



# Assessing the Acceptability and the Feasibility of an Agricultural Package of Technologies for Risk Management in Southern Haiti

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**Abstract** Haitian farming faces serious climate risks. Losses due to hurricanes, droughts, floods, and diseases seriously threaten productivity. This paper aimed to study the feasibility and acceptability of agricultural technology packages that could help manage risk while improving the productivity of farming in Haiti. Significant risks faced by farmers include uninsurable disasters due to their systemic and catastrophic nature. Therefore, a package of technologies including a paid-in-kind "stabilization account" component may be an appropriate financial tool for risk management. Are Haitian farmers open to such innovation? To answer this question, we collected data from 28 agricultural experts and 1,400 farmers, including 234 maize farmers in southern Haiti, and adopted the new product development (NPD) process to test the feasibility of the concept. We used the Spearman correlation, multinomial logistic regression, and linear regression to determine factors affecting the openness of Haitian farmers to innovation. We also conducted the Cochran-Mantel-Haenszel test to analyze the association between "financial inclusion" and "openness to innovation." Based on the results, 70% of farmers expressed their willingness to pay 6% to more than 12% of their harvested crop as a stabilization account. Farmers with "financial inclusion" are expected to be twice as likely to adopt innovative technologies, while farm size, gender, household size, and revenue had a significant positive impact on openness to innovation. However, contrary to the trends found in literature, we found that risk aversion may positively affect the acceptance and adoption of some technologies. The results also suggest that, in Haitian farming, risks linked to natural disasters are more strongly related to financial incapacity than uncertainty. Therefore, access to proper just-in-time inputs complemented by a financial tool to overcome uncertainty will significantly boost the adaptability and resilience of Haitian farmers toward climate risks.

**Keywords** climate risks, product development, stabilization account, technology adoption

## INTRODUCTION

Natural hazards represent a severe issue disrupting farming activities in Haiti. Between 1990 and 2008, Haiti was the Caribbean country most affected by natural disasters (3 droughts, one epidemic,

22 floods, 23 storms, and hurricanes) (Weissenberger, 2018). Regions with exceptionally high production in agriculture generally present higher vulnerability to natural risks and disasters (earthquakes, landslides, floods, hurricanes, and droughts) (UNDP, 2015). In the aftermath of Hurricane Matthew in 2016, the agricultural sector was most affected; with losses and damages estimated at 603.8 million dollars (around 4.3% of the country's GDP at the time), 80% of the agricultural plantations were destroyed in its path (Icart, 2017). The southern peninsula of Haiti is particularly exposed to tropical storms, hurricanes, floods, and landslides (IFAD, 2022). Haitian agricultural producers, who already operate with inadequate working capital, additionally find themselves confronted with various risks accelerating the process of decapitalization. Thus, an appropriate model of Haitian agriculture should put risk mitigation first (Bureau et al., 1994) because exposure to uninsured risks is a proven major cause of low yields, slow growth, and persistent poverty (Carter et al., 2015). Over 20% of the country's GDP is from agriculture (Vansteenkiste, 2022); therefore, the agricultural sector demands serious consideration despite its high-risk exposure.

Technology refers to tools and techniques or knowledge, ideas, and methods people use to achieve an activity (Dholey, 2019). In agriculture, climate-smart technology has been used for risk mitigation, such as drought-resistant seed, rescheduling planting, and micro-irrigation (Tanti et al., 2022). Therefore, adopting technology (tools and techniques) for managing climate risk may be an essential alternative for Haitian farmers. In addition, agribusiness firms supplying inputs to farmers may need to provide new products and services. Thereby, this research provides insights relevant to the acceptability and feasibility of integrating stabilization accounts in an agricultural package of technologies in Southern Haiti as tools and techniques for managing risks linked to climate hazards. The southern peninsula of Haiti is particularly exposed to tropical storms, hurricanes, floods, and landslides (IFAD, 2022). Previous works mention the risk aversion of Haitian farmers (Bureau et al., 1994) and its possible negative impact on technology adoption in general (Murray and Bannister, 2004; Macours et al., 2018). These works focused on lessons learned from agroforestry projects and a pilot phase of subsidizing technology transfer. For this reason, our study provides a specific view of how adopting technology to manage hazards may be approached differently.

Armstrong et al. (2014) suggest eight (8) stages to develop a new product: idea generation, idea screening, concept development and testing, marketing strategy development, business analysis, product development, test marketing, and commercialization. As a feasibility study, this research covers the three initial phases of a new product development process (NPD), the purpose of which is to find out whether Haitian farmers are willing to accept such innovation. Continuous and discontinuous innovations are inevitable for all business activities regarding productivity improvement and risk management. The NPD process is suitable for continuous and discontinuous innovation (Corso and Pellegrini, 2007); therefore, we focused on this process to guide our methodology.

In the remaining part of this work, after clarifying the content of the package of technologies, we present a brief review of the "stabilization account," the study's objectives, the methodology used, the results, the discussions, and the conclusions with some recommendations.

**The package of technologies:** It was demonstrated by Valcin and Uchiyama (2021) that an adequate package of technologies has a significant positive impact on productivity in southern Haiti. This package included plowing service, certified seed, fertilizers, irrigation, and pesticides. These inputs would be provided to farmers in the contract framework as a loan. Besides, farmers mentioned that climate risk may prevent them from reimbursing their credit. This feedback is the basis for testing the feasibility of including a financial tool, the "stabilization account," as a risk management component in the package.

**A brief review of "stabilization accounts":** Several approaches to agricultural insurance have been implemented worldwide (Nair, 2010); each country finds a more suitable scheme based on its situation (Kalfin et al., 2022). However, for countries or regions where catastrophic risks are frequent, risk management tools such as stabilization accounts for farmers are increasingly being considered (ČOP and Njavro, 2020).

According to Diaz-Caneja et al. (2009), "the stabilization accounts is a form of self-insurance. They consist of individual accounts where farmers put in a certain amount of money every year.

Which they can withdraw in a year of big losses. Stabilization accounts can be based on yield, revenue, or other indices." The stabilization accounts will be managed as a mutual fund. It is based on the accumulation of reserves from participants' contribution (in kind, in our scenario) from which members will receive support in the event of a loss according to the arrangement between farmers and the managing company (Meuwissen et al., 2013; Kislingerova and Spika, 2022). Risks such as drought and hurricanes are examples of systemic and complex for insurers to diversify (Kislingerova and Spicka, 2022); they are hard to insure. Having a disaster-based stabilization account paid in kind as part of a mutual fund can be an excellent financial tool for managing risk for Haitian farmers. The stabilization account is the most innovative aspect of this research. Its acceptability by farmers is the ultimate purpose of this feasibility study. This alternative has been chosen instead of the traditional form of agricultural insurance because we assume that Haitian farmers' most significant risks are insurable.

**Conceptual framework:** The concept consists of an arrangement between firms and farms, through which farmers will receive a package of technologies on credit from the firm after a subscription fee is paid in kind. Farmers will repay the firm at harvest time by returning the crop-equivalent value of the granted package. According to a prior agreement, the firm will also buy the farmer's harvested crop. The subscription fee paid in kind will be held as a contribution to the stabilization account of each farmer and will vary according to the plot size. We are testing the following concept: an agreement between the firm and the farm. This institutional arrangement will help farmers access high-quality inputs on time and credit. We aim to reduce the inability to meet the crop calendar while offering specific coverage in case of significant loss. Consequently, it is advantageous for firms to provide risk management tools to their clients (farmers), as it helps to protect, increase, and sustain their investment (Maggio and Sitko, 2019).

## **OBJECTIVES**

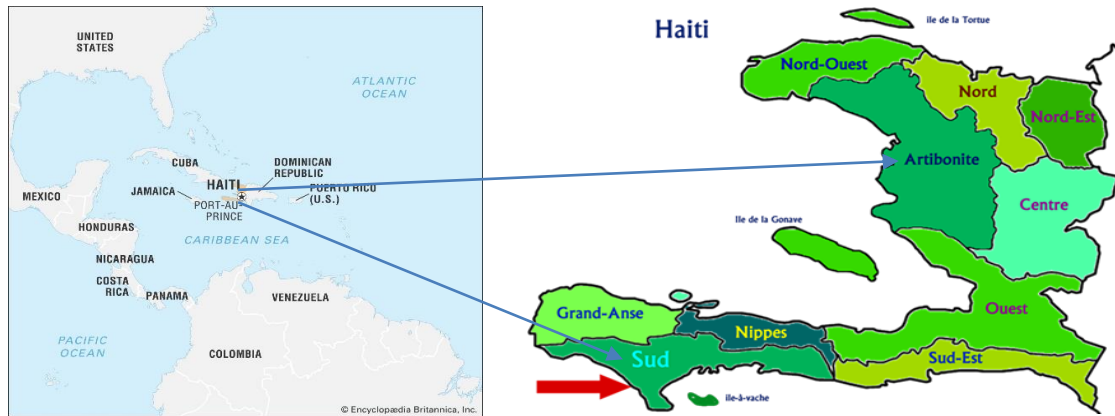
This study assesses the Acceptability and Feasibility of Integrating Stabilization Accounts in an Agricultural Package of Technologies among farmers in Southern Haiti. Specifically, the study aims include: i) discovering the perception of Haitian agricultural experts on introducing a climate-smart package of technologies to Haitian farmers, ii) identifying the relationship between farms and farmers' characteristics and the propensity to adopt new technologies, and iii) evaluating the Haitian farmer's willingness to pay (in-kind) for the agricultural new technologies (Disaster-based Stabilization Account (DSA)) through a contractual agreement.

## **METHODOLOGY**

Two categories of data were used in this research:

**Primary data:** Besides the variables from the primary data that we used to analyze the determinants of farmers' openness to innovation, some additional variables necessary for the idea screening and the concept testing, such as the willingness to accept and to pay, were collected in the summer of 2022 in the framework of this study. Two samples were surveyed for this purpose: a sample of 28 Haitian agricultural experts and a sample of 234 farmers. A Google Form was used for data collection among experts; however, a direct paper survey was distributed to farmers. Experts were asked to give the concept a score (from 0-100%) based on the following criteria: "How much will the product meet a need? Will it offer superior in-use value? Can it be distinctively advertised? Will the product deliver the expected sales volume, sales growth, and profit?" For each question, 70% was considered as the target to conclude validity. We adopted this methodology from Toubia and Florès (2007). This information was explicitly used to conduct a qualitative analysis. In addition, key informants were interviewed for a comprehensive understanding of the sector. This sub sample includes the Director of the Organization for the Rehabilitation of the Environment (ORE), the Dean of the Faculty of Agricultural Sciences and Environment at Quisqueya University (FSAE/UniQ), the Director of the Agro-socio-economy of FSAE/UniQ, a former employee of the Financing and Agricultural Insurance

System in Haiti (SYFAAH), an employee of the Industrial Development Fund (FDI), and an employee of Haitian Foundation for Sustainable Agricultural Development (FONHDAD). They were asked to give their expert opinion, on the importance, the advantages, inconveniences, and challenges of the proposed package concept. Primary data were collected from farmers in the Sud district of Haiti; however, secondary data also cover an additional district called Artibonite (Fig. 1).



**Fig. 1 Location of the study area**

**Secondary data:** In the fall of 2022 and winter of 2021, a survey targeting more than 1,200 farmers was conducted by Quisqueya University and the Ministry of Agriculture in Haiti, funded by the Interamerican Development Bank. Until our study, this database remained unused for similar research purposes. Variables related to our objectives found in this database were used in this paper. This information enabled us to make a quantitative analysis, including modeling and previsions.

For data analysis, multinomial logistic regression and the Cochran-Mantel-Haenszel test were used through the Statistical Package for Social Science (SPSS). The techniques were used respectively to analyze factors affecting openness to innovation and the association between financial inclusion and openness to innovation. The New product development process is used as the guideline for this research project. Three steps are taken in this paper: ideation, idea screening, and concept testing.

## RESULTS AND DISCUSSIONS

### The General Situation of Haitian Farmers

The interview with key informants revealed that farmers usually begin in risky agricultural timeframes because of their inability to start their cultural operations on time. The crop calendar is so tight in Haiti that even slight delays may lead the farmer into the beginning of spring's heavy rain or the cyclonic season (June to November). Our study defines *uncertainty* as a lack of knowledge or data on future events based on Machiels' findings (Machiels, 2023). In Haitian farming, risks linked to natural disasters seem more correlated with financial incapability to observe an ideal crop calendar than general uncertainty.

### Expert Perception of the Firm-Farm Concept

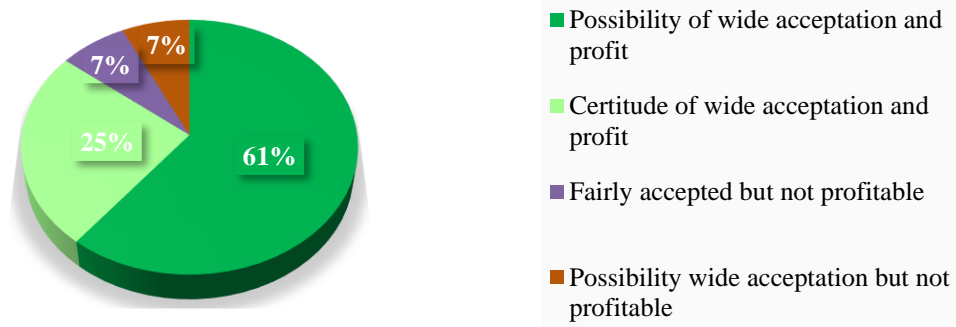
For the idea screening, each expert surveyed was an agronomist. Among the 28 experts, 16 participants had 10 to 38 years of experience, and 9 participants had experience working in financial institutions. They were asked to score the firm-farm concept (from 0 to 100%) based on the questions from Table 1.

**Table 1 Screening result of the concept according to expert point of view**

Label / Indicator	Score Level	Validity
Will the product meet a need?	100%	High
Does the product offer superior in-use value?	92%	High
Can the product be distinctively advertised?	59%	Fair
Does the company have the necessary know-how and capital?	60%	Fair
Will the product deliver the expected sales volume, sales growth, and profit?	86%	High

Note: Number of respondents=28, Source: Survey by authors, 2022

When questioned about the possibility of success, in terms of acceptability, adoption, and profit, their answers were as illustrated in Fig. 2.



**Fig. 2 Experts' points of view on the prospective success of the concept**

Results shown in Table 1 and Fig. 2 suggest that experts highly score the concept's potential ability to meet a need, its superior in-use value, and its expected financial success. However, it will require more effort to build awareness and may require additional know-how and capital. These efforts do not limit the concept quality as innovation is always costly, risky, and requires knowledge capital (Laperche, 2013; Zambon and Monciardini, 2015).

**Farms and Farmers' Characteristics and the Propensity to Adopt New Technologies**

In this section, we highlight a key finding suggesting that aversion to risk linked to natural hazards may boost the propensity to adopt new technologies to mitigate those risks. This could be considered a sort of risk preference influenced by loss aversion (Filiz et al., 2020). Many factors have already been identified for their impact on technology adoption. Some of them have been confirmed in the Haitian farmer's framework; some factors have been expressed differently. Farmers from this area are not significantly different in education level since most have only completed primary education. Table 2 shows how the relevant factors affect their openness to innovation.

**Table 2 Factors affecting the openness of farmers to technology for risk management**

	B	S.E.	Wald	df	Sig.	Exp(B)
Gender	-.463	.172	7.200	1	.007	.630
Age	-.004	.005	.714	1	.398	.996
Revenue	.000	.000	16.824	1	.000	1.000
Farm Size	.985	.203	23.491	1	.000	2.677
Household Size	.113	.041	7.441	1	.006	1.119
Org. Membership	-.365	.135	7.300	1	.007	.694
Constant	.322	.330	.954	1	.329	1.380

Note: Dependent variable: Openness to innovation; Number of respondents: 1078. The model was well fitted as shown by the Omnibus Tests of Coefficients (Chi-square: 83.8; Sig.: .000) and the Hosmer and Lemeshow Test (Chi-square: 10.3; Sig.: 0.244). However, the Nagelkerke R Square was relatively low (0.10), therefore including more variables in the model might increase the explanatory power.

Source: Computed from FSAE-UniQ data by the authors

Female Haitian farmers were more likely to accept new technologies, which is opposite to the findings of Doss (2001) who found that female African farmers were less likely than their male counterparts to adopt improved crop varieties and management systems. However, this result is in line with what was observed in Zimbabwe (Masuka et al., 2016), as well as a New Zealand case (Brown and Roper, 2017).

Farmers with a higher revenue were more capable of affording new technologies; by acquiring good quality or lasting tools, they enact changes less frequently than farmers with lower revenue. In addition, low-revenue farmers have much to lose; adoption decisions appear rational. Therefore, if there is no direct benefit, farmers will not adopt (Suri, 2011).

Household size could affect the decision to positively adopt new technology. Suppose the new technology will require additional routine maintenance and operation. In that case, it may be more adapted to a bigger family (Uhunamure et al., 2019). However, if it is seen as an opportunity to diminish labor, it will be more attractive to smaller households.

Like the Haitian case, most studies agreed on a farm size's positive effect on technology adoption because, in many cases, technologies help farmers reduce the cost and difficulties of farm operations (Gargiulo et al., 2018). However, Mwangi and Kariuki (2015) suggest a mixed effect.

Ultimately, having affiliation with some local organization or being part of a farmers' association is known to influence the adoption of new technology (Ruzzante et al., 2021). However, in some cases, the effect may differ based on the type of technology (Buyinza and Wambede, 2008; Chuchird et al., 2017); these groups will also influence individual decisions.

### Association Between Openness to Innovation and Financial Inclusion

“Having a bank account” is critical evidence of “financial inclusion” (Karlan and Morduch, 2009; Brune et al., 2016; Grohmann et al., 2018). The Cochran-Mantel-Haenszel was used to analyze the association between financial inclusion and openness to innovation using a sample of 1,078 Haitian farmers included in the original survey data. They were asked whether they had owned a savings account within the past five years. Table 3 shows a significant association between “financial inclusion” and the “Openness to Innovation.” According to the estimated Odds ratio, a farmer with “financial inclusion” tends to be 1.5 times more disposed to accept and use new technologies. A farmer who is open to new technology and has financial inclusion will be a potential target for the developing concept.

**Table 3 Crosstabulation and tests of conditional independence**

		Financial inclusion		Total		Chi-squared	df	Asymp. sig (2-sided)
		No	Yes					
Openness	No	367	159	526	Cochran-Mantel-Haenszel test	10.554	1	.001
	Yes	333	219	552				
Total		702	378	1,078	Est. odds ratio	1.518		.001

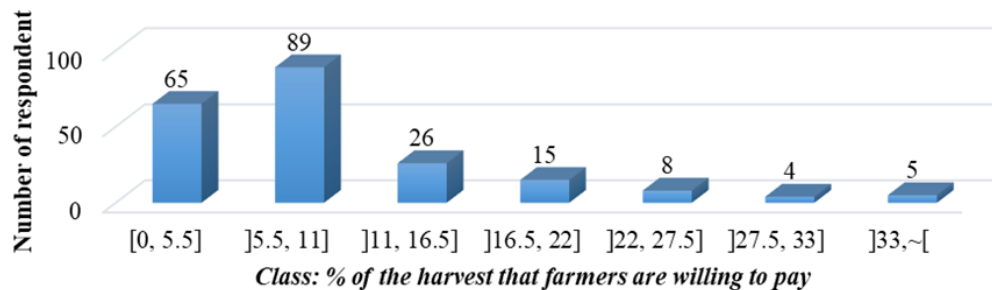
Source: Computed from FSAE-UniQ data by the authors

With the integration of the financial component (disaster-based stabilization account) for risk management, farmers must have a bank account to join the contract. Therefore, it is a good antecedent for farmers to have financial inclusion history because it enhances access to financial services such as credit and insurance (Peprah et al., 2020).

### Farmer's Willingness to Pay (In-kind) for Agricultural New Technologies (WSA)

At the beginning of all interviews, the concept features were explained in detail to farmers, as described in the conceptual framework section. Then, we asked questions concerning their understanding of the concept, willingness to accept the agreement, and willingness to pay in-kind as an account deposit. Respondents were primarily male (91%) and between 22 and 82 years old,

averaging 47.5 years old. They had anywhere from 0 to 17 years of schooling, with 32% having at least seven years (up to the secondary level). As a result, seventy percent of farmers express a propensity to accept the arrangement by paying from approximately 6% to more than 12 % of the harvested crop as a stabilization account, as shown in Fig. 3. This percentage refers to the subscription fee which will be held in the stabilization account. This contribution will return to the farmer in the event of a qualifying natural hazard as stipulated in the agreement.



**Fig. 3 The percentage that farmers are ready to pay from their harvest**

## CONCLUSIONS AND RECOMMENDATIONS

This study proposes a systemic approach by including risk management tools and techniques in a package of technologies. The latter includes appropriate inputs, including credit and a stabilization account as financial tools for risk management. The stabilization accounts were chosen instead of the traditional form of agricultural insurance because major risks affecting Haitian farming are complex to insure due to their systemic and catastrophic character. Interviews and surveys were conducted to assess the arrangement's acceptability and feasibility. The main results were as follows:

- i. Haitian agricultural experts and farmers favor the concept and predict its financial success.
- ii. Farmers expressed a high propensity to pay up to 12% of their harvested crop as a stabilization account. Therefore, the concept successfully passes the screening and testing phases of its development. The results convey some evidence of its acceptability and feasibility in Haitian farming.
- iii. "Financial inclusion" plays an essential role in financial technology adoption; farmers with financial inclusion will be two times more open to innovative technologies. Thus, prioritizing farmers with bank accounts may guarantee higher success rates during concept implementation.
- iv. In Haitian farming, risks linked to natural disasters are more related to financial incapacity than uncertainty. Therefore, if farmers could adhere to the crop calendar, that would be a significant step towards risk mitigation in Haitian farming.

As per the above results, the following recommendations were given:

1. The implementation of this concept should be started with a limited group of farmers, preferably young, literate, and financially included. This small group will be used as a model for potential scaling.
2. A clear explanation or a demonstration of any concept to the potential buyers (farmers in the framework of this study) will enhance its probability of acceptance and adoption. That will be very important in promoting new technologies to Haitian farmers.
3. A paid-in-kind stabilization account worth 7% to 10% of the farmer's harvested crop or about 180 kg of maize equivalent will be affordable for most farmers.

## Limitations of the Study

The study could not provide more information regarding the viability aspect of the concept feasibility. A subsequent study should focus on developing a cross-sector business model demonstrating the concept's viability.

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