, 6.

$$\text{COR}_{m/2} = \frac{\Omega_{m/2}(X, X_k+1)}{\Omega_{m/2}(X, X_k)} = \exp(\beta_{k,m/2}) \quad (7)$$

For m = 1, 3, 4, 5, 6.

$$\text{Or, } \text{COR}_{m/2}(X_k/X) = \frac{Prob(Y=m/X_k+1,X)/Prob(Y=2/X_k+1,X)}{Prob(Y=m/X_k,X)/Prob(Y=2/X_k,X)} = \exp(\beta_{k,m/2}) \quad (8)$$

For m = 1, 3, 4, 5, 6.

The COR allow to estimate if an explanatory variable increases or decreases the probability to choose such alternative compared with the alternative taken in reference. For example, in the equation (8) an

incremental variation of the variable X_k increases the occurrence probability of the modality m instead of the modality 2 of an exponential factor.

3.3 Economics theoretical basis of multinomial logit model

We consider a farmer, described by a set of socioeconomic, cultural, demographic, institutional and political characteristics, face one or several possible choices of agricultural productions (or/and maize, cotton, manioc, millet, sorghum, etc.) described also by characteristics (acreage, pluviometry, humidity, temperature, etc.) which are specific. For example, the agricultural producers have to choose between several agricultural productions by taking into account several observable and non-observable parameters. They make their choice by comparing the agricultural production costs, the risks and the uncertainties and the prices to the producers of the various productions. Their choice is going to depend also on their income and on other specific characteristics. To explain in economic terms why such agricultural producer makes such speculation choice (maize/ cotton) rather than another one, are needed specific models, because those derived of the standard theory of the consumer are ineffective. This approach cannot be applied to questions as choice of a method of agricultural production because the agricultural producer does not arbitrate between quantities of the properties, but between possible options. The standard theory is not applicable because of the fundamentally discreet character of the choice. Thus are needed specific models. They are the models of discreet choices.

Economists were inspired by works led in psychology (de Palma and Thisse (1987) for a historic and epistemological presentation of the discreet choices models. Thurstone (1927), in particular, had introduced the notion of chance to explain the variability of the answers of the same individual to identical stimuli. By interpreting the level of stimulus as a level of utility, Marschak (1960) then transposed the original idea of Thurstone into the economic framework, to give rise to the RUM models (Random Utility Maximization)

The logit multinomial model was already used in agricultural economics to specify equations of parts of surfaces Wu and Segerson (1995). This theoretical frame allows to divert equations of parts of surfaces of logit multinomial shape

Two approaches are considered: "the costs function approach and the discreet choices approach". In this paper, the discreet choices approach is used. This approach allows to define a multi-produced economic model which considers cultivated surface as an allocable fixed input and takes into account the cultural rotations effects (maize or / and cotton). The producers are confronted with speculations. A choice of agricultural production can turn out to be difficult to make or not, but whatever is its nature. The agricultural producer estimates the various possibilities which offer themselves to him by basing itself on criteria and choice which adorned him the most adequate. The criteria of decision of choice can be quantifiable or logical (yes/no), then there is an economic theory which proposes models allowing to predict the behavior of agricultural producers confronted with a choice of cultures. This economic theory is the one models of discreet choices Ben-Akiva and Lerman (1985) and Ben-Akiva and Bierlaire (1999).

The mathematical modelling of this economic model bases on several fundamental hypotheses. Among this one, we consider that an individual (agricultural producer) chooses the alternative which possesses according to him the biggest utility. The multinomial model is the most used, because it is based on a hypothesis of independences of the unpredictable terms of the utility functions.

A condition of use of the logit multinomial is the respect for the hypothesis of Independence of the non-relevant alternatives (IIA), according to which the reports of probability between the alternatives are independent. Several statistical tests allow to verify this hypothesis, in particular the test of McFadden (1973) for whom the check of this hypothesis returns directly to the use of the model in the choice of the alternatives jointly estimated. Several indicators were built with the log-likelihood to appreciate the quality of the adjustment of the model in the data, with the idea to make it equivalents of the coefficient of empirical determination R^2 of the classic linear model. McFadden (1973) so defined the coefficient ρ^2 called sometimes so called R^2 , equal to: ρ^2

$$= 1 - \frac{\ln L}{\ln L_0}$$
 Where L is the likelihood estimator of the model and L_0 the likelihood estimator of

the small-scale model in the only constant terms, that is without explanatory variable. As the model with explanatory variables is more likely than the model without variable, $\ln L_0 < \ln L$, consequently $0 < \rho^2 < 1$.

The inconvenience of ρ^2 is that it is not in reality, the analogue of the coefficient of determination R^2 of the linear model, because it does not possess several properties. In particular, its values do not cover the interval $]0, 1[$ and always remain low. To mitigate this defect, Estrella (1998) proposed another indicator, which possesses the statistical properties of R^2 .

We wish in particular that the value 0 of the indicator corresponds to a total absence of adjustment and the value 1 in a "perfect" adjustment. Estrella's indicator is equal to:

$$\phi_0 = 1 - \left(\frac{\ln L}{\ln L_0} \right)^{\frac{2 \ln L_0}{n}}$$

Where n is the size of the sample.

The main tests of hypothesis examined here concern the nullity of one or several parameters of the model: (or) value estimated by the maximum of likelihood of one or several parameters is she distant enough from 0 so that we can deduce from it, without great risk of making a mistake, that corresponding variable has an effect on the choice j?

In principle, because we used the method of the maximum of likelihood to estimate the parameters, we have the choice between several tests, which are equivalent on the condition of having a sample enough important. In practice, the method depends on the test to be made: if we have to test the nullity of a single parameter, we shall employ the statistics of Student; if we have to test the simultaneous nullity of several parameters, he is more suitable to use the test of the likelihood ratio.

3.4 Descriptive Statistics of the multilogit model variables

We use here the chi2 test to analyze the distribution between the binary variables of the various agricultural activities selections and adoptions. This test is centred on two hypotheses supplied by the Pearson statistics, the threshold with which we can is not agree with the null hypothesis. The null hypothesis is strongly is not agree withed here if ($Pr < 0.05$) that implies an Independent distribution, and is strongly accepted if ($Pr > 0.05$) that implies a dependent distribution Gourieroux (1989).

Table 1. Descriptive statistics of the multilogit model qualitative variables

Distribution between the technical vulgarization assistance of the agricultural activities selections and adoptions								
Selection and adoption		Actcton (1)	Actctmas (2)	Actctomls (3)	Actctomac (4)	Actctontrs (5)	Actctoigme (6)	Total
Assistance	0	86	127	86	69	36	98	502
	1	36	57	27	36	15	29	200
Total		122	184	113	105	51	127	702
Pearson c hi2(5) = 5.5391 Pr = 0.034								
Distribution between a membership of agriculturalcooperative and selections and adoptions								
Cooperativemembership	0	58	72	48	45	22	54	299
	1	64	112	65	60	29	73	403
Total		122	184	113	105	51	127	702
Pearson c hi2(5) = 2.1338 Pr = 0.830								
Distribution between c ash credits access and agricultural activities selectio ns and adoptions								
creditsaccess	0	73	103	66	70	24	88	424

	1	49	81	47	35	27	39	278
Total		122	184	113	105	51	127	702
Pearson c hi2(5) = 11.4246 Pr = 0.044								
Distribution between inputs credits access and agricultural activities selections and adoptions								
Inputs credits	0	66	94	60	65	28	65	378
	1	56	90	53	40	23	62	324
Total		122	184	113	105	51	127	702
Pearson c hi2(5) = 3.7219 Pr = 0.590								
Distribution between breeding and agricultural activities selections and adoptions								
Breeding	0	85	131	75	77	36	79	483
	1	37	53	38	28	15	127	219
Total		122	184	113	105	51	127	702
Pearson c hi2(5) = 4.50 06 Pr = 0.008								
Distribution between payment delay and agricultural activities selections and adoptions								
Retard	0	79	105	63	32	85	43	437
	1	43	79	40	42	19	42	265
Total		122	184	113	105	51	127	702
Pearson chi2(5) = 4.1112 Pr = 0.534								
Distribution between producers debts and agricultural activities selections and adoptions								
Debts	0	39	62	38	30	18	54	241
	1	83	122	75	75	33	73	461
Total		122	184	113	105	51	127	702
Pearson chi2(5) = 5.70 34 Pr = 0.336								
Distribution between agricultural insurance and agricultural activities selections and adoptions								
Insurance	0	87	119	70	71	35	78	460
	1	35	65	43	34	16	49	242
Total		122	184	113	105	51	127	702
Pearson chi2(5) = 3.8776 Pr = 0.567								
Distribution between instruction level and agricultural activities selections and adoptions								
Instruction	0	89	132	80	76	28	88	493
	1	33	52	33	29	23	39	209
Total		122	184	113	105	51	127	702
Pearson chi2(5) = 6.6665 Pr = 0.247								

429 **Source: Results of Chi2 test; author; 2015**

430 The Table 1 indicates a number of stylized facts in the cotton zones of Benin. Among these facts
431 we have: - the framing of the agricultural technical vulgarizations actions are not independently
432 distributed with various agricultural activities selections and adoptions; - the members of an
433 agricultural cooperative are independently distributed with various agricultural activities selections
434 and adoptions; - the access to the cash credits is not distributed independently with various
435 agricultural activities selections and adoptions; - the access to the inputs credits is distributed
436 independently with various agricultural activities selections and adoptions. The access to the inputs
437 credits is not connected to various agricultural activities selections and adoptions; - the breeding
438 activity is not independently distributed with various agricultural activities selections and
439 adoptions. This result shows an association between the breeding and the certain agricultural
440 activities selections and adoptions; - the delay in payment of the agricultural income persists about
441 the agricultural activities selection and the adoption in the cotton basin of Benin; - the debts are not
442 connected to the agricultural activities selection and adoption in the cotton basin of Benin; - the
443 agricultural insurance is connected to agricultural activities selections and adoptions; - the

academic levels are independently distributed with various agricultural activities selections and adoptions in the cotton basin of Benin.

Table 2. Descriptive statistics of normality test on the multilogit model quantitative variables
Skewness / Kurtosis tests for Normality

Variables	obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
ages	702	0.0000	0.0014	24.79	0.0000
depeducat	702	0.0000	0.0000	.	.
dép_santé	702	0.0000	0.0308	.	0.0000
ldéplogmt	702	0.0198	0.7391	5.53	0.0030
pri cotb	702	0.0000	0.0000	.	.
primais	702	0.0039	0.0003	18.50	0.0001
prixagme	702	0.0000	0.0000	.	0.0000
prixigman	702	0.0000	0.0001	.	0.0000
prixmil	702	0.0000	0.0000	62.79	0.0000

Source: Author, 2015

The probability of Skewness (Pr (Skewness)) is close to 0 for the majority of variables .It is the same for the probability of Kurtosis (Pr (Kurtosis)) ; they are thus leptokurtiques (the presence of thick tails). The hypothesis of normality of variables during the period of our study is thus verified. Gaps returns to the norm further to a confrontation, of agricultural products, of expenses (health; education and accommodation) quantified essentially on the basis of the prices to producers. In this example, we conclude in the is not agree withion of H_0 for the majority of variables ($(P_r < 0.05)$). These agricultural prices characteristics return on the practical plan to the existence of fluctuations which are normal and without memory.

Table 3. Multilogit model estimations and marginal effects

Mltinomial logistic regression

Number of obs = 702

LR chi2 (-2) = 2429.75

Prob> chi2 = 0.005

Log likelihood = 0

Pseudo R2 = 0.045

agricultural Activities	Variables actagrc	RRR	probabil	Marginal effects after mlogit y = Pr (actagrc==2) (predict, p outcome (2)) =0 .69248938		
				dy/dx	z	P> z
	actcton	8.47e+60	0.003	-0.999	0.601*	0.901
	actcmas	-.0000879	0.347	0.508	-0.003**	0.008
	actctomls	6.65e+09	0.676	-0.213	-0.412**	0.087
	actctomac	0.953015	0.67	-0.131	-0.023	0.000
	actctontrs	4.344638	0.543	-0.010	-0.003	0.065
	actctoigme	0.1014463	0.231	0.802	0.005	0.430
	assv	-0..010485	0.002**	0.146	0.516**	0.434
	mbrec	3.808169	0.421	-0.007	-0.004**	0.110
	aces	2.53798	0.001**	-0.701	-0.007**	0.240
	acesint	13.4025	0.043**	-0.022	-0.503*	0.700
	elvag	-0..031546	0.12	0.002	0.001**	0.21
				dy/dx	z	P> z

agricultural Activity Coton associated with Manioc	4	actcton	1.08e+29	0.765	-0.623	0.052*	0.357
		actctmas	-0.004225	0.0034	0.328	-0.038**	0.0014
		actctomls	1.29e+10	0/0432	-0.365	-0.011**	0.042
		actctomac	3.48e+15	0.0045	-0.2178	-0.0024	0.231
		actctontrs	2.944351	0.0098	-0.0217	-0.0022	0.013
		actctoigme	0.976396	0.9854	0.428	0.012	0.235
		assv	-.026670	0.0321**	0.216	0.0016**	0.323
		mbrec	- 2.227513	0.0324	-0.0016	-0.0023**	0.114
		acces	-4.398148	0.0045**	-0.356	-0.0211**	0.246
		acesint	- 3.40569	0.123**	-0.0154	-0.0015*	0.367
		elvag	-0.21392	0.064	0.098	0.0223**	0.567
		retard	399.0246	0.002**	-2.0023	-0.0218**	0.0216
		asurace	-13.5119	0.34	-7.010	-0.018**	0.0254
		deteinsc	188.6191	0.349	0.012	-0.0525*	0.015
		nivea	-.0111923	0.0021	-2.3412	-0.3210*	0.123
		lpricotb	-2.90e+71	0.0065**	-5.245	-0.0018**	0.0267
		lprimais	2.96e-12	0.0045	0.560e-67	0.2671	0.125
		lprixigme	5.59e-09	0.468	0.0423	0.0333*	0.0432
		lprixman	-1.5739.23	0.0025**	-2.0342	-0.024**	0.016
		lprixsmil	0.634313	0.6754	-1.224	-2.0321*	0.011
		lnages	-0.10512.	0.004	-3.210	0.3786	0.0043
		lnages2	(omitted)	0.984	0.017	0.0125	0.029
		ldepeducat	1.00028	0.0230**	-2.3721	-0.0032**	0.023
		lndép_santé	2.858442	0.0067**	-3.013	-0.015**	0.029
		lndéplogmt	0.0028932	0.0086**	2.450	0.010**	0.1862
				Marginal effects a ftermlogit y = Pr (actagrc==2) (predict, p outcome (2)) =0 .6 9248938			
				dy/dx	z	P> z	
agricultural Activity Coton associated with other cultures	5	actcton	2.78e-15	0.0087	-0.123	0.042*	0.367
		actctmas	5.10e-28	0.0315	0.348	-0.026**	0.00187
		actctomls	-0..000468	0.8754	-0.565	-0.0091**	0.063
		actctomac	-0..000117	0.00432	-0.117	-0.0016	0.255
		actctontrs	1.04e+13	0.0005	-0.037	-0.0143	0.0156
		actctoigme	-0.416120	0.0984	0.442	0.0187	0.2410
		assv	-3.59e-27	0.6732	0.236	0.0119**	0.3542
		mbrec	-.0162228	0.0043	-0.011	-0.00343**	0.1153
		acces	-0..000031	0.008	-0.456	-0.01121**	0.2553
		acesint	-0.019012	0.021	-0.0124	-0.02145*	0.3490
		elvag	-.02129	0.985	0.095	0.0363**	0.5543
		retard	12.15628	0.321	-2.0029	-0.0222**	0.02145
		asurace	-4.609887	0.0045	-7.0165	-0.0132**	0.02538
		deteinsc	2.79e-07	0.0032	0.0154	-0.0543*	0.0111
		nivea	-0.00004	0.9864	-2.3498	-0.32321*	0.1223
		lpricotb	1.91e+80	0.023**	-5.2543	-0.00165**	0.02656
		lprimais	1.31e-45	0.6243	1.560e-77	0.26320	0.12234
		lprixigme	3.37e-56	0.5219	0.04543	0.03376*	0.04388

	lprixman	0.64093.32	0.8643	-2.03332	-0.0219**	0.01378
	lprixsmil	4.14e+32	0.6065	-1.2532	-2.03288*	0.01199
	lnages	-5.96e-06	0.0023	-3.2223	0.377420	0.00442
	lnages2	(omitted)	0.0125	0.01765	0.012345	0.02854
	ldepeducat	1.000469	0.045**	-2.35421	-0.00346**	0.022180
	Indép_santé	2.062556	0.021**	-3.01432	-0.01218**	0.02435
	Indéplogmt	1.72e-07	0.0321**	2.44430	0.0111**	0.18210
(*) dy/dx is for discrete change of dummy variable from 0 to 1						

Source: author, from the data of survey, 2013-2014. * 10 % level and ** 5 % level

3.5 Hausman independence test of non-relevant alternatives: in favor of a theoretical justification

The necessary and sufficient condition of using the multinomial logit is the respect centred on the hypothesis of independence of the non-relevant alternatives (IIA). The most used tests are those of Hausman and Mc Fadden (1984). The recent works on this test is not agree with the results of Hausman et al (1984). Long and Freese (2006), show that the Hausman and al (1984) IIA test does not still allow to reach a good decision. From the theoretical point of view, the selection of the agricultural activities in this article retain the independence hypothesis of Hausman and al (1984), as far as each of the agricultural activities seems good as agricultural activities strategy different from others.

3.6 Modalities Grouping

The multilogit model wonders on the relevance to distinguish alternatives if certain explanatory variables tend to the same direction. So, the Wald test on the multilogit equations regressors shows us that none of alternative does not tend to explain significantly the well specified activities.

Table 4. Test of Wald: modalities grouping

(1) [1]actcton = 0	(13) [1]actctomls = 0	(25) [1]actctontrs = 0
(2) [2].actcton = 0	14) [2].actctomls = 0	(26) [2].actctontrs = 0
(3) [3]actcton = 0	(15) [3]actctomls = 0	(27) [3]actctontrs = 0
(4) [4]actcton = 0	(16) [4]actctomls = 0	(28) [4]actctontrs = 0
(5) [5]actcton = 0	(17) [5]actctomls = 0	(29) [5]actctontrs = 0
(6) [6]actcton = 0	(18) [6]actctomls = 0	(30) [6]actctontrs = 0
(7) [1]actcmas = 0	(19) [1]actctomac = 0	(31) [1]actctoigme = 0
(8) [2].actcmas = 0	(20) [2].actctomac = 0	(32) [2].actctoigme = 0
(9) [3]actcmas = 0	(21) [3]actctomac = 0	(33) [3]actctoigme = 0
10) [4]actcmas = 0	(22) [4]actctomac = 0	(34) [4]actctoigme = 0
(11) [5]actcmas = 0	(23) [5]actctomac = 0	(35) [5]actctoigme = 0
(12) [6]actcmas = 0	(24) [6]actctomac = 0	(36) [6]actctoigme = 0

Source: author; from the data of survey, 2013-2014

3.7 Results and interpretations

Results of the estimated multilogit model are so directly presented as exponent coefficients in the Table 3. The interpretation of results of Table 3 allows to release some stylized facts on the

determinants of selections and adoptions of agricultural activities in the cotton zones of Benin. On the other hand, treatments confirm relations of classic independents observed in the agro-economic literature between the age, the credits access, the academic level and the various agricultural activities. They underline the existing links between the agricultural technical agents of vulgarization and the selections and adoptions of various agricultural activities. Finally, they reveal the influence of the subscription in the agricultural insurance in the agricultural activities selection and the impacts of agricultural productions prices and finally the role of agricultural cooperative membership. Table 3 shows that variables such as the assistance of technical vulgarization (assv); the breeding (elvag) have positive and significant effects on the variation of probability of selection and adoption of the agricultural activities. The fact of benefiting technical vulgarization assistance (assv) increases the agricultural activity of 15 points of percentage compared with those of the agricultural rural households(0.02 points) who practiced the breeding (elvag). This result mean that the vulgarization agents' actions are perceptible in the cotton basin of Benin, the agricultural rural households benefit from a good membership of an agricultural cooperative (mbrec); the access to the cash credits (access) and the access to inputs credits (acesint) have positive effects.

3.6.1. Relation between age, credits access (inputs and cash), education level and agricultural activities selected and adopted.

The variable age (lnages) of the agricultural producer influences negatively and significantly the various agricultural activities. This result confirms the works of Hussain(1989); Pinheiro (1992); and Bravo-Ureta and Pinheiro (1997). The old producers have less opportunity of selection and adoption of efficient and profitable agricultural activities. They are little inclined to adopt the new techniques and modern inputs. The young producers have the opportunity to get a formal education.

They can be more skillful in the research for information and the practice of new techniques. The variable education level (nivea) influences negatively and significantly the various agricultural activities in the cotton zones of Benin. This result shows that in these zones the numbers of years of primary or secondary studies and the experience years of certain agricultural activities exercise are very low. Results thus confirm the works of Welch (1970); Feder et al (1985); Thirle et al (1995); and Bravo-Ureta et al (1994) indicate a positive relation between the technical efficiency and the educational level. Variables cash and inputs access credits (Acesint and access) influence negatively and significantly the other agricultural activities. These results invalidate the works of Taylor et al (1986) and Bravo-Ureta and Evenson (1994); (Nuama, 2006; Hazarika and Alwang, 2003), (Nyemeck et al, 2004).

3.6.2. Relations between agricultural vulgarization agents and agricultural activities

Selections and adoptions.

The variable technical assistance of vulgarization (assv) influences negatively and significantly the agricultural activities. This result shows that producers whatever are their selections and adoptions do not benefit from elementary advice concerning the conduct of the various cultures and few agricultural investments are granted for selected and adopted agricultural activities. The result invalidate the works of Ouédraogo (2004); Jensen P. et al. (2008); Jensen (2007) whose results show that the investments which are granted for creation of the varieties and for their vulgarization give a profitability rate of 81, 28 %. The technical assistance seems often not as the mean to help producer but the way to integrate or to get a job in public office by letting rural world. These agents live in cities whereas the agricultural producers are in village. This behavior of the technical assistance agent justifies the negative impact of the agricultural activities selection and adoption.

3.6.3. Relations between agricultural insurance subscription and agricultural activities selections and adoptions.

Agricultural producers' needs are varied as their tasks and their lifestyle require adapted insurance protections to all kinds of exploitations. The variable agricultural insurance subscription has a negative influence on various agricultural activities in the cotton zones of Benin. The insurance

structures propose indexed insurances to levels of pluviometry and concern the production of cereal, guarantee credits taken by producers, in particular campaign credits (inputs, etc.) but they are doubtful. We noticed that agricultural activities are done in the small areas inducing producer not get insurance services. These producers are often subject to flood or animals attacks. This perverse effect explain why insurance has negative impact on various agricultural activities (Barnett . and Mahul .2007)

3.6.4.Relations between agricultural productions prices and agricultural activities selections and adoptions.

The multiplication of agricultural activities selections and adoptions in the cotton zones is positively impacted by agricultural price to producers. The selection and adoption of unique agricultural activity of cotton (actcton) and the other agricultural activities are influenced positively and significantly by the price of cotton producers (lpricotb). This result is not surprising because "the gold" benefits from enormous government supports (price before agricultural campaign; organized sector; access to the cash and inputs credits). In opposite productions prices marketed to the south of Benin and bordering countries such the one of maize (Lprimais) and manioc (Lprixman) influence positively and significantly the unique agricultural activity of cotton. This last result shows that the cotton, the maize and thus the manioc are positioned as substitutable cultures according to the monetary report during the agricultural campaigns 2013-2014 in Benin. In the agricultural activity 2 (cotton associated with the millet), the price of the millet (Lprixmil) and the price of the cotton (Lpricotb) have opposite and significant sign (-0.140 and 2.62e+75) at the level of 5 %. This relation reveals according to the monetary income that cotton and millet constitute complementary products in the cotton zones of Benin. This result explains the incomes from the selling of cotton are partially reinvested in the production of the millet which constitutes a speculation of major foodstuff in this cotton zone. In the agricultural activity 3 (cotton associated with manioc), the price of manioc (Lprixman) and the price of cotton (Lpricotb) have negative and significant sign at level of 5 % (-1.5739.23 and 2.90e+71). The cotton and thus manioc are positioned as competitive cultures in the monetary report during the agricultural campaigns of 2013 and 2014. The negative relation between this agricultural activity and the cotton and manioc prices reveals the incomes from cotton and manioc marketing seem to be approximate. This result explains that in spite of manioc sector does not benefit from government supports, its production marketed especially toward the south of Benin and Nigeria leads important currencies for cotton producers. In the agricultural activity 4 (Associated cotton with others), the cotton price (Lpricotb) has a positive and significant coefficient at level of 5 % (1.91e+80). This positive relation shows the cotton price to producers stimulates this agricultural activity and the non-significativity of price factors of the other speculations indicates that the cotton dominate this agricultural activity and the other activities are very non-existent in selection and adoption of producers. In the agricultural activity 5 (cotton associated with yam) show that the cotton's price (Lpricotb) and the yam's price (Lprignam) have respectively negative and positive coefficients. Only the cotton price's coefficient is significant at level of 5% (5.08e+73). The yam's price (5.77e-40) has a positive coefficient but is not significant. This last result indicates the existence of socio-cultural behavior in the cotton zones where the production of the yam is centred on endogenous criteria and dedicated to a bracket of old producers. The presence of the opposite signs explain that the yam and the cotton are positioned as complementary cultures in the monetary report during the agricultural campaign of 2013 2014. Incomes from the yam's selling are partially reinvested in the cotton culture for the purchase of inputs for cotton; the extension of cotton cultivated surfaces; The debts solvency to micro-credits structures.

3.6.5.Relations between expenses in education, accommodation and health and agricultural activities selections and adoptions.

Considering cotton production as unique activity, coefficients of expenses variables in education (Ldepeducat = 1.000242), in health (Ldépsanté = 3.322704) and in accommodation (Lndéplogmet = 0.0078028) have negative and significant impacts. In other agricultural activities of cotton associated with other speculations, the impacts of expenses coefficients in education; in health and in accommodation are positive and significant at level of 5 %. This result indicates the weaknesses in cotton sector. The cotton thus assures the well-being of producers. The producers who only opt cotton are subject in enormous financial difficulties. This unique activity of cotton seems not to improve producers' well-being. The prevailing cottons-cereal association of cultures practices ((actctomls (Ldepeducat = 1.000285, Ldépsanté =3.1869, Lndéplogmet =0.0024); actctomac

(Ldepeducat = 1.000, Ldépsanté =2.858, Lndéplogmet =0.0028); (actctonontrs (Ldepeducat = 1.0004, Ldépsanté =2.06255, Lndéplogmet = 1.72e-07) ; actctoigme (Ldepeducat = 1.0002, Ldépsanté = 126.167, Lndéplogmet = 4.54e-09)) infer positive response on agricultural activities. The immaterial investments such as health and education impact positively and significantly the cotton-cereal practice. These cereal seem to benefit thus from previous effects of cotton and infer additional income.

3.6.6.Relation between breeding, agricultural income payment delay and agricultural activities selections and adoptions.

The relation between agricultural activities and the breeding is not clearly established, because empirical results on this question are often shaded. Some conclude in dissociation between the agriculture and breeding. In Bolivia for example the system of production which prevails is the one based on the association of agriculture and cattle's breeding. The evolution of exploitations confirms the general trend in the region, Julio et al (2011); in opposite, another authors show the dissociation between breeding and agricultural activities. This dissociation often results from financial, technical and organizational means (veterinary treatment; diseases; the pasturage and conflicts between producers and breeder). FAO (2011) shows that the intensive systems of animal production produce high levels of residues of nitrogen and phosphor and the concentrated pouring of toxic materials. In this article, the breeding has a non-significant impact on the various agricultural activities (cotcton (0.0315469); actctomls (0.1144); actctomac (0.21392); actctontrs (0.02129); actctoigme (0.0019)) in spite of the potentialities of cattle and goats available in cotton zones of Benin. This result shows a dissociation between the agriculture and the breeding. The latest is intended to a part of the population (Fulani). The delay in payment of the agricultural income is a factor which slows down the desire of producers for increasing productions and surfaces. The factor delay in payment of the cotton income (retard) affects negatively and significantly of 258.265 the unique agricultural activity of cotton (actcton). This result explains partially the state and administrative slowness of the structures in charge of the cotton marketing in Benin. Other agricultural activities such as the associations of cotton with food-producing (cotton and millet (298.592); cotton and manioc (399.0246); cotton and yam (1.68e+10) and cotton and the other non- selected cultures (12.15628)) have a positive and significant relation with the factor delay in payment of the agricultural income. This result confirms the income of the food-producing speculations is received before cotton income and allow to finance the food needs and the cotton production.

4 Conclusion

In this article, a particular accent is put on the agricultural activities selection and adoption in the cotton zones of Benin. The unique choice of cotton as agricultural activity presents no more considerable socioeconomic stakes for the cotton producers in Benin. The association of cotton production in a food crop brings more well-being in the acquisition and the satisfaction of the food goods, in health, educational and accommodation expenses. Results of the multilogit model estimation show that the prices of the food productions favor and stimulate the investment in the cotton sector. The cotton zones are not exempt of organizational, structural, institutional and political order difficulties. The regression of the systems of culture and the absence of adequate techniques increase the deficit of the food productions. In this situation, the training and the emergence of the young producers have to infer structural releasing, which, unfortunately, mortgage the green growth in Benin. On the whole, elasticities of the agricultural activities selections and adoptions compared with the significant variables are low. A significant improvement of the agricultural associated activity practice (cotton and/ maize; yam; manioc; millet and other food-producing speculations) requires then actions on several factors in a simultaneous way. Considering the importance of the food-production weight in the auto consumption (more than 78 %) and in the marketing (less than 30 %) in the cotton zones of Benin, the promotion and the orientation of a diversified agricultural policy generating income and well-being must be undertaken. This could guarantee and assure the food security, expenses in children's education, health, and decent accommodation, as well as organization of food-producing selling. It is also necessary to more encourage the integration agriculture - breeding as effective improvement tool of adoption of the hitched culture and source of fertilizing able to substitute chemical fertilizers, as alternative sources of fertilization. An effort of food-producing agricultural seeds renewal by producing basic seeds for varieties in vulgarization is essential to perpetuate the performance of these improved varieties. There is good reason to promote the implementation of

agricultural insurances structures to secure producers and their productions in case of the risks and agricultural uncertainties.

References

Adéoti R., O. Coulibaly et M. Tamò (2002) “ International Institute for Tropical Agriculture (IITA), Bulletin de la Recherche Agronomique du Bénin. Numéro 36 – Juin 2002 ; Facteurs affectant l’adoption des nouvelles technologies du niébé *Vigna unguiculata* en Afrique de l’Ouest

Akinola AA, Alene AD, Adeyemo R, Sanogo D, Olanrewaju, 2009. “Impact of Balanced Nutrient Management Systems Technologies in the Northern Guinea Savanna of Nigeria. *J. Food Agric. Environ.*; Vol 7 n°2, p. 496-504

Ayinde OE, Adewumi MO, Olatunji GB, Babalola OA., 2010. “Determinants of Adoption of Downy Mildew Resistant Maize by Small-Scale Farmers in Kwara State, Nigeria. *Global J. Sci. Frontier Res.*, , vol 10 n° 1, p 32-35.

Barnett J. and Mahul O. .2007. *Weather Index Insurance for Agriculture and Rural Areas in Lower-Income Countries* . American Journal of Agricultural Economics VL: 89 NO: 5

Ben-Akiva et Lerman (1985). *Discrete choice Analysis*, MIT Press

Ben-Akiva et Bierlaire(1999). *Discrete choice methods and their applications to short term travel decisions*, in R.Hall(ed); *Handbook of transportation Science*, Kluwer.

Bravo-Ureta B. E., et Pinheiro, A.E., 1997; “ Technical, Economic and Allocative Efficiency in Peasant Farming : Evidence from the Dominican Republic “ *The Developing Economics*, Vol. XXXV, n° 1, p.48-67.

Bravo-Ureta, B.E., Evenson, R.E., 1994, “Efficiency in Agricultural Production : The case of Pesant Farmers in Easten Paraguay”, *Agricultuaral Economics*, n°10, p.27-37.

Bravo-Ureta B. E., et Pinheiro, A.E., 1993; “Efficiency Analysis of developing country agriculture : A review of the frontier function literature “ *Agricultural and Ressources Economics Reviews*, Vol 22, n° 1, p. 89-101.

Caswell, M.Zilberman,D.(1985). The choice of irrigation technologies in California.*American Journal of Agricultural Economics*,67(2);224-234.

De Mc Fadden(1973).Conditional logit Analysis of qualitative choice Behavior, in ZarenbKa,P(ed), *Frontiers in Econometrics*, Academic Press

Easterlin Richard (2001): income and happiness: towards a unified Theory economic journal, 2001, vol 111, 465-484.

FAO (2011): Département de l’Agriculture et de la Protection des Consommateurs Protection.

Feder, G., Just, E. R., Zilberman, D., 1985 « Adoption of Agricultural Innovations in Developing Countries », A Survey, *Economic Development and Cultural Change*, Vol.33, n°2, p. 225-298.

Ghirotti M. (1994): Rapid appraisal, Benefiting from the experiences and perspectives of Livestock breeders *World Animal Review* 77: 26-37.

Hazarika G., Alwang J. (2003). Access to credit, plot size and cost inefficiency among smallholder tobacco cultivators in Malawi. *Agricultural Economics*, vol. 29, p. 99-109

Hausman, J., et D. McFadden. 1984 « Specification test for the Multinomial Logit Model », *Econometrica*, 52.. P. 1219-1240

Hirschman A. O. (1958), «The strategy of economic development», New Haven, Yale University Press.

692 **Hussain, S.S., 1989**, « Analysis of Economic Efficiency in Northern Pakistan : Estimation, Causes
693 and Policy Implications » Ph. D dissertation, University of Illinois.

694 **Jensen P. 2007**. Pratiques de vulgarisation des chercheurs du CNRS , Analyse statistique. Journal
695 of Science Communication.

696 **Jensen P., Croissant Y. et al., 2008**. Scientists connected with society are more active
697 academically *Science and Public Policy*.

698 **Julio et al ., 2011** .HCI for Policy Display and Administration

699 **Lewis. A.. (1955)**, «The theory of economic growth», Homewood, Hill. Richard D. Irwin.

700 **Long. J.S., (1997)** :Regression Models for Categorical and Limited Dependent Variables
701 (Advanced Quantitative Techniques in the Social Sciences). Sage Publications.

702 **Long J. C et Freese. J (2006)**: Regression Models for Categorical Dependent Variables Using
703 State, Second Edition .STATA Press .

704 **MAEP (2013)** : Ministère de l'Agriculture, de l'Elevage et de la Pêche- Etat de mise en œuvre des
705 réformes et performances des structures déconcentrées du MAEP au regard de la promotion des
706 filières agricoles et de décentralisation

707 **MAEP (2014)** : Ministère de l'Agriculture, de l'Elevage et de la Pêche, Le Plan Stratégique de
708 Relance du Secteur Agricole (PSRSA)- La Politique Agricole Nationale (PAN)

709 **MAEP (2015)** :Ministère de l'Agriculture, de l'Elevage et de la Pêche Revue des efforts de
710 développement dans le secteur agricole- Département de l'Agriculture, l'Environnement et des
711 Ressources en Eau Politique Agricole Régionale (ECOWAP)

712 **Mellor J. W. (1966)**, «The economics of agricultural development», Ithaca, New York: Cornell
713 University Press.

714 **Maddala, G.S., (1985)** .Limited –dependentand quantitative **variables** ineconometrics, Cambridge.

715 **Mc Fadden D.,1968**. The Revealed Preferences of a Government Bureaucracy. *Economic Growth*
716 *Project, Technical Report n° 17*, Berkeley.

717 **Nuama E., Yoli Bi Sani Martin (2008)**.*African Imperatives in the New World Trade Order, Case*
718 *Studies of Agriculture and Food Security*. Chapitre III: a study of the agricultural sector in Côte
719 d'Ivoire, AERC, p. 22- 52.

720 **Nianogo A J. 1994** : la participative association des producteurs au processus de recherche
721 (Participatorydiagnosis : Producers associations in the researchprocess) Ougadougou INERA.

722 **Nyemeck B.J., Tonyè J., Wandji N., Nyambi G., Akoa M. (2004)**.Factors affecting the technical
723 efficiency among smallholder farmers in a slash and burn agriculture zone of Cameroon. *Food*
724 *Policy, Elsevier*, vol. 24, p. 531-545

725 **Ntsama Etoundi, S.M. (2008)**, *Analyse de l'impact de l'innovation sur la productivitéagricole :*
726 *cas du maïs dans la province du centre- Cameroun*, mémoire de DEA-PTCI, université de
727 Yaoundé 2- Sao, Cameroun

728 **Ouédraogo Souleymane (2004)** : Impact économique de la recherche et de la vulgarisation des
729 variétés, améliorées de maïs au Burkina Faso. Revue du CAMES - Série B, vol. 006 N° 1-2,2004.

730 **ONASA (2014)** : Office National D'appui à la Sécurité Alimentaire -Synthèse des problèmes et
731 risques identifiés comme conséquence de la hausse des prix

732 **Pinheiro, A., 1992**, An Econometric Analysis of Small Farms in the Dominican Republic, M.S.
733 Thesis, University of Connecticut, Storrs.

734 **Paturel, J. E., Servat, E., Kouame, B., Boyer, 1. F., Lubes, H. & Masson, 1. M. (1995)**
735 **Manifestations de la secheresse en Afrique de l'ouest non sahélienne. Cas de la Cote d'Ivoire,**
736 **du Togo et du Benin. Secheresse 6(1).**

737

738 **Sen. A., 1985** *Commodities and Capabilities*, Amsterdam, North Holland,.

- 739 **Taylor, T.G. , Shonk Wiler, J. S., 1986**, « Alternative Stochastic Specification of the Frontier
740 Production Function in the Analysis of Agricultural Credit Programs and Technical Efficiency »
741 Journal of Development Economics, 21, p. 149-160.
- 742 **Taylor, T.G. , Shonk Wiler, J. S., 1986**, « Alternative Stochastic Specification of the Frontier
743 Production Function in the Analysis of Agricultural Credit Programs and Technical Efficiency »
744 Journal of Development Economics, 21, p. 149-160.
- 745 **Thirle, C.D., Hadley, Townsend. R., 2003**, « Policy-Induced Innovation in Sub-Sahara Africa
746 Agriculture », Development Policy Review, 13, p.323-348.
- 747 **Thiombiano T., Soulama S. et Wetta C. 1992**. Déterminants de la consommation urbaine à
748 Ouagadougou. In CEDRES-Etudes et Centre Sahel, Ouagadougou.
- 749 **Thurstone L. (1927)** "A Law of Comparative Judgment." Psychology Review, 34:
750 273-286.
- 751 **Quesnay François**, *Œuvres économiques complètes et autres textes*, Paris, Tableau économique,
752 INED, volume I, p.426
- 753 **Quesnay**, article « Grains » dans l'*Encyclopédie*, in Quesnay, *Œuvres*, I, p.209
754 **Quesnay**, *Dialogue entre M. H et M. N*, in Quesnay, *Œuvres*, II, p.893
755 **Quesnay**, article « Hommes », projet d'article inédit pour l'*Encyclopédie*, cité par Weulersse, *Le*
756 *mouvement physiocratique*, I, p.481
- 757 **Water-Bayer A, Bayer W (1995)**. Planification avec des pasteurs: MARP et au-delà, un compte
758 rendu de méthodes centrées sur l'Afrique. Deutsche Gesellschaft ; RFA GTZ ; 186 p..
- 759 **Wehrhahn, R. 2009**. *Introduction to Reinsurance* . Primer Series on Insurance Issue 2, April 2009.
760 The World Bank, Washington D.C.
- 761 **Welch. F., (1970)** « Education in Production », Journal of Political Economy, 78. P. 35-39.
- 762 **Wu,J.Sergerson,K.(1995)**.*The impact of policies and land characteristics an potential groundwater*
763 *pollution in wisconsin.American Journal of Agriculture, 77(4), 1033-1047*