Establishment of a Waste Exchange in a Circular Economy in Cameroon

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Abstract

The general objective of this paper is to show how the establishment of a waste exchange contributes to sustainable development through environmental protection in a circular economy in Cameroon. To carry out this study we adopted a qualitative and quantitative approach. For the qualitative approach, we carried out semi-structured interviews aided by an interview guide and questionnaires with resource people likely to provide useful information on the management of a waste exchange in Cameroon for the collection of data that we supplemented with documentary analysis. These interviews were analyzed using N-Vivo data analysis software. 12. The main results obtained show on the one hand that the existing shortcomings in the current procedures for managing a national waste exchange in a circular economy in Cameroon constitute a major obstacle to the returns of the structures in charge of waste in Cameroon. On the other hand, awareness and popularization strategies in the management procedures of a national waste exchange in a circular economy improve the performance of structures in charge of waste in Cameroon, as well as training linked to typologies and categories. of waste in the procedures for managing a national waste exchange in a circular economy improve the performance of waste structures in Cameroon thus validating our research proposals. As for the quantitative approach, a questionnaire was designed and the data collected was measured in a descriptive and deductive manner using the estimation of an econometric model, in particular, the logistic regression model. From these analyses, it is found that variables such as belonging to an organization, having property rights and the distance from home to the plot of land positively influence decisions to adopt sustainable development methods. for a better implementation of a waste exchange. Two recommendations emerge from these results. First, we suggested to those responsible for waste management in Cameroon to further increase strategic environmental actions among the population. Secondly, to further increase an internal communication policy specific to the environ-

ment within the populations of Cameroon.

1. Introduction

Since the beginning of the 1990s, questions related to environmental protection have become the common denominator of all actors who act directly or indirectly on nature. Indeed, aware that their actions produce externalities, especially negative, on the environment, countries and companies are putting in place strategies that can enable them to better manage it and considerably reduce the damage caused to the environment.

In addition, the circular economy is a response to climate issues and the disappearance of biodiversity by bringing about more virtuous economic models. Today, the dominant economic model pushes companies into a logic of linear use of resources: Extract, produce, consume and throw away. This functioning is not sustainable in a world with finite resources. The circular economy offers a new model inspired by the looping operation of natural ecosystems

Waste can be defined in different ways depending on the field and interest of study and sometimes the origin and state of the waste. waste is defined "as a product whose use value and exchange value are zero for its holder or owner. This deficit in economic value is due to the fact that waste is not a rare product, unlike air for example.

The Waste Exchange is a service for publishing offers or requests for materials, objects and equipment for sale or donation. It promotes the reuse and recycling of materials, equipment and waste. It is intended for all establishments, whether the private sector (craftsman, trader, SME, large company), the associative sector, the public sector (Hazinski et al., 2004; Catalano et al., 2004).

In Cameroon, to strengthen waste management policies, the State has created a legal framework as well as institutions to put the defined strategies into practice. Despite the implementation of these tools, the inadequacies of the public waste service led to the cessation of waste collection in Yaoundé in 1994. The introduction of a marginal tax on evacuated waste risks generating dumping behavior illegal. This is why, Choe and Fraser (1999), Glachant (2005), Becker (1968) and Dahlen and Lagerkvist (2010), in their models, take into account this alternative, illegal disposal (wild dumping, burning), in connection with the development of service pricing based on quantities of waste produced. The same is true for authors like D'Amato and Zoli (2012) who developed a theoretical model in which they study the role of organized crime in illegal waste disposal.

Therefore, this concern leads us to pose the problem: *How can the establishment of a waste exchange contribute to development through environ-*

mental protection in a circular economy in Cameroon?

2. Literature Review

This subsection presents the literature review.

2.1. Theoretical Foundations of the Concepts

Waste is all residue from a production, transformation or consumption process, of which the owner or holder has the obligation to dispose of or eliminate it (Djemaci, 2012).

2.2. Definition of Waste

The old concept assimilated waste to "non-value" or negative value, to a nuisance, pollution and a danger that had to be gotten rid of (Bouterfas, 2017) Currently, it is considered a "resource", a raw material that must be managed intelligently (Bouterfas, 2017). Waste can be defined in different ways depending on the field and interest of study and sometimes the origin and state of the waste. For Bertolini and Celsi (1990), waste is defined as a product whose use value and exchange value are zero for its holder or owner. This deficit in economic value is due to the fact that waste is not a rare product, unlike air for example.

2.3. Economic Approach to Waste

Relativity refers to the value of waste which evolves over time, social perceptions and the uses we make of it. The obligation refers to the responsibility of the producer of the waste to eliminate it or have it eliminated because, due to its characteristics and properties, the waste can be dangerous for humans and the environment.

Maystre et al. (1994), also show that the legal definition of waste is based on subjectivity and objectivity. According to the subjective conception, a good can only become waste if its owner has the desire to get rid of it. But until that property leaves that person's property or the space they are renting, that person can change their mind at any time. If the item has been placed on the public highway or in a garbage dump, its owner may have clearly indicated his desire to abandon all ownership rights over the item. In fact, what is left on the public highway belongs to the owner of the public highway, that is to say, the municipality. The subjective conception is implicit because here we cannot determine the real intention of the holder of the "waste".

2.4. The Approaches Underlying the Circular Economy

The definition of the circular economy given by the PLTE, adopted at first reading by the National Assembly, is as follows: "The transition towards an economy circular call for sober and responsible consumption of natural resources and primary raw materials as well as, as a priority, reuse and, failing that, recycling of waste, secondary raw materials and products.

Finally, according to Ademe, "The circular economy can be defined as an economic system of exchange and production which, at all stages of the life cycle of products (goods and services), aims to increase the efficiency of the use of resources and reduce the impact on the environment. The circular economy must generally aim to drastically reduce resource waste in order to decouple resource consumption from GDP growth while ensuring the reduction of environmental impacts and an increase in well-being. It's about doing more and better with less."

3. Literature Paper

This is the presentation of theories related to the implementation of waste in a circular economy.

3.1. The *x*-Inefficiency Theory

x-efficiency theory was developed by Leibenstein (1966) to take into account the fact that certain organizational inefficiencies do not result from a failure to allocate production factors. According to the theory of efficiency-x[1], the sources of inefficiency in public organizations are justified by the inappropriate behavior of the State and its agents, on the one hand, and by the highly bureaucratized organizational structure of these-here, on the other hand. Leibenstein's primary reflections on *x*-efficiency theory focused on the analysis of underdevelopment and did not establish formal links between *x-inefficiency* and public organizations.

Furthermore, the multiplicity of objectives assigned to public companies constitutes, according to Leibenstein (1978), an explanatory factor for their inefficiency. Despite the fact that he does not question the merits of these missions (economic, social and political), he points out, however, that their often-conflicting nature tends to exacerbate the evaluation difficulties of managers, and leads to the arbitrariness of the waltz of leaders by the supervisory ministries.

Efficiency theorists maintain that the 3Ps could contribute to substantially reducing the sources of inefficiency *in* public organizations, thus allowing them to return to performance and competitiveness. According to the postulates of *x-efficiency theorists*, the 3Ps should therefore make it possible to shield public organizations from bad political influences and consequently, to simplify and clarify their objective functions.

3.2. Public Choice Theory

The theory of public choice, which was born from the Virginia School, appears to be one of the theories which most helped to advance libertarian and neo-liberal ideas on the economic level during these decades. Buchanan and Tollison (1984) are the precursors of this theory which postulates that the inefficiency of public companies is due in particular to interest groups and political

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[1]x-efficiency represents the non-measurable or non-identifiable factors which are at the origin of the organization's performance).

games which characterize public administrations.

The "Public Choice" school is based on the fact that the people who are supposed to make public decisions, notably the directors of public companies, politicians and bureaucrats, do so not by privileging the interests of society as a whole, but rather according to their own interests, as is the case for any other individual in other contexts of private life (Hodge, 2000).

In fact, the theory of "Public Choice" is intended, in its essence, to be a kind of critique of the "New Welfare Economics" where the State in reality only maintains the myth of commitment and dedication to the general interest and public affairs. Thus, the "Public Choice" movement pits the State against the market, with the market being considered the efficient allocation mechanism par excellence. Theorists' concern is therefore focused on how to minimize state intervention in the economy.

The avowed objective of theorists of the school of "Public Choice" is "*… an effort to formulate a general theory of public economics which makes it possible to do in the field of collective choices what has been done for a long time in level of the microeconomics of markets. It is in fact a question of supplementing the theory of production and exchange of market goods and services with an equivalent theory and, as far as possible, compatible with the functioning of political markets*" (Buchanan & Tollison, 1984).

Ultimately, the intervention of the State, through regulation or by the creation of public companies, is hardly well received by this current for whom the privatization of public companies would only be a fair return of things, a just return to the market and efficiency. The theory of property rights and public choices constitute two complementary approaches for analyzing performance gaps between public companies and private companies.

4. Empirical Review

Most studies on the method of household solid waste disposal emphasize household characteristics as well as socio-economic and institutional factors as factors influencing household choice. To analyze the determinants of the method of removing household solid waste, several empirical works are carried out. Two trends seem to emerge on this subject. One shows that the determinants are linked to the good behavior of households in terms of the removal of household solid waste and have positive and significant effects on the method of removal. The other focuses on the negative and significant effects of the method of removing household solid waste.

The results of studies carried out by Najih (2015) and Planchat (2007), show that the determinants have a significant influence on the behavior of the individual as a main element in the process of waste removal Based on the work of Sotamenou et al. (2019), a certain number of variables are identified as determining factors for the use of recovered and recycled household waste (DMRR), in order to propose a. household waste management system which is compatible

with the development concerns of urban and peri-urban agriculture. The estimation of two econometric models (Binomial Logit and Ordered Logit), used by these authors shows that several socio-economic and technical determinants influence the. Use of organic waste, negatively, while others positively influence the decision to use (DMRR).

As stated in the study by the NGO Bethesda, on the experimental phase of sorting at source, which uses the probit model, this model made it possible to estimate the probability of household sorting acceptance and analyzes the factors (determinants) which influence sorting at source, that is to say as one of the methods of removing household waste. On the other hand, the results of the work carried out by Bénard (2008), Fullerton and Kinnaman (1995) and Sotamenou et al. (2019), by applying the unordered multinomial model, on the removal of solid household waste, reveal that the tax linked to the volumes of waste rejected is a determinant which encourages households to illegally divert their waste, by burning it or depositing it in nature (Kouamé et al., 2013).

Contrary to the results of Babio and Houssou (2016), the logistic regression revealed a very strong correlation between the determinant level of education and the method of disposal of household waste. Rather, it is the level of education that determines the tendency of households to throw their garbage into the environment. But, for Kinnaman and Fullerton (2000), among the socio-economic characteristics of users, the level of education is an important determinant of choice perceived as an indicator of the environmental sensitivity of users. Other authors such as Baabereyir (2009) have shown that socio-economic factors and those of the urban space, the institutional context and cultural parameters have revealed that waste management is not a problem isolated from urban reality.

Finally, Callan and Thomas (2001), through logistic regression, highlighted the influence of certain socio-economic characteristics (income, level of education, etc.), of users of household waste management services. as an important determinant of policy success. Indeed, the use of an unordered multinomial logit model, in this paper, is explained by the rarity of this model in the work carried out in Congo.

The review of the empirical literature on the method of solid household waste removal emphasizes two characteristics. First, socioeconomic characteristics of households and second, institutional factors as factors influencing household choice.

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5. Research Hypotheses

To achieve these objectives, we formulate the main hypothesis that **the successful integration of a waste exchange in the context of the circular economy in Cameroon will promote a more effective convergence between economic**

and environmental objectives. The hypothesis thus referred to can be broken down into two specific hypotheses which are specified below:

Hypothesis 1: The establishment of a waste exchange in tandem with the circular economy will stimulate the efficiency of economic cycles while minimizing environmental impact;

Hypothesis 2: The interaction between the waste exchange and the circular economy will be positively correlated with the progression of sustainable development indicators.

6. Methodology

The relevance and credibility of research depend on the choice of appropriate methodological options. This study uses secondary data to verify the hypotheses and opts for a quantitative-qualitative approach in line with the axes of analysis identified.

- **Approach adopted or choice of approach for our study**

The validity of any study depends on the methodology followed to conduct it. In particular, this methodology concerns the steps followed to obtain the main materials of the study which are the data, as well as the procedures for their processing. In this study, we adopted a quantitative approach based on a single case study. This will allow us to examine our study in depth.

- **Theoretical foundations or even theoretical corpus of our methodology**

Constructivism is a theory of learning based on the idea that knowledge is constructed by the learner on the basis of mental activity. Learners are seen as active beings seeking to give meaning and significance to what they perceive from their experiences. Constructivism assumes that, based on our experiences, we construct our own "rules" and "mental models", determining our view of the world.

Learning is therefore a process of adjusting our mental models as we gain new experiences. Initially, our mental models may have little connection with reality (as in children's naive theories), but they gradually become more and more refined, complex, differentiated and realistic (Dumez, 2015).

From an epistemological point of view, constructivism maintains that each individual has a unique vision of reality and the world around them. Everyone has their own truth. Under the prism of psychology, constructivism considers in a more nuanced way that, if each individual actually has his or her conception of the world, this is due to the social learning and cognitive development that he or she has experienced until now (Girod-Seville & Perret, 1999).

- **Choice of sample for quantitative analysis**

To analyze the effect of the circular economy on development sustainable: The case of a waste exchange in Cameroon, a socio-economic survey was also administered to the various stakeholders. For this, the primary data was collected in the cities of Yaoundé and Bafoussam in order to have a sufficient database and to identify the effect of the circular economy on sustainable development,

through the importance of a waste exchange. Several reasons justify the choice of the cities of Yaoundé and Bafoussam. By their administrative function, their economic weight and their population, Yaoundé and Bafoussam are among the three largest cities in Cameroon. As a result, the effect of the circular economy on sustainable development is very intense in its two cities.

For this study, the sampling frame consisted of all individuals working in the circular economy. THE questionnaire (see appendix) was administered to any natural person who works in the operation having a link with the circular economy and who agreed to answer the questions of the study and likely to provide us with information that was retained in the samples. The Yaoundé investigation covered the districts of Yaoundé I, II and IV. After purification of the database, in the end 282 individuals chosen according to the non-probability sampling method were thus retained. The method of collection of data known as "Transect" or even "space step survey" has been used. In the Bafoussam region, the questionnaires were administered only to individuals in the Bafoussam I, II and III districts. After purification of the database, in the end, 180 individuals chosen according to the non-probability sampling method were thus retained. The method of collection of data known as "Transect" or even "space step survey" has been used. In total, 462 individuals were surveyed.

- **Data collection, variables and econometric analysis model**

The objective of this section is to present, on the one hand, the data collection methodology and on the other hand, the econometric analysis model and the variables.

7. Data Collection Methodology

The data collection methodology involves first delimiting the scope of the study, then developing the sample size for this study.

7.1. Delimitation of the Scope of the Investigation

It consists, on the one hand, of presenting the geographical area of the study within which the data will be collected, and on the other hand, of determining the theoretical size of the observation units.

7.2. Scope of Investigation

Cameroon is located in Central Africa a little above the Equator between the 2nd and 13th degrees of northern latitude. With an area of 475,000 km^2, it is divided into 10 regions. Cameroon, which is open to the Atlantic Ocean, is surrounded to the west by Nigeria, to the north by Chad, to the east by the Central African Republic, and to the south by Gabon, Congo and Equatorial Guinea. It is divided into ten (10) regions. Its main cities are Yaoundé (central region), Douala (coastal region), Bafoussam (western region), Garoua (northern region), Bamenda (north-western region), etc. Several reasons justify the choice of the cities of Yaoundé and Bafoussam. By their administrative function, their economic

weight and their population, Yaoundé and Bafoussam are among the three largest cities in Cameroon. As a result, the effect of the circular economy on sustainable development is very intense in its two cities.

7.3. The City of Yaoundé

The city of Yaoundé is the seat of the institutions of the Republic of Cameroon. The capital of the Center Region, is located at 3˚5' north latitude and 11˚31' east longitude, approximately 200 km from the Atlantic coast. Extending over a total area estimated at 300 km², Yaoundé is subdivided into seven districts, its relief is made up of a set of hills and valleys with altitudes varying between 700 and 1200 m. Its temperate subequatorial climate is characterized by four seasons: a long dry season (November-March), a short rainy season (March-June), a short dry season (June-August) and a long rainy season (August-November). The agroecological conditions of the city of Yaoundé are favorable to the circular economy (production and consumption model which consists of sharing, reusing, repairing, renovating and recycling existing products and materials for as long as possible so that they retain their value). Furthermore, Yaoundé includes several waste exchanges, the main one of which is that of Hysacam and which can affect the sustainable development of the city of Yaoundé.

For this study, the sampling frame consisted of all individuals working in the circular economy. The questionnaire (see appendix) was administered to any natural person who works in the operation having a link with the circular economy and who agreed to answer the questions of the study and likely to provide us with information was retained in the samples. The Yaoundé survey covered the districts of Yaoundé I, II and IV.

7.4. The Town of Bafoussam

The town of Bafoussam is the capital of the Western Region. Its geographic coordinates are 5˚30' North latitude and 10˚25' East longitude. Located 300 km from Yaoundé in an area made up of mountain ranges, Bafoussam has a mild subequatorial climate tempered by the altitude (1450 m). It is punctuated by a dry season (November-March) and a rainy season (March-November) with an average rainfall of around 1800 mm/year. Temperatures vary between 19˚ in July and 21˚7 in March. The average is 20.2˚ monsoon characterized by a long rainy season (March-October) and a short dry season (November-Mid-March). Its relief is made up of mountain ranges (altitude varying from 1500 to 2500 m), plains and plateaus.

The demarcation between the urban area and the rural area is not very clear on the outskirts of the city, agricultural practices there are semi-urban and semi-rural. Agricultural activity mainly concerns food crops (vegetables, corn, tubers, etc.) with family labor. In this area, there is a high concentration of the circular economy which therefore can impact sustainable development. In this region, the questionnaires were administered only to individuals in the districts

of Bafoussam I, II and III.

7.5. Sample Size

The sample size can be assessed both quantitatively and qualitatively.

7.6. Quantitative Sample Size

In our study, the sampling unit is the "household" while the observation unit is the "individual" in the household. The choice of the observation unit is justifiable especially since the same phenomena are observed through the same mechanisms. Thus, determining the size of the observation units (n^*) requires first determining the size of the sampling units (n). The latter is obtained by the formula of Sudman and Bradburn (1982) for large populations (beyond 100,000), i.e.:

$$n = \frac{(1.96)^2 \times p \times (1-p)}{ET^2}$$

where n represents the sample size to be calculated, the number 1.96 represents the choice of a 95% confidence interval[2]. p represents the proportion of the population having the characteristic studied and ET represents the tolerable error, i.e. the margin of error for the investigation. The latter is based on the idea that the sample mean differs from the population mean and adjusts the standard error to account for differences between the sample and the population, by calculating the interval of confidence for the population average. In our study, the characteristic studied is the circular economy. In principle, this characteristic should be used as p in the formula above. However, given the absence of this information, Sudman and Bradburn (1982) propose using $p = 50\%$ in the event of an absence of information on the proportion of the population having the characteristic studied. This assumes that at least 50% of households in the cities of Yaoundé and Bafoussam participate in the circular economy for better sustainable development. Using a 95% confidence interval and a tolerable margin of error of 5%, the size of the sampling units is determined as follows:

$$n = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{ET^2} = 384.16 \approx 384 \quad \text{households}$$

Furthermore, taking into account imponderables such as the possibility that some respondents refuse to answer all of the questions appearing on the questionnaire, the rate of "incomplete questionnaires", taking into account budgetary constraints, was set at 5%. This led to adjusting the size of the sampling units (n) to 384 households[3]. In each household two (2) respondents over fourteen (14) years old are interviewed. Consequently, the theoretical size of the observation

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[2]In a normal distribution, 95% of the area under the curve is within 1.96 standard deviations of the mean.

[3]384 + (384 × 5%) = 403 households.

units (n^*), is equal to 806 individuals. The distribution of this sample between the different districts of the city of Yaoundé and Bafoussam was done on the basis of the population residing in the city from the General Population and Housing Census (RGPH) of 2005. based on the fact that the average size of a household in Cameroon is equal to 4 (ECAM4)[4]. The number of households per district is determined by the ratio: *population of the district*/4. The latter thus makes it possible to determine the distribution key which is applied to the size of the sampling units ($n = 403$) in order to obtain the theoretical size of the observation units (individuals) by District in the different cities of Yaoundé and Bafoussam.

After cleaning the database, ultimately 282 individuals chosen using the non-probability sampling method were retained for the city of Yaoundé and 180 individuals for the city of Bafoussam. A total of 462 individuals. The data collection method known as "Transect" or "space step sampling" was used. Table 1 presents the distribution of individuals surveyed by region.

The survey forms completed as part of this study were fully entered using CSPro software and STATA 17 allowed us to carry out descriptive and econometric analyses.

8. Validation of Research Proposals and Discussion of Results

This subsection concerns the validation of research proposals and the discussion of results.

8.1. Validation of Research Propositions

This subsection discusses the verification of research propositions.

Table 1. Distribution of individuals surveyed by region.

Institutions	Yaoundé (central region)	Bafoussam (western region)
YAOUNDE I	100	-
YAOUNDE II	98	-
YAOUNDE VI	84	-
BAFOUSSAM I	-	83
BAFOUSSAM II	-	50
BAFOUSSAM III	-	47
TOTAL	282	180

Source: Authors, from the survey.

[4]Third Cameroonian Household Survey relating to the production of indicators on the living conditions of the populations.

8.2. Validation of the First Proposition P1

Regarding the link between the existing shortcomings of current procedures for managing a national waste exchange and the performance of the structures in charge of waste, in fact:

"*The existing shortcomings in the current procedures for managing a national waste exchange in a circular economy in Cameroon constitute a major obstacle to the performance of the structures in charge of waste in Cameroon. It is necessary first of all to clarify the management of a national waste exchange in Cameroon is only opinion because our country is limited to collecting waste with a few exceptions. It is difficult to say something about a structure or platform that only partially exists. (20%)*" (**Essential responses from field respondents**).

This validates the first proposition P1, according to which the existing shortcomings in the current management procedures of a national waste exchange in a circular economy of Cameroon constitute a major obstacle to the performance of the structures in charge of waste in Cameroon.

8.3. Validation of the Second Proposition P2

Regarding the link between concrete actions (specific actions) awareness and popularization strategies in the management procedures of a national waste exchange on the performance of the structures in charge of waste, it appears that the concrete actions (specific actions) awareness and popularization strategies in the management procedures of a national waste exchange improve the performance of structures in charge of waste, in fact: *The awareness and popularization strategies in the management procedures of a national waste exchange in a circular economy improve the performance of the structures in charge of waste in Cameroon, in the sense that the popularization of an awareness strategy allows us will allow each person to better understand the process of managing a national waste exchange in a circular economy and will help for better organization within the structure.*

The awareness-raising and popularization strategies on the functioning of the management of a national waste exchange in a circular economy are a very significant contribution and well received because they make it possible to convince the skeptics. (Essential responses from field respondents).

This validates the second proposition P2 according to which, awareness and popularization strategies in the management procedures of a national waste exchange in a circular economy improve the performance of structures in charge of waste in Cameroon.

8.4. Validation of the Second Proposition P3

Regarding the link between concrete actions (specific actions) training linked to the typologies and categories of waste in the management procedures of a national waste exchange on the performance of the structures in charge of waste

currently, in fact: *Training related to the typologies and categories of waste in the management procedures of a national waste exchange in a circular economy improve the performance of waste structures in Cameroon. They will allow staff to understand and be informed and allow acceptance of the management of a national waste exchange in a circular economy.* (**Essential responses from field respondents**). And finally for others: "*The influence will be direct, the impact very significant. Training related to the typologies and categories of waste in the management procedures of a national waste exchange in a circular economy within the company is well received in the sense that the phrase of achievement is accompanied by the work program and tests take into account the detected anomalies*" (**essential responses from field respondents**).

This validates the second proposition P3 according to which, training linked to the typologies and categories of waste in the management procedures of a national waste exchange in a circular economy improves the performance of waste structures in Cameroon.

8.5. Discussion of Research Results

This subsection presents the analysis and discussions of the main results.

- Quantitative survey results

We first present the results of the statistical analyzes of the model. These statistical results will be followed by the results of econometric estimates.

8.6. Results of Statistical Analyzes

While Table 2 presents the results of the statistical analyzes relating to the explanatory variables of our model, Table 3 presents the statistical results relating to the dependent variable.

8.7. Characteristics of Explanatory Variables

Table 2 represents the characteristics of the circular agents. It appears from Table 2 that the average age of the circular agents in our sample is 41 years old.

This table also indicates that 68% of urban and peri-urban circular agents in Cameroon are men and 44% of our sample carry out their activities in Yaoundé; 83% of them have at least one diploma. Statistics also show that 38% of circular agents belong to an organization involved in the renovation and recycling of products and materials so that they retain their values. Very few circular agents are grouped together within associations. Despite strong land pressures, 78% of agents in our sample own their farms. A little more than half of the agents surveyed (52%) live less than 500 m from their home.

8.8. Characteristics of the Dependent Variable

Table 3 presents the characteristics of the dependent variable of the binomial Logit model. According to the table, 2.64% of the agents in our sample do not affirm that there is sustainable development.

Table 2. Descriptive statistics of the explanatory variables used.

Variables	Terms and conditions	Proportion/ average	Std.Err./ Std.Dev.
	Social variables		
AGE	Age of circular agent	41	11
SEX	0 = Female	32%	0.265
	1 = Male	68%	0.622
NIVE	0 = None	17%	0.022
	1 = Primary level	39%	0.028
	2 = Secondary level	27%	0.026
	3 = Higher level	17%	0.022
	Economic variables		
AORR	0 = Does not belong to an AORR	61%	0.554
	1 = Does not belong to an AORR	38%	0.332
	Technical variables		
DPEC	0 = Does not have property rights	22%	0.245
	1 = Does not have property rights	78%	0.208
DIST	1 = Distance from home to plot less than 500 m	32%	0.027
	2 = Distance from home to plot between 500 m and 1000 m	35%	0.028
	3 = Distance from home to plot between 1000 m and 2000 m	21%	0.024
	4 = Distance from home to plot greater than 2000 m	12%	0.019
AREA	0 = Bafoussam	56%	0.505
	1 = Yaoundé	44%	0.379

Source: authors, from the survey.

Table 3. Statistics of the dependent variable of the binomial logit model.

Variables	Terms	Number	Proportion/ average	Std.Err./ Std.Dev.
$Y_1 = 0$	The circular agent does not affirm that there is sustainable development	282	64%	0.283
$Y_1 = 1$	The circular agent affirms that there is sustainable development	180	36%	0.283

Source: Authors, from the survey.

8.9. The Results of the Statistical Analyzes for Estimating the Binomial Logit Model

Table 4 presents the results of the estimation of the binomial logit model on a sample of 166 circular agents, as well as the odds ratio of the explanatory variables on the dependent variable. The dependent variable is the dichotomous variable reflecting the fact that there is or is not sustainable development in Cameroon. Overall, the model is statistically valid. Indeed, its Chi-Square (χ^2) (31.573) is significant at 01%. The pseudo-R^2 (0.101) is satisfactory, it approximates the proportion of the variance explained by the model. The percentage of good prediction of the model is also satisfactory; this percentage indicates that in 70.25% of cases, our model correctly predicts the behavior of Cameroonian circular agents.

Table 4. Binomial logit model estimation.

Explanatory variables	Adoption of sustainable development	Odds Report	Std.Err.
Age of agent	0.015 (1.060)	0.003	0.003
Agent gender	−0.476 (−1.316)	−0.107	0.083
Level of education (ref: without level)			
Primary	0.397 (0.853)	0.088	0.105
Secondary	−0.201 (−0.382)	−0.043	0.112
Superior	0.492 (0.846)	0.113	0.139
Membership in an organization	0.807** (2.282)	0.181	0.079
Has a property right	0.718* (1.811)	0.144	0.071
Home-plot distance (ref: less than 500 m)	-		
Between 500 and 1000 m	0.870* (−1.853)	−0.167	0.076
Between 1000 and 2000 m	−0.010 (−0.021)	−0.002	0.107
More than 2000 m	−0.124 (−0.285)	−0.026	0.093
Yaounde	−0.432 (−0.878)	−0.094	0.106
Constant	−1.590 (−0.995)		
observations	166		
Log-likelhood	−140.46		
Chi 2	31,573		
Adjusted R2	0.101		

Source: Author, from the survey. Notes: ***; ** and *represent significance at 1%; 5% and 10% respectively. Standard deviations in parentheses.

The results of Table 4 reveal that the variables that influence sustainable urban and peri-urban development in Cameroon are: Membership of a peasant association (AORR), the right of ownership on the exploited plot (DPEC), and the distance between home and plot. (DIST). Let us now interpret the significance of these variables:

- The AORR variable:

It reflects belonging to an organization involved in the renovation and recycling of products and materials so that they retain their values and present a positive sign. This result is consistent with the hypothesis according to which the fact of an agent being a member of an association positively influences his decision to adopt sustainable development methods since he often benefits from training and advice within these associations of specialists (Adesina et al., 2000). The AORR variable is significant at the 05% threshold and the odds ratio also shows that if the percentage of those who belong to an association increases by 10% then the probability of using sustainable development increases by 18%.

- The DPEC variable:

It reflects the right of property on circular farms and presents a positive sign. This result is consistent with the hypothesis that land ownership has a positive impact on sustainable development (Gillis, 1990). The DPEC variable is significant at the 10% threshold and the odds ratio also shows that if the percentage of those who hold property rights over their plot increases by 10% then the probability of using sustainable development increases by 14%.

- The DIST variable:

The category "home-plot distance between 500 and 1000 m" is significant at the 10% threshold and has a negative sign. The odds ratio shows that if the percentage of agents who live quite far from their plot increases by 10% then the probability of adopting sustainable development decreases by 16%.

9. Conclusions

The general objective of our research is to show how the establishment of a waste exchange contributes to development through environmental protection in a circular economy in Cameroon. From there, we asked ourselves the question: How can the establishment of a waste exchange contribute to development through environmental protection in a circular economy in Cameroon,

To try to answer this question, we turned to existing theories, setting up the possibility that certain relationships could be verified. For this, we used the theory of inefficiency-x, the theory of public choices, the theory of New Public Management, The theory of contestable markets, Coordination theories, Externalities and economic theory

In the empirical part, data collection is made from individual semi-directive interviews with resource personnel (having a position of responsibility) likely to provide useful information on the management of a waste exchange in Cameroon encountered in the city of Yaoundé likely to provide important and neces-

sary information used to carry out the research and served as a basis for collecting the data necessary for qualitative analysis.

The survey technique used for our research is reasoned choice. The data collection instrument that was used in this research work is the interview guide. In this study, we opted for qualitative research. The epistemological approach considered is the constructivist approach. based on a Steps inductive e.

During the second part, we presented the results of the survey on the establishment of a waste exchange in a circular economy in Cameroon. This analysis validates the propositions established in the research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Adesina, A. A., Mbila, D., Nkamleu, G. B., & Endamana, D. (2000). Econometric Analysis of the Determinants of Adoption of Alley Farming by Farmers in the Forest Zone of Southwest Cameroon. *Agriculture, Ecosystems & Environment, 80,* 255-265. https://doi.org/10.1016/S0167-8809(00)00152-3

Baabereyir, A. (2009). *Urban Environmental Problems in Ghana: A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi-Takoradi.* Master's Thesis, University of Nottingham.

Babio, S., & Houssou, C. S. (2016). *Analyse des déterminants du mode d'évacuation des déchets solides ménagers dans les principaux centres urbains du nord-Bénin: Cas des villes de Parakou, Djougou, Kandi et Malanville [Analysis of the Determinants of the Mode of Disposal of Municipal Solid Waste in the Main Urban Centers of the North Benin: Case of the Cities of Parakou, Djougou, Kandi].*

Becker, G. S. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy, 76,* 169-217. https://doi.org/10.1086/259394

Bénard, F. (2008). Waste Management and Usage Fees: Pay-As-You-Throw Programs as an Economic Model. *Flux, 74,* 30-46. https://doi.org/10.3917/flux.074.0030

Bertolini, R., & Celsi, S. (1990). Proposals for the Re-Utilization of Waste Sludge Resulting from Stone Cutting and Finishing Processes. *Acimm per il marmo, 27,* 53-71.

Bouterfas, I. (2017). *Identification et Caractérisation des déchets ménagers solides de la ville de Tlemcen.* Ph.D. Thesis, Faculté des Sciences de la Nature et de la Vie et Sciences de la Terre et de l'univers.

Buchanan, J. M., & Tollison, R. D. (1984). *The Theory of Public Choice—II.* University of Michigan Press. https://doi.org/10.3998/mpub.7229

Callan, S. J., & Thomas, J. M. (2001). Economies of Scale and Scope: A Cost Analysis of Municipal Solid Waste Services. *Land Economics, 77,* 548-560. https://doi.org/10.2307/3146940

Catalano, R. F., Haggerty, K. P., Oesterle, S., Fleming, C. B., & Hawkins, J. D. (2004). The Importance of Bonding to School for Healthy Development: Findings from the Social Development Research Group. *Journal of School Health, 74,* 252-261. https://doi.org/10.1111/j.1746-1561.2004.tb08281.x

Choe, C., & Fraser, I. (1999). An Economic Analysis of Household Waste Management.

Journal of Environmental Economics and Management, 38, 234-246.
https://doi.org/10.1006/jeem.1998.1079

Dahlen, L., & Lagerkvist, A. (2010). Evaluation of Recycling Programmes in Household Waste Collection Systems. *Waste Management & Research, 28,* 577-586.
https://doi.org/10.1177/0734242X09341193

D'Amato, A., & Zoli, M. (2012). Illegal Waste Disposal in the Time of the Mafia: A Tale of Enforcement and Social Well-Being. *Journal of Environmental Planning and Management, 55,* 637-655. https://doi.org/10.1080/09640568.2011.620324

Djemaci, B. (2012). *La gestion des déchets municipaux en Algérie: Analyse prospective et éléments d'efficacité.* Master's Thesis, Université de Rouen.

Dumez, H. (2015). De nouvelles perspectives sur la performativité. *Gérer et comprendre, 1,* 82-83. https://doi.org/10.3917/geco1.119.0082

Fullerton, D., & Kinnaman, T. C. (1995). Garbage, Recycling, and Illicit Burning or Dumping. *Journal of Environmental Economics and Management, 29,* 78-91.
https://doi.org/10.1006/jeem.1995.1032

Gillis, A. M. (1990). The New Forestry. *BioScience, 40,* 558-562.
https://doi.org/10.2307/1311294

Girod-Seville, M., & Perret, V. (1999). *Fondements épistémologiques de la recherche, in Thiétart RA et coll, méthodes de recherche en management.* Edition L'Harmattan.

Glachant, M. (2005). La politique nationale de tarification du service des déchets ménagers en présence de politiques municipales hétérogènes. *Economie prevision, 167,* 85-100. https://doi.org/10.3406/ecop.2005.7400

Hazinski, M. F., Markenson, D., Neish, S., Gerardi, M., Hootman, J., Nichol, G., Smith, S. et al. (2004). Response to Cardiac Arrest and Selected Life-Threatening Medical Emergencies: The Medical Emergency Response Plan for Schools: A Statement for Healthcare Providers, Policymakers, School Administrators, and Community Leaders. *Circulation, 109,* 278-291. https://doi.org/10.1161/01.CIR.0000109486.45545.AD

Hodge, I. (2000). Agri-Environmental Pelationships and the Choice of Policy Mechanism. *World Economy, 23,* 257-273. https://doi.org/10.1111/1467-9701.00271

Kinnaman, T. C., & Fullerton, D. (2000). Garbage and Recycling with Endogenous Local Policy. *Journal of Urban Economics, 48,* 419-442.
https://doi.org/10.1006/juec.2000.2174

Kouamé, A. A., Jaboyedoff, M., & Derron, M. H. (2013). Parametric and Comparative Study of the Impact of Waste Pollutants in Groundwater: The Case of the District of Abidjan (Côte d'Ivoire) and Polluted Site in Switzerland. *Geophysical Research Abstracts, 15.*

Leibenstein, H. (1966). Allocative Efficiency vs. "X-Efficiency". *The American Economic Review, 56,* 392-415.

Leibenstein, H. (1978). On the Basic Proposition of X-Efficiency Theory. *The American Economic Review, 68,* 328-332.

Maystre, L. Y., Duflon, V., Diserens, T., Leroy, D., Simos, J., & Viret, F. (1994). *Déchets urbains: Nature et caractérisation.* Presses polytechniques et universitaires romandes.

Najih, A. (2015). Analyse du système et proposition d'un modèle de gestion des déchets ménagers à khouribga. Application de la technique d'analyse multicritère.

Planchat, C. (2007). Protéger l'environnement: Un objectif pour une grande majorité de Français. *Insee première, 1121.*

Sotamenou, J., De Jaeger, S., & Rousseau, S. (2019). Drivers of Legal and Illegal Solid

Waste Disposal in the Global South—The Case of Households in Yaoundé (Cameroon). *Journal of Environmental Management, 240,* 321-330. https://doi.org/10.1016/j.jenvman.2019.03.098

Sudman, S., & Bradburn, N. M. (1982). *Asking Questions: A Practical Guide to Questionnaire Design.* Jossey-Bass.