The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte

Magali Aubert, Orane Debrune, Joël Huat, Laurent Parrot

▶ **To cite this version:**

Magali Aubert, Orane Debrune, Joël Huat, Laurent Parrot. The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. 11. Journées de Recherches en Sciences Sociales (JRSS), Société Française d'Economie Rurale (SFER). Paris, FRA.; Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD). FRA.; Institut Supérieur d'Agriculture et d'Agroalimentaire Rhône-Alpes (ISARA Lyon). FRA.; Laboratoire d'Etudes Rurales (LER). FRA.; Institut National de la Recherche Agronomique (INRA). FRA., Dec 2017, Lyon, France. 22 p. hal-02733930

HAL Id: hal-02733930
https://hal.inrae.fr/hal-02733930

Submitted on 2 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

The institutional environment as an essential support to agro ecology: The case of the formal market gardeners in Mayotte

Magali Aubert
UMR 1110 MOISA,
INRA-Montpellier Supagro,
2 place Viala, 34060 Montpellier Cedex 2, France
magali.aubert@inra.fr

Orane Debrune
VetAgro
89 avenur de l'Europe
63370 Lempdes, France
orane.debrune@cirad.fr

Joël Huat
CIRAD,
UPR HORTSYS, BP 1304,
97600, Mamoudzou, France
joel.huat@cirad.fr

Laurent Parrot
CIRAD,
UPR HORTSYS,
F-34398 Montpellier, France
laurent.parrot@cirad.fr

11èmes Journées de recherches en sciences sociales (JRSS)
Lyon – 14 et 15 décembre 2017

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

The institutional environment as an essential support to agro ecology: The case of the formal market gardeners in Mayotte

Magali Aubert ; Orane Debrune ; Joël Huat ; Laurent Parrot

Abstract:

Sanitary requirements are strengthening in response to consumers' expectations, European regulations and private actor's requirements, through retailers, in particular. Farmers are directly concerned by the dynamic, which has emerged for the last twenty years, since specifically the "mad cow" crisis. Mayotte is a French overseas department since 2011 and an ultraperipherial region of Europe since 2014. It is supposed to comply to European requirements. However, numerous studies highlight that the retrofit between practices and sanitary expectations is not already achieved. In order to answer this inadequacy in a context where almost 80% of the total production is informal, we have surveyed 47 tomatoes producers. This production is very sensitive to pests and particularly to tomatoes fly during the dry season, which can destroy all or some parts of the harvest. We demonstrate that more than producers' individual characteristics, numerous exogenous factor could help understand the inadequacy observed. Institutional environment could be a brake as well as a leverage to setting up more environmental friendly practices.

Keywords: Mayotte, tomato, agro-ecology, formal agriculture, logit model

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

1. Introduction

While the use of pesticide increases yield and the income of farmers, the counterpart of such utilization is the negative impact on both health and the environment (Aktar et al., 2009 ; inserm, 2013). Because of these negative effects, public authorities define and impose phytosanitary requirements to guarantee products' safety.

In 1992, a reform of the Common Agricultural Policy considered the environmental dimension to avoid harmful agricultural activity by providing mainly financial incentives. Progressively, the European policy takes into account an agricultural model dedicated to the implementation of environmental-friendly practices [1] . Consideration of biodiversity, landscapes, climate change, air and water quality became an integral part of European policy guidelines. Progressively, price and production supports evolved into direct aid policies and rural development measures, reducing the pressure to produce more and intensify the use of pesticides. Agri-environmental measures or green payments are supposed to promote agricultural economic development through the environment, since the rules imputed for access to these public subsidies are respected. In addition to financial incentives, Europe is committed to reducing the risks of exposure to pesticides. In 2005, Regulation (EC) No 396/2005 defines Maximum Residue Limits (MRLs) for authorized active substances in food in order to reduce the exposure of consumers to excessively high product doses (European Commission, 2008). In 2009, Europe adopted the "pesticide package": each Member State has to define a national action plan aimed at reducing mainly the use of pesticides.

France is the first european country consuming pesticides (Aubertot et al., 2005). To reduce the use of pesticides, France implemented the national action plan Ecophyto 2018 and Ecophyto 2025, launched and co-piloted by the Ministry of Agriculture. The first 2018 plan whose aim was to reduce quantitatively the use of pesticides did not achieve its objectives (Potier, 2014). Hence, a second plan adopted both quantitative and qualitative objectives. This second plan aims at reducing if possible by 50 % by 2025 the use of pesticides incitating producers to adopt environmental-friendly practices and involving all actors of the sector.

It is through the development of agro-ecology supported by the Agricultural Ministry in 2012 that a new model appeared as a guideline of French agricultural development. Defined as *"the application of ecological science to the study, design and management of sustainable agrosystems"* by the French government, agro-ecology is a *"set of agricultural practices favoring biological interactions aiming at optimizing the use of the possibilities offered by agrosystems "* (Direction de l'information légale et administrative de la République, 2015). This approach aims to combine the productivity of the agricultural sector and the rational use of natural resources. Wherever possible, the pesticides used must be replaced by natural processes. Improving soil quality, maximizing ecosystem services, optimizing farm resilience and, indirectly, reducing health risks, are the main objectives targeted by agro-ecology (De Schutter, 2010 ; Altieri et Nicholls, 2012 ; Silici, 2014).

[1] https://ec.europa.eu/agriculture/envir/cap_en

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

The evolution of European and national requirements in terms of phytosanitary reduction means a change in the practices of producers. It should be noted that if all the national territory is concerned by these requirements, Mayotte island is a privileged field of study since it is a French department only since 2011 and an overseas region since 2014. Hence, the harmonization of these practices with European and national regulations is recent (Sourisseau et al., 2008). The compliance of the agricultural practices of Mahorais to the health and environmental requirements is far from reaching the expected levels and there still exists an inadequacy between what is practiced and what should be (Daaf, 2016).

Mayotte is a relevant case study because of its recent integration at the French and European level. Mayotte is also relevant since its history translates into a co-existence between legal and illegal population and between formal and non-formal one. Farmers who can benefit from technical and financial support are formal ones: farmers who have a SIRET number (the French Computer System for the Business Directory on the Territory). Because of this potential support and the implication of such support, our study focuses on formal farmers who represent 20 % of the total agricultural production.

In Mayotte, the main crop using pesticides is the tomato. Hence, our study focuses on this production and more precisely on field tomato production since it is the more sensible one to pest. This production is a seasonal and perishable one.

The aim of this study is to analyze to what extent Mahorais' farmers are affected by the evolution of phytosanitary requirements and to what extent they will be inclined to adopt alternative practices. The first part of this study is the explanation of the Mahorais' context. The second part aims at identifying, through a literature review, factors that condition the farmers' behaviour and more precisely their propension to adopt environmental-friendly practices. The third part defines data and methods. This part declines the two surveys performed, the sampling methodology adopted and the econometric model implemented. The first one consisted in interviews among the main actors of the sector and the second survey covered formal farmers. While the first survey aimed at describing the organization of the sector, the second survey identified opportunities and constraints for the implementation of environmental-friendly practices. Since fourty-seven farmers were surveyed, the econometric model used a bootstrap sampling even if these farmers represent almost all the formal population. The last part puts into perspective the results issued from this model, at the farmer level, with results from the first survey.

1. Background

Mayotte is a 375 km² group of island located in the Indian Ocean, 300 km away from Madagascar and 500 km East of Africa next to the Mozambique canal. The archipelago, composed of 2 main island (Grande-Terre and Petite-Terre), is situated between the equator and the Capricorn tropic, 8 000 km away from France. Mayotte is a relevant case study, since this insularity represents numerous constraints reflected in every small island economy such

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

as vulnerability to naturals and economic exogenous chocks, high transport cost, dependency to product or services from others countries. It makes difficult industrialization, diversification and competitiveness on the island (Rivière, 2010). Because Mayotte acquired in 2011 the French Overseas Department status followed by the status of Ultraperipherial Region of Europe, in 2014 January1st, the political, financial and economic framework is evolving.

Therefore, a departmentalization process has been engaged with a legal, economic, legislative and social retrofit in order to achieve European and National requirements (Sourisseau et al., 2008). Its isolation, low area, small economy, hilly landscape and hard climate (two distinct season under a wet tropical climate) are recognized by the new European status (De Lavergne et al., 2012). It gives to Mayotte access to financial measures, and particularly concerning trade and fiscal policy for agriculture and fishing. For the agricultural sector, Mayotte must meet European requirements, with, in particular, the European framework directive 2009/128/CE, aiming at sustainably use phytosanitary product in every Member State. Through the French national plan Ecophyto, only operating since 2013 in Mayotte, a drastic change in production practices has emerged. The transition towards agro-ecological practices and alternative innovating methods to phytosanitary product is allocated by financial and technical European and national means. Food value chain structuration, upgrading farms, innovation and transfer project are carried by European and national programs as PDR[2] or POSEI[3]. They aim at enhancing Mayotte agricultural sector and at reducing its pesticide consumption.

In Mayotte, exclusively used on horticultural crops (Daaf, 2016), pesticides are at the heart of local preoccupation and territories challenges. The vegetable sector is one of the most dynamic on the island, representing 1, 9% of total cultivated area and 8% of farms. These cash crops, because they provide fast financial flow due to their short production cycle, attract an increasing number of producers: around 40 ha in 2003 and 130 ha in 2010 (Daaf, 2010). Produced for local consumption, horticultural crops keep growing to respond to the 2011 riot "against expensive life" to reduce importations and enhancing island food security potential. However, climate seasonality (southern summer and southern winter) guide the productive strategies of farmers (Daaf, 2017). Heavy rainfalls during southern summer limit the full-field production, at the origin of high variation of price during the year. It is particularly the case for tomatoes production, the most represented on the island : 44% of horticultural farm produce tomatoes and 93% is in open-filed (or 58 ha of the total agricultural area) (Daaf, 2010). It is exclusively produced during the dry season (from June to September), when agro-climatic conditions are the most favorable. However, during this season, tomato production is highly impacted by *Neoceratitis cyanescens* (Diptera: Tephritidae). This insect fly causes major damage to Solanaceae crops, mainly tomato. Yield losses can reach 80% (Huat et al., 2013). The fly pricks the fruit to lay its eggs. Larvae as well as other pathogen penetrate in the injuried fruit, rotting the fruit, which is then no longer consumable (Brevault, 1999).

[2] Rural Development Program

[3] Programmes of options specifically relating to remoteness and insularity

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

Chemical responses are essentially used against *Neoceratitis cyanescens*. Nor specific, nor selective, products mainly used on the island (lambda-cyhalothrine et deltaméthrine) master only partially the pest (Ryckewaert et Fabre, 2002). Rules defined by the European directive for phytosanitary use (maximal dose of use, number of application, pre-harvest delay, physical protection) are not respected by every producer on the island (Didelot et al., 2017). A treatment frequency index, 4 to 8 times higher than in mainland France, has been observed in certain case. Products use, which are not always allowed in France, and supposed being distributed through official center with a Certiphyto, are still present in numerous farms. However, only 20% of them are legal and can buy chemical products in official distribution networks. This highlights the importance of an informal supply system: illegal importations of products from bordering islands allow farms to easily have access to them.

Contrary to a solid control system in France mainland, few control are realized in Mayotte before selling the product. Tomatoes value chain is not structured since 90% of the selling is done through informal trade networks, nor respecting the maximal residues limit, nor the traceability on origin or quality of the product. Rather than that, producers as well as consumers follow an opportunist logic, creating a low competitiveness in the tomatoes sector. With the limited market of the island, the atomization and the seasonality of the offer, the local economy is destabilized. The formal sector which requires quantity and quality standards encounters difficulty to expand.

Even though there is an important use of pesticides in Mayotte, few technics are available and known by farmers to effectively fight the fly. This production is essential in mahorais' consumption habits and reduce imports is another stake that has to be controlled. Agricultural practices evolution should in consequence pass by integration of innovative practices in production systems. Nets are an example where their benefits have already been highlighted in Kenya and Benin, in terms of agronomic productivity (pest number reduction, yield increase) (Martin et al., 2006 ; Muleke et al., 2014) and economic viability (Martin et al., 2006 ; Martin et al., 2015 ; Vidogbéna et al., 2015). Adoption of agro-ecological practices to answer the requirements of European rules could however be difficult to reach. In order to achieve mahorais'food habit, development of new market, increasing population and demand from supermarket to have access to fresh fruit and vegetables, it is important to understand personal, structural, institutional determinants of farmers deciding their productive strategy.

2. Theoretical framework

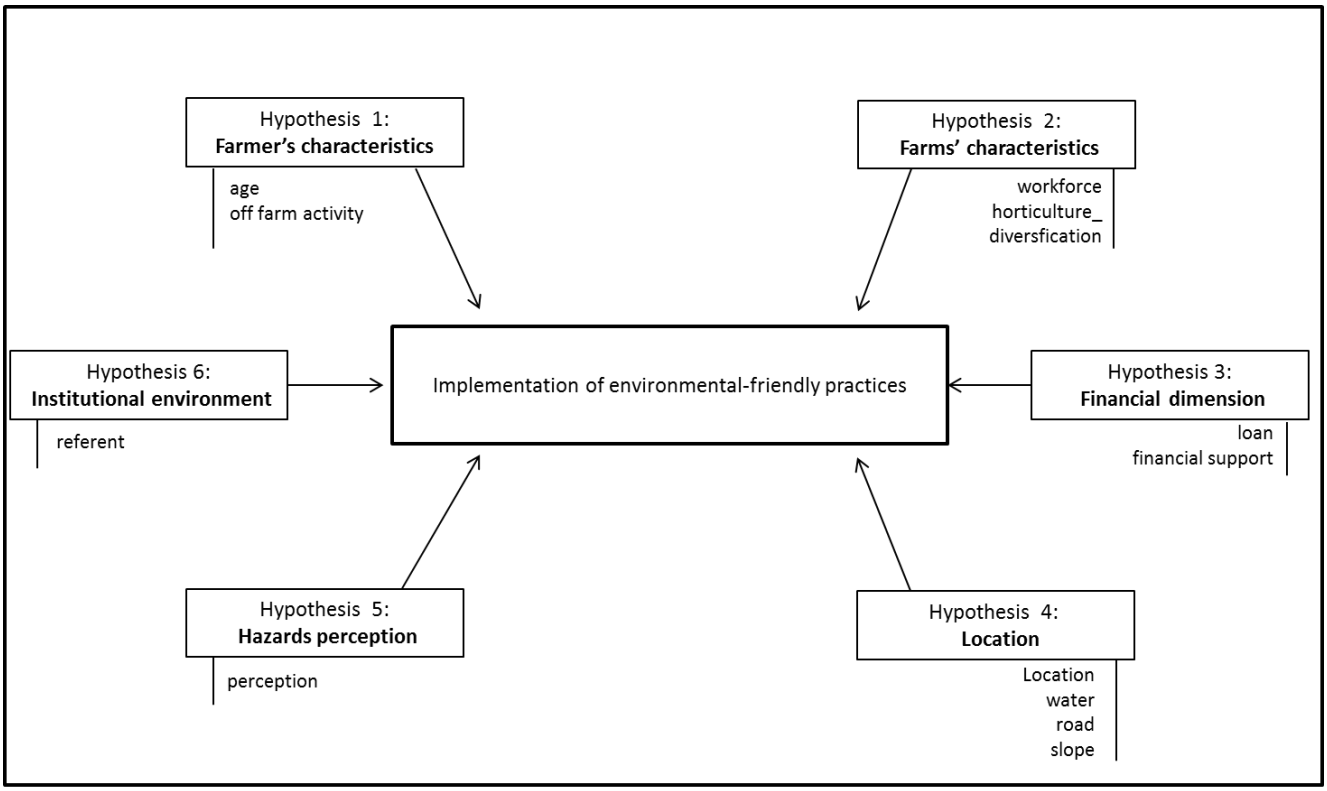
In this section, we consider the definition of more environmental-friendly practices before considering the determinants of the implementation of such practices. "Environmental-friendly practices" is a terminology that embraces different behaviours from the adoption of a certificate (Chemnitz, 2007 ; Dörr et Grote, 2009 ; Asfaw et al., 2010 ; Kersting et Wollni, 2011 ; Zhou et al., 2011) to the implementation of a specific practice (Okoye, 1998 ; Traoré et al., 1998 ; Fernandez-Cornejo et Ferraioli, 1999 ; Pereira de Herrera et Sain, 1999 ; Galt, 2008 ; Sharma et al., 2015) such as the use of nets to protect production from insects.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

To understand to what extend farmers are more or less likely to implement environmental-friendly practices, an analysis of the literature let us appreciate brakes and leverages of this productive choice. The determinants related to the implementation of more environmental-friendly practices are largely studied in the literature. From developing countries to developed ones, all studies highlight the importance of farmers' characteristics (Hypothesis 1), their farm characteristics (Hypothesis 2), their financial dimension (Hypothesis 3) and their geographical location (Hypothesis 4). Since these characteristics are unanimously considered, our study focuses on others determinants less studies in the literature: on one hand the hazard perception of farmers (Hypothesis 5) and the institutional environment on which farmers' evolve (Hypothesis 6). These hypotheses are summarized in Figure 1.

Figure 1. Determinants of the implementation of environmental-friendly practices



- **Hypothesis 1: Farmers' characteristics**

The main characteristic of the farmers considered is their age (Fernandez-Cornejo et Ferraioli, 1999 ; Dörr et Grote, 2009 ; Asfaw et al., 2010 ; Kersting et Wollni, 2011 ; Sharma et al., 2011). Almost all studies underline the fact that younger farmers are more aware with the impact of pesticides on environment. They are supposed to be more educated to these impacts and be more likely able to estimate the positive impact of the implementation of an environmental-friendly practice. Hence, we hypothesize that:

Younger farmers

are more likely to implement environmental-friendly practices.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

Another individual characteristic taken into account is the fact that farmers have, or not, off-farm activity. The impact of such activity has an ambivalent impact since on one hand this can translate into a higher income letting the farmer more likely to implement more environmental-friendly practices (Clay et al., 1998 ; Knowler et Bradshaw, 2007 ; Galt, 2008) and on the other hand this can translate into a lower implication of the farmer on his farm leading to a less probability to implement these practices (Gould et al., 1989). Since the main brakes declared by Mahorais' farmers to the adoption of alternative strategies is the price, we assume here that:

Farmers who have off-farm activity
are more likely to implement environmental-friendly practices.

- **Hypothesis 2: Farms' characteristics**

Beyond individual characteristics of the farmers, the literature assumes that the characteristics of the farms have also an influence on farmers' behaviour. More precisely, the area cultivated is the only unanimous factor considered. Therefore, while there is unanimity with the fact that area is an essential information to take into account, its impact on the implementation of more environmental-friendly practices is controversial. Some authors consider that bigger farms benefit from economy of scale and are hence more likely to implement these practices (Feder et al., 1985 ; Fernandez-Cornejo et al., 1994 ; Galt, 2008 ; Asfaw et al., 2010 ; Zhou et al., 2011). Others consider that smaller farms are more inclined to implement such practices (Clay et al., 1998 ; Aubert et Enjolras, 2014). In the Mahorais' context, where the access to land is quite difficult, we consider the physical dimension of the farm through the workforce employed. Hence, we assume that:

Farms, which employ more workforce
are more likely to implement environmental-friendly practices.

The second characteristic considered is the degree of crop diversification. As a matter of fact, the more farmers are crop diversified on one production, the less they are economically dependent from this activity (Mc Laughlin et Mineau, 1995 ; Altieri, 2000 ; Roschewitz et al., 2005 ; Dörr et Grote, 2009). In such a case, they are more likely to implement environmental-friendly practices. This point is reinforced by the fact that being diversified translates into a less parasite pressure.

Diversified farms
are more likely to implement environmental-friendly practices.

- **Hypothesis 3: Financial dimension**

Individual characteristics of farmers and characteristics of their farm are the two main items considered in the literature to understand to what extend they are more or less likely to implement environmental-friendly practices. More than these characteristics, the financial dimension needs to be highlighted (Nowak, 1992 ; Clay et al., 1998 ; Okoye, 1998 ; Knowler

Version postprint
Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

et Bradshaw, 2007). As a matter of fact, farmers who benefit from financial support of Common Agricultural Policy or who benefit from credit access are more likely to invest to answer phytosanitary requirements.

Farmers who benefit from any support
are more likely to implement environmental-friendly practices.

- **Hypothesis 4: Location**

More than active variables, some are considered as controlled variables since farmers cannot modify them (Houmy, 1994 ; Rosenzweig et al., 2001 ; Koleva et al., 2009). The location is one of these variables. The location incorporates several characteristics that can appear as opportunities or constraints for the implementation of environmental-friendly practices. We have to notice that all opportunities become constraints once they are missing. A first constraint for the adoption of an alternative strategy is the access to water. A second opportunity for the adoption of an alternative production strategy refers to the infrastructural characteristics and more precisely to the access to paved roads. The last leverage identified is the access to plots. Some farmers have plots with a slope of more than 15 % (Daaf, 2010). Farming on these plots is hence more complicated and does not facilitate the implementation of environmental-friendly practices. We assume that farmers have to adapt to their geographical environment.

Farmers' behaviour in terms of use of pesticides
is conditioned by their geographical location

- **Hypothesis 5: Hazard perception**

In the literature, few authors take into account the hazard perception of farmers. Any innovation or newness translates into some degree of uncertainty (Rogers, 1962 ; Ervin et Ervin, 1982 ; McDonald et Glynn, 1994 ; Traoré et al., 1998 ; Lefebvre et al., 2014). As a matter of fact, this perception is quite difficult to measure and national surveys let not appreciate this subjective information. A way to quantify the risk perceived by the producers is to consider the risk related to the use of pesticides on health. Farmers whose entourage has suffered from the consumption of contaminated products are more aware to the impact of pesticide used than others (Traoré et al., 1998 ; Li, 2002 ; Deng et al., 2003 ; Zhou et al., 2011). We assume that:

Farmers whose entourage has suffer from the consumption of contaminated products
are more likely to implement environmental-friendly practices.

- **Hypothesis 6: Institutional environment**

More than characteristics related to the farmers and their farm, the institutional environment in which they evolve can favour the implementation of environmental-friendly practices. For the tomato production, a way to appreciate the support of institutional

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

environment is the access to technical support (McDonald et Glynn, 1994 ; Traoré et al., 1998 ; Pereira de Herrera et Sain, 1999 ; Adsadpur, 2011). More precisely, farmers can declare to have no access, or have an informal or a formal access. Formal access is defined by any official structure such as cooperatives or DAAF.

Farmers who have access to information through a formal way are more likely to implement environmental-friendly practices.

All variables considered are presented in Table 1.

Table 1. Description of variables

Variable	Unit	Definition
Interest variable		
pps	yes/no	Use of phytosanitary product
Farmer's characteristics (H1)		
age	-	Age of the farmer
off_farm_activity	yes/no	The farmer has an off-farm activity
Farm's characteristics (H2)		
workforce	-	Number of workforce supporting the farm work
horticulture_diversification	-	Number of horticulture products
Financial dimension (H3)		
loan	yes/no	The farmer already asked for a loan to the bank
financial_support	yes/no	The farmers has/had financial support from France or Europe
Location (H4)		
location	(1) weast ; (2) east ; (3) south	Location of the farm
water	yes/no	Water is easily accessible and available for farming
Road	(0) bad (1) good	Quality of road to go to the farm
slope	yes/no	More than 50% of the farm is on a slope
Hazards perception (H5)		
background	yes/no	Health damaged enounced after tomato consumption
Institutional environment (H4)		
referent	(0) Informal; (1) Formal	Technical referent

3. Material and method

Two surveys were performed. The first one is a qualitative survey whose aim is both to identify farmers producing tomatoes and to appropriate the organisation of this sector. The second one is a quantitative survey performed at the farmers' level to understand to what extend they are likely to adopt alternative practices.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

3.1. Qualitative survey to appropriate the organization of the tomato's sector

To understand the organization of the tomato's sector, almost all structures were surveyed. More precisely six institutional structures and one non-institutional structure were surveyed:

- The cooperative COOPAC is the main cooperative for tomatoes' producers.
- The AEM (Agri-Evolution Mahorais) is a producers group interested in the market gardeners and poultry.
- The DEPHY network whose aim is to support producers who want to implement alternatives practices to reduce their use of pesticides.
- The agricultural secondary school, which takes over mainly an epidemiology monitoring and follows the evolution of parasite pressure for market gardeners.
- The syndicate 'Jeunes agriculteurs' helps producers for their installation.
- The CIRAD, which has an expertise in term of market gardeners.

More than these institutional structures, one association was surveyed: the "Saveurs et Senteurs de Mayotte". This organization of manufacturers coordinates a network to help producers transforming their production through a collective manufacturing center or to help producers being in relation with manufacturers of fresh fruits and vegetables. The main objective is to enhance local production through a value chain more structured. Hence, we surveyed these manufacturers and their suppliers.

All information collected was put into perspective to understand the organization of the tomato's sector and to identify formal farmers producing tomatoes. These information's let us position more precisely the farmers environment.

3.2. Quantitative survey to understand to what extend farmers are likely to implement environmental-friendly practices

3.2.1. Sampling methodology

The agricultural census performed in 2010 in Mayotte identified all farms producing more than 1 hectare[4] or more than 0.2 hectare of specialized production. Since we can make the hypothesis that from 2010 to 2017 the Mahorais's landscape has evolved and since we have no more recent data to position our sample, we position our sampling to this last census, with all bias that can occur because of this evolution.

To identify tomatoes' producers, the qualitative survey let us identify the base of our first sample. From this one, all producers were surveyed, other tomato producers were identified with a snowball sampling methodology. To complete our sample, agricultural markets where visited and each seller was asked to tell us the name of their suppliers.

[4] 1 hectare = 2.47 acres

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

To insure the validity of our sample and insure that producers surveyed represent almost all the formal population (farmers who have a SIRET identification), we compared the tomato area of our sample with the tomato area identified through the agricultural census. The concordance between these areas let us think that almost all formal field farmers were surveyed.

3.2.2. Econometric model

The aim of our study is to understand to what extend tomatoes' producers are inclined to implement more environmental-friendly practices depending the individual and structural characteristics and conditioned by their institutional environment. To understand this dual choice, a logit model is implemented. This model let us differentiate farmers who use pesticides from others. Formally, this model can be written as follow:

$$Y_i = 1 \; if \; Y_i^* > 0; O \; otherwise$$

And:

$$Y_i^* = \alpha + \beta IC_i + \gamma SC_i + \zeta FC_i + \theta Location_i + \lambda HP_i + \delta IE_i + \varepsilon_i$$

Where:
Y_i^* is the choice done by the farmer to use, or not, pesticides
β is the coefficients associated to individual characteristics, denoted IC_i
γ is the coefficients associated to structural characteristics, denoted SC_i
ζ is the coefficients associated to financial characteristics, denoted FC_i
θ is the coefficients associated to location, denoted $Location_i$
λ is the coefficients associated to hazard perception, denoted HP_i
δ is the coefficient associated to the institutional environment in which the farmer evolves, denotes EI_i
ε_i is the error term

3.2.3. The Bootstrap resampling method

Even though producers surveyed are exhaustive, their number is not sufficient to implement an econometric model that leads to robust results. To compensate this lack of observations, we implement the Bootstrap resampling method. The aim of such method is usually summarized as follow: "to put oneself up by one's bootstrap". As a matter of fact, such process let create information by information contained in the initial database, thanks to a random draw. The new database let implement statistical inference. This methodology is used in case of empirical samples (Davidson et Mac Kinnon, 1993 ; Vial et al., 2015).

Version postprint
Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

Considering a vector x that can be denoted as follow: $x = (x_1 \dots x_n)$, B bootstrap sampling can be performed where one new vector is denoted $x^* = (x_1^* \dots x_k^*)$. An empirical rule estimates the number of B optimal to guarantee the quality of results: from 25 estimations we obtain a first estimation and from 50 we obtain relevant estimations (Efron et Tibshirani, 1993).

In our study, we consider first 50 samples constituted by 100 replications and then 50 samples constituted by 150 replications of the initial database. From the simulations performed, we compared the results obtained to validate the results robustness.

4. Policy implications

Since econometric results confirm statistics elements (Table 2 and Table 3), our reading focuses on econometric analysis.

Table 2. Quantitative characterisation of formal farmers depending they use, or not, pesticides

	Pps	Mean	Equality of mean	Std Deviation	Equality of variance
Farmers' characteristics (H1)					
age	No	46,3	*	12,95	ns
	Yes	53		13,45	
Farms' characteristics (H2)					
workforce	No	1,91	***	1,05	ns
	Yes	2,89		1,08	
horticulture_diversification	No	5,75	ns	2,62	ns
	yes	6,04		2,82	

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

Table 3. Qualitative characterisation of formal farmers depending they use, or not, pesticides

		Repartition		Equality of distribution
		Use of pesticide		
		no	yes	
Farmers characteristics (H1)				
off_farm_activity	no	79%	78%	ns
	yes	21%	22%	
Financial dimension (H3)				
Loan	yes	62%	65%	ns
	no	38%	35%	
financial support	no	50%	56%	ns
	yes	50%	44%	
Location (H4)				
Location	West	46%	35%	ns
	East	38%	35%	
	South	16%	29%	
Water	no	38%	40%	ns
	yes	62%	60%	
Road	Not paved	42%	35%	ns
	Paved	58%	65%	
Slope	no	71%	79%	ns
	yes	29%	21%	
Hazards perception (H5)				
Perception	no	38%	53%	ns
	yes	62%	47%	
Institutional environment (H6)				
Referent	informal	75%	65%	ns
	institutional	25%	35%	

The model implemented let us appreciate that almost all factors influencing the farmers' behaviour are considered since the concordant rate of our model equals 82.16 % (Table 4).

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

Table 4. Econometric model

	Coef.	Std. Err.	z	P>|z|	Odds Ratio
Hypothesis 1: Individual characteristics					
Age	.0059019	.0349473	0.17	0.866	
Off farm activity	-.7086424	.9634848	-0.74	0.462	.4923121
Hypothesis 2: Structural characteristics					
Workforce	1.3909***	.488455	2.85	0.004	
Specialization in tomato	.0359451	.0260401	1.38	0.167	
horticultural diversification	.1249624	.1721143	0.73	0.468	
Expansion	1.116221	1.019156	1.10	0.273	3.053295
Hypothesis 3: Financial characteristics					
Loan	-.5927116	1.047991	-0.57	0.572	.5528262
Financial support	1.177423	1.132234	1.04	0.298	3.245999
Hypothesis 4: Location					
Location	*(Reference : West)*				
East	.0148257	1.044913	0.01	0.989	1.014936
South	2.145506*	1.275832	1.68	0.093	8.546362
Hypothesis 5: Hazard perception					
Background	.150235	.903114	0.17	0.868	1.162107
Hypothesis 6: Institutional environment					
Referent	1.702858*	1.032916	1.65	0.099	5.489615
Constant	-6.843223	2.69473	-2.54	0.011	
Concordant Rate	82.61%				

Econometric results that identify brakes and leverages, at the farmer level thanks to the second survey, have to be put into perspective with the first qualitative survey (Table 4). This cross reading lets appreciate constraints refraining producers to promote their productive efforts in terms of environmental-friendly practices.

Results from the econometric model highlight that, in the Mayotte context, individual characteristics do not impact practices implemented (Hypothesis 1 non-validated). Neither the age nor the potential off-farm activity has an impact on the use of pesticides. This information is all the more important as it translates the importance of environmental factors.

Considering the physical dimension of the farm, estimated by the total workforce, our model underlines that farms that employ more workforce are more likely to implement environmental-friendly practices (Hypothesis 2 validated). This result translates that bigger farms benefit from economy of scale and a higher economic potential that let them reduce their chemical input used.

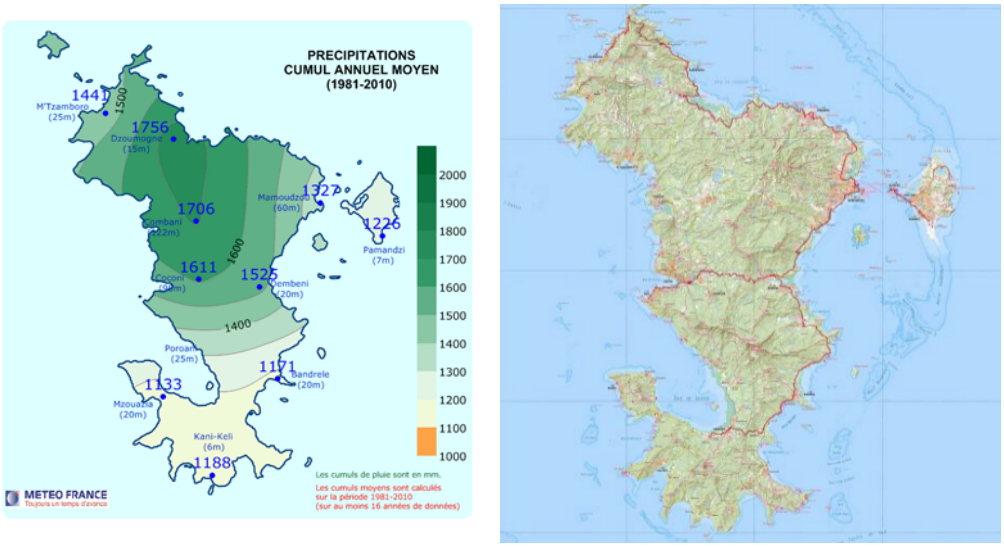
Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

The financial dimension of the farm is considered through the access to European support. The results highlight the specificity of the Mahorais' context. As a matter of fact, the non-significance underlines that even if farmers can benefit from these supports, they are no more likely to implement environmental-friendly practice (Hypothesis 3 non-validated). To understand this point, let us highlight the experience of a farmer surveyed who benefited from support to buy a cistern. Even if this material was bought, the farmer could not use it since before being installed, it was stolen. The result confirms that in Mayotte, theft is a major problem (Agreste, 2011).

Results also confirm the importance of the location (Hypothesis 4 validated). Even if Mayotte is a small island, there are geographical specificities between the three main regions in terms of access to water, access to road and hence access to training. Mayotte is subjected to a water gradient (Figure 2). Southern farmer benefit from less water than those located in the north. Water is a major condition to tomatoes' productivity. Location also reflects roads and hence trainings access. As a matter of fact, training centres such as the agricultural high school in Coconi where are given every farming trainings are located in the centre of the island. Depending the location of the farmer, the access to these centres appears as a brake. Farmers located in the South are disadvantaged once more since sparsely served by paved roads.

Figure 2. Mayotte location specificities



Source: Météo France, 2017 - Geoportail

The hazard perception of farmers considered in our study appears to be non-relevant to understand the farmers' behaviour in terms of environmental-friendly practices (Hypothesis 5 non-validated). Even if farmers are conscious about the environmental impact of the pesticides used, the fact to be ill after consumption of contaminated fruits seems to be sufficient to modify their consumption's behaviour but not their farming practices.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

The last hypothesis tested in our model is the importance to access to information (Hypothesis 6 validated). We observe that farmers who benefit from formal information are more likely to implement environmental-friendly practices rather than those who benefit from informal networks. During our investigations, almost all farmers underlined the need to be more supported by a technician for knowledge and skills acquisition and transfer. Even if they have access to some information through their official or non-official networks, their wish is to benefit from a concrete support of technician on their land. Almost all would like to implement environmental-friendly practices but they do not know the way to do. A long-term follow up is necessary for all farmers who need advise since between custom and belief, some farmers do not hesitate for instance to treat using *ourouva*, which is a toxic plant, or to use fire to avoid pests. Supervision and monitoring would help farmers to improve their productive practices.

Beyond results highlighted by the econometric model, the investigation of the first survey that considers all actors of the sector, we have observed two main brakes to help farmers implementing environmental-friendly practices.

At a financial level, farmers have to be supported at the very first stage since some of them neither read, nor write and speak French. During our investigation alongside producers, some confess not to benefit from European financial support, whereas they are eligible to, because of this language divide.

The second brake that is the main factor for the adoption of environmental-friendly practices is the lack of laboratories to perform phytosanitary tests. Since in Mayotte there is no laboratory, even if producers implement environmental-friendly practices, they cannot promote the quality of their production. Hence, neither farmers nor cooperatives can promote alternative practices. No collective action can be undertaken at this stage.

Version postprint

5. Conclusion

Mayotte is a French department since 2011 and an overseas department since 2014. Its recent integration of Mayotte to France and hence to European makes Mayotte a relevant case study. As a matter of fact, Mayotte has to answer phytosanitary requirements and harmonize farmers' practices with the legislation. Mayotte is also a relevant case study since legal and illegal population co-habites and since the agricultural legal population considers both formal and non-formal producers. While the first ones benefit from a SIRET number and hence can benefit from european support, the second ones have no right to produce and sell their production. Our study focuses hence on this first population. More precisely, our study considers the tomatoe's sector since it represents one of the main crop using pesticides.

Based on two surveys, our study aims both at appreciating the organisation of the tomatoe's sector and at understanding to what extend farmers are more likely to implement environmental-friendly practices. While the first survey considers almost all actor of the sector, the second one considers formal farmers. This last survey let us implement an

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

econometric model to understand to what extend individual characteristics of farmers, structural and financial characteristics of their farm impact their pesticide use. More than these factors, our study also considers the location specificity and the impact of institutional environment through the access to formal or informal network.

The main results confirms the need for farmers to walk hand by hand with institutional supports. More precisely, while some support have to be defined at the producer level, others have to be identified at a more aggregated level.

At the producer level, financial support does not appear to be the first leverage. As a matter of fact, because of theft farmers cannot benefit from these supports. Robberies divert farmers from the use of such support since they are stolen before being installed. Moreover, even if farmers can benefit from financial support they are not necessarily able to ask them because of the language divide. Mahorais do not all speak and read French.

At an aggregated level, the first brake identified is the infrastructure. Three main regions can be defined. While some benefit from access to water and road, others are penalized. These lack go beyond the only infrastructure need since the non-accessibility of tracks prevent farmers to go and benefit from training. The infrastructure dimension appears also in terms of laboratory. There is indeed no laboratory in Mayotte to let farmers or organisation promote the quality of their production. None can confirm that practices implemented are more environmental-friendly and answer phytosanitary' requirement. In such context, no incitation to implement these practices appears to be relevant since none can control their effective implementation.

The implementation of environmental-friendly practices in Mayotte is still in its infancy. More than individual brakes, farmers suffer from institutional environment brakes. Because of the recent adhesion of Mayotte as a French department, numerous efforts are performed and time will let Mahorais' farmers improve their productive practices. The main limit to our study is due to the specific context of Mayotte. As a matter of fact, our study focuses on formal farmers but we have to notice that 80 % of the farmers are illegal or non-formal. The aim of our study is not only to understand the farmers' behaviour but also to identify leverages that could help the whole mahorais' agriculture to improve the quality of its production. Since only formal farmers can benefit from european support, we had to concentrate on this population. One perspective is hence to follow non-formal farmers and study to what extend they will be incitated to become formal, knowing that to become formal, farmers have to obtain a SIRET number proving they are mahorais and paying 21€.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15)

Bibliography

Adsadpur H. (2011). Socio-economic factors affecting the development of biological technologies stem borer pest in rice fields of Mazandaran. *Agricultural Economic and Development* 19 (76): 231-252.

Aktar M.W., Sengupta D., Chowdhury A. (2009). Impact of pesticides use in agriculture: their benefits and hazards. *Interdisciplinary toxicology* 2 (1): 1-12.

Altieri M.A. (2000). Ecological impacts of industrial agriculture and the possibilities for truly sustainable farming.

Altieri M.a., Nicholls C. (2012). The scaling up of agroecology : spreading the hope for food sovereignty and resiliency A contribution to discussions at Rio + 20 on issues at the interface of hunger , agriculture , environment and social prepared by The scaling up of agroecology : spread. *Socla*: 20-20.

Asfaw S., Mithöfer D., Weibel H. (2010). What impact are EU supermarket standards having on developing countries export of high value horticultural products? Evidence from Kenya. *Food agribusiness marketing* 22 (3-4): 262-276.

Aubert M., Enjolras G. (2014). The determinants of chemical input use in agriculture : A dynamic of the wine grape-growing sector in France. *Journal of Wine Economics* 9 (1): 75-99.

Aubertot J.M., Barbier J.M., Alaphilippe A. (2005). Pesticides, agriculture et environnement : Réduire l'utilisation des pesticides et en limiter les impacts environnementaux. In: *Rapport d'expertise scientifique collective INRA et Cemagref*.

Brevault T. (1999). Mécanismes de localisation de l'hôte chez la mouche de la tomate, neoceratitis cyanescens (bezzi) (diptera : tephritidae).

Chemnitz C. (2007). The compliance decision with food quality standards on primary producer level. A case study of the EUREPGAP Standard in the Moroccan tomato sector. Berlin.

Clay D., Reardon T., Kangasniemi J. (1998). Sustainable intensification in the highland tropics: Rwandan farmers' investments in land conservation and soil fertility. *Economic development and cultural change* 46 (2): 351-377.

Daaf. (2010). Synthèse illustrée du recensement agricole 2010. 23-23.

Daaf. (2016). Analyse des pratiques en maraîchage. 1-4.

Daaf. (2017). Programme portant mesures spécifiques dans le domane de l'agriculture en faveur des régions Ultrapériphériques.

Davidson R., Mac Kinnon J. (1993). Estimation and Inference in Econometrics. Oxford.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

De Schutter O. (2010). Agroécologie et droit à l'alimentation. 17850 (Habitat II): 1-4.

Deng J.A., Qu H., Huang R., Yang Y., Zhen X., Wang H. (2003). Survey of food poisonning by organophosphorus pesticide at the employee refectory. *Practical Preventive Medecine* 10 (5): 766-767.

Didelot D., Meule-aldebert A., Hoarau D. (2017). Le plan Ecophyto à Mayotte - exemple du maraîchage. 39-41.

Direction de l'information légale et administrative de la République F. (2015). Vocabulaire de l'agriculture et de la pêche. *Journal officiel de la République Française* (1).

Dörr A.C., Grote U. (2009). Impact of certification on fruit producers in the Sao Francisco Valley in Brazil. *Economics and applied informatics*: 5-16.

Efron B., Tibshirani R. (1993). An Introduction to Bootstrap.

Ervin C.A., Ervin C.E. (1982). Factors affecting the use of soil conservation practices : Hypotheses, evidence and policy implications. *Land economics* 58: 277-292.

European Commission. (2008). Evaluation des mesures concernant les organisations de producteurs du secteur des fruits et légumes. C. Européenne (Ed.).

Feder G., Just R.E., Zilberman D. (1985). Adoption of agricultural innovations in developping countries : A survey. *Economic development and cultural change* 33 (2): 255-298.

Fernandez-Cornejo J., Beach E.D., Huang W.-Y. (1994). The adoption of IPM techniques by vegetable growers in Florida, Michigan and Texas. *Journal of agricultural and applied economics* 26 (1): 158-172.

Fernandez-Cornejo J., Ferraioli J. (1999). The environmental effects of adopting IPM techniques: The case of peach producers. *Journal of agricultural and applied economics* 31: 551-564.

Galt R.E. (2008). Toward an Integrated understanding of pesticide use Intensity in Costa Rican vegetable farming. *Human Ecology* 36: 655-677.

Gould B.W., Saupe W.E., Klemme R.M. (1989). Conservation tillage: The role of farm and operator characteristics and the perception of soil erosion. *Land economics* 65 (2): 167-182.

Houmy K. (1994). Importance des conditions climatiques dans l'applictaion des produits phytosanitaires. *Revue ANAFIDE* 96 (6): 34-40.

Huat J., Doré T., Aubry C. (2013). Limiting factors for yields of field tomatoes grown by smallholders in tropical regions. *Crop Protection* 44: 120-127.

inserm. (2013). Pesticides - Effets sur la santé. Paris, France.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

Kersting S., Wollni M. (2011). Public-private partnerships and GLOBALGAP standard adoption: evidence from small-scale fruit and vegetable farmers in Thailand. *EAAE congress*.

Knowler D., Bradshaw B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food policy* 32: 25-48.

Koleva N.G., Schneider U.A., Tol R.S.J. (2009). The impact of weather variablibity and climate change on pesticide applications in the US : An empirical investigation. FNU 171, p. 33.

Lefebvre M., Langrell S.R.H., Gomez-y-Paloma S. (2014). Incentives and policies for integrated pest management in Europe : a review. *Agron. Sustain. Dev.*

Li X. (2002). Analysis of food poisoning due to taking vegetable contaminated with organophosphorus pesticide. *China Tropical Medecine* 2 (4).

Martin T., Houndete T., Hougard J.M. (2006). Efficacy of Mosquito Netting for Sustainable Small Holders ' Cabbage Production in Africa. 450-454.

Martin T., Simon S., Parrot L., Komlan F.A., Vidogbena F., Adegbidi A., Baird V. (2015). Eco-friendly nets to improve vegetable production and quality in sub-Saharan Africa. 221-228.

Mc Laughlin A., Mineau P. (1995). The impact of agricultural practices on biodiversity. *Agriculture, Ecosystems and Environment* 55: 201-212.

McDonald D.G., Glynn C.J. (1994). Difficulties in measuring adoption of apple IPM : A case study. *Agriculture Ecosystems & Environment* 48: 219-230.

Muleke E.M., Saidi M., Itulya F.M., Martin T., Ngouajio M. (2014). Enhancing Cabbage (Brassica oleraceae Var capitata) Yields and Quality Through Microclimate Modification and Physiological Improvement Using Agronet Covers. 3 (2): 24-34.

Nowak P. (1992). Why farmers adopt production technology. *Journal of soil and water conservation* 47 (1): 14-16.

Okoye C.U. (1998). Comparative analysis of factors in the adoption of traditional and recommended soil reosion control practices in Nigeria. *Soil & Tillage Research* 45: 251-263.

Pereira de Herrera A., Sain G. (1999). Adoption of maize conservation tillage in Azuero, Panama. In: Economics (Ed.).

Potier D. (2014). Pesticides et agro-écologie : Les champs du possible. In: *Rapport EcoPhyto Réduire et améliorer l'utilisation des phytos*. Paris.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .

Rivière F. (2010). Mutations et évolutions de l'économie mahoraise à la veille de la départementalisation.

Rogers E. (1962). Diffusion of innovations. New York. *(Free Press of Glencoe)*.

Roschewitz I., Thies C., Tscharntke T. (2005). Are landscape complexity and farm specialization related to land-use intensity of annual crop fiels ? *Agricultural Ecosystems and Environment* 105: 87-99.

Rosenzweig C., Iglesias A., Yang X.B., Epstein P.R., Chivian E. (2001). Climate change and extreme weather events : Implications for food production, plant diseases and pests. *Global Change and Human Health* 2 (2): 90-104.

Ryckewaert P., Fabre F. (2002). Lutte integrée contre les ravageurs des cultures maraîchères a la reunion. (July 2014).

Sharma A., Bailey A., Fraser I. (2011). Technology adoption and pest control: strategies among UK cereal farmers: Evidence from parametric and nonparametric count data models. *Journal of agricultural economics* 62: 73-92.

Sharma R., Peshin R., Shankar U., Kaul V., Sharma S. (2015). Impact evaluation indicators of an Integrated Pest Management program in vegetable crops in the subtropical region of Jammu and Kashmir, India. *Crop Protection* 67: 191-199.

Silici L. (2014). Agroecology. What It Is And What It Has To Offer. *International Institute for Environment and Development, London* (June): 1-27.

Sourisseau J.-m., Bonnal P., Es C., Sociétés E. (2008). Changement institutionnel et agriculture à Mayotte Les impacts d ' une intégration renforcée à la République française sur l ' activité agricole des ménages. 303-304.

Traoré N., Landry R., Amara N. (1998). On-farm adoption of conservation practices: The role of farm and farmer characteristics. *Land economics* 74 (1): 114-127.

Vial C., Aubert M., Perrier-Cornet P. (2015). Loisirs de pleine nature et utilisation des territoires : Le cas des activités équestres diffuses. *Géographie, économie, société* 17: 289-314.

Vidogbéna F., Adégbidi A., Assogba-Komlan, F. M., T., Ngouajio M., Simon S., Tossou R., Parrot L. (2015). Cost: Benefit analysis of insect net use in cabbage in real farming conditions among smallholder farmers in Benin. *Crop Protection* 78: 164-171.

Zhou J., Elen J.H., Liang J. (2011). Implementation of food safety and quality standards: A case study of vegetable processing industry in Zhejiang, China. *The social science journal* 48: 543-552.

Version postprint

Comment citer ce document :
Aubert, M., Debrune, O., Huat, J., Parrot, L. (2017). The institutional environment as an essential support to agro ecology: the case of the formal market gardeners in Mayotte. Presented at 11. Journées de Recherches en Sciences Sociales (JRSS), Lyon, FRA (2017-12-14 - 2017-12-15) .