

Domestication of UNFCCC Commitments in Food Crop Sector: Case of Rice and Cassava in Cavally Region, Cote d'Ivoire

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DECLARATION

I hereby declare that I am the sole author of this Master thesis entitled '**Domestication of UNFCCC Commitments in Food Crop Sector: Case of Rice and Cassava in Cavally Region, Cote d'Ivoire**', that I have not used any sources other than those listed in the bibliography and identified as references. I further declare that I have not submitted this thesis at any other institution in order to obtain a degree.

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ABSTRACT

In recent decades, the question of climate variability and change has been gradually taken into account in public policy. Climate variability have been affected food crop production including rice and cassava in Cote d'Ivoire. As many nations, Cote d'Ivoire has convened at the highly publicized May 1992 Rio de Janeiro Conference that led to the drafting of environmental policies known as the United Nations Framework Convention on Climate Change (UNFCCC). Since the decree No 94-616 of 14th November 1994 pursuing ratification of the UNFCCC, Cote d'Ivoire is committed to reduce its emission of greenhouse gases and protects its population against the impacts of climate variability and change. The study contributes to investigate the status of commitments of Cote d'Ivoire in food crop sector. The study, also tries to assess the policy integration of climate measures such as adaptation and mitigation. In addition, the paper analyzes the local awareness and determinants of farmers' adoption of agro-environmental measures.

Purposive sample was done to select the communities having benefited from projects and activities to assess the policies implementation. For this study, a random sampling was used to select a sample of 6 communities through 349 rice and cassava farmers. The study used the Content Analysis method to review national policies as well as the Obligation Integration Susceptibility Index (OISI) to evaluate the level of integration in relevant sectoral policies of rice and cassava crops. The study also used the Descriptive Statistics and the Binary Regression model to investigate awareness and adoption factors of sustainable practices.

The study revealed a very weak level of climate integration of food crops policies at 35%. The findings showed that 66.8% of farmers were aware of lowland rice management, 59.3% to agroforestry practice, 40.45% to improved cassava varieties, and 34.4% to natural fertilizers use. In addition, the findings suggested that about 60% of farmers have adopted agro-environmental

measures. The resting 40% that are non-adopters explained that the lack of finance, the quality of improved seeds, the lack of farming land and the low revenue from food crops constituted overall the barriers for adopting of sustainable practices. Another major finding is that perceived impact, level of education, farm size and farming experience emerged as determinants factors influencing farmers' adoption. The study therefore recommends that governments should promote climate education towards smallholders, experienced farmers, less educated that would mentor and stimulate other farmers to adopt friendly environment practices. Also, policy makers should promote the natural fertilizers based on local knowledge such as Eucalyptus leaves used as inputs. This would sustain the use of environmental practices and increase climate considerations in food sector.

Keywords: UNFCCC, Cavally Region, Cassava, Rice, Cote d'Ivoire, Policy Integration, Commitments.

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DEDICATION

Dedicated

To

The Lord

My beloved Mother Ble Clotilde,

My Husband Sitionon Willards,

Late Prof Sow (Former Wascal Director)

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LIST OF ABBREVIATION

GHG: Greenhouse Gas

GPD: Gross Domestic Product

IPCCC: Intergovernmental Panel on Climate Change

NAMA: Nationally Appropriate Mitigation Actions

NAPA: National Adaptation Programme of Actions

OISI: Obligation Integration Susceptibility Index

SPSS: Statistical Package for Social Science

UNFCCC: United Nations Framework on Climate Change

CHAPTER ONE

INTRODUCTION

1.1 Background

In recent decades, the question of climate variability and change has been gradually taken into account in public policy. In the 1970s, several scientists raised awareness of human activity impacts on ozone degradation. Though, the problem was just perceived as simple environmental issue. During the 1990s, with the use of sophisticated models, it was clear that stabilizing of greenhouse gases were mandatory (IISD, 2008).

Because of planetary nature of climate change issues, many nations convened at the highly publicized May 1992 Rio de Janeiro Conference that led to the drafting of environmental policies known as the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC entered into force in March 1994 with 165 signatory parties including Cote d'Ivoire (UNFCCC, 1992). It is important to note that Cote d'Ivoire is a driving force in West Africa as the first economic power of ECOWAS (Economic Community of Western African States) and the second of WAEMU (West African Economic and Monetary Union). It aims to attain the status of emergence country by 2020 (PND, 2015). The Ivorian economy relies heavily on the Agriculture, which contributes to 26% of GDP (Gross Domestic Product). Furthermore, agriculture employs 2/3 of its active population with 85% engaged in the food crop sector (MAAFF, 2015; TCN, 2017). However FAO (2016) reported that agriculture will be affected by a range of drivers such the rapid growth rate in population. Indeed, Cote d'Ivoire registers one of the highest immigration ratios in the world, fueled by a steady flow of immigrants over the final 50 years. The Ivorian population has increased more than six-fold in the last 20 years, from three (1960) to 22 (2014) million (FAO, 2016b). Furthermore, the UN scenario has projected that the Ivorian population will double in the

next 35 years (FAO, 2016b). However, crop production is already affected by climate change with a decrease of 50% of rain-fed crops production within the period of 2000 to 2010 (TCN, 2017). The reason lies on the fact that agriculture is strongly dependent on rainfall that registered an average decrease of 6% (Dibi-Kangah, 2004; 2010; TCN, 2017). In addition, the main supports of food production such as soil, water, and biodiversity are negatively threatened by climate change (FAO, 2009).

Despite environmental agreements, gap lies between international environmental agreements and implementation of concrete policy actions, as such that farmers have developed their own adaptive capacity (Adou & Deddy, 2015; Cherif, 2012). Rice and cassava were considered as important staple crops because of their strategic significance food reserve to hamper famine (Adou & Deddy, 2015; Brou *et al.*, 2005). Indeed, these crops are relatively resilience to climate variability and change. Thus, increase in rice and cassava production would be obvious. Nevertheless, there is still about 50% gap in the supply-demand with a post-harvest loss of 10 to 20% of cassava production (PND, 2015; Aminou, 2017).

Following 20 years of efforts as signatory party of the UNFCCC, Cote d'Ivoire is still impacted by climate variability and change, especially on food production. The study aims to analyze the consequences of international environment commitments in Cote d'Ivoire.

1.2: Statement of the Problem

Cote d'Ivoire lies mostly within the tropical humid African region. However, it is affected to climate variability and change in ways comparable to what was observed further north in the

Sahelian region (Dibi-Kangah, 2004). Thus, Cote d'Ivoire is vulnerable to potential environmental impacts.

Since the decree No 94-616 of 14th November 1994 pursuing ratification of the UNFCCC, Cote d'Ivoire is committed to reduce its emission of greenhouse gases and protects its population against the impacts of climate variability and change. In addition, tropical forests are continuously threatened by degradation ranging from 18 (1996) to 40 (2017) percent (MAAFF, 2015). Furthermore, the annual greenhouse gases emission is rising steadily at 8.675 (1990) to 18.957 (2012) Gg CO² with 119% increase out of forestry. The agriculture sector registered 32% of emissions with 3.5% of rice (TCN, 2017). These trends indicate that not only the country contributes to environmental degradation but also it worsens the vulnerability of its communities to climate variability and change.

This situation raises serious question on respect of international environmental obligations. Until recent decades, studies have mainly focused on negotiation processes and interactions among countries. However, limited attention is paid to linkages between domestic and international policies (Hanf, 2001). The issue is not to produce agreements at national level, but rather strategies to handle issues within the country, especially as far as food security is concerned. The interest is to find out how international climate policies are handled in such a way that households are protected against food insecurity and adverse effects of climate variability and change. According to CGIAR (2011), developing countries face, not only a tremendous variety of development challenges, but also vary greatly in their policies. In 2015, the National Development Plan (NDP) of Cote d'Ivoire acknowledged a limited implementation of global treaties (PND, 2015). A sector-based diagnostic particularly in relation with food production will help solving the problem. The

study aims to investigate rice and cassava sectors, as staple and strategic crops in a region with high production such as Cavally region (EVSACC-CI, 2013).

1.3: Significance of the Research

The study provides an opportunity to assess the influence of international agreement on local farming practices. Therefore, this research is expected to reduce the gap between policy-makers and farmers by investigating from the national to the local level. In addition, the paper intends to offer an overview of the preferred climate related actions of farmers.

Further, the importance of the research resides in the selection of the study area which is situated in a forestry zone of Cote d'Ivoire. The country ambitions to restore forest resources, thus, the outcomes of this study might be useful to policy makers.

Indeed, this research includes implications to the governance. The environment issues raise human right concerns. Negligence may affect the reliance of the population towards their public authorities. The credibility of the governments is inherent to their capability of fulfilling their obligations, such that limited domestication of duties might be seen as a broken promise. In addition, it is believed that democratic countries would generally implement better their obligations (Broache, 2015; Neumayer, 2002; Okley, 2004). If this holds some truth, then Ivorian citizens will appreciate to (re) elect leaders that are mindful of implementation of commitments. Indeed, the respect of international responsibilities is essential for demonstrating the attachment to democracy.

1.4: Purpose of the Research

The primary aim of the survey is to examine the state of domestication of UNFCCC commitments in rice and cassava sectors in Cavally Region of Cote d'Ivoire. The specific objective seeks to:

- Review climate change integration in food crop policies
- Analyze the awareness of farmers of agro-environmental practices
- Identify factors that motivate farmers to adopt agro-environmental policy measures

1.5: Research Questions

In the purpose of achieving the above objectives, the study focused on the following questions:

- What is the extent of implementation of climate variability and change commitments in rice and cassava sectors?
- Has the country, after ratifying the UNFCCC, ensured that the national policies of food crops are properly integrated?
- Are rice and cassava farmers aware of national environmental measures?
- Which factors might influence farmers' adoption of agro-environmental practices?

1.6: Delimitation of the Study

In this study, only policies that are related to agriculture and environment were analyzed. Likewise, the focus was on the National Strategy of Rice Development (SNDR) and the National Strategy of Food Crops other than Rice (SNDCV). They provide the policy framework for rice and cassava in

Cote d'Ivoire. The research was limited to communities that have benefited from food crops projects. This is founded on the general norm that policy are implemented by projects, and vis-versa, projects are justified by existing policies.

1.7: Limitation of the Study

Detailed demographic information useful for the sample size determination were missing, compelling to embark on lengthy administrative processes. In fact, the information at the regional offices relies on the authorization from central authorities which be a time-consuming operation. Also, recent social conflict particularly around Guiglo, the chief-lieu of Region, were delayed the fieldwork for the sake of security.

1.8: Definition of terms

Domestication: The domestic implementation of a treaty ratified and incorporated into national laws and policies in order to meet the objectives of the treaty.

Ratification: Ratification is a process that occurs after a country has signed an agreement. Formal consent to a treaty signed by the competent authority, generally the President of the Republic, which bind the State to follow its provision.

Policies: Processes and practices taken by the government to accelerate mitigation and adaptation measures.

Commitments: Measures which bind to do and to not do.

Implementation: Actions taken to meet commitments under a treaty and encompasses legal and effective phases.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1: Empirical Review

2.1.1: Concept of Domestication of Commitments

Domestication of international commitments is relatively recent (Najam, 1995). In the past decades, most research rather focused on policy formulation as well as policy implementation (Andresen *et al.*, 1995). With the proliferation of international environment agreements, it appears interesting to consider the domestication of policies.

Many authors have defined the concept of domestication of international agreements. For Najam (1995), it implies a domestic implementation of international commitments. Kirumba (2014) considered the translation of international agreement at a domestic level. Rubadiri (1999) adopted a broader perspective and argued that many international engagements can be seen as domesticated. For this author, the most important is the status of policy implementation. This offers the possibility to investigate the internalization of duties beyond translation. Likewise, Alasuutari (1994) noted that the domestication is the process of transforming international environmental obligations into domestic rules before they can affect the targeted population. The process may succeed when it starts from commitments translation to an influence on citizens. Furthermore, Cerna (2013) assessed that passing policies do not guarantee success on the ground if policies are not enforced well.

What it's known about the domestication of environment agreements is largely based upon empirical studies that investigate policies documents and targeted population.

Kirumba (2014) conducted a research on the domestication of the UNFCCC among farmers in the Mirunga County in Kenya. He concluded that Kenya has not significantly domesticated the UNFCCC commitments. Kirumba also found at, in Mirunga, irrigation farming has been mostly domesticated amongst farmers followed by drought-tolerant crops. Kirumba has extracted from Kenyan national documents eight measures as the interpretation of the UNFCCC commitments related to the agriculture sector. One of the objectives of this study is to find out if the UNFCCC obligations translate into Ivorian policies and their awareness by rice and cassava farmers. However, Kirumba has not treated the abstraction of the measures from the public documents in much details. Such process is unsatisfactory because there is a need to understand the various methods of document analysis.

This current paper will follow the Gregorio *et al.* (2016) approach which has considers policy coherence in their research on the integration of mitigation and adaptation in climate and land use policies in Brazil. According to their conceptual framework, policy integration refers to the climate change policy architecture and policy coherence. Hone *et al.*, (2002), a first stage of commitments fulfilment requires policies that combine development and climate change objectives. Non-environmental policies sector have to take account of climate change mitigation and adaptation targets (Jacob & Kannen, 2015). However, the current study is focused on policy integration, which includes the level of integration of climate change commitments within food crop policies, their coherence, awareness, and factors influencing their adoption among farmers.

2.1.2: Differentiated Obligations

The United Nations Framework Convention on Climate Change (UNFCCC) is a treaty legally binding countries or parties to an agreement (Kirumba, 2014). A treaty is an international agreement concluded between States in written form and governed by international law (Vienna Convention on Law of Treaties, Art. 2). The UNFCCC contains Precautionary Principles (Art 3.3), Sustainable Development (Art 3.4), Cost-effectiveness (Art 3.1 and 3.2), Inter-Generational Equity (Art 3.1) and Common but Differentiated Responsibilities (Art 3.1). The UNFCCC aims to stabilizing greenhouse gases (GHGs) and ensuring that food production is not threatened (Art 2). To this end, different levels of commitments are laid down with three annexes based on the Principle of Common But Differentiated Responsibilities (CBDR).

In this study, the CBDR are analyzed because it influences the repartition of different commitments among parties. Khalfan & Segger, (2002) summarized the concept as different responsibility based on the social, economic and ecological situations. Therefore, the parties are obligated according to their respective group (Annex I, Annex II, and Non-Annex I). This study will discuss the Principle of CBDR and its implications before presenting the obligations assigned to Cote d'Ivoire.

Table 1: Summary of Commitments of Parties at the UNFCCC

	Non-Annex I	Annex I	Annex II
National Mitigation and Adaptation Measures	Commitment	Commitment	Commitment
Report Requirements	Commitment	Commitment	Commitment
Take the lead		Commitment	Commitment

Provide financial support			Commitment
Technology transfer			Commitment
Allow degree of flexibility			Commitment

Source: Author

As seen in Table 1, the Non-Annex I countries fulfill fewer commitments than parties in Annex I and Annex II. This can be explained by the contribution of each to the environmental problem. According to the Fifth Assessment Report of IPCC (2014), industrialized nations have contributed the most to greenhouse gas emissions while developing have less. In addition, climate models have shown that developed countries to about 60-80%, while developing countries to about 20-40% (Wei *et al.*, 2012).

Nevertheless, issues that are the conflicting views among parties on their interpretation of CBDR. On one hand, developing countries contemplate developed countries as first contributors to greenhouse gases. Hence, they advocate for increase commitments and responsibility on major industrialized nations. On the other hand, developed countries are critical of the flexibility of developing countries' commitments. They argued that developing countries misuse their rights of finance support and technology transfer. This view is supported by Petrescu-Mag *et al.* (2013) which noted that the CBDR might be a pretext for unindustrialized countries to extract maximum of benefits. Craig (2017) stated that this principle would imply relax period with delayed implementation and less stringent obligations for Non-Annex I. Unlike Craig (2017), Petrescu-Mag *et al.* (2013) claimed that the CBDR is a portion of responsibility in environmental issues for developing countries. In addition, developed countries, especially the United States raised the limited responsibilities attributed to India and China. The United States observed that the CBDR has only used the past contributors while India and China are the actual major emitters.

Consequently, the UNFCCC should categorized China and India as emerging countries in order for them to face their responsibilities. Bortscheller (2010) reminded that the absence of commitments for China in Kyoto Protocol was raised by the United States for not ratifying. Further, Bortscheller (2010) criticized the UNFCCC for classifying China and Botswana in the same group. For him, the international community has witnessed the growth of China and its related environmental issues. For example, recent modernization plans and air pollution problem have caused about 750,000 deaths per year in China. Bortscheller (2010) urged the UNFCCC to not range China among developing countries. In addition, Dallier *et al.* (2009) maintained that the rapid industrialization of China and India stand them as great polluters. Stone *et al.* (2015) added that the CBDR failing to extract China and India from the Non-Annex I has affected the progress of the UNFCCC. Overall, these views indicate that the interpretations of the principle of CBDR are controversial.

The position of international laws is found in Article 32 of the Vienna Convention on the law of treaties. The Convention states that when the interpretation of a term leads to a result “manifestly absurd or unreasonable”, a supplementary means shall be given to this term. This implies that the CBDR, object of debates, should be redefined in the provision of UNFCCC. It is also interesting to note that the principle of CBDR is not a legal obligation (Ozuah, 2015).

However, the principle of CBDR has prevailed over more than 20 years since the Convention entered into force in 1994. The UNFCCC binds upon the parties which must acted on their commitments in good faith (Vienna Convention, Art. 26). An evaluation of the application of the Convention by parties may be required for further progress towards the environmental protection.

Cote d’Ivoire ratified the UNFCCC through the Presidential Decree No. 94-616 of 14th November 1994 and the Kyoto Protocol by the Presidential Decree No. 2005-726 of 28th December 2005. In

2015, Cote d'Ivoire adopted the Paris Agreement during the 21st Conference of Parties (COP 21). The legal analysis is ongoing for an eventual ratification (Road Map for Paris Agreement Implementation, 2016).

2.1.3: Initiatives related to UNFCCC Provisions in Cote d'Ivoire

2.1.3.1: International Agro-environment Provisions

Cote d'Ivoire has demonstrated efforts to manage agriculture and environment nexus. One of the fundamental agreements linked to the Nexus was the 1968 African Convention on the Conservation of Nature and Natural Resources. Cote d'Ivoire ratified in 1969 this treaty, which urged parties to sustain land resources by taking into account the indigenous knowledge and rights of local communities. The Convention also encourages the parties to fight pollution and soil degradation that are caused by agricultural practices.

Another important agreement is the 1992 Convention on Biological Diversity at the Rio de Janeiro Conference that was ratified in 1994. Through this treaty, Cote d'Ivoire affirmed to be responsible for conserving the biological diversity of species and communities which have cultural, scientific, economic and agricultural value (Annex I).

Likewise in 2001, Cote d'Ivoire took part of two major agreements namely the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) adopted in Rome during the FAO Conference and the Stockholm Convention Protocol on Persistent Organic Pollutant (PoPs). Ratified in 2003, the ITPGRFA agreement promotes the conservation and sustainable use of genetic resources as well as the technology transfer between parties for the purpose of ensuring food security. The Stockholm Convention aims of ensuring human health and protecting the

environment from PoPs (Dessau-Rosslau, 2012). In the agriculture, PoPs are intentionally or unintentionally produced in persistent chemical organisms with a potential bioaccumulation and toxicity that are mainly contained in pesticides (Sharma *et al.*, 2014).

Cote d'Ivoire is a member of the Coalition for Clean Air and Climate (CCAC) since 2015. This membership compelled to fight against GHGs namely Short-term Life Climate Pollutants (SLCPs) including those from agriculture.

At the local collectivity, representative authorities have signed the Yamoussoukro Declaration in 2015 during the meeting for African Cities and Regions for Climate. This Declaration, reaffirmed the support of integrated agricultural policies which sustain land use, biodiversity preservation, agricultural waste development and organic fertilizers promotion.

The Ministry of Environment in Cote d'Ivoire signed in 2017 an important Decision from the African Ministerial Conference on the Environment (AMCEN) in Libreville. The aim of this Conference was to invest in Innovative Environmental Solution for accelerating implementation of the Sustainable Development Goals. Ministries committed a green agriculture and formulated an ecosystem-based adaptation driven agriculture.

Note that Cote d'Ivoire ratified these aforementioned treaties which converge to the UNFCCC objectives. The review of these agreements help highlighting the lawful efforts of Cote d'Ivoire to protect the environment and the agriculture. The current study requires further analysis into the UNFCCC agreement since the climate change is the main concern.

2.1.3.2: National Agro-Environment Policies Documents

Cote d'Ivoire enacted numerous laws and policies aligning with environmental goals. The following documents shown preexisted and current efforts related to the implementation of international environmental commitments.

2.1.3.2.1: Constitution, Environment Code, Sustainable Development and Agricultural Laws of Orientation

The first domestic policies are not specific to agriculture and environment issues. Although, the integration of environment disclosure is important since these policies are fundamental laws.

The Ivorian Constitution of 2000 recognized in its Article 19 the right to a safe environment. This right consecrated in the fundamental law is an evidence of environmental concern. Besides, Article 19 of the Constitution engages Cote d'Ivoire to protect Ivorian citizens against environmental issues.

The Law No 96-766 of 3rd October 1996 pursuing Environment Code has established the legal framework of the environment in Cote d'Ivoire. The Environment Code touches the issues of bushfire as a major environmental issues in the agricultural sector. Increasingly, the Environment Code is criticized for lack of adapted measures of recent environmental issues.

The Law No 2014-390 of 20th June 2014 pursuing Sustainable Development Law of Orientation seeks to define policy instruments of sustainable development and climate change. The law aims not only to conciliate environmental, economic and social objectives but also to frame the utilization of modified organisms (Art 2). Unfortunately, the law is not yet applicable because of lack of application decree defining the implementation of some measures.

The Law No 2015-537 of 20th July 2015 pursuing Agricultural Law of Orientation ambitions to achieve food security and natural resources preservation (Art 2). The law is applicable to the widely agricultural sector such as agriculture, forestry, agroforestry, fishing, and breeding (Art 2).

2.1.3.2.2: Agricultural Development Master Plan 1993 and National Environment Action Plan 1994

In 1993, the Ministry of Agriculture established the Agriculture Development Master Plan ('PDDA') from 1992 to 2015, which ambitioned to develop agriculture through diversification, finance instrument and modernization of the agriculture sector. The integration of environment targeted reforestation.

The National Environment Action Plan ('PNAE-CI') was published in 1994 and was the backbone of environmental actions in Cote d'Ivoire over a time-frame of 1995 to 2015. At the point of agricultural strategy, the plan was questioned on the conciliation between forestry protection plan and development of agriculture extension requirements: "How to implement both plans without that the success of one may infringe on the other?" The answer has been to limit forest clearing by focusing on the reduction of losses of agricultural products, production potential, and productivity improvement. The plan was focused on the productivity development. However, measures for rice farming revealed the limitation of the strategy. The PNAE-CI recognized that the rice importation required an alternative solution. The expanding of surfaces is necessary. This incoherence in the strategy may be explained by the lack of adaptation and mitigation measures at this stage, the concept of sustainable development was a relatively new entrant on the countries agenda.

In overall, it appears that in the 1990s, the nexus agriculture and environment were targeted only the reforestation.

2.1.3.2.3: The Nationally Determined Contribution (NDC) and National Communications

The publication of National Communications and INDC, transformed after into NDC, constitutes the UNFCCC commitments which aimed to update actions in the fight against climate change.

The Intentionally National Determined Contribution of Cote d'Ivoire seeks to reduce agricultural vulnerability and focus on the resiliency through 5 major objectives. First, an agro-ecological approach would be developed in terms of land fertility management, organic fertilizers and compost from household waste, the combination of agriculture-breeding, agroforestry. The second task is to develop and disseminate improved varieties to climate change. Third, the document highlights the improvement of storage in order to decrease the crops loss. Fourth, the seasonal forecast would be used to improved farmers adaptation. Finally, the document reveals the intention the protect women through their right to land access.

Cote d'Ivoire has published three National Communications. The 1st National Communication was published in 2000 and contains the national inventories of greenhouse gases by sectors and mitigation strategies. The 1st National Communication has divulged that in the agricultural sector, the breeding, irrigated rice crop, savannah fire and agricultural waste were the main greenhouse gases from the agricultural sector. The disclosure has noted that the carbon monoxide had the highest rate of release with 85.12%, followed by the methane (13.32%), nitrogen oxide (0.042%). Turning to the mitigation options, the 1st National Communication has suggested coercive measures against the deforestation and bushes fire. It is important to highlight that the document had pointed out the research of innovative techniques to replace those harmful agricultural

practices. In addition, the agroforestry promotion has been suggested as an adaptation measure into the document.

Those factors are some evidence that at this stage, Cote d'Ivoire did not sufficient policy tools to fight impacts climate change in the agricultural sector. This point is true in the way that the 2nd Communication came up with the prioritization of research, capacity building, and technologies transfer.

Thus, the Second National Communication was published in 2010 and has underlined the importance of policies and financial instruments for the implementation of adaptation and mitigation strategies. The document stated that without measured and adequate resources, 'it is not necessary to organized adaptation measures'. Also, the Second National Communication revealed the issues of the collaboration amongst institutional and key actors of environmental management. Unfortunately, there is an overlapping of mission between structures in charge of environmental actions because of a lack of assignment clarification, slowing down the implementation of international commitments.

The 3rd Communication released in 2017, aims to implement four strategically axis of adaptation. First, this strategy aims to raise awareness of climate change impacts and disseminate technologies transfer throughout farmers' population. The second objective is to increase the agricultural productivity in a sustainable way through water and land management, improved seeds and inputs. Third, the promotion of fight against deforestation into agricultural plans and programs, the effective participation of local actors in the natural resources management would be useful. The fourth axis seeks to promote effective collaboration within institutions of research and agricultural extensions and also to implement research projects on adaptation. In addition, the third National

Communication has presented the agricultural mitigation strategy focused on the nexus agriculture and forestry through the concept of ‘Agriculture Zero Deforestation’.

2.1.3.2.4: Agriculture Zero Deforestation Policy

The policy published in 2014, aims to mainstream the concept of Agriculture Zero Deforestation launched by the international mechanism REDD+. This country has integrated REDD+, a mechanism of greenhouse gases reduction, by implementing a National Commission REDD+ in 2010 (AIC, 2014). The Agriculture Zero Deforestation Policy found its justification in the New York Declaration on Forests signed by Cote d’Ivoire in 2014. This declaration targets to eliminate deforestation related to agricultural production (REED+, 2014). In addition, during the Climate Summit of United Nations in 2014, the Ivorian government has reaffirmed the goal of 20% of forest recovery and to mainstream an agriculture of zero deforestation.

Thus, the policy has involved three sectoral Ministries: Agriculture, Environment, and Forestry. It pursues to make the Ivorian agriculture more respectful of reserved domains, which contribute to forest recovery, resilient to the impacts of climate change and improve communities’ rights and their livelihood. For the purpose of achieving these goals, Agriculture Zero Deforestation policy plans to involve stakeholders in a common forestry policy but also to identify area relevant for carbon sinks, ecological value, and land delimitation. Furthermore, the policy seeks to mend the agricultural productivity by monitoring and facilitating improved varieties and inputs. Additionally, the Agricultural Zero Deforestation Policy brings about an innovative incentive

policy of type environment service payment in order to encourage communities to adopt mitigation measures. The Policy is ongoing over 10 years (2015-2025). Pilot projects have been made and target cash crops such cocoa, rubber plantation and palm oil.

2.1.3.2.5: The Vulnerability Study of Agricultural Sector to Climate Change and Climate Change Adaptation and Mitigation Agricultural Strategy

In Mai 2013, the Ministry of environment and sustainability development (MINESUDD) published in collaboration with United Nations Development Programme (UNDP) the Vulnerability Study of Agriculture Sector to Climate Change in Cote d'Ivoire. The Study has not only pointed out the situation of food and cash crops of climate change impacts but also presented farmers' adaptation responses to climate change. The main responses are the increasingly resorting to fertilizers, adjusting cropping calendars, abandonment of certain crops to the detriment of some, agriculture diversification and irrigated rice alternative. The Study stated that farmers are assisted by extension workers of the national agency of rural development (ANADER) which provides training and improved seeds from national agronomic research center (CNRA). In addition, the study has concluded by suggesting some adaptation measures which are the reforestation, strip farming, and agroforestry; short cycle varieties; resilient cultivation techniques, irrigation development and seasonal forecast.

The policy raises some important implications related to the indigenous knowledge and the play role of national agencies. The Vulnerability Study emphasizes the local adaptation strategies of climate change. This means that farmers have developed their own responses to climate change. This confirms arguments of researchers in this field. Brou *et al.* (2005) explain that in the northern

region, farmers of maize and cotton have increased their fertilizers use while crop food farmers tend to abandon long cycle crops such as rice and yam to cultivate short cycle varieties. Concerning the calendar adjustment, Brou *et al.* give the example of farmers from south-western region of Cote d'Ivoire which delay the sowing period in May instead of April. As an example of agriculture diversification, food crops farmer's lean towards rubber plantation, cashew, cotton, and fishery. He has also found that increasingly, farmers tend to abandon their cultural food crops at the detriment of some more resilient to climate variabilities. He explained that in the northern region, for instance, farmers less cultivate yam and rice for maize crop which is more adapted to their current climatic conditions. In the same vein, Adou & Deddy (2015) revealed in their studies, that the resiliency of cassava crop raised it as a main food crop before rice and banana in Zuenoula Department of Cote d'Ivoire.

2.1.3.2.6: Climate Change Adaptation and Mitigation Agricultural Strategy and PNIA

In 2014, the Ministry of Agriculture released the Climate Change Adaptation and Mitigation Agricultural Strategy. The goals of this Strategy is clearly to protect farmers especially the vulnerable groups, to build the stakeholders capacity of climate change, to promote sustainable agriculture. The strategy has focused the implementation design on the sensitization of good practices. Therefore, the policy highlights the promotion of adapted technologies transfer, seasonal calendars, adapted improved varieties, storage development, agroforestry, water management, research and effective collaboration among institutions.

The national investment programme of agriculture (PNIA 2010-2015) is adapted from the agriculture development master plan ('PDDA' 1992-2015) and is the fruit of Maputo Declaration in 2003. At Maputo, African heads of State have declared to allocate 10% of the national budget

to the agriculture (3rd National Communication, 2017). The 3rd National Communication has made an analysis of PNIA policy and did not miss to deplore the lack of climate change into the sub-programme of PNIA. Meanwhile, PNIA has planned to implement adaptation actions like improved varieties and water management. The third Communication suggested that integrated land fertility and smallholders' access to fertilizers need to be documented in the PNIA.

2.2: Theoretical Review

In policy analysis, the agency theory is used to investigate how principals delegate implementation to state agents (Kiser 1999). Political science pays attention to three issues: third parties, administrative procedures and multiple principals. But several questions remain unanswered, such as who exactly the principal is that is supposed to monitor the actions of the agents, and how agents are selected (Kiser 1999). The theory is better at explaining outcomes when preferences are settled, rather than clarifying the origin of preferences and the reason for change (John 2003).

Another method to of investigating international commitments is the Albert Humprey' SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats). SWOT is a strategic planning tool used to analyze a policy, program, project, and interventions (Giusti & Maggini, 2018). The SWOT was applied to assess obligation for ex situ conservation of biodiversity in Romania (Antofie, 2011), collect good practices on soil management within European Union states (Bory & Dallhamme, 2009). However, a limitation of this method is, it generates a naïve list of factors which might present serious risk if the SWOT is left at this simple level (Pickton & Wright, 1998).

Weiss & Jacobson (1998) built their analysis on the Constructivist theory. The concept considers that states are highly sensitive to their position relative to other states because they fear the social and psychological consequences of being seen as a free-rider. Reputation is especially important

in areas that are highly visible because of such massive, well-publicized events as the Rio Conference or the concerted efforts of prominent NGOs. Weiss & Jacobson explained that a number of developed democratic states and states eager to be accepted into European Union are concerned enough about their reputations as environmentally progressive states to adopt policies that they otherwise might not. However, the impact of this reputational incentive is never very great. It inspires states to perform slightly better than a narrower conception of their self-interest would predict (Downs, 2000).

Shah (2016) used the Regime Theory to explain why Kenya has failed to domesticate biodiversity commitments. Shah argues that policies and communities contribute to the successful implementation of international agreements. This theory will be used for the study

CHAPTER THREE

METHODOLOGY

3.1: RESEARCH DESIGN

The data for this study were collected using qualitative and quantitative survey techniques. The research design provides the analysis of national food crops agriculture policies and farmers' awareness and responses to the agro-environmental measures. The study used the Content Analysis Model, a Descriptive Analysis, and the Binary Logistic Regression Model.

3.1.1: The Content Analysis Model

The first objective of the study aims at investigating the climate policy integration. Climate policy is mainly summarized in the adaptation and mitigation (Ahmad, 2009). The separation of mitigation and adaptation results from the UNFCCC objectives to reduce greenhouse gases emission (UNFCCC, 1994), which adaptation has been actively emphasized in Marrakesh Accord (Schipper, 2004). Therefore, policy integration will help to reduce minimize negative environmental issues in sector level. Therefore, integrating climate change is an opportunity to meet economic and environmental objectives (Pilato, Sallu, & Gaworek-Michalczenia, 2018). This concept is based on the integration of adaptation, mitigation, and development strategies in order to achieve 'triple-wins'. It is important to observe that policy integration do not prioritize

climate measures on development objectives. It calls for simultaneous responses to climate change and development (Persson, 2004). In some cases, mitigation and adaptation benefits might be higher if they are treated and implemented separately (Klein, Schipper, & Dessai, 2005). Suckall et al. (2012) observes that opportunities for triple-wins exist and are being implemented in other sectors (e.g., energy, water). In addition, the integration of existing policy to cope with climate change might be a difficult task. Although, central policies should send out a very clear message about which matters should be considered and in what order (Urwin & Jordan, 2008). For instance, recent regulations in the UK have forced privatized water companies to integrate climate change considerations into their resource management plans. The integration assessment uses on two main framework of policy integration and policy coherence (Gregorio et al., 2016; Urwin & Jordan, 2008). The policy integration used in this is study is based on the Obligation Integrated Susceptibility Index (OISI) adapted from (Shah, 2016). Policy coherence is studied in respect of a target group, a geography area or a policy sector (Mickwitz et al., 2010). In this paper, the policy coherence relies on assessment of trade-offs in sectoral policy (Gregorio et al., 2016).

The study uses the content analysis method for the policy review. The content analysis has been mostly used for qualitative data such as research on barriers in the implementation of climate change adaptation policies in Switzerland (Dupuis & Knoepfel, 2011), key informants interview focused on awareness and adaptations of climate variability at the local level (Ogalleh et al., 2013), literature review on environmental disclosures studies (Milne & Adler, 2013). The most frequent and efficient process of content analysis is to count the frequency of a relevant word or expression in a document. Thus, the word frequency is an indicator of its importance (Dupuis & Knoepfel, 2011). The content analysis method presents some weaknesses. Dupuis & Knoepfel outlined that the relevance of a word should rely solely on its appearance frequency. In order to address these

drawbacks, the study used the OISI Obligation Integration Susceptibility Index (OISI) and a standard classification system adapted from Shah (2014) in his research on the domestication of international biodiversity commitments in Kenya policies.

3.1.2: Frequency Analysis Model

The frequency analysis model was used to show the distribution tendencies in the variables of farmers' awareness of the UNFCCC interventions related in Cavally region. This technique measures the occurrences of variables role in a specific question. The results from the frequency analysis were presented and graphically symbolized by bar charts and pie-charts. Note that this technique is strictly a description of tendency measure of sample data.

The technique has been using by literature to describe the rate of adoption and access of national activities related to domestication of the UNFCCC towards farmers in Kenya (Kirumba, 2014), the awareness of farmers and response to climate strategies in the central river region of the Gambia (Bagagnan, 2015), adoption of sustainable agricultural practices in West Virginia farmers (D'Souza *et al.*, 2017), factors affecting the adoption of improved planting materials by cassava farmers in Ekiti State in Nigeria (Adetule *et al.*, 2017). To go in-depth analysis, the study used the binary logistic regression model.

3.1.3: Binary Logistic Regression Model

Standard Economic Models such as the Market Theory, Travel Cost Theory, Lancaster's Model, Cost-Benefit Model and Discrete Choice Model (Khan *et al.*, 2016) methods are the main approaches used to assess the awareness, preference, and adoption amongst farmers. For instance,

Lagarde (2009) employed Discrete Choice Experiment Model for investigating the preferences of actual choices of rural service in three developing countries. Similarly, Zapata (2007) used Lancaster's Model to determine technology adoption by farmers, adoption decision in a voluntary program, for conservation practice adoption. Zapata argued that this method is a relevant way of predicting preferences and adoptions for agricultural practices and policies. Lagarde (2009) claimed that the Discrete Choice Experiment Model is quick and a cheap method and produce a rich set of data. Respondents easily understand by the fact that it shares similarities with real choice behavior. The model also provides policy-relevant information such evaluate incentives not yet available, the potential for cost-effectiveness analysis of policy options and investigate differences between sub-groups. Essentially, it is easy to interpret by policymakers.

There are certain problems with the use of Standard Economic Models. One of these is the assumption that producers conclude economic decisions based on profit maximization. Therefore, these models neglect psychological and sociological factors, which also affect economic behavior. Specifically, Folmer (2009) argues that human behavior, including economic behavior, is strongly influenced by awareness, expectations, and habits. Weck-Hannemann and Frey (1995) argue that intrinsic motivation and internal sanctions promote environmentally-friendly behavior. Intrinsic motivation and internal sanctions in their turn strongly depend on environmental awareness and awareness, which determine attitudes that affect future behaviors (Ramsey and Rickson, 1976; Napier and Napier, 1991; Bayard and Jolly, 2007). Hence, to comprehend and influence farmers' responses to policies programmes, insight into their awareness and awareness of the problem is a prerequisite for the development of adequate and effective policies.

Overall, the third objective of the study was achieved using the Binary Logistic Regression Model. Logistic Regression has been widely used in policies adoption studies such as Conteh *et al.* (2013)

for exploring farmers' decisions to adopt or not adopt Alley farming in the Freetown Peninsular; Gadedjisso-Tossou (2015) in its studies of understanding farmers' awareness of adaptations to climate change and variability in Togo; Monela (2014) in a study of farmers' adoption of improved maize and seeds in Tanzania.

Nevertheless, the model has not done the unanimity amongst academics. One of the most farouche detractors of the model has reproached the overconfidence of its results (Robinson, 2001). The Logistic Regression Model has a tendency to overstate the accuracy of its predictions. Robinson (2001) has deplored that researchers are vulnerable to include wrong independent variables. However, Lani (2010) has broken down Robinson's (2001) argumentation by defending that the scheme of the Binary Logistic Regressions, overcame many of the restrictive assumptions of linear regressions. For example, linearity, normality and equal variances are not assumed, nor is it assumed that the error term variance is normally distributed. Aside, the author overlooks the fact that Logistic Regression is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variables. This method has the major advantage of the ease of computation, mathematical tractability, and interpretability.

Finally, this section was so far focused on the Research Design. The following section will discuss the Study Area and Population.

3.2: Study Area and Population

The study was carried out in the Cavally Region of Cote d'Ivoire, which is located in the western part of the country. Formerly Moyen-Cavally when including Duekoue, the Cavally region covers

11.300 km² and comprises four departments namely Toulepleu, Bolequin, Tai and Guiglo. The boundaries of this region are the Tonkpi region on the north, the Guemon (Duekoue) region on the East, the department of San Pedro on the south and the Liberia Republic on the West (Cavally Regional Council, 2014).

The effect of climate change has already affected food production while there is a rapid of Ivorian population (FAO, 2014). This which might require tripling crop yields on existing farmland to minimize expansion of agriculture into remaining rainforests, wetlands, and grasslands. This appears to be problematic when studies have shown that Cote d'Ivoire is vulnerable to Climate Change because it relies on red-fed agriculture. The Climate Change impact is already felt in food crops sector. The production of cassava and rice have decreased. This affects simultaneously the four agro-climatic zones of Cote d'Ivoire (UNDP, 2013). Early rice tends to disappear due to agriculture calendar (Brou *et al.*, 2005). In the particular region of the western agro-climatic zone, CNRA reports that most vulnerable farmers tend to abandon food crops. Ensuing Brou *et al.*, this study has purposively chosen the region of Cavally in consideration of the main food crop activities which rice and cassava.

The population of Cavally region is estimated at 459,964 inhabitants with 34.5%, are cassava and rice farmers (INS, 2014). The native people are “We” from the ethnic group of ‘Krou’. The water body is the Cavally streams and rivers like N’Zo, Douihi, N’Ze, Niyon, and Goin. The region has a national park named Tai spanning over 530.000 ha of land (Conseil Regional du Cavally, 2015). The chef-lieu of the region is Guiglo or “Guinglo” which means the village of forgiveness and peace in the local language. Though the region was severely affected by politic-militaro crisis from 2002 to 2011. Aftermath still resisting to the time: houses burnt and refugees not yet back.

3.3: Sampling Procedure

In Cote d'Ivoire, the regions are subdivided into departments. The study was conducted in the four departments of the Cavally region. The four departments were selected for the purpose of covering as much as possible the variability of awareness of climate policies. The choice of communities was purposively made from interviews at ministries, agencies, and NGOs that have implemented projects and activities in Cavally region.

The interviews revealed that among the 4 Departments, 2 Departments benefited each, of only 1 specific project on cassava and rice crops. Therefore, 1 community was selected from each of these 2 Departments and 2 communities per Department. According to Ary and Jacobs (2006), the most important is that sample size must be representative of the population to allow the researcher to make inferences or generalization from the sample statistics of the population.

Turning now to the sample size determination, the study used the list of cassava and rice farmers made available by the National Statistical Institut (INS). Krejcie and Morgan (1970) method were applied for the investigation. Krejcie and Morgan (1970) developed one of the most practical ways of sample size determining. This method is widely used by several researchers as Findlay (1992) in his study on vocational agriculture teachers, Tallman (1994) to determine representative number of students awareness on correspondence study, Chizari *et al.* (1999) to select extension workers regarding sustainable agriculture in Iran, Hamidi & Eivazi (2010) to select employees for organizational performance. Summarizing all calculation based on the Sample Size Formula for Finite Population, Krejcie and Morgan (1970) method performed a simple and clear table of established statistic (Table 1).

Table 1: Sample Size Formula for Finite Population

$$n = \frac{x^2 N p (1 - p)}{e^2 (N - 1) + x^2 p (1 - p)}$$

n=Sample Size

N=Population Size

e=Acceptable Sampling Error

x^2 =Chi-Square of degree of freedom 1 and confidence 95%

From this method, 364 respondents were randomly selected. However, during the data collection, this target was not met because most of the farmers abandoned some food crops to the detriment of cash crops. Also, in one the community, several natives left the villages for the town. For these reasons aforementioned, the number of respondents was 349 instead of 364. According to Hausen and Hurwitz (1946), the response rate above 90% is acceptable.

$$\text{response rate} = \frac{\text{response obtained}}{\text{response expected}} \times 100$$

The response for the study was of 96% and then achieved a significantly higher response rate.

Overall, the sampling procedure focused on 349 rice and cassava farmers from 6 communities in four departments of Cavally Region (Table 2).

Table 2: Selected Communities

Department	Villages	Number of respondents
Touleupleu	Klobli	90
Blolequin	Koadeguezon	90
Tai	Vodelobly	31
	Zaipobly	46
Guiglo	Troya	46
	Ponan	46

3.4: Data Collection

3.4.1: Primary data

The primary data was collected from interviews and questionnaires. On one hand, the Semi-Structure Interviews were developed and administrated to local government officials and other stakeholders on climate change and agriculture knowledge. Semi-Structure Interviews provided researchers with the flexibility to adjust the interview based on interviewees' knowledge and perspective (Berg & Lune, 2012).

The survey engaged Snow Ball Sampling Technique as used by FAO (2015) for identifying interviewees who have some precise comprehensive knowledge. When there is no standard number of interviews needed to reach theoretical saturation, it has been estimated that between 5

and 25 as a sufficient number (Mason, 2010). Overall, 16 interviews of Key Informants were carried out in order to reach saturation.

The interviews collected information on laws and regulation, policies success and failure, activities ongoing, farmers' level of awareness, farmers' perceived attitude towards specific policies, database, and way forwards.

On the other hand, the study used a Questionnaire of 3 sections. The first section was gently developed to collect socio-demographic information. The second section was measuring awareness and the last section dealt with adoption variables.

The Random Sampling was selected for the data collection to reducing eventual biases. In the point, respondents were chosen 1 or 2 per islet depending on the size of the islet. The survey lasted 2 weeks due to the time constraint, social conflicts having delayed the start of the study and administrative processes of courtesy. Though, the process of introduction before prefects, villages chief and youth presidents, facilitated the trust of respondents.

3.4.2: Secondary data

This stage was based on the Literature Review. The Literature Review consisted of search Non-Annex 2's commitments related to agriculture, from the UNFCCC document. Aside the original text, regional and national policies formulation, legal legislation, plans, strategies, programmes and institutional arrangements were examined in the study. These official documents were investigated in order to extract from the international agro-environmental responsibilities translated into the domestic policies as well as regional cooperation. In addition, for the purpose

of this study, the National Development Strategy of Rice (SNDR) and the National Development Strategy for Food Crops other Rice (SNDCV) was investigated.

3.5: Data Analysis

To achieve the first objective which is the policies review, a content analysis and the Obligation Integration Susceptibility Index (OISI) adapted from Shah (2014) were used, fitting well the purpose of the current study.

Given that Parties received little details on UNFCCC Commitments agriculture-related, the level of integration of agro-environmental into sectoral policies is difficult to assess. Therefore, a content analysis was used to three main information. First, the method aimed to identify adaptation and mitigation measures proposed by general relevant policies from 1994-2017. Second, it helped to compare the measures from the general policies in order to assess the level of integration into sectoral policies. For example, after that the water management measures have been identified from the general policies, the content analysis checked the existence of water management in Rice policy. The level of integration was later all analyzed using a Score Index. Third, the content analysis investigated the coherence of these food crops policies related to their development goals and the integrated environmental measures.

The policy documents were coded using a direct coding approach which identifies initial codes and categories before the data analysis (Weber, Hsieh & Shannon as cited by Gregorio *et al.*, 2016). A selection of keywords and policies was made from a literature review of UNFCCC commitments in the agriculture sector (Richards *et al.*, 2015). Then, text passages familiar to the predefined set of keyword were selected to code a specific measure and then searched and counted.

An examination of the context of the selected word helped to exclude wrong results. For instance, the research of the word ‘fertilizers’ might refer to chemical fertilizers rather than organic fertilizers. In this case, the word was left out in the count. The Content Analysis was run by NVivo 11 Software (Gregorio *et al.* 2016)

As aforementioned, the level of integration of climate change measures in food crops policies was calculated. Adapted from Shah (2014), the level of sectoral integration was obtained from the Obligation Integration Susceptibility Index (OISI) and a standard classification system. The OISI computed the environmental measures extracted from the general agro-environmental policies was compared to those from food crops policies. The total number of measures from sectoral policies divided by the total number of general policies was multiplied by 100 (Equation 2)

$$\frac{\text{Number of measures of each sectoral policy featured in}}{\text{Total number of general policies}} \times 100 \quad \text{Eq.2}$$

The standard classification system (Shah, 2014) was used to classify the score of integration by each sectoral policy.

Table 3: Score from Standard Classification System

Score (%)	Level of integration
90-100	Excellent
70-89	Very good
50-69	Good
40-49	Weak
39 and below	Very weak

Source: Shah (2014)

To achieve the second objective which is the awareness of environment measures and policies towards rice and cassava farmers, descriptive statistics were used. The descriptive statistics provided the general view of the extent of data (Shah, 2014). Frequency histograms and charts were used to display and analyze farmers' awareness of climate policies and measures. SPSS V23 Software was used to analyze the data.

To achieve the third objective, the Logistic Regression Model was used to analyze factors influencing farmers' adoption of policies programmes. Following Conteh *et al.* (2015), for the sake of clarification, let φ be a farmer adoption and x the vector of independent variables. The farmer's adoption is articulated as:

$$\varphi = f(x, \varepsilon) \quad (1)$$

where ε is the error term, also a vector.

A hypothetical mathematical model that explains the above logit function can be expressed (Conteh *et al.*, 2015) as:

$$\varphi_{ik} = f(I_{ik}) = \frac{e^{S_{ik}}}{1 + e^{S_{ik}}} \text{ for } S_{ik} = x_{ik}\alpha_{ik} \text{ and } -\infty < S_{ik} < +\infty \quad (2)$$

Conteh *et al.* (2015) explained that φ_{ik} was the dependent variable with a value of zero (0) for non-adoption and (1) for adoption of farming technology by i th farmer in the k th ecotone; x_{ik} is the matrix of explanatory variables for the i th farming technology adopter in the k th ecotone; α_{ik} is the estimated set of parameters; and I_{ik} is the implicit adoption index.

Adapted from Conteh *et al.* (2015) approach of the Binary Logistic Regression, the current study used as dependent variables, the adoption or non-adoption of agro-environmental measures. The

value is 1 for YES (Adopted) and 0 for otherwise (Non-Adoption). The independent variables were age, household size, farming experience, level of education, farm size, gender, land property, origin. These variables were treated as binary and continuous variables (Table 4). A Descriptive Analysis through frequency histogram was also done to highlight different factors such as barriers and preferences of agro-environmental activities. Stata version 10 was employed for this objective.

Table 4: Description of the Variables used in the Binary Regression Model

Dependent variable		Categories	
Adopt_Dec	State of Adoption Decision	Adopted=1 No Adoption=0	
Independent Variables			
Age	Age of the respondent	40 years & below=0	Above 40 years=1
Perc_Imp	Perceived Impact	Yes=1	Otherwise=0
Gend	Gender	Male=1	Female= 0
Lev_Ed	Level of education	Not educated=0	Educated=1
Land_P	Land Property	Family owned=1	Otherwise=0
Farm_S	Farm Size	1ha & above=1	Less than 1ha=0
Farm_Exp	Farming Experience	17 years & above=1	More than 17 years=0
HH_Size	Household Size	5 people & above=1	Otherwise=0

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1: Content Analysis of Policy Integration and Coherence

4.1.1: Climate Measures in Agriculture and Climate Change Policies

The results shown major adaptation and mitigation policies of Cote d'Ivoire (Figure 1 & 2).

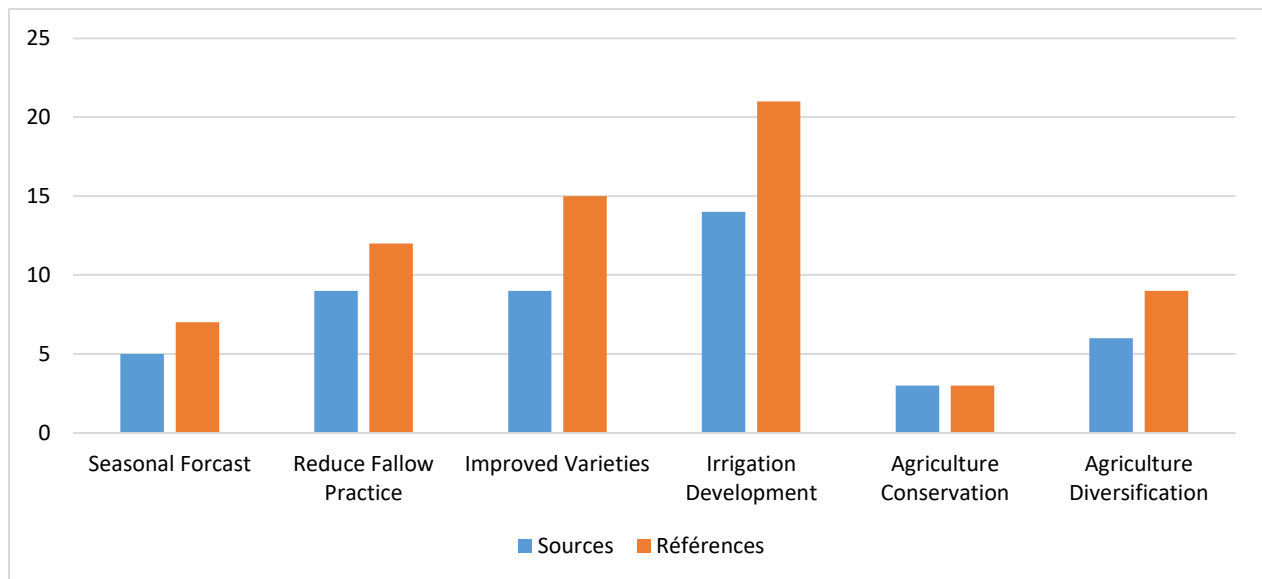


Figure 1: Adaptation Policies and Measures from General Agro-environment Documents

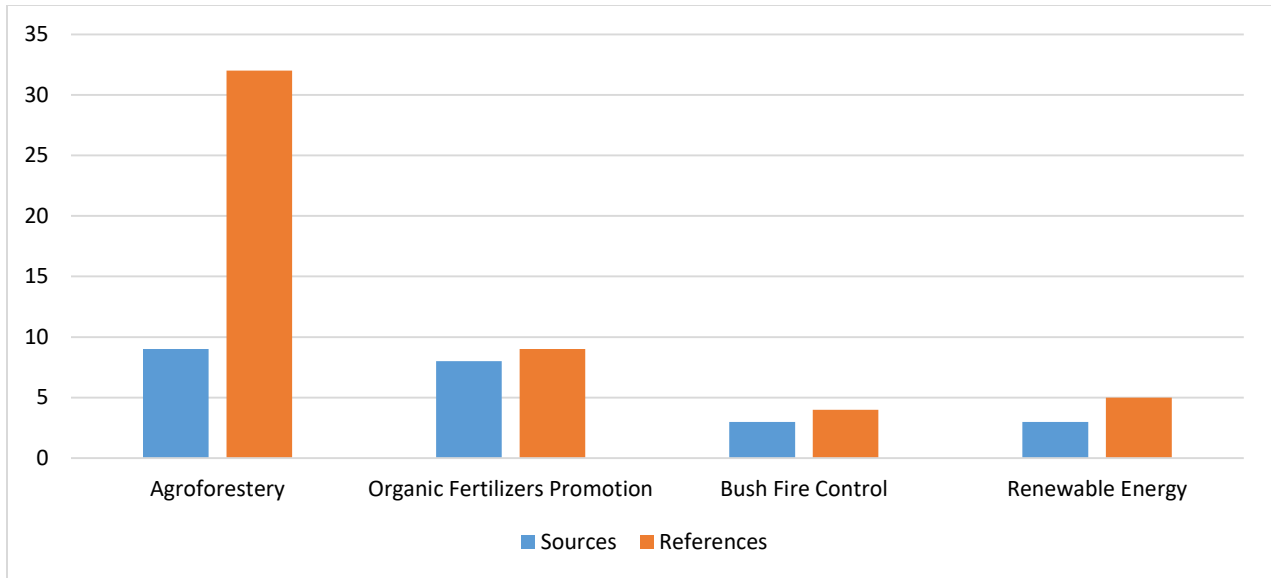


Figure 2: Mitigation Policies and Measures from General Agro-environment Documents

Among the adaptation strategies (Figure1), there is a visible focus on irrigation development. This can be explained by the presence of a wide natural water body in Cote d'Ivoire such the main are Cavally, Bandama, Comoe, and Sassandra but also Bagoé, N'Zo, Boubo, Soumie, Sankani, N'Zi, Bia, Tano, Dagbe, Leraba, Soumie. Aside the natural resources, the high interest of water management might be explained by the support of legal instruments. In fact, the Agricultural Law of Orientation (2015) emphasized the key role of water management for the sustainable agriculture. The Law outlined that the irrigation should help to protect water resources against agriculture activities impacts. This view has been followed by national policies. According to the National Agricultural Strategy of Mitigation and Adaptation (2014), water management appears to be a 'requirement for an optimum intensification of agriculture'. The choice for the Ivorian government to improve irrigation as a major adaptation measures is similar to other countries. For instance, Bolivia's goal is to triple irrigation area to over 1 million hectares by 2030 and double

food production under irrigation by 2020 (Richards *et al.*, 2015). Also, The Gambia had planned to lead a Programme on Improvement of Agricultural Land and Water Management. The Programme objective was to invest in water management practices of 24.000 ha rice production (Gambia National Agricultural Investment Plan-GNAIP, 2011).

The figure 1 shown that improved seeds, reduce of fallow practice and agriculture diversification were the second main adaptation measures and policies. This may be due to the high pressure on forestry resource from agriculture practices (REDD+, 2014). For instance, the rate of Ivorian forest's degradation passed from 18% in 1996 to 40% in 2017 (FAO, 2016).

Surprisingly, the seasonal forecast is weakly integrated in policies. The seasonal forecast includes early warning system and climate information system in a context of agricultural context. In Cote d'Ivoire, the structure in charge of seasonal forecast is SODEXAM. However, this weak integration is probably due to the fact that the seasonal forecast are payable and then, might be difficult for smallholders to get access. This confirm an argument of an interviewee revealing that the dissemination of seasonal forecast in Cote d'Ivoire is weak. This indicates a potential need for further efforts in this area.

The results suggest that agriculture conservation is the least count into the policy documents. Conservation agriculture is defined by FAO as an agriculture based on minimum soil disturbance, permanent organic soil cover and sequence of crops diversification (FAO, 2011). Conservation aims at increasing the input of fresh organic matter and reduce soil erosion (Tilahum *et al.*, 2014). However the adoption of the conservation system is relatively new and its integration is increasing in agricultural practices at the worldwide level. In 2010, FAO estimated that 100 million hectares was cultivated in conservation agriculture in the world with 45 million in 2000 (MAAF, 2013). This can explain the low integration of agriculture conservation in ivoirian policies.

Turning to mitigation strategies (figure 2), the results shows that agroforestry is the most frequent mentioned. This is an evidence of prioritization of agroforestry by policies Cote d'Ivoire. For example, REDD+ policy has introduced the concept Agriculture Zero Deforestation to preserve forest including sustainable agriculture. Agroforestry includes combination of trees and crops no ligneous cultivate on a same surface (Kouame, 2017). According to Kouame, the promotion of agroforestry practice might not only contribute to mitigation of climate change but also to food security. Thus, the agroforestry may promote plants useful for family consumption and the local market. In the same vein, Adebayo & Oluronke (2014) present agroforestry as multi benefits for farmers because it provides income, food, fuel wood, fodder for animal consumption.

Additionally, number of policies integrated organic fertilizers promotion that have implication on soil fertility and reduce of greenhouse gases. Organic fertilizers include manure, slurry, worm castings, peat, seaweed, humic acid, guano, sewage sludge, compost, blood meal, bone meal (FAO, 2011). Natural fertilizers improve soil fertility and reduce greenhouse emission from agriculture. This is one of the most important differences with chemical inputs. Soluble chemical fertilizers contain mineral salts that plant roots can absorb quickly. However, they do not provide a food source for soil microorganisms and earthworms. Over time, soils treated only with synthetic chemical fertilizers lose organic matter and the living organisms that help to build a quality soil (FAO, 2011). The integration into agriculture policy is interesting for the environment perspective, it remains to be seen whether it has been considered in sectoral food crops policy.

Contrary to expectations, as per the result of content analysis reflected that bushfire control and renewable energy were those with the lowest mentions in policy documents. Thus, it could be possible that the topics have not taken seriously by Ivorian authorities. This is surprising when it

known that bushfire highly contributes to greenhouse gases with 970.02 Gg over 1065.73 Gg either 91% of carbon monoxide from agriculture sector emission (1st National Communication, 2000). Naturally occurring but mainly human-made, bushfires have affected increasing numbers of people and natural resources. For instance, in the Eastern part of Cote d'Ivoire at Zanzan Region, bushfire has destroyed five villages with 20.000 victims in 2010. Between 1999 and 2006, there was a loss 3.370 hectares of crops and about 67.000 hectares of forests (SNGRC, 2011).

Furthermore, the renewable energy was highlighted in only one document which is the Assessment Report of the Project 'ANCR-GEM'. The report mentioned technologic discoveries of two inventions: the gazogene from coconut flock and rubber plantation and the digester for biogas from cassava peelings (MEME, 2005). This is agreeing with the hypothesized idea which says renewable energy technologies are almost not existent and do not receive a fair chair of public investment (Wolde-Ghiorgi, 2002). This might be so because of the lack of finance and laboratories specialized in environmental research (MEME, 2005).

Based on this analysis from key national agro-environment policies, an exploration of sectoral food crops papers was analyzed.

4.1.2: Climate Integration in Food Policies

The findings from the content analysis revealed that over ten policies measures extracted from general agro-environmental documents, only five were considered in sectoral food crops policies (Figure 3). Based on the Obligation Integration Susceptibility Index (OISI) and the standard classification system, the integration of environmental measures in rice crop sector policy related to UNFCCC domestication is considered very weak with a score of 20% (Table 5). Holding the

highest level of climate change policy integration between both crops in the study, the SNDCV including cassava crop has a good degree of integration with an OISI score of 50%. At the same time, the average integration of climate measures in rice and cassava policies is only 35% (Table 5). This reflected that integration status in this sector is quite weak.

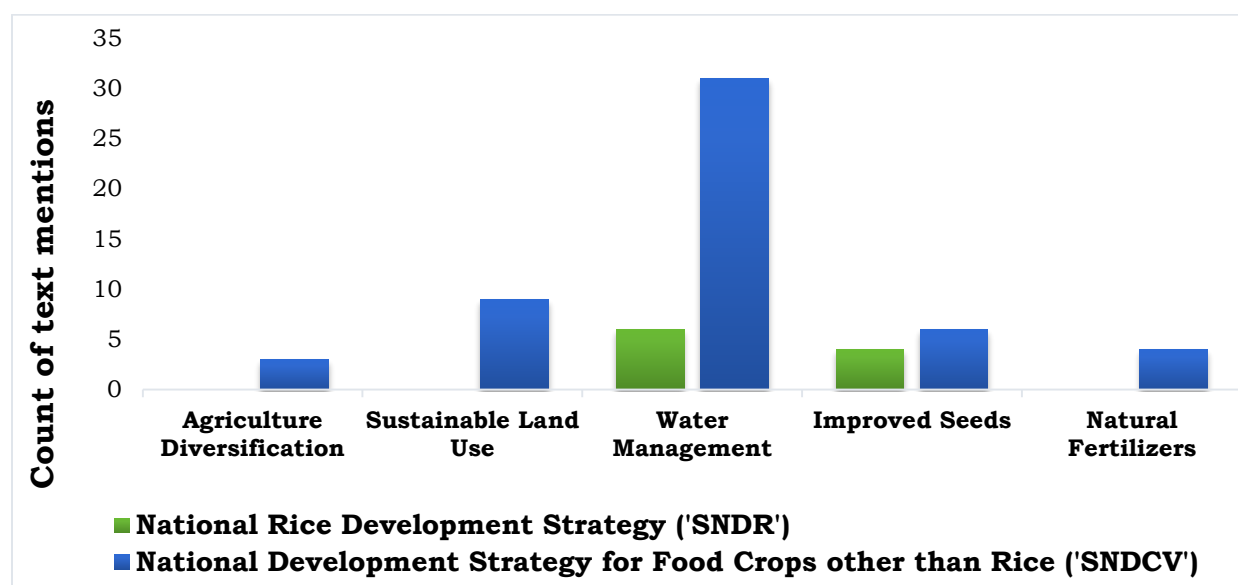


Figure 3: Climate Measures Integrated into Rice and Cassava Policies

Table 5: Level of Integration in Rice and Cassava Policies

Categories		Food Crops Policy
Range	Interpretation	
50%	Good	National Development Strategy for Food Crops other than Rice (SNDCV)
20%	Very weak	National Rice Development Strategy (SNDR)
35%	Very weak	Both policies

This confirms the Third National Communication which stated that the National Agriculture Investment Plan (PNIA), the backbone of agriculture policy in Cote d'Ivoire, did not extensively consider the question of climate change in its sub-programmes (TNC, 2017).

Apart from improved seed and water management, less attention has been made on land use and the access of fertilizers by smallholders. This is not similar to other African countries such as Democratic Republic of Congo which dedicated an entire programme for climate change adaptation addressing the problem of land use, fertilizers, agroforestry, water management, seasonal forecasting, and protection of vulnerable population (PNIA Congo, 2013). This might explain why the sectoral agriculture policies in Cote d'Ivoire suffer from a weak rate of environmental incorporation. According to IPCC (2014), climate change without adaptation is projected to negatively impact major crops production for local temperature increase of 2°C.

This might also be an evidence of apparent incompatibility between climate actions and economic development. Such an argument support existing climate policy integration literature which argues that climate change measures carry possible trade-offs (Gregorio *et al.*, 2016; Thuy *et al.*, 2016; Shah, 2016). For instance, the agricultural policy may have development objectives that are threatened by climate change (Lim *et al.*, 2004). For the purpose of anticipating such trade-offs, scholars found that the policy coherence would offer opportunities to reconcile common interests and realization of mutual benefits. In practice, policy mentioned that for instance, the National Adaptation and Mitigation Strategy for Ivorian Agriculture to Climate Change (MINAGRI, 2014) have mentioned that climate measures are an impossible task without an effective development agenda of the agriculture sector. This is all the more the case as UNFCCC outlined that the fight against climate change should not threat food production (UNFCCC, Art. 2, 1994).

Also, the findings might result from the flexibility conceded by UNFCCC principle of Common but Differentiated Responsibilities (Craig, 2017).

4.1.3: Policy Coherence in Food Strategy Document

Negative interactions between environmental goals and economic development are illustrated in the figure 4. The results indicate a large evidence that fertilizers and expansion of cultivable land are opposed to environmental protection. In one hand, it might be controversial to target emission reduction while ignoring the use of organic fertilizers. No reference is made to the promotion of manure within food crops production in particular when rice production is one of the main greenhouse gas source (TCN, 2017). This poses a potential drawback for the common interest of agriculture production and sustainability (Antwi-Agyei *et al.*, 2017) and may imply a restriction of pursuing natural fertilizers promotion among food crops producers. Such trade-off is not online with the prescription of IPCC (2001) which suggest for policies to minimize the inputs of energy and synthetic fertilizers.

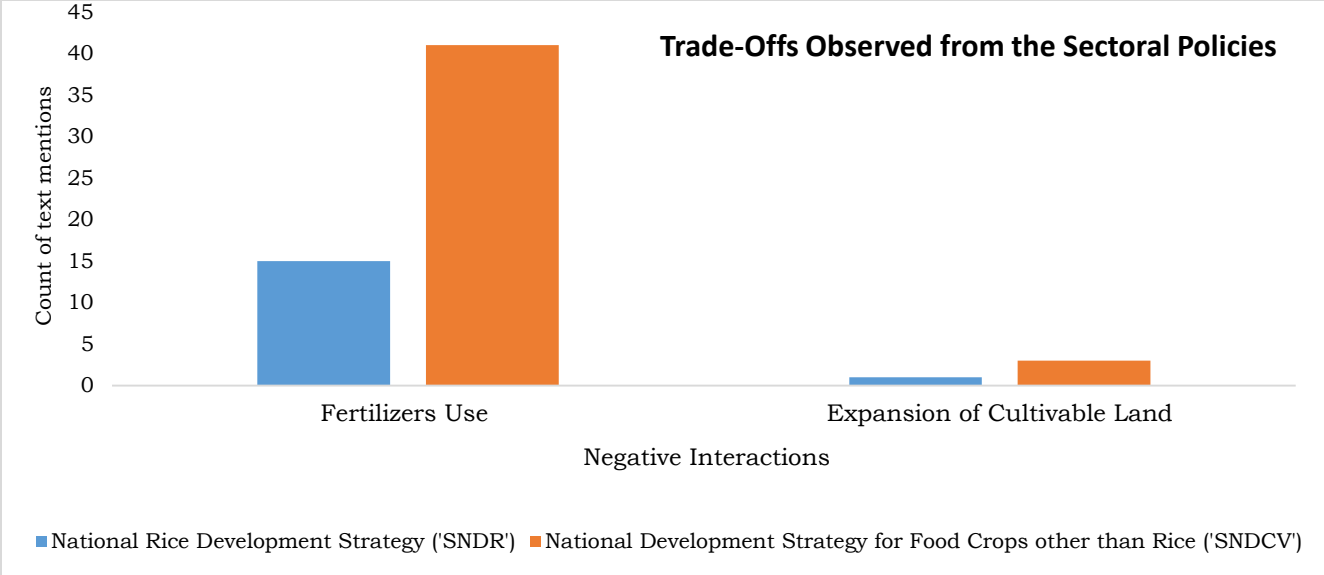


Figure 4: Trade-Offs Observed from the Sectoral Policies

In other countries, there is an effort of organic fertilizers promotion integration within their food crop policies. For example, the National Investment Plan (NAIP) of Nigeria, one of the most rice consumer countries ranking 1st in Africa and 11th in the world, set a target of a 30% increase in fertilizer use in the period 2010-2015. Towards the increase in fertilizer use, Nigeria focused on three main initiatives within the NAIP which are the Organic Fertilizer Development Programme (OFDP) promotes the use of organic fertilizer through a Public Private Partnership (PPP) approach; the Fertilizer Quality Control (FQC) project aims at increasing the quality of fertilizer used and distributed; and the National Foundation Seed Multiplication aims at releasing high-quality foundation seeds to certified producers (FAO, 2013). Likewise Nigeria, Benin has also taken measures to promote fertilizers from raw material (SNDR, 2010b). The Republic of Central Africa also has revealed a need of 15.000 tonnes of inputs and planned to provide loans, subsidies and organic manure as soil fertility and human protection requirements (SNDR, 2012c). Ghana paid

attention to the nexus artificial and natural nutrients by outlining that ‘where applicable, organic sources of fertilizers will be part of the specific rice ecology’ (NRDS, 2009a). This is similar to The Gambia food crops policy which also intended to monitor and raise awareness of environmental hazards of fertilizers and agro-chemical usage towards farmers (NRDS, 2014b).

The study findings showed an integration of the expansion of cultivable land as a strategic axis. This is probably due to the traditional approach where food crops are not considered as a threat to forest conservation compared to cash crops. Though, this might still be a negative spillover in the way that food crops face to high demand due to the population growth. However, Ghana (NRDS, 2009a) has considered the agroforestry to minimize the need for land expansion. In Congo where cassava is the main food crop, the Ministry of Agriculture is outreach programmes on agroforestry and cultivars in order to improve crop yields without increasing the initial surface (MCADRDC, 2011).

Scholars have widely discussed the need for sectoral policies to support national environmental policies. Antwi-Agyei *et al.* (2017) pointed out the importance that the Food and Agriculture Sector Development Policy (FASDEP II) to be well aligned to NDC measures. In addition, Scobie (2015) maintained that the policy coherence is a major determinant of effective climate change integration in developing countries. She added that the case of the specific case of climate policy coherence is less about the integration of climate measures into general policy and more about engaging sectoral to especially pay attention to goals addressing climate change.

However, with a low level of policy integration, caution must be applied as the findings might not depict general actions of Cote d’Ivoire in terms of designing agro-environmental actions. In fact, the rest of the study will reveal the extent of actions towards the rice and cassava farmers. Based on information from key informants, the implementation of climate change actions related to

agriculture such as improved varieties, lowland management for rice crops, agroforestry and natural fertilizers were purposively investigated in the study area.

4.2: Farmers' Awareness of climate change adaptation and mitigation practices

4.2.1: Socio-Demographic Characteristics

The study analyzed data from 349 farmers which 27% were female and 73% were male. This is the evidence that most growers of rice and cassava involved themselves are men. One explanation of these results is correlate with the pessimism of some authors on the women labor. These authors argued that female farmers are more likely to neglect family needs and mostly to reduce childcare (Immink & Alarcon, 1991). Haugen (1990) found that social pressures led to decrease women's participation in Norway in agrarian work. Another explanation would be that rice crop implies intensive labor, thus men are likely to get involved in this food crop sector.

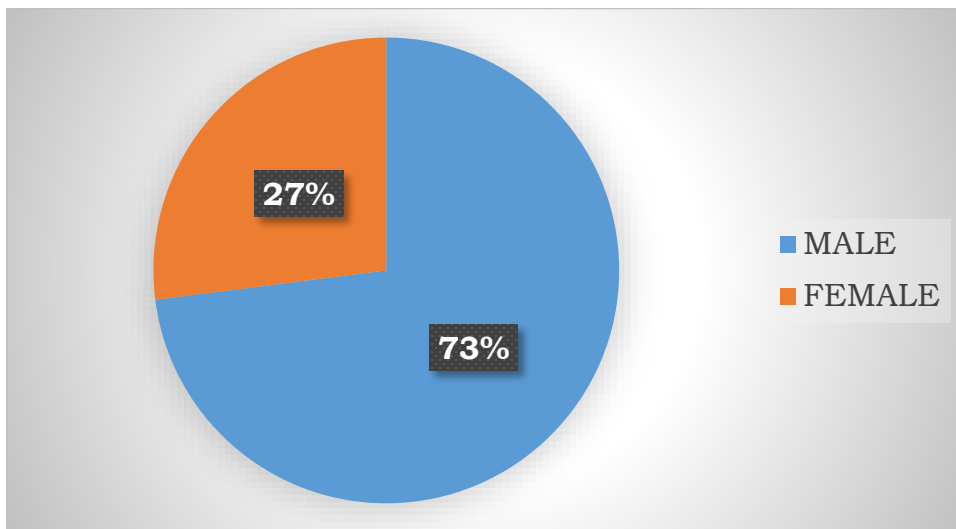


Figure 5: Gender profile of farmers

Among the respondents, 59.6% were reported educated. Most authors agree on the positive influence of farmers' education level. For instance, Fielke *et al.* (2014) noted the importance of

education for the future sustainability of the agriculture sector. He argued that higher the level of education, farmers are likely to prioritize environmental issues. In addition, Das & Sahoo (2012) indicated that the relationship between the level of farmers' education and level of productivity is positive.

The average household size was between 5 and 10 people per household. The large household is potentially workforce for agriculture practices. Therefore, policy activities may focus on large size household in order to spread the impact of the measure. Although, Dvorak (1993) thinks that when household becomes dense, they occupied a significant area. He supported by Muyanga (2014) who add that total household income per adult decrease drastically as population density increase.

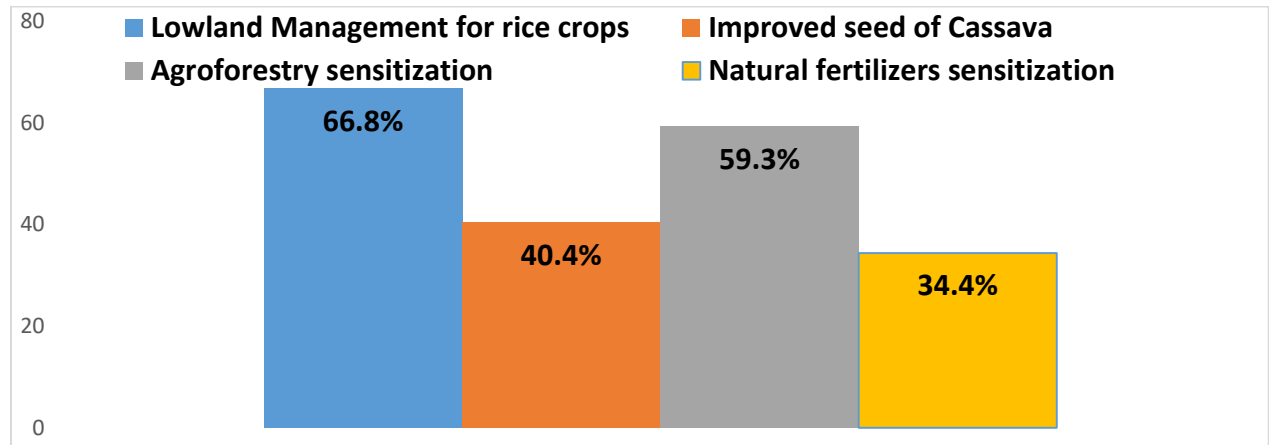
The result suggested that 96% of cassava growers and 77.7% of rice farmers cultivated less than 2 ha of the farm. This implies that the most cassava and rice farmers in the study area are smallholders also named subsistence farmers (Morton, 2007; Akinbile *et al.*, 2007).

4.2.2: Farmers' awareness of policies actions

This research sought to review farmers' awareness of climate change policies in Cavally Region towards cassava and rice farmers. Farmers' awareness of existing policies actions was evaluated (Figure 6).

The findings revealed that majority of the farmers are aware (more than 50%) of rice crops development and agroforestry practice in Cavally Region.

Table 6: Farmers' Awareness of Agro-environmental Practices



The improved seed of cassava (40.4%) is the third practices known, while natural fertilizers use (34.4%) registers the least farmers' awareness.

A great level of awareness on the lowland rice management (66.8%), was found amongst respondents. It seems possible that the reputation of lowland rice development and agroforestry towards farmers is due to the Ivorian national strategy of food security and sustainable development. The policies for lowland rice development are highly contained in national documents such 'Livre Blanc' (1994), 'Plan National de Developpement 2010-2015 and 2016-2020'; for water management in 'Loi d'Orientation sur le Developpement Durable' (2014),

The agroforestry is also well known towards farmers in the study area (59.3%). This also accords with earlier observations, which showed that majority of farmers were aware of the agroforestry practices in States of Ondo (Akinbile *et al.*, 2007), and Adamawa (Jamala *et al.*, 2013) in Nigeria.

The explanation might be that agroforestry practice is promoted in national strategic document such as the 2nd National Communication (2010), the Investment Agricultural National Programme 2010-2015 and the Agricultural Law of Orientation (2015).

These results on rice water management and forestry are in line with policies documents and came up for example in interviews and reports. One NGO's leader said: 'agroforestry is the trend policy' while the 'Programme National d'Investissement Agricole 2010-2015' (PNIA, 2010) indicates that '70% of rice projects are focused on lowland rice development'. In addition, an official of the Ministry of Agriculture mentioned that 'Ivorian governments focused on the forestation, have gradually prioritized water management such as lowland rice development'. Another informant having conducted a lowland rice development project in Cavally Region commented that 'the activity implemented resulted from the National Agriculture Investment Programme 2010-2015'. Other countries have also operated this policy decision. For example, this can be seen in the case of Nigeria which has promised to promote agroforestry and improve water management in multi-sector such as rice irrigation projects (Nigeria's Second National Communication, 2014).

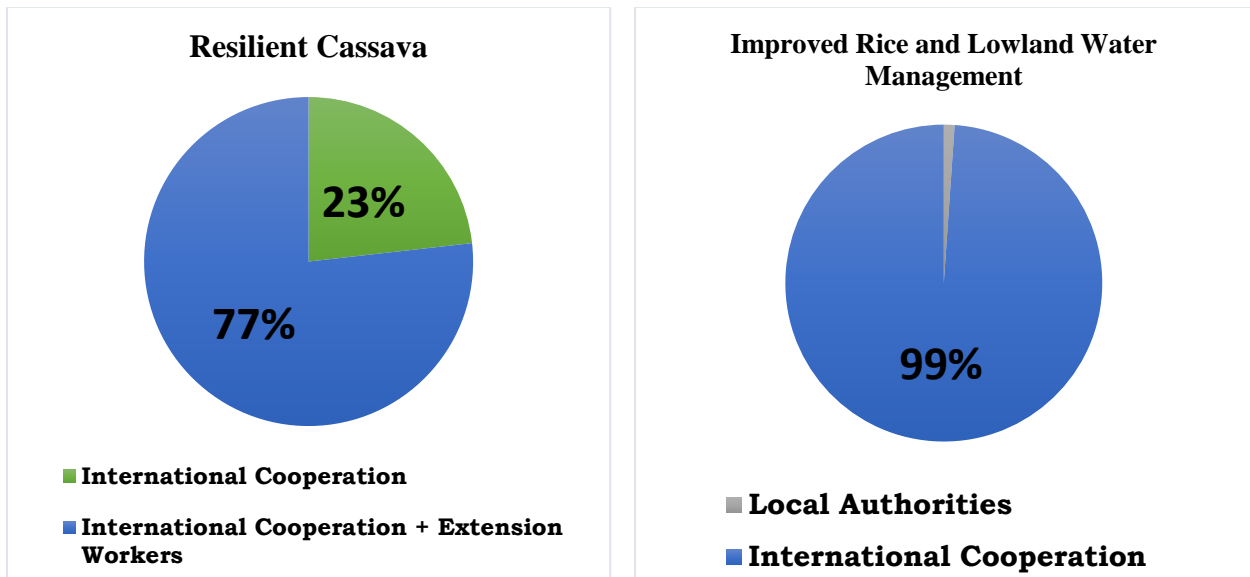
Generally, the result suggests that fewer farmers are aware of improved varieties of cassava (44.4%) and natural fertilizers sensitization (34.4%). One explanation for the cassava sector might be that there are fewer projects implemented for this crop in the study area. The implication is that there might be a law adaptation options for cassava crops. Therefore, policy makers should encourage research on resilient cassava varieties. In addition, the general good soil fertility of this forestry region may explain why promotion of organic fertilizers use have been lately executed (Cavally Regional Council, 2013).

4.2.3: Sources of Awareness

It is necessary here to clarify that the section will be categorized into specific and general actions. The specific actions qualify the adaptation and mitigation measures proper to rice and cassava crops that are lowland rice management and improved varieties. The general adaptation and mitigation activities rely on agroforestry and natural fertilizers use.

4.2.3.1: Specific Climate Activities Sources of Awareness

Table 7: Specific Climate Activities Sources of Awareness



From these Table 5, it can be seen that by far the greatest implementation structures are from international cooperation. With 77% and 99% respectively for rice and cassava crops, international cooperation such as ADRAO (Africa Rice), GIZ (German Cooperation), and DRC (Danish Refugee Council) implemented resilient projects. Prior studies that have noted the importance of international assistance in resilient strategies implementation in Kenya (Scherr, 1995), and New Zealand (Kenny, 2011). This results shown a collaboration between the international organization and extension workers (ANADER). It can, therefore, be assumed that cassava and rice farmers of the study area have expensively benefited from technologies transfer.

The study revealed that the local authorities (Regional Council) have initiated 1% of the programmes on cassava and rice policies actions. The explanation may emerge from an official's argumentation. The official from the Regional Council said: "Cavally Region is losing its forest and we are working on projects of youth and women sensitization for afforestation online with the national strategy". This means that local authorities are focused on forest preservation promotion.

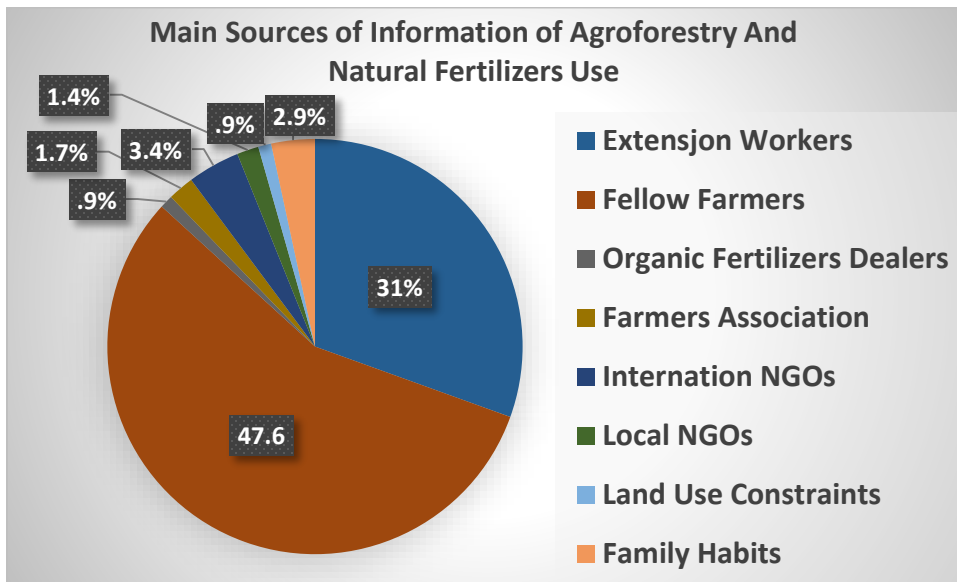
Critically, this study found that public authorities lacked concrete and sufficiently resilient programmes for cassava and rice crop in the study area. This helps to explain why national climate change policies rely mostly on international cooperation.

The next section of the survey was concerned with the general policies actions which are agroforestry and natural fertilizers.

4.2.3.2: General Climate Activities Sources of Awareness

Farmer respondents were asked about their primary information sources of agroforestry and natural fertilizers advocators.

Table 8: Main Sources of Agroforestry and Natural Fertilizers Sensitization



Fellow farmers provided the largest set of information source at 47.6%. These findings support the idea that informal contacts between farmers can be a significant source of information (Thangata & Alavalapati, 2003; Alene & Manyong, 2005; Edeoghon et al., 2008; Donkoh & Awumi, 2011; Prantilla & Laureto, 2013; Ndagi et al., 2016; Karshie *et al.*, 2017). These results may be an evidence of social accordance between farmers in the study area.

In addition to the neighborhood influence, extension workers are the second information source (31%). This research thus identified that extension workers are strongly involved in sensitization activities.

The study revealed that International NGOs (3.4%) were also part of general policies promotion, followed by family habits (2.9%). This is an evidence of indigenous knowledge present in the study area. The low rate of this may be due to the abandon of new generation for family knowledge on agro-environmental practice. This also can illustrate that agroforestry and natural fertilizers use are not new practices amongst farmers in the study area.

Farmers association (1.7%) and local NGOs (1.4%) are part of the source of policies information. The low may be due to that there are few NGOs involve in agro-environmental issues and farmers

associations would be more focused on trading process. In addition, local NGOs work with farmers associations which helps to enhance the sensitization to agro-environmental actions. These results are in line with previous studies conducted towards NGOs assisting rice farmers' association in Philippine (Piadozo et al., 2014), farmers sensitized on agroforestry adoption in Tanzania (Hillbur, 2014). For example, in the community of the study area named Zaipobly, a head of women's association stated that: "we have been sensitizing on the income that we can get from agroforestry practices. Today, the association plants *Macore* trees and women increase their revenue by selling the *Macore* oil at 2.000 FCFA per liter".

The study showed that organic fertilizers dealers (.9%) and land use constraints (.9%) implicitly communicate on the importance of general polices practices. In the study area, the local enterprise of chickens manure participates in the farmers' awareness of natural fertilizers. The lack of land constraint farmers to adapt by mixing different culture in the land. This confirms the statement of an extension worked when he said: "the culture of rubber has occupied larger farmland, farmers are obliged to use the smaller land. Consequently, they use more fertilizers and avoid the monoculture".

The implication is that Ivorian authorities should maintain the social cohesion amongst communities. The instability would be a break for their commitments implementation to preserve farmers against climate change in Cote d'Ivoire.

4.2.4: Barriers to Farmers' Adoption of Agro-Environmental Measures

Despite the high rate of beneficiaries, however, do farmers met barriers in their adoption of resilient techniques? This study measured barriers and adoption rate towards farmers. The results obtained from the preliminary analysis of farmers' adoption choice are presented in Figure 7. From this figure, 60% of farmers have adopted lowland rice management and improved varieties of cassava. These findings seem to be consistent with other studies, in which majorities of farmers adopt improved varieties and resilient techniques (Adetule *et al.*, 2017; Conteh *et al.*, 2015; Mudiwa, 2011). Consequently, about 40% of respondents did not embrace the techniques

associated with agro-environmental policies. When the participants were asked to provide their concern about the programmes, they indicated 4 main barriers (Table 8).

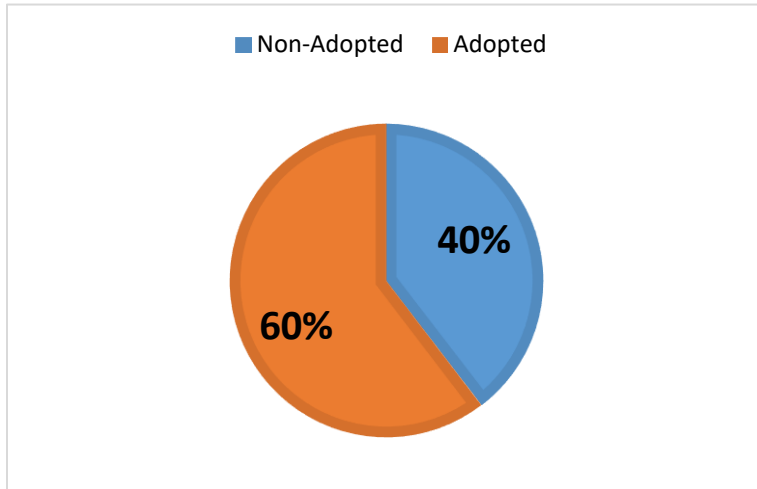
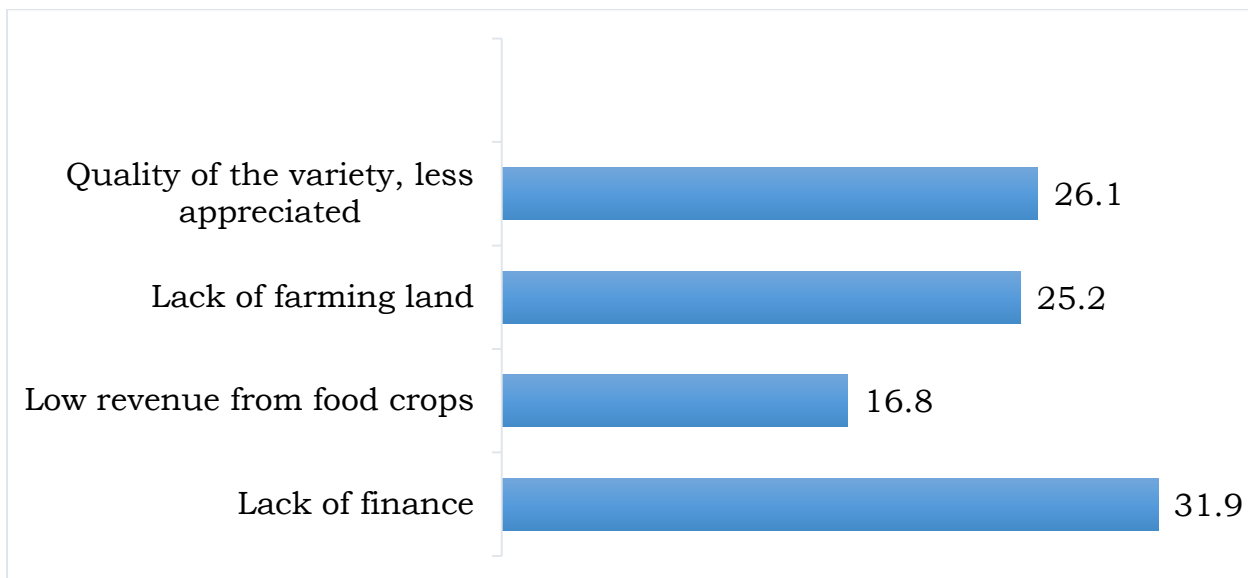


Figure 6: Farmers' Adoption Rate of Agro-environment Practices

Table 9: Barriers to Farmers' Adoption of Agro-environment Practices



4.2.4.1: Lack of Finance

From the Table 2, it can be seen that by far the greatest barriers for ‘non-adopters’ is the lack of finance.

Two discrete reasons emerged from interviewees’ arguments. Some mentioned the laborious physical requirement of the practices while others considered the technical requirements, especially for the rice crop. Emphasizing the need of workforce, one individual said: “We received improved seed varieties and numerous farm techniques such as establishment of nursery, water management, fertilizer application rate, dibbling, sowing in rows, picketing, and compartment. However, the compartment technique implies an arduous work and then difficult to implement without any workforce”. Another interviewee confessed that: “After the pilot project operation, the majority of participants felt sick”.

Talking about the technical issue which involves sufficient finance, respondents argued that the expected productivity of the rice will match with the use of fertilizers applied twice or 3 times per year. Some farmers are discouraged by the price of the fertilizers costing about 60 000 FCFA (100 €) either 180 000 FCFA per year (300 €). Therefore, the financial needs include workforce hiring and fertilizers purchase.

As mentioned in the literature review, the high cost of inputs for improved planting materials for food crops (Adetule et al., 2017), workforce constraints (Rodriguez et al., 2008; Pereira, 2011) are the major reasons of lack of finance towards farmers (Komba & Muchapondwa, 2015).

An implication of this is the possibility of loss of productivity for farmers and failure for farm program policies (Vanclay & Lawrence, Wandel & Smithers as cited by Rodriguez *et al.*, 2008).

Another implication is that this may exacerbate the vulnerability of older people and women to

adapt. Over 349 respondents, 94 are female and 84 older people either 178 people. This means that 59% of respondents may suffer from their physical or financial vulnerabilities.

4.2.4.2: Quality of Improved Varieties

The quality of the improved varieties (26%) is the second reason on the list of barriers. Labor *et al.* (2015) who conducted a similar research, explained the comparison between improved and traditional varieties can occur and led to some preferences. Farmers' choice to adopt improved varieties is influenced by factors such as taste compared to the local varieties Kafle (as cited Labor *et al.*, 2015). Sall *et al.* (2000) added that sometimes, the improved varieties might be more appreciated than the local one. Farm policies of improved seed may include preferred varieties of local people.

4.2.4.3: Lack of Farming Land

The lack of farming land (25%) suggests that rice and cassava farmers in Cavally Region need of space. While food demand is increasing, a place to farm is decreasing. Some respondents said that: 'when rubber plantation become bigger, it must not grow other crops under the trees'. In other words, rubber plantation appears to reduce labor for food crops. Likewise, low revenue of food crops is a barrier (17%) to adopt, farmers may prefer of getting involved into more profitable crops. Thus rubber cash crop implies a monthly payment for farmers while food crops are periodical. Such analysis was required because some of the farmers would prioritize land for non-food crops in detriment of subsistence crops. However, the profitability of cash crops, improved varieties, and resilient techniques involve high productivity and frequent harvest. For instance, lowland rice

reduces water use and harvesting two or three times a year. This factor might be emphasized by policies maker and project implementers in order to motivate farmers of the business insight of the food crops.

4.2.4.4: Low Revenue from Food Crops

It is apparent from this table that few food crops farmers (16.8%) see low revenue of food crops as a motif of non-adoption of environmental practices. This may explain the fear for farmers to change their practices which will not increase their income. There are similarities between the attitudes expressed by farmers in Cavally Region in the study and those described by Schneeberger *et al.* (2009) and Adetule *et al.* (2017). Schneeberger *et al.* have conducted a study on barriers of organic farming by cash-crop producers in Austria and explained that farmers participate in programmes that can increase their economic performance. While Adetule *et al.* discovered that 5.0% of cassava farmers in Ekiti State in Nigeria, complained about marketing problem as a barrier to adopting improved planting materials.

The implication of the existing barriers if they are not resolved would lead to the failure of farm policies, exacerbating the vulnerabilities of farmers. This presents a challenge for policy implementers in Cavally Region because this factor might negatively influence food production in the study area. Turning now to the experimental evidence on farmers' adoption aspects.

4.3: Logistic Regression of Factors Influencing Farmers' Adoption of Agro-environmental Practices

It must be remembered that the main objective of this section was to find out the determinants that influence the adoption of climate change technologies by rice and cassava farmers in Cavally Region. These climate change measures are improved seed, irrigation development, agroforestry and natural fertilizers use. Following Conteh *et al.* (2015), the Binary Logistic Regression Model was used to analyze the factors influencing farmers' adoption (Table 10). A positive correlation was found between the dependent variable that are farmers having adopted resilient farming policies practices and independent variables such as perceived impact, level of education, farm size, farming experience.

Table 10: Effects of independent variables on adoption of policies from Binary Regression Model

Dependent Variable	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
Age	-0.369	0.392	-0.94	0.347	-1.137	0.399
Perceived Impact	2.028	0.347	5.84	0***	1.347	2.71
Gender	-0.032	0.392	-0.08	0.935	-0.801	0.737
Level of Education	-0.86	0.412	-2.09	0.037***	-1.66	-0.052
Land Property	0.277	0.48	0.58	0.564	-0.663	1.218
Farm Size	-0.735	0.395	-1.86	0.063**	-1.51	0.04
Farming Experience	-0.829	0.46	-1.8	0.071**	-1.73	0.072
Household size	-0.461	0.418	-1.1	0.27	-1.282	0.359

Note: ***significant at 1% level; **significant at 5% level, *significant at 10% level. Dependent variable=having adopted resilient farming practices

4.3.1: Perceived Impact

Not surprisingly, the perceived impact has the strongest significance at the $p=.01$ level. This provides important insights into the farmers' choice to adopt resilient techniques. Respondents were asked whether they have noticed any impacts or benefits from the practices of environmental technologies. Some indicated that fruits from agroforestry were used as income for children. Also, some farmers affirmed that natural fertilizers use was less expensive and healthy than chemical fertilizers. Therefore, the perceived impacts could be considered as rewards for their efforts of change (Dwane *et al.*, 2013). Dwane *et al.* explained that farmers believed to have been rewarding, either financially or in terms of the well-being of their stock. Farmers are more likely to adopt a specific method in accordance with some expecting benefits from their choice (Akudugu & Dadzie, 2012), especially from small-scale farmers (Abara & Singh as cited by Akudugu & Dadzie, 2012). Such results demonstrate that in Cavally Region, cassava and rice farmers might achieve environmentally sustainable agricultural production once they noticed any positive impact on the food production. Likewise, projects as mini-package of policies (Thomas *et al.*, 1999), and “containing measures to mitigate (...) and facilitate adequate adaptation to climate change” (UNFCCC, Art 4), should emphasize impacts towards farmers. This suggestion is highly important because countries are engaged to “ensure that food production is not threatened” (UNFCCC, Art 2). From the assumption that the agro-environment policies aim of teaching resilient practices to farmers, an educational approach should be taken into account in these results implication. Krieger (2016) defines the learning as a process where the learner voluntarily acquire knowledge, skill, attitude, habits, and awareness after teaching has taken place. In other words, learning leads to a desirable change of mind, attitude or habit after the teaching occurred. Equally and broadly considered, the adoption of resilient techniques may involve change after policies actions are

taught by implementers. The impact perceived influencing the adoption may be justified by an educational theory called Andragogy. The Knowles Theory of Andragogy explains that, in the learning process, adults need to know why they have to learn something. This means that adults need to learn experientially because they are more practical in their learning process. This implies that in Cavally Region, policy makers and implementers should consider practical evidence of the positive impacts of agro-environmental technologies. The perceived impacts might be emphasized through pilot projects, sensitization on benefits of resilient practices.

4.3.2: Level of Education

Turning now to the second relationship on table 3, the level of education has a significance at the $p=0.05$ level with a negative sign. This negative sign is contrary to the prior expectation that farmers' literacy is high, more they are likely to adopt environmental farm practices. In this study, the negative sign implies that rather, farmers who are not educated are likely to adopt environmental practices. This means that rate of adoption is supposed to be higher with the decreases of the level of education. Yegbemey *et al.* (2014) who found similar results have argued that environmental change is a physical phenomenon which imposes to farmers, such that there is no need for a particular formal education to adopt. They stressed that training in local languages should be considered by extension workers and projects implementers.

Contrary to the current findings, similar studies conducted in this topic reported a positive significance of the level of education as a determinant of environmental practices adoption. Ndambiri *et al.* (2012) enlightened the exposition of educated farmers to more information on climate change. Supported by Norris & Batie; Igoden *et al.* (as cited by Ndambiri *et al.*, 2012) who

noted that higher levels of literacy are likely to enhance information access and therefore able to receive and comprehend information relevant to making decisions in their farms. The level of education is expected to enhance the decision making (Monela, 2014; Nkonya *et al.*, 1997; Farid *et al.*, 2015, Adetule *et al.*, 2017).

4.3.3: Farm Size

The findings indicated also that the variable farm size is a factor influencing negatively farmers' adoption, with a significance level of 5%. Farm size was another variable whose sign did not meet previous expectations. The anticipated result was supposed that larger farmers' filed the greater the adoption of the adaptation and mitigation technologies. In accordance with the priori expectation, previous results have demonstrated correlation between the farm size involving adoption of rice-wheat in Pakistan (Sheikh *et al.* as cited by Pereira, 2011), sustainable practices by farmers of Osun State in Nigeria (Odebode as cited by Edeoghon *et al.*, 2008), improved soil conservation in Tanzania (Mbagal-Semgalawe & Folmer, 2000), beef farmers from Brazil (Pereira, 2011), improved cowpea in northern Nigeria (Alene & Manyong, 2005), hybrid maize in western Ethiopia (Hassan as cited by Alene & Manyong, 2005).

However, the findings of the current indicated that small size farmers are likely to adopt climate prescriptions. The observed results may help to understand that smallholders relied solely on their farms. Rather, Sall *et al.* (2000) explained that farm size is an evidence of farmers' wealth, such that they are more involved in other farm and off-farm activities.

4.3.4: Farming Experience

The results detected an evidence at $p=.05$ level, that farming experience is correlated to cultivators' adoption. This means that the more experienced the farmers are the more they can possibly adopt resilient farm practices. The finding is in line with other researchers (Edeoghon *et al.*, 2008; Kebede *et al.*, 1990; Nhemachena & Hassan, 2008; Ndambiri *et al.*, 2012). Authors agreed that farming experience increases the probability of uptake of all adaptation options because experienced farmers have better knowledge and information on changes in climatic conditions and crop and livestock management practices (Nhemachena & Hassan as cited by Gbetibouo, 2009). Farming experience improves awareness of potential benefits and willingness to participate in local natural resource management and conservation activities. According to Madison (as cited by Hassan & Nhemachena, 2008), experienced farmers are expected to have more knowledge and information about climate change and agronomic practices that they can use in response.

This implies that policy implementers in Cavally Region can identify experienced farmers as mentors and influencers for less experienced farmers to adopt environmentally sustainable practices.

4.3.5: Age

As expected, this study did not find a significant difference between age, gender, land property and household size. The study suggests that age did not influence the farmers' adoption. Although, these results differ from some published studies (Komba & Muchapondwa, 2015; Akudugu & Dadzie, 2012; Ullah *et al.*, 2015; Ndambiri *et al.*, 2012). These authors have maintained that *age* is

a primary latent characteristic in adoption decisions. They said that older farmers have more experience in farming and are better able to assess the attributes of adaptation technologies.

A serious weakness with this argument, however, is that age may not always be associated with the farming experience. 'Older farmers' is it related to 'older people' or farmers with long farming experience'? If age and farming experience were similar, there was no need to consider them as different variables. Thus, a younger farmer may have more experience than an aged farmer. From the assumption that a younger might involve in agricultural activities since the youthful while the older has been working as civil servant abroad, has commenced farming experience at his retired. Thus, it is the experience rather than age that matters for adopting resilient practices. Farmers are therefore likely to adapt to climate change policies actions on the basis of their farming experience. Edeoghon *et al.*, 2008; Apata (2009), Ullah *et al.* (2015) and Farid *et al.* (2015) attested these findings when, in their respective studies, they observed a negative relationship between age of the household head and the adoption of sustainable agricultural practices.

4.3.6: Land Property

The results from the model indicated that land property is not a factor determining farmers' adoption of agro-environmental practices. The probable reason could be due to the fact that adaptation is a plot-specific (Deressa et al. 2009), that considers the specificity of the land rather than those of the landowners. Empirical studies confirmed that land property has no influence on land property associated with farmers' adoption of sustainable practices (Ullah et al., 2015; Farid *et al.*, 2015)

The results contradicted other studies such as Conteh et al. (2015) who found out that traditional land tenure systems in Africa limited adoption of agricultural technologies. Adedayo, 2014 explained that land tenure is a major constraint to the adoption of agroforestry practice in Osun State in Nigeria.

These findings is interesting because it showed that in Cavally Region, land tenure issues would not be a barrier to the implementation of food crop policy climate change related.

4.3.7: Gender

This experience did not detect any evidence for gender as a factor influencing farmers' adoption. It is encouraging to confirm this finding with those found by Yegbemey *et al.* (2007) in their studies conducted on maize growers in the Northern Region of Benin; Apata *et al.*, (2009) in a research on climate change adaptation of arable food crop farmers in South Western Nigeria; Doss & Morris (as cited by Akudugu & Dadzie, 2012) in their studies on factors influencing improving maize technology adoption in Ghana; and Overfield & Fleming (2001) analyzing coffee production in Papua New Guinea (as cited by Akudugu & Dadzie, 2012).

However, these findings contradict those of Akudugu & Dadzie (2012); Deressa *et al.* (2009). Moreover, the probable reason for the negative relationship between gender and adoption is that male as well as female are equally concerned about climate change.

4.3.8: Household Size

One unanticipated finding was that household size would not be significant. The possible explanation is that in this region, families relied on hired labor rather than household labor.

Comparing these findings to other farmers' adoption studies, household size is found to be a significant factor of adoption by Deressa *et al.* (2009), Ndambiri *et al.* (2012), Adnjii *et al.* and Idrisa *et al.* (as cited by Ndagi *et al.* 2016) and Ndagi *et al.* (2016). Unlike other studies, however, Donkoh & Awuni (2011) found that no correlation between household size and farmers' adoption of sustainable measures.

The results in this Chapter indicate that the awareness of environmental policies amongst rice and cassava farmers in Cavally Region and the determinants that can influence their adoption. The next Chapter, therefore, moves on to summarize the main findings and recommendations for future work.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1: Conclusion

This project was undertaken to evaluate the integration of environment commitments within agriculture policies and discuss the awareness and determinant factors of rice and cassava producers in Cavally Region.

The study uses the Content Analysis method to review national policies and the Obligation Integration Susceptibility Index (OISI) to evaluate the level of integration in relevant sectoral policies of rice and cassava crops. The study also uses the Descriptive Statistics and the Binary Regression model to investigate awareness and adoption factors of sustainable practices.

The first major finding to emerge from this study is that the Ivorian food policies recorded a very weak level of climate change integration. On another hand, the results revealed some incoherence between environmental commitments and the lack of organic fertilizers promotion and the will of expanding cultivable land in sectoral policies. An implication of this is the possibility that the weak sectoral policy integration and incoherence retard the public engagements while the environmental issues compel urgent actions.

The second major finding was that lowland rice management and agroforestry practice are well known among rice and cassava farmers in Cavally Region. Besides, natural fertilizers and improved varieties of cassava are less known. Also, the results show that the international organizations and cooperation were the major sources of awareness through their projects implementation in the study area. The secondary sources of information were respectively fellow farmers, extension workers, NGOs, family, farmers association and organic fertilizers dealers. In

addition, the findings suggest that most of farmers have adopted agro-environmental measures. Existing financial and land constraints, quality of improved seeds, and low revenue from food crops constituted overall the major reasons of non-adoption of sustainable practices.

The third major finding showed that perceived impact, level of education, farm size and farming experience emerged as determinants factors influencing farmers' adoption.

5.2: Recommendations

The study revealed that some windows of opportunity to improve environmental policy integration and farmers' resilience in Cote d'Ivoire such as:

- 1- Sensitizing policy makers on the benefits of climate measures for the economic development of food crops sector
- 2- Promoting indigenous and local technologies that would sustain the use of natural fertilizers. For example: To promote the use of Eucalyptus leaves as inputs that applied by farmers in The Gambia.
- 3- Governments should stimulate research on improved seed of cassava but also on renewable energy from agriculture products.
- 4- Policy implementers should focus training for smallholders, experienced farmers, less educated that would mentor and stimulate other farmers to adopt friendly environment practices in the study area.

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Appendix 1: Questionnaire Guide for Farmers

My name is Sitionon Aka Sandrine, student for a Master of Research Programme in Climate change and Education at WASCAL The Gambia. I am conducting titled “Domestication of United Nations Convention on Climate Change (UNFCCC) in food sector: *Case of rice and cassava crops in Cavally en Côte d’Ivoire*”. Please answer to the best of your knowledge and understanding. All information will be treated with confidentiality

Date _____ Name _____

1. Departement:	4. Age: A. Less than 20 B. 21-40 C. 41-60 D. 60 and Above
2. Village:	5. Household size : A. 1-4 B. 5-10 C. 10 and Above
3. Gender : [] A. Male B. Female	6. Education Level: [] A. No Formal Education B. Primary C. Secondary D. Tertiary
7. What is your main food crop? A. Cassava B. Rice C. Other	
8. What is the type of your land? [] A. Family Property B. Rent C. Sharecropping D. Other, please specify	
9. Farming Experience? [] A. Less than 3 years B. 3-7 years C. 8-17 years D. 18-30 years E- More than 30 years	
10. What is the size of your farm? A. Moins d’un ½ ha B. ½-4 ha C. 5-10 ha D. 6-Plus de 10 ha	
INFORMATION ON ADAPTATION AND MITIGATION POLICIES ACTIONS	
11. Have you heard about Climate Change? A. Yes B. No	
12. If yes, what was the primary source of information? A. Media B. Extension Worker C. School D. Other	
13. Did you heard about the following policies actions (choose as much as possible) A- Agroforestry B. Organic Fertilizers Uses C. Improved Seed of Cassava (Bocou 1 or Witta 9) D-Improved Seed of Rice E- Water Management for Rice Crops	

MITIGATION AND ADAPTATION PROJECTS

16. Have you benefited from a project on agricultural development and environment? A. Yes B. No

If, Yes specify the nature of the Project?

.....
.....

If yes, which structures have implemented the project?

.....

17-Did you adopt the sustainability practices from the projects?

18-If yes, what is the main barriers of non-adoption?

Appendix 2: Fieldwork Pictures



Figure 7: Project on Climate Change and Adaptation by GIZ in Cavally Region



Figure 8: Fieldwork Questionnaire Administration