

DETERMINANTS OF PROCESS INNOVATION IN SMALL FOOD MANUFACTURING FIRMS IN SOUTH KIVU (EASTERN PART OF THE DR CONGO)

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Abstract: This article focus on determinants of process innovation in small food manufacturing firm in the eastern of Democratic Republic of Congo. Its purpose was to determine what factors influence introduction of innovation in small firms. In total 92 small firms were surveyed though an occasional sample. Questionnaires were administrated to managers or the owners of the firms. Though a logistic binary model data gathered on field were analyzed using SPSS 24 for descriptive statistics and STATA 24 for binary model. The findings are based on a quantitative analysis on nine internal and three external small firm ' characteristics. Results indicated that entrepreneur ' educational background, supply contract where positively correlated to innovation whereas firm location, lack of trained workforce were significant and negatively correlated to process innovation. Firms in urban area are likely to innovate than rural ones. Size, managerial experience and collaboration with similar firms didn't influence innovation. Less firms introduced product innovation.

Key words: Product and process innovation determinants, small firms, South Kivu

INTRODUCTION

Congolese industrial sector had been neglected and abandoned for several decades. The DRC heavily relies on food imports as armed conflicts have devastated plantations and fields leading to a serious decrease in crops, fish and animal production (Iyenda 2005). High corruption also negatively affects the capacity and functioning of institutions, hindering investment and entrepreneurial activity (Sebigunda, 2013). The agri-food sector of South Kivu is mostly composed by unregistered micro and small enterprises and few modern and operational enterprises (Vwima, 2014).

Considered as low-tech sector, the agri-food sector scarcely use scientific inputs to innovate. Schmooker (1996) indicates that innovation in agri-food sector is stimulated by market demand rather than scientific discoveries and small firms lacks internal resources to undertake innovation (Minarelli, Raggi, and Viaggi 2015, Rama and Von ; Bareghen et al. 2012). Although innovation in food sector is considered as one of the

most the important factors enhancing competitiveness and growth; in developing countries, there is an acute lack of resources and institutional support enabling it (Chen and Puttitanun, 2005). Innovation is a polysemic concept which does not have a consensual definition. In this paper innovation is understood as the introduction of a new good or a change in the quality of an existent product; the introduction of a new production process; the introduction of product into a new market; the acquisition of a new source of supply of raw materials; and the implementation of a new industrial organization (Minarelli, Raggi and Viaggi, 2015). The aim of this paper is to contribute on the existing literature on innovation in manufacturing sector by examining the determinants of product and process innovation in micro and small sized enterprises in South Kivu the eastern part of DR Congo.

Most studies on innovation were conducted in developed countries and their findings cannot be generalized in developing countries (Radas and Boz'ic', 2009). To contribute to this research area, this study

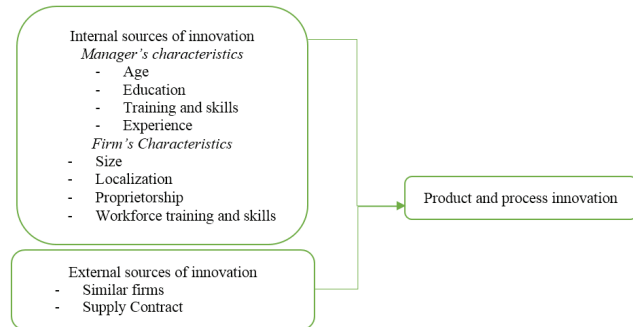
explicitly focuses on innovation introduction in micro and small sized enterprises with limited resource especially in the Eastern part of the DR Congo. Previous works have focused on large enterprises in the formal sector while emphasizing on R&D effect in adoption of innovations. Nevertheless, in developing countries, R&D expenditure is lower and almost non-existent, our work will focus on micro and small enterprises in informal sector where R&D expenditure is not taken into account, enterprises that Avermaete (2004) qualified as non-innovators enterprises in occidental context. Process innovation is qualified as the use of new or improved technique and equipment of production in order to (OECD 2005). The acquisition of new production equipment in the past five years will be considered as introduction process innovation in this study.

CONCEPTUAL FRAMEWORK

Determinants of product and process innovation in small food manufacturing firms will be evaluated through the lens of this conceptual framework. Figure1 visualizes the conceptual framework used in this research. One dependent variable has been explained by internal and external factors. Internal factors include managers or entrepreneurs and firms characteristics. External factors explain the ability of the firm to use external sources of information to innovate. In this study three hypotheses will be tested. The first hypothesis suggests that the manager's or entrepreneur's characteristics impacts on firm's innovation behavior. Higher educated, skilled and experienced entrepreneurs positively influence firm's innovation whereas their age is expected to negatively affect innovation. The Second hypothesis posits that the firm location affects innovation. Firms located in rural areas will be less likely to innovate than those based in urban areas. Workforce training and skills are regarded as contributors of product and process innovation. However this study argues that lack of a trained and skilled workforce hinders firms' innovativeness. Third, small firms rely on external source of information to enhance their ability to innovate. Collaboration with similar firms, local association or cooperative, supply contract with local supermarket or business man will positively contribute to enhance firm's innovativeness. Firms were asked to indicate whether they introduced substantially modified process or product over the past five years. Based on the literature, theoretical and empirical studies, 10 variables were taken into account

in this study. The variables were either dummies or continuous. Eight internal variables and two external variables were selected for all firms. To verify variables retained in this framework a survey was conducted. The target population included small firms with 2 employees and above. The conceptual framework is presented in figure 1.

Figure 1 : Figure 1: conceptual framework



Source: own adaptation through theoretical background

CONGOLESE ENTERPRISES CLASSIFICATION

SMEs constitute the backbone of global economy in DR Congo and main drivers of innovation, wealth and employment as well as social integration (Ministère de PME RD Congo, 2009). The number of SME has significantly increased particularly in informal sector following multiple political crises the DRC has faced. Following the law No. 073/011 of 05 January 1973 establishing and organizing the Office for the Promotion of Small and Medium Congolese Enterprises, in acronym OPEC, the new framework aims to achieve the following specific objectives:

- Provide the country with a definition adapted to Congolese realities and categorization criteria for SMEs;
- Provide SMEs with a favorable environment for their expansion;
- Promoting entrepreneurship, innovation and associative spirit that will enable SMEs to face new challenges;
- Reduce the informality rate of SMEs;
- Facilitate the integration of SMEs into

the conventional banking sector and microfinance institutions;

For the purposes of this Charter, small and medium-

sized businesses are defined as any economic unit owned by one or more natural or legal persons and having the following characteristics presented in table 1 below.

Table 1: Table 1: Congolese enterprises classification

Types	Workers	Turnover	Investment	Management mode
General	1- 200	1- 40.000\$	≤ 350.000\$	Individual or corporate
Micro	1- 5	1- 10.000\$	≤ 10.000\$	Concentrated
Small	6 - 50	10.001 - 50.000\$	10.001 - 150.000\$	Concentrated
Medium-sized	51 - 200	50.001 - 400.000\$	150.001- 350.000\$	More or less open to decentralization

Source: Ministère de PME RD Congo, 2009

THEORETICAL REVIEW AND INNOVATION DETERMINANTS

Generally, there are several determinants of innovation that are common and vital to all firms. These include but are not limited to the firm's age, size, and strategic features such as orientation in foreign markets, barriers to finance innovation, level of market competition, the economic situation of the country, and research and development subsidies (Abdu and Jibir, 2018). Innovation has been defined in many ways according to authors beliefs, and country context and the sector where innovation is held.

In agri-food firms, innovation refers to inclusion of both creation of products, processes and methods that are new or significantly improved and the adoption of those that were developed by other companies or organizations (Awuah et al., 2005; Caiazza and Volpe, 2015). In the manufacturing field, innovation process is mainly achieved through the introduction of innovative products and processes that promote the ability of organizations to enter or create new markets to satisfy the demand of customers and to be competitive (Becheikh et al., 2006; Smith and Tushman 2005). Innovation in manufacturing sector is influenced by both internal and external factors. In figure1 are presented expected determinants of innovation in small manufacturing firms in South Kivu.

PROCESS AND PRODUCT INNOVATION DETERMINANTS

Manager's characteristics

Entrepreneur's characteristics play a capital role in innovation adoption in small firms. (Oluwajoba,

Oluwagbemiga and Akinade, 2007) stressed that the higher educated is the manager, the more innovative he will be. This implies possession of higher degree is very important for innovativeness (Romero and Martínez-Román 2012).

Work force training

In many Sub-Saharan African countries, the traditional apprenticeship provides entrepreneurial and technical skills to many entrepreneurs (McGrath and King 1999). The quality of human resources can be increased by providing employee training to expand knowledge, and skills (Mahemba and De Brujn 2003). Also, (Romiji and Albaladejo 2000), stated that beside investment in R&D and training, SME can develop work force experience and technical skills in order to succeed in their innovation efforts without counting on innovation hubs provided by collaboration (Vrgovic *et al.*, 2012).

Firm size

Among traditional determinants of innovation firm size has been considered as one of the important factors (Huiban and Bouhsina, 1998). However, this argument is inconclusive. Some authors suggest that large firms are more innovative can easily capitalize innovativeness through their ability to imitate innovations than smaller (Hausman, 2005). However, (Adeyeye *et al.*, 2016)the influence of firms' innovation activities on the propensity to implement innovations and second, whether size influences the type of innovation implemented by firms. Using the data from the Nigerian Innovation Survey 2008, the results show that intramural R&D influences firms' likelihood of implementing all the four innovation types being statistically significant at 0.05 level. In addition, investment in machinery and equipment specifically

increases firms' likelihood of introducing product innovation. Similarly, market introduction of innovations impacts on marketing innovation. The binary regression result however shows that the size of manufacturing firms in Nigeria does not significantly influence the introduction of any type of innovation.”;”author”:[{“dropping-particle”：“”,“family”：“Adeyeye”,“given”：“Adedamola D”,“non-dropping-particle”：“”,“parse-names”：false,“suffix”：“”}],{“dropping-particle”：“”,“family”：“Jegede”,“given”：“Oluseye O”,“non-dropping-particle”：“”,“parse-names”：false,“suffix”：“”}],{“dropping-particle”：“”,“family”：“Oluwadare”,“given”：“Adekemi J”,“non-dropping-particle”：“”,“parse-names”：false,“suffix”：“”}],{“dropping-particle”：“”,“family”：“Aremu”,“given”：“Folake S”,“non-dropping-particle”：“”,“parse-names”：false,“suffix”：“”}],“container-title”：“Innovation and Development”,“id”：“ITEM-1”,“issue”：“1”,“issued”：{“date-parts”：[[“2016”]],“page”：“1-14”,“title”：“Micro-level determinants of innovation: Analysis of the Nigerian manufacturing sector”,“type”：“article-journal”,“volume”：“6”},“uris”：[“http://www.mendeley.com/documents/?uuid=b018e6da-8d1e-3378-8b5f-23a3d4a20408”]],“mendeley”：{“formattedCitation”：“(Adeyeye <i>et al.</i>, 2016 posit that smaller firms flexibility nature allows them to be more efficient innovators. There is limited evidence in developing countries which could prove that older and larger enterprises tend to innovate more than smaller ones (Goel and Nelson, 2018).

Similar firms and location

In sectors where product and process innovations are incremental and often have some of the characteristics of imitation, firms seem to learn from the successes and failures of their colleagues to improve their own strategy, organization and operations (Antonelli & Calderini, 1999; Maskell, 2001). From the literature, it has been shown that proximity in informal and formal contact with similar firms enhance innovation. According to (Davenport, 2005) rapid internationalisation and subsequent customisation strategies fostered organisational proximity-based knowledge-acquisition from international sources. It is argued that local contextual factors will determine if organisational or geographic proximity (or both firm can develop knowledge acquisition and innovation through geographic proximity.

EMPIRICAL STUDIES

Many studies have proven that innovation in small manufacturing firms sector is influenced by both internal and external factors; (Goel and Nelson, 2018) examined determinants of innovation in 115 developing countries. They found that innovation specifically process innovation is significantly influenced by investment in R&D. Unlike to other authors stating investment in R&D do not enable larger firms to be more innovative than smaller one. Size and firm's age do not necessarily lead to firm innovation. Furthermore, Avermaete et al(2004) found that large proportion of qualified managerial and professional staff reduce flexibility of the firm, but qualified and skilled manager and workforce influence innovation. They point out that small food firms are mainly engaged with incremental product and process innovations with a low rate of radical process innovations. Oke et al., (2007) found that SME in England focused more on innovating in product than process and service. In contrast, Tanm (2006) found that small firms in manufacturing sector were more engaged in process than product innovation. (Bareghen *et al.*, 2012).

MATERIAL AND METHODS

The survey was conducted in South Kivu province in rural and urban areas in order to make a comparison of food processing firms in the study area using a face-to-face interview with the manager. The sample for the survey was drawn from multiple sources, processors listings, producer associations. The study collected primary data by administering questionnaires to the sample size. In adopting questionnaires, the study used closed-ended and open-ended questions because they guided respondents in giving relevant responses for easy analysis and permitted a greater depth of response respectively (Saunders et al, 2009). The target population included small food manufacturing firms with between 2 and more than 50 employees. Bakeries were excluded from the sample to avoid the inclusion of firms do not use local products. Due to the absence of public register on small business, we managed to spot the survey through the concentration of processing firms at a workplace and through local processors association listing where 116 firms were identified. The final response include 92 firms representing at least 80 percent of the target population. Descriptive

statistics helped to organize, summarize, interpret and communicate qualitative information obtained from the study (Mutai, 2001; Kothari, 2010). A logit regression was used as a hypothesis test tool to correctly determine the relationship between the independent and dependent variables (Cooper & Schindler, 2003). The construction of Logistic regression model was set to determine variables affecting process innovation in small food and agribusiness firms in South Kivu as following:

Logistic regression on introduction of process innovation in SMEs, where,

$P_i = 1$ if Process Innovation, $1 - P_i = 0$ if No Process

Innovation, X= the list of explanatory variables

$$L = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + u$$

Where are Y = Innovation of goods or products in the last 5 years (Yes =1, No=0)

X1 = Age of entrepreneur, X2= Entrepreneur's education, X3= Entrepreneur's experience, X4 = Firm size, X5= Firm location, X6 = Firm proprietorship, X7 = Workforce training, X8= Collaboration with similar firms, X9 = Equipment supplier, X10= Supply contract, u= Error term and β_0 = Constant (intercept term) $\beta_1, 2...10$ are the coefficients of explanatory variables.

RESULTS AND DISCUSSION

Table 2 : Manager's characteristics

Indicators	Urban		Rural		Chi-square	df	P
	N	%	N	%			
Gender					1.963	1	.219
Male	36	39	44	47,8			
Female	8	8,7	4	4,4			
Marital status					1.685	1	.216
Bachelor	7	7,6	13	3,2			
Married	37	40,2	35	38			
Education					12.721*	3	.005
None	4	4,3	3	3,3			
Primary	5	5,4	11	12			
Secondary	17	18,5	29	31,5			
University	18	19,6	5	5,4			
Experience					14.282*	3	.003
<10 years	8	8,7	26	28,3			
10-19 years	23	25	17	18,5			
>20 years	13	14,1	5	5,4			
Age					14.26*	5	.014
<25years	2	2,2	5	5,4			
25-34years	10	10,8	23	25			
35-44years	15	16,3	15	16,3			
45-54years	10	10,9	2	2,2			
55 years>	7	7,6	3	3,3			
Training					1.416	1	.287
None	24	26,1	32	34,8			
Yes	20	21,7	16	17,4			

Source: own data compilation 2018 with SPSS 24.

Findings from the table above show that an average age of entrepreneurs is 37,9 years where 34,5 and 41,6 years old respectively the average years in rural and urban area. These results show that interviewed entrepreneurs were mostly young. Men represent 87% and women 13%, mostly 78,3% are married. It noticed that entrepreneurs have completed an average secondary school, 25% have reached university with the higher rate is in urban 19,6% and 5,4% in rural area whereas; only 7% of them are uneducated. Entrepreneurs education is a crucial factor of innovation (adoption and application). The chi-square ($P < 0.05$) test show a significant difference between entrepreneur's education and his location. most of rural entrepreneurs have achieved secondary level whereas urban entrepreneur have achieved university level. Training is a domain in which larger and smaller firms invest in order to improve their internal capabilities by increasing the productivity and satisfy their market

demand. From table1 we can see that 39,1% of our respondents attended a training in addition to their formal education background. It is worth mentioning that only a few of the have took training that fits with their current entrepreneurial activity. Training in South-Kivu agri-food sector related to use of processing machines, starch extraction, fruit juice processing, high cassava quality, soap processing.

Firm's characteristics

Workforce types and firm's proprietorship

According to the Congolese SME classification micro enterprise employs 1 to 5 people, small enterprise employs 6 to 50 people. In our study we found that micro enterprises represent the majority with 78,2% and small ones 21,8%. Table 3 presents number of workforces among enterprises surveyed and their proprietorship.

Table 3. workforce and proprietorship

Location	Numbers	Workforce (Employees)			Proprietorship	
		fulltime	Part-time	Previous	Private	Cooperative
		Means ± Std. Deviation				
Rural	48	2,8± 1,32	2,1± 2,09	0,5± 1,4	38	10
Urban	44	6,5± 6,41	3,5± 4	5,4± 6,8	40	4
Sign.		.000	.000	.000		
Total					92	

Source : own data compilation 2018

Most of small firms are owned by private 84,8% while 15,2% are owned by cooperatives dominated mostly by maize and cassava processors, very few are soap processors. 66,3% of the enterprises are run by their owners as managers while 33,7% of managers are not owners. As presented in table 3 above, there is a significant difference between number of full time employees in rural and urban areas. The average number of part-time workers in town is 3,5 whereas in rural 2,1. Comparing the number of previous workers (previous workforce is a number of workers managers engaged at the beginning of their entrepreneurial activities). Same difference is observed among rural and urban on permanent workers. Rural firms hires at least 3 employees while in urban area employ 7 staff.

Innovation introduction

Two types of innovation were introduced by the surveyed firms. However, only one type, the process

innovation will be part of the model due to number firms that introduced product innovation.

Table 4. types of Innovation groups

Location	Process		Product		Process and product	
	Number	%	Number	%	Number	%
Urban	34	37	15	16,3	18	19,6
Rural	20	21,7	10	10,9	12	13
Total	54	58,7	25	27,2	30	32,6

Sources: own data compilation 2018

Evidence from the table 4 above show on 92 small firms surveyed only 30 (32,6%) introduced both product and process innovation, whereas 25 (27,2%) introduced only product innovation and 54 (58,7%) introduced only process innovation. It can be concluded that that small firms located in urban area 34 (37%) introduced

more process innovation than those in rural settings 20 (2,7%).

LOGIT MODEL RESULTS

Table 5: Estimation results

	(1)	(2)	(3)
VARIABLES	Process	Process	Process
Age	0.27271 (0.33469)	-1.84309 (1.28219)	-1.11889 (1.10117)
Ages		0.41286* (0.24478)	0.33446 (0.21780)
Education	0.98117** (0.40015)	1.25906*** (0.45113)	1.09778*** (0.38744)
Experience	0.08550 (0.06394)	0.10542 (0.19977)	
expe2		0.00050 (0.00916)	
Lsize		0.79396 (1.22216)	
Locfirm	-0.96964 (0.62596)	-1.13357* (0.65222)	-1.44669** (0.57619)
Propmanager	0.39444 (0.62699)	0.23346 (0.65630)	
WFform	-0.18800 (0.61143)	-0.25913 (0.63438)	
Simfirm	0.02040 (0.57736)	0.00377 (0.59477)	
Contract	1.42985** (0.60272)	1.44015** (0.61680)	1.50613** (0.58665)
Size	0.52456 (0.67563)		
Constant	-4.48597** (2.07234)	-2.28354 (2.32208)	-1.38198 (1.93953)
Observations	92	92	92

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: own calculation with STATA 24

From table 5 presented above, there is a negative relationship between the entrepreneur's age and innovation. The more aged is the entrepreneur the less innovative he/she is. As shown earlier, the average age

of entrepreneurs in our study area was 37,8 years. This negative relationship can be explained by the fact that among firms that have introduced process innovation, 63.6% of them are run by managers aged between 25 and 44 years old while the other 36,4% are aged between 45 and 73 years. However, entrepreneur educational background is positively correlated to firm's innovation behavior. As mentioned earlier, entrepreneurs surveyed had at least achieved the secondary cursus in both rural and urban area. No relationship was found between entrepreneur experience and innovation. These findings do match with (Abereijo *et al.*, 2007) while analyzing capabilities of SME industry in Nigeria. On contrast (Avermaete *et al.*, 2004) found no significant relationship between manager's background and experience. (Plotnikova, Romero and Martínez-Román, 2016) found that having secondary education and higher professional training increase both 12% of firm higher probability to involve in innovative activities. University education alone does not influence engagement in innovative activities.

Furthermore, the firm's location is found negative and significantly correlated to innovation. In tab.4 it can be observed that firms located in rural area, were less likely to innovate, nearly 21,7% introduced process innovation less other things equal than 37% firms based in urban did. These firms may not have enough capital investment in acquisition either in new machinery or replacing one of their machines to improve their production process. The workforce training was negatively correlated to innovation. Lack of trained workforce hinders small firm performance. In South-Kivu, the lack of center of training and capacitation, leads entrepreneurs to supervise their own workforce. Most of workforce in small firms are trained in daily activities either by the manager or by their colleagues. Only 39,1% of workforce were trained. One can argue that this lack of technical capabilities can harm productivity and competitiveness of small local firms in South-Kivu. There is little evidence showing that collaboration with a similar firm can lead a firm to innovate. No relationship was found between collaboration with similar firms and process innovation introduction. On the contrary Plotnikova (op.cit) found that self-employed people running manufacturing firms were likely to innovate when they collaborate with other firms with a 29% greater probability.

Collaboration between similar firms allows to reinforce the sharing or transfer of technology but also strengthen their bargaining power with the authorities in terms of pricing and protecting small start-ups. Not surprisingly that there is lack of government support in promoting small business innovation. Although there have been small firms that have adopted the innovation process, unfortunately their number still insignificant a sector that has so many opportunities, such as South Kivu.

The variable contract is related to firms that have a signed contract or mouth-to-mouth contract of supply. The model shows a positive and significant relationship with innovation. Firms have either bought new machines or improved their production process in order to satisfy their customer demand. Managers of firms reported that some supermarkets in the city subcontract production of their goods (all raw material are bought by the supermarket). It not surprisingly that these contracts were mostly verbal which is not reassuring for the firms because it can be broken from one moment to another. In the long run these contract are not guaranteed as they are often done according to the customer's appreciation. Finally, there are limited evidence that larger (size) firms and older (experience) tend to innovate than smaller firms. These findings are conform to (Goel and Nelson, 2018) results who found less evidence that shows that larger and older to innovate than smaller. Results show significant difference between the number of permanent ($p < .000$) and non-permanents employees ($p < .000$) between both rural and urban small firms, the fact that most small firms belong to the same category may explain the non-significance of the firm's size and age on innovation.

CONCLUSION AND RECOMMENDATIONS

The aim of this paper was to identify determinants of process innovation in small food manufacturing firms in South-Kivu. In total 92 small firms were surveyed. A binary logistic model was conducted in this research. The first hypothesis related to the manager (entrepreneur) characteristic was partially confirmed. Only entrepreneur's education was positively correlated to innovation. The second hypothesized that location and lack of trained workforce will negatively influence innovation. The results of our model fully confirmed that hypothesis. Rural small firms were less likely to

innovate than urban firms. Lack of trained workforce was also negatively correlated to process innovation. Training and skills are gained in daily activities in small firms in South-Kivu. Finally, the third hypothesis also partly confirmed as only supply contact with local customers and supermarket seem to have significant correlation with small firm innovation.

Results show that South Kivu's agri-food sector still needs support both internally and externally. Internally, training of producers as well as the workforce would be a factor stimulating the improvement of the products quality and their processing diversification. On the external front, technical support through acquisition of processing equipment will enable firms to optimize their productivity.

Our study opens up a venue for further research in the field of innovation in small food firms. Questions can arise from the this research concerning the technical efficiency and competitiveness of these small firms in an open market like South-Kivu where most consumed product come from Great Lake Region and the rest of world. A deeper insight into processing activities and the level of technical efficiency, strategies used to survive in such market can contribute to enhance firms awareness on innovative activities and technical measure to adopt to be performant and successful. These results are important for policymakers to focus attention on these kinds of job-creating and income-generating activities by providing them with financial support and facilitate equipment acquisition and finally by lightening their business climate.

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