

Perception of producer satisfaction and the effect of agricultural financing models implemented by decentralized financial systems in Northern Benin

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ABSTRACT

Decentralized Finance (DeFi) operating in Benin are essential for financing the agricultural sector and for achieving the Sustainable Development Goals. This research contributes to the debate on the effectiveness of agricultural financing models proposed by DeFi in Northern Benin. Two theoretical approaches are mobilized to assess farmers' perceptions: Triandis' interpersonal behaviour model (1979) and the balanced incomplete block design method for analyzing farmers' choices. A total of 585 farmers were surveyed, including 385 financing beneficiaries, using purposive sampling. Data were analyzed with R version 4.3.0 and RStudio version 2022.02.0. The results highlight a preference for individual financing models (61.26%) over group-based models (38,74%), as they better meet the immediate needs of farmers. Regarding the impact of financing models on agricultural factors of production, farmers acknowledge the positive effect of individual financing on the purchase of inputs and equipment, but criticize the inability of group financing models to stimulate overall productivity and land expansion. The overall perception of support systems implemented after financing is negative, as they remain disconnected from farmer's real needs. It therefore appears that while financing models satisfy beneficiaries in terms of immediate operational aspects (inputs, equipment, financial needs), and they fail to address structural expectations such as productivity growth and farmland expansion.

Keywords: Perceptions; Agricultural financing models; DeFi; Northern Benin

1. INTRODUCTION

Agriculture plays a crucial role in the economic development of low-income countries, contributing to the reduction of social inequalities, job creation and food security (FAO, 2018, p.4). In developing countries, particularly in West Africa, economies are largely based on this sector (WB, 2018, p. 2). This sector remains a key pillar capable of stimulating economic growth in regions where it contributes significantly to the Gross

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Domestic Product (GDP) (Mardalena, 2019, p. 234). In Benin, its role in food security and income generation for rural households is indisputable (FAO, 2020, p. 11). It has been demonstrated at the macroeconomic level that a 0.97% increase in total agricultural factor productivity leads to a 51% increase in agricultural productivity (FAO, 2020, p. 16), all of which contributes to improving overall economic growth, reduce trade deficits (Charnovitz, 2014, p.715), and increase household incomes and government revenues (Howse & Langille, 2023, p.2). At the microeconomic level, it has also been proven that an increase in agricultural productivity has a direct impact on food security (Gnedeka & *al.*, 2024, p.2), employment, income levels, poverty reduction (Agani & *al.*, 2024, p.123) and inequality, especially in West Africa (Mourey & *al.*, 2024, p.2).

However, recent levels of agricultural productivity growth, particularly in Africa, have proven to be lower than those recorded in the early 1960s, and as a result, remain too low to address hunger, poverty and food insecurity on the continent (Bjornlund, 2020, p.23). Indeed, evaluations have shown a significant increase in food prices in Africa between 2000 and 2016 despite positive and significant agricultural productivity over the same period (Jayne & *al.*, 2017, p.2), justifying the low nature of these productivity increases. Several studies have highlighted the various factors responsible for this low productivity. These factors include financing constraints which are a major drag on productivity, aggravated by limited access to agricultural land (Traoré & *al.*, 2025, p. 220) and traditional cultivation methods, unfavourable climatic conditions (Yue, 2024, p.10) and a glaring lack of training for farmers (Goudjo, 2023, p. 2). To remove these funding constraints.

Efforts have been made on the part of financial institutions to mitigate these financial constraints through the implementation of different financing models in the goal of improving the level of accessibility to financial services for producers (Suhaib & *al.*, 2026, p. 8). These models are generally grouped into two broad categories, namely individual and pooled financing models. The individual funding model involves providing financial resources directly to a farmer or farm. It allows autonomy in the use of financial resources and adapts to the specific needs of each farmer (Fronza & *al.*, 2024, p. 124). The bundled model, it implies that farmers must be in a group before receiving funding, which implies sharing the costs and risks associated with non-payment. This model promotes the pooling of resources, the reduction of transaction costs, and better collective risk management (Ogouvide & *al.*, 2022, p. 80). However, despite the objectives of these models and their potential benefits, the level of access to credit for producers is still (very) low (Goudjo, 2023, p. 2) on the one hand, and accessibility and efficiency vary according to the financing models on the other hand (Sossou, 2015, p.iii). According to Sossou (2015), for example, access to formal credit in Benin is clearly unequal, favouring farmers with stable incomes, guarantees, or members of agricultural organisations, while the others are rationed. Another study carried out in central Benin with 537 cotton producers in groups revealed that access to formal credit remains very low and that the use of informal credit is almost widespread, despite the availability of formal loans. Finally, the experience of the National Fund for Agricultural Development (FNDA) clearly shows that farmers in groups (at least 5 members) have preferential access to formal credit, unlike isolated individuals who struggle to gather the required guarantees (FNDA, 2022). These few examples sufficiently show that the contribution of the different financing models to producers' access to credit remains mixed. The effectiveness of these models is often assessed through, among other things, the number of actors

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in the agricultural sector, producers more specifically, who have been able to obtain credit during a given period. However, few studies have focused on the assessment of the different procedures for applying for credit; submitting an application is a sine qua non condition for obtaining credit. Indeed, the effectiveness of funding models also depends heavily on the perceptions that beneficiaries have of the application procedures. The procedures that a producer, applying for credit, is confronted with are personal. The producer may have different assessments of the procedures for obtaining credit depending on the conditions offered through the available financing models. In fact, producers, and those in the study region in particular, have a great deal of heterogeneity in terms of resources, experiences, needs and access to financial information (Bidou & *al.*, 2018, p. 2). Understanding the reasons for the low level of access to credit despite the different existing financing models requires examining producers' attitudes and perceptions regarding these models.

In addition, although several studies have focused on assessing the perceptions of agricultural producers, they have all focused on a specific aspect of financing models. This is particularly the case with the work of Janvier & Baco (2016) and Agossadou & Yabi (2023), which exclusively analysed producers' perceptions of the warrantage system. In addition, a study conducted by Binswanger-Mkhize & *al.* (2016) on producers in several Latin American and Asian countries found that distrust of financial institutions is a major barrier to the demand for formal agricultural credit, hence the preference for endogenous financing models such as tontines or village savings and loan associations. These studies, although relevant and very informative, remain partial because they do not take into account the perceptions of funding recipients and are generally limited to a microfinance institution. Also, these financing models are, for the most part, appreciated from the point of view of financial institutions. What do producers think of the different financing models offered by Decentralized Finance (DeFi)? Understanding these perceptions becomes essential to adapting agricultural policies to realities. Thus, the objective of this study is to analyze producers' perceptions of the two main agricultural financing models implemented by financial institutions in Northern Benin.

As part of the debate on the effectiveness and relevance of financing strategies, this study highlights producers' perceptions of the different financing models in the agricultural sector based on quantitative survey data from a randomly selected and stratified sample of 385 producers, in proportion to the number of beneficiaries per type of financing model selected. In addition, by comparing producers' perceptions of different financing models, this research makes it possible to analyze the specific opinions of key players in the agricultural sector who contribute 26.6% to GDP (Amjad, 2023, p. 254). The results of this research would help inform efforts to improve the effectiveness of financing models in the agricultural sector.

2. RESEARCH ANALYTICAL FRAMEWORK

The present study mobilizes two theoretical frameworks of analysis, the theory of interpersonal behavior developed by Harry Triandis (1977) and the balanced incomplete block device of Louviere and Lusk (Louviere & *al.*, 2000, p. 6 ; Lusk & Briggeman, 2009, p. 186) often used to assess individuals' perceptions of economics and agronomy. The combination of the two approaches is innovative because it removes the biases associated with the traditional methods of assessing perception, such as the Likert scale. This method is based on two scales of perception and the evaluation of the coefficient of utility

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Although the Likert scale has demonstrated its effectiveness in analyzing perceptions, it has some limitations. These include the often biased choice of modalities, the lack of compromise between the options evaluated, and the difficulties in interpreting the results obtained (Amadou, 2021, p. 294). To address these shortcomings, a new approach, called the best-to-worst scale, has been developed (Louvière & al., 2013, p. 294). This method allows the modalities to be classified into two categories: those considered the most important and those considered to be the least important. In addition, each modality has an equal probability of being selected as the most or least important, which aligns with the principle of equiprobability (Lusk and Briggeman, 2009, p. 186).

This concept refers to a systematic, logical, and decomposable approach applied to the analysis of individual perceptions in situations of choice. In this study, this approach is operationalized through the Balanced Incomplete Block Design experimental design, which makes it possible to structure the questions presented to agricultural producers in two scales of choice. For example, yes or no ; in order to analyze the different options of choice according to the evaluation criteria of a given question. This device is based on the principles of utility theory and makes it possible to identify individual perceptions among a set of choices without having to compare all possible combinations. Simply put, this theory assumes that individuals choose the option that brings them the most "satisfaction" or utility. By observing the choices made by farmers in the face of different combinations, researchers can deduce which characteristics (or attributes) of the options are most valued by farmers and to what extent.

For Triandis' theory of interpersonal behaviour (1977; 1979); It posits that choice is not only determined by the intentions of individuals, but also by the force of habit, social norms, and enabling conditions. More precisely, according to Triandis (1979) and according to the case at hand, the choice of a funding model depends on three fundamental elements: social norms, i.e., the perceived pressure by the individual to adopt a funding model; attitudes towards the choice made, and personal perception of its constraints. To this is added the strength of habits, defined as the tendency to repeat according to previous experiences.

Figure 1 presents the theoretical analytical framework inspired by the work of Triandis (1979) and the methods of analysis of perceptions as developed by Louvière & al. (2000).

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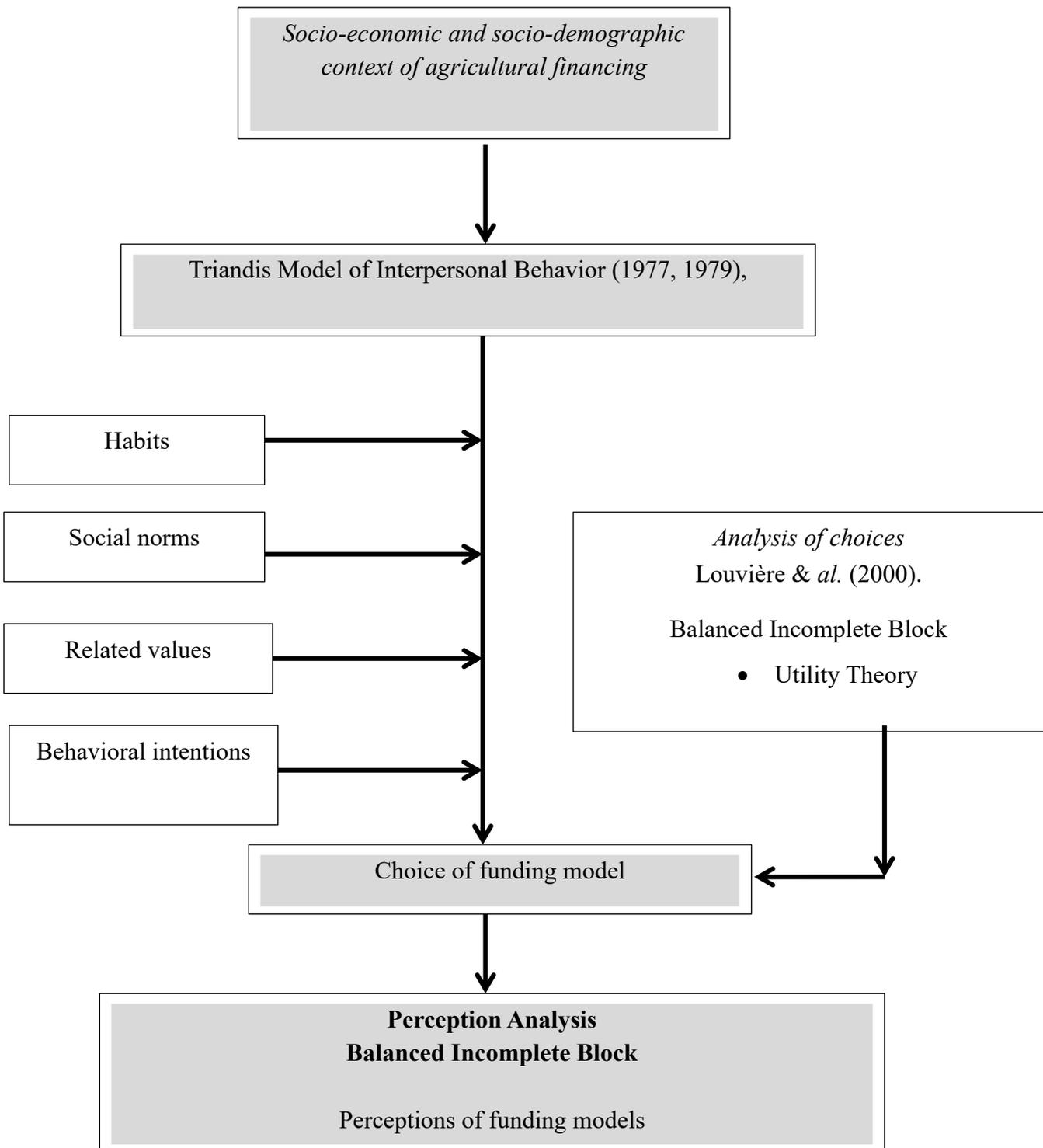


Figure 1: Analytical framework of the study inspired by the work of Triandis (1979), Louvière (2000), and Lusk (2009).

The framework for analyzing agricultural producers' perceptions of financing models is based on an articulation of two complementary approaches: Triandis' (1979) model of interpersonal behaviour and the method of preference analysis based on utility theory. The framework integrates the components of the Triandis model, focusing on the choice of the agricultural financing model. The analysis of perceptions, in

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particular through the mechanism of the balanced incomplete block, makes it possible to analyse the real choices of producers while taking into account comparative logic.

3. MATERIALS AND METHODS

3.1 Study Environment

The study was conducted in four communes in northern Benin, namely Péhunco, Sinendé, Bassila, and Banikoara. These municipalities were selected because of the importance of the agricultural sector in their economy and the strong presence of microfinance institutions (FNDA, 2022). Péhunco, located in the department of Atacora, stands out for its agricultural dynamism and its proximity to strategic commercial areas. Sinendé, a commune in Borgou, remains largely a rural commune marked by a high level of agricultural activity. Bassila, in the Donga, offers a great agroecological diversity, while Banikoara, in the Alibori, is one of the country's major agricultural centres, particularly for cotton cultivation.

According to RGPH 4 data, in the commune of Péhunco, agriculture employs a large part of the active population (77%), showing the strong involvement of the population in agricultural activities (RGPH 4, 2013). The commune of Sinendé also has a predominantly agricultural profile, with more than 56,000 agricultural workers out of a total population of about 88,383 inhabitants in 2013, according to an analysis based on RGPH-4 data. In Bassila, agriculture is the main activity of the population and employs more than 80% of the resident workforce (RGPH 4, 2013). In Banikoara, it employs 85.8% of the active population (RGPH 4, 2013).

Figure 2 below shows the geographical location of the study municipalities,

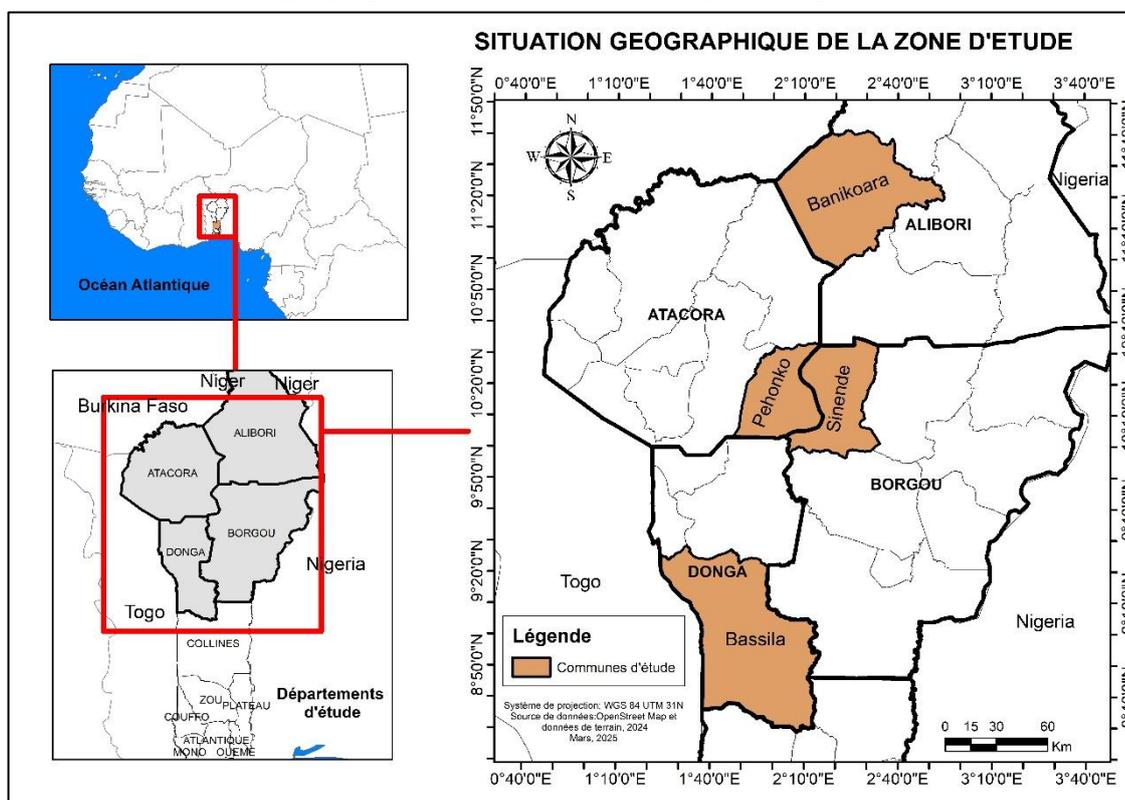


Figure 2: Geographic location of the study area

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In the northern zone, DFS has a particularly developed network of agencies (ANSSFD, 2020). This region remains the largest agricultural production area in Benin, which means that this area receives the largest number of financing granted by microfinance institutions in the agricultural sector (APRM, 2018; ANSSFD 2020) Figure 3 shows the level of concentration of DeFi in the study area.

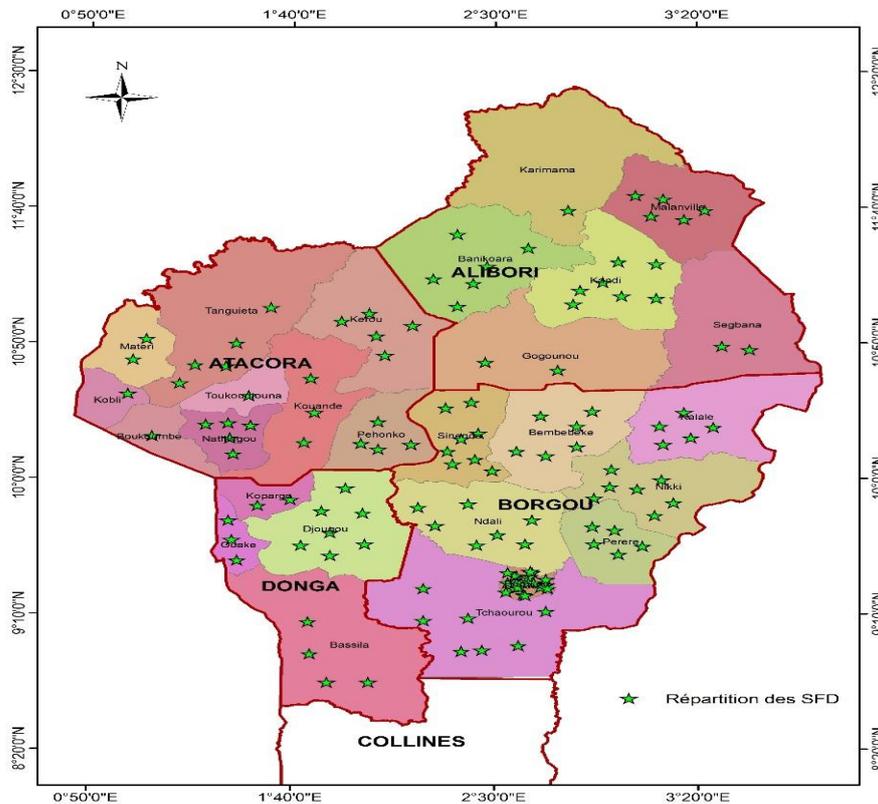


Figure 3. Level of concentration of DeFi in North Benin

3.2 Sampling And Data Collection Method

To constitute the sampling frame for sampling, an exhaustive inventory of the Decentralized Financial Systems (DeFi) operating in the study area was carried out. Particular attention was paid to institutions with at least ten years' seniority. This selection criterion is based on the premise, widely recognized in the literature, that the longevity of an institution is generally an indicator of stability, reliability, and data availability (Kipesha, 2013). Moreover, the attention paid to these DeFi is due to their significant engagement in agriculture financing. The DeFi identified continue to be vibrant, robust and valued by local communities. This demonstrates their solidity and integration into the local socio-economic structure. Once the institutions had been identified, the list of beneficiaries was taken from each DeFi. This database subsequently facilitated the establishment of the sample size, which was determined using Schwartz Cochran's (1977) formula, which is frequently used in empirical research to ensure statistical representativeness, both in quantitative and qualitative terms.

Schwartz's formula is as follows:

$$N = \frac{Z^2 * p(1 - p)}{e^2}$$

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With N which represents the total sample size ;

Z the confidence level according to the reduced centered normal distribution, here the confidence level is 99% with $Z = 2.576$);

e corresponds to the margin of error allowed (here 5%) ;

p represents the proportion of agricultural finance recipients in the study areas. Based on the information collected from the DFS selected for the study, 11,255 beneficiaries of financing were counted out of a total of 34323 beneficiaries of agricultural financing for the study municipalities, which represents a rate of : $p = 32.8\%$. On this basis, the sample size was calculated at 585 producers to be surveyed. The latter were allocated among the four study municipalities according to the relative weight of each municipality: 182 producers for Banikoara, 120 for Pehunco, 154 for Sinendé and 129 for Bassila.

The selection of participants was carried out using purposive sampling. However, for the specific purposes of this chapter, the analysis focused exclusively on producers who have received agricultural financing... Thus, a total of 385 beneficiaries of agricultural financing were surveyed. Table 1 illustrates the proportion of producers surveyed by municipality

Table 1: Number of beneficiaries and non-recipients of agricultural financing surveyed

To	Municipalities	Number of people surveyed	Proportions
	Sinendé	154	17.4 %
	Banikoara	182	31, 11 %
	Pehunco	120	20, 51 %
	Bassila	129	22,05 %
	Total	585	100 %

assess respondents' perception, a two-way scale ("most satisfied" and "less satisfied") was used to collect data from respondents. Thus, the beneficiaries' perceptions of the financing models were collected through questions on the characteristics of the models, their effects on the improvement of the factors of production and the levels of perceived satisfaction.

3.3 Data Analysis Method

The analysis of the data collected in this research was carried out through several methodical steps in order to examine and understand the perceptions of beneficiaries on funding models. The information collected through the structured questionnaires was processed and reviewed using R software version 4.3.0 and Rstudio version 2022.02.0. This step also made it possible to check the quality of the data, clean up missing or outlier data and perform the necessary encodings. Significance tests were performed for descriptive analyses. The utility coefficients (and the relative weight (%)) of the beneficiaries' responses were calculated through the operationalization of the perception analysis model via Rstudio. The utility coefficient (α) comes from the

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theory of utility, according to which each individual seeks to maximize the satisfaction (or utility) he or she derives from a choice among several alternatives. Thus, each modality of a financing criterion is assigned a utility value. Thus, the higher the coefficient, the more advantageous the modality is perceived as advantageous for the beneficiary. The relative weight (%), on the other hand, indicates the importance given to each criterion in the overall evaluation, making it possible to prioritize the perceptions expressed. α)

Operationalization of the Triandis model of interpersonal behavior and the balanced incomplete block experimental design

The analysis of the perception of farmers' choice of the two agricultural financing models is based on the operationalization of the Triandis model of interpersonal behaviour and the experimental design of the incomplete balanced block as developed by Louviere and *al.* (2000), which is based on the principles of random utility theory derived from microeconomics, which makes it possible to model individual perceptions based on declarative choices made by producers. Thus, each response provided by a participant was interpreted as a reflection of an underlying utility. For a respondent *i* evaluating an item *j* (e.g : "*optimization of costs and benefits*"), the utility function U_{ij} has been defined as follows:

$$U_{ij} = V_{ij} + \epsilon_{ij}$$

where:

V_{ij} : the observable component of utility, determined by the intrinsic characteristics of the item (e.g., flexibility of repayment terms).

ϵ_{ij} : captures the individual hazard, reflecting the unobservable factors influencing the choice.

In order to measure the relative impact of each item on overall satisfaction, a weight coefficient α_j was assigned to each evaluation criterion. This coefficient is derived from the difference between the number of respondents who selected "*Most Satisfied*" () and those who chose B_j "*Less Satisfied*" (), normalized by the sample size (W_jN) and the response scale (4 levels):

$$\alpha_j = \frac{B_j - W_j}{4 * N}$$

This formula makes it possible to obtain comparable scores between items, where a $\alpha_j > 0$ indicates a positive perception, and a negative perception. $\alpha_j < 0$

The items were grouped into thematic sections (e.g. "*Impact on productivity*"), and the overall utility of each section () was modelled as a linear combination of the weighted items, adjusted by socio-economic variables (V_k):

$$V_k = \sum_{j=1}^m \alpha_j \cdot X_j + \sum_{s=1}^p \beta_s \cdot Z_s$$

X_j : Binary variables enabled if item *j* is evaluated.

β_s : Coefficients measuring the influence of contextual factors (e.g. sector of activity, size of the company).

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To express the relative importance of each item or section in an intuitive scale (0 to 100%), normalization by exponential function was applied :

$$P_j = \frac{e^{\alpha_j}}{\sum_{j=1}^m e^{\alpha_j}}$$

This transformation ensures the comparability and additivity of choices, facilitating the interpretation of the results.

4. RESULTS

4.1 Socio-Demographic Characteristics of Respondents

Analysis of the data shows that the majority of respondents are men (84%). 54% of the respondents have a low level of education, and only 6% have higher education. Almost all respondents are married (86%). In financial terms, the majority of respondents have average annual net incomes of between 200,000 and 500,000 CFA francs (41%) and in 63% of cases prefer loans from DFS for the purchase of their inputs. Their lending experience is relatively recent, with 60% of people having between 1 and 5 years of experience. The main lending structures are CLCAM (79%), PADME (40%), SIANSON (23%) and BETHESDA (10%) (Table 2).

Table 2: Socio-demographic characteristics of beneficiaries (qualitative variables)

Variables	Modality	Average	p-value	Significance
Sex	Woman	16%	0,0479	***
	Man	84%		
Education	None	54%	2.00E-06	***
	Primary	26%		
	Secondary	14%		
	Upper	6%		
Marital status	Other	0%	0	***
	Single	13%		
	Married	86%		
	Widow	1%		
Revenue annual net	50 000 - 100 000	5%	0	***
	100 000 - 200 000	18%		
	200 000 - 500 000	41%		
	500 000 - 1 000 000	25%		
	More than 1,000,000	11%		
Purchase of inputs	Cash	35%	0	***
	DeFi Credit	63%		
	Subsidy	2%		

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Lending Experience		1 to 5 years	60%	1.00E-06	***
		5 to 10 years	36%		
		10 years and up	4%		
Loan Structure	CLCAM	Yes	79%	0	***
		No	21%		
	PADME	No	60%	8,00E-06	***
		Yes	40%		
	BETHESDA	No	90%	0	***
		Yes	10%		
	SIANSON	No	77%	0	***
		Yes	23%		
	Other	No	87%	0	***
		Yes	13%		

4.2 Farm Finance Models and Types of Associated Financial Services

Two financing models are implemented by the DeFi in the municipalities of investigation (Table 4). The analysis of the table highlights a preference for individual financing models (61.26%). For this model, production credit, which allows beneficiaries to finance the acquisition of agricultural inputs (seeds, fertilizers, labor, etc.) necessary for the conduct of agricultural activities, remains largely dominant (73.90%). Others use crop credits (18.01%) and equipment credits (8.09%) for specific needs, relating to the post-harvest phase and the improvement of production means. It should be noted that the harvest credit is a type of financing designed for farmers to cover expenses related to the harvest season. This loan is used to cover expenses related to harvesting activities, including the costs of labour, transportation, and storage of agricultural products. In addition, the equipment loan is a loan intended for the procurement of equipment essential for production. This system offers farmers the opportunity to acquire equipment in order to optimise their yield. Unlike crop credit, which is often short-term, equipment credit is designed for long-term investments that impact multiple production seasons.

At the same time, for the grouped financing model, ordinary group credit, which consists of granting loans to informal or semi-formal groups of producers on the basis of the collective responsibility of their members, is the most widespread (58.24%), because of the solidarity and social guarantee it offers. This form of pooled financing model is followed by the loan to village groups (GV) which accounts for 21.18 per cent, the grouping credit to rural women representing 13.53 per cent, the community credit (6.47 per cent) and the warrantage (0.59 per cent). The loan to village groups (GV), on the other hand, targets groups structured at the community level, often recognized by the local authorities, and makes it possible to finance agricultural or para-agricultural activities. The credit to rural women is specifically dedicated to women's groups. It supports economic initiatives carried out by women in a logic of social inclusion. Community credit is intended for collective projects for the benefit of a community, often managed by local committees or associations. For

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warrantage, this type of credit is guaranteed by the secure storage of the crops in stores. The producer or group can obtain a credit while waiting for a better period of sale of the products. Overall, looking at information gathered in the field and from DFS, the pooled funding model is based on solidarity between members of a group or collective. It reduces the risk of non-payment risk through social pressure and mutual commitment.

Table 3 : Financing Models And Types Of Credit Adopted By Beneficiaries

Funding model	Type of credit	(%)	Total (%)	p-value
Pooled funding model	Ordinary group loan	58,24%	38,74%	1,00E-05
	Group loan to GV	21,18%		
	Group credit to rural women	13,53%		
	Community group loan	6,47%		
	Warrantage	0,59%		
Individual Funding Model	Production credit	73,90%	61,26%	
	Crop loan	18,01%		
	Equipment loan	8,09%		

4.2 Beneficiaries Perceptions Of Funding Models

4.2.1 Recipients Perceptions Of The Characteristics Of Funding Models

a. Individual Model

An assessment of recipients' perceptions of the features of the individual funding model reveals that the model responds positively to some needs, while exhibiting weaknesses in other aspects. The model's ability to meet the financing needs of beneficiaries is positively assessed, with a positive coefficient of 0.085 and a significant relative weight of 18.92%. The vast majority of recipients (210 out of 222) report being more satisfied with this aspect, confirming that the model is effective in meeting their immediate financial needs. However, major concerns remain. The interest rate received is the main source of dissatisfaction, as indicated by the negative coefficient of -0.200. In this aspect, satisfaction is very low, with only 40 people declaring themselves "more satisfied" compared to 182 "less satisfied". Similarly, the ease of meeting the conditions of access is perceived very negatively, with only 22 beneficiaries satisfied. In addition, the most important aspect for beneficiaries, access to training and technical support, which represents the highest relative weight (21.62%), is also a source of high dissatisfaction. Only 42 beneficiaries are satisfied, compared to 180, who are less satisfied. Thus, despite some efficiency in providing adequate financing, the model has significant shortcomings in terms of support, flexibility, access costs and interest rates, aspects which are considered important by beneficiaries for sustainable effectiveness. Table 4 presents recipients' perceptions of the characteristics of individual funding models

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Table 4: Recipients' perception of the characteristics of individual funding models

	Evaluation criteria	More Satisfied (B _j)	Less satisfied (W _j)	Workforce (N)	Coef (alpha _j)	Exp(alpha _j)	Relative Weight (P _j)
Individual model	Level of financing obtained (reinforcement of the means of production)	210	12	222	0,085	1,089	18,92%
	Ease of meeting the conditions of access (Ease of access)	22	200	222	-0,030	1,031	10,67%
	Interest rate received	40	182	222	-0,200	0,818	10,81%
	Duration and repayment terms	130	92	222	0,050	1,051	11,00%
	Access to training and technical support	42	180	222	-0,045	1,046	21,62%
	Additional services (insurance, subsidy)	100	122	222	-0,020	1,020	12,50%
	Adaptation of financing to new challenges (climate, markets, land fertility, financial constraints, etc.)	21	201	222	-0,035	1,036	14,48%
	Overall Perception (Average)	80,72	141,28	222	-0,042	-	100%
	Standard deviation	52,07	--	--	0,1001	-	-

a. Bundled Model

The analysis of the results on the beneficiaries' perceptions of the characteristics of the pooled financing model

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shows that the model is distinguished by its ability to facilitate access to funds and by the quality of the technical support provided to groups and associations in the management of the funds. Thus, the ease of meeting the conditions for access to financing is positively perceived by the beneficiaries, with a relative weight of 24.64%. Access to training and technical support is also a positive aspect (coefficient of 0.070), perceived favourably by 85 beneficiaries and representing a relative weight of 18.87%. However, the level of funding obtained, a criterion of great importance (relative weight of 24.56%), is perceived negatively, with a coefficient of -0.35. Only 45 people are "more satisfied" compared to 94 "less satisfied" which indicates that the amounts of loans granted are insufficient. The interest rate is the main source of dissatisfaction, with a coefficient of -0.3 and 114 beneficiaries declaring themselves dissatisfied. The adaptation of funding to new challenges is also perceived negatively, with 99 beneficiaries "less satisfied." It is therefore noted that for the grouped financing model, the main source of dissatisfaction concerns the interest rate, followed by the amount of financing deemed insufficient and the lack of adaptation to external challenges (climate, markets, land fertility, financial constraints, etc...). Table 5 presents recipients' perceptions of the characteristics of pooled funding models.

Table 5: Recipients' perception of the characteristics of pooled funding models

	Evaluation criteria	More Satisfied (B _j)	Less satisfied (W _j)	Workforce (N)	Coef (alpha _j)	Exp(alpha _j)	Relative Weight (P _j)
Bundled Model	Level of financing obtained (reinforcement of the means of production)	45	94	139	-0,350	0,704	24,56%
	Ease of meeting the conditions of access (Ease of access)	100	39	139	0,065	1,067	24,64%
	Interest rate received	25	114	139	-0,300	0,740	9,00%
	Duration and repayment terms	70	69	139	0,045	1,046	15,10%
	Access to training and technical support	85	54	139	0,070	1,072	18,87%
	Additional services (insurance, subsidy)	50	89	139	-0,020	1,020	12,90%
	Adaptation of	40	99	139	-0,035	1,036	13,80%

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financing to new challenges (climate, markets, land fertility, financial constraints, etc.)							
Overall Perception (Average)	59.29	79,71	139	-0,075	-	100%	
Standard deviation	42,08	--	--	0,2013	-	-	

4.3.2 Perceived Adequacy Of Different Funding Models

Analysis of the results in Table 6 reveals that for the individual funding model, the criterion that is well perceived by the beneficiaries is "Meets the financial needs of the producer." This criterion stands out as the most popular, with a positive coefficient of 0.120 and a relative weight of 27.40%, making it the most important criterion. On the other hand, the "lack of flexibility in terms of repayment" is the main point of criticism. It has a negative coefficient of -0.200 and a relative weight of 22.52%. This result shows the difficulties encountered by beneficiaries in the face of repayment conditions that are not well suited to their fluctuating incomes. The criterion "Adequate model with measurable positive results" obtains a significant weight of 24.05% and a positive coefficient of 0.150. This translates into a recognition on the part of the beneficiaries that the model, despite its limitations, generates tangible results on the ground. "Cost and benefit optimisation" is perceived more negatively, with a coefficient of -0.1. This coefficient shows that beneficiaries consider the model to be ineffective in terms of return on investment, with 142 respondents dissatisfied compared to only 80 satisfied. The overall perception, although positive with a coefficient of 0.2675, shows a strong heterogeneity of opinions. Some beneficiaries value meeting financial needs and measurable results, while others strongly criticize the lack of flexibility and cost optimization.

As for the overall perception of beneficiaries on the pooled financing model, it is negative, as indicated by the average coefficient of -0.024. The model struggles to meet the most important criteria for beneficiaries. The lack of flexibility in the repayment terms is a major source of dissatisfaction, with a coefficient of -0.150 and a relative weight of 28.01%. Similarly, the perception of beneficiaries is that the model does not fully meet their financial needs, although this is the most important criterion (relative weight of 35.36%). The majority of beneficiaries say they are less satisfied on this point. "Cost and profit optimization" is also viewed negatively. Despite these weaknesses, the model has positively perceived strengths. The beneficiaries believe that it is an "adequate model with measurable positive results", as evidenced by a coefficient of 0.200. In conclusion, while the pooled financing model generates concrete results, it fails to meet the basic needs of beneficiaries in terms of financing needs and flexible access conditions, which explains the overall negative perception with a coefficient of -0.024. Table 7 presents the assessment of recipient satisfaction with the pooled funding model.

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Table 6 : Assessment of beneficiary satisfaction with the individual funding model

	Evaluation criteria	More Satisfied (B _j)	Less satisfied (W _j)	Workforce (N)	Coef (alpha _j)	Exp(alpha _j)	Relative Weight (P _j)
Satisfaction with individual funding models	Low flexibility in repayment terms	51	171	222	-0,200	0,818	22,52%
	Adequate model with measurable positive results	121	101	222	0,150	1,162	24,05%
	Optimization of production costs and profits in financing	80	142	222	-0,100	1,105	26,03%
	Meets the financial needs of the producer	129	93	222	0,120	1,127	27,40%
	Overall Perception (Average)	86,25	135,75	222	0,2675	-	100%
	Standard deviation	61,32		0.000			

Table 7: Assessment of beneficiary satisfaction with the pooled funding model

	Evaluation criteria	More Satisfied (B _j)	Less satisfied (W _j)	Workforce (N)	Coef (alpha _j)	Exp(alpha _j)	Relative Weight (P _j)
Satisfaction with pooled funding models	Low flexibility in repayment terms	41	98	139	-0,150	0,860	28,01%
	Adequate model with measurable positive results	81	58	139	0,200	1,221	17,60%
	Optimization of production	52	87	139	-0,100	1,105	19,03%

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costs and profits in financing							
Meets the financial needs of the producer	47	92	139	-0,120	1,127	35,36%	
Overall Perception (Average)	55,25	83,75	139	-0,024		100%	
Standard deviation		60,04	0,000				

4.3.3 Overall Assessment Of Beneficiary Satisfaction Based On The Alpha Utility Coefficient (α)

The overall assessment of beneficiaries' satisfaction with funding models reveals a mixed perception. The ability of financing models to meet the concrete needs of beneficiaries, increase input purchases, facilitate the acquisition of agricultural equipment and improve yields is well perceived by beneficiaries. These elements reflect a favourable perception of the immediate and visible effects of financing on agricultural productivity. On the other hand, some aspects had a negative impact on satisfaction. This is the case for the flexibility of reimbursements, which is perceived as restrictive, as well as the optimisation of the costs incurred, which is considered ineffective and support is considered unsuitable for local realities. In addition, the absence of impact on the structural productive capacity of some farms is also reported. Criteria with an ambivalent effect are also observed, in particular support, which is considered useful but is marred by practical shortcomings. Finally, although some beneficiaries perceived an increase in their capacity to invest, a majority deplored a limited or temporary impact.

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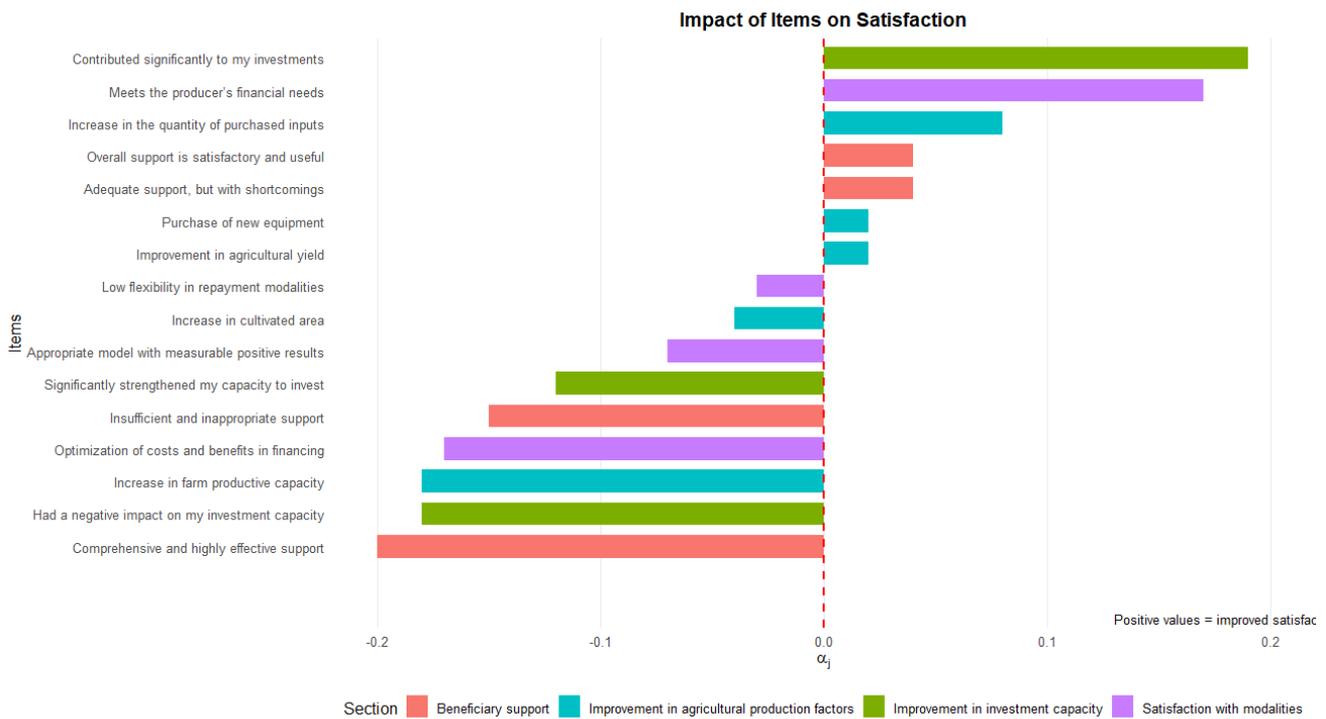


Figure 3: Overall Recipient Perceptions of Funding Models

From all the above, the analysis of the graph shows that the financing models satisfy the beneficiaries on immediate operational aspects (response to financial needs), but fail to meet structural expectations (flexibility, cost optimization, qualitative support).

5. DISCUSSION

The comparative analysis of the perceptions of beneficiaries highlights significant contrasts between the individual and group funding models. The individual model is distinguished by its ability to effectively meet the immediate financial needs of beneficiaries. This finding corroborates the observations of Zeller & Sharma (1998, p.15) that direct access to credit improves the investment capacity of farm households. However, the strong dissatisfaction with the interest rate (-0.200) and the complexity of access conditions are in line with the findings of Gubert & Roubaud (2021, p.10), who point out that high borrowing costs limit the inclusive scope of financial arrangements in rural areas.

Regarding the grouped model, beneficiaries appreciate its ability to facilitate access to financing and to offer appropriate technical support, confirming the importance of social capital and solidarity in the success of collective schemes (Karlan, 2007, p.52). Nevertheless, dissatisfaction with the amount of credit and the interest rate reveals structural limits. The overall assessment of beneficiary satisfaction, based on the α utility coefficient, reveals a shared perception of agricultural financing models. Overall, the results confirm the beneficiaries' preference for individual financing, which is perceived as a lever for agricultural intensification, while pooled financing struggles to meet the essential expectations of beneficiaries. However, several constraints are listed by the beneficiaries, especially with regard to the terms of repayment and the interest rates applied.

Regarding the terms of repayment, the dissatisfaction expressed by beneficiaries is in line with the conclusions

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of Mani & Bouchard (2015, p. 106), according to which small producers have difficulty meeting fixed deadlines, given the volatility of agricultural yields. This criticism is also noted by Efe (2025), who points out that the inflexibility of repayment systems increases the risk of repayment default.

In addition, the support provided to beneficiaries by the DeFi is considered useful but insufficient. This assessment is in line with the conclusions of Adégbidi & al. (2021), who note that limited technical monitoring undermines the effectiveness of agricultural credits. However, more positive results have been observed in areas where DeFi work in partnership with clusters, as reported by Mandiangu (2025), who shows that integrated financing models, combining financial support and training, are better followed. Regarding investment capacity and financing limitations, our results confirm the findings of Romain & Tenekeu, (2022), who show that financing has a positive effect on short-term investments, especially for the purchase of inputs and equipment. However, contrary to Ethier (2024), who considers that microloans are sufficient to stimulate agricultural growth, our study shows the need for more flexible financing models, taking into account, for example, medium- and long-term loans in order to sustainably strengthen the productivity and resilience of agricultural producers.

6. CONCLUSION

The results obtained in the evaluation of the perceptions of beneficiaries in Northern Benin on financing models show that they have a marked preference for individual financing models, which are more appropriate to their immediate financial needs and generate perceptible effects on productivity. However, the bundled model, while beneficial for solidarity and support, is not capable of effectively meeting the essential requirements, including access to flexible and adequate funding. These findings encourage us to rethink the schemes by incorporating more flexibility in reimbursements, better adaptation to local realities, and a stronger balance between financial efficiency and structural support for beneficiaries.

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