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CONSTRAINTS AND OPPORTUNITIES FOR INNOVATION IN GREEN ENTERPRISES :

IMPLICATIONS FOR LAND AND WATER MANAGEMENT IN RURAL UGANDA

ISAAC M.B. SHINYEKWA | YUSUF KIWALA

CONSTRAINTS AND OPPORTUNITIES FOR INNOVATION IN GREEN ENTERPRISES: IMPLICATIONS FOR LAND AND WATER MANAGEMENT IN RURAL UGANDA

BY

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LIST OF ACRONYMS

BRICS	Brazil, Russia, India, China and South Africa
COMESA	Common Market of Eastern and Southern Africa
EAC	East African Community
OECD	Organization for Economic Cooperation and Development
R&D	Research and Development
SMEs	Small and Medium Enterprises
UBoS	Uganda Bureau of Statistics
UGX	Ugandan Shilling
UNCST	Uganda National Council for Science and Technology
USA	United State of America
VAT	Value Added Tax

ABSTRACT

This paper examines the factors that hamper innovation and the opportunities for innovation in green enterprises. A descriptive analysis of secondary data of 423 enterprises was done, including the 2014 National Innovation Survey, retrieved from Uganda National Council for Science and Technology (UNCST). In addition, a comparative case study analysis of three green enterprises was also undertaken to allow for a more detailed and contextualized investigation. The results show that cost and market factors are the key hindrances to innovation in green enterprises. Furthermore, the emerging customers and suppliers from BRICS, the potential for local fertilizer market and increased demand for knowledge on organic farming provide great opportunities for innovations in green enterprises. Finally, the study finds that green enterprises in the agricultural sector mainly depend on information from customers, suppliers and indigenous knowledge from local production networks for innovation. These results have important policy implication for those companies that want to improve eco-innovation, management of resources and the types of actions within firms most suitable for improving their eco-innovative behavior.

Key terms: eco-innovation, green SMEs, Uganda, constraints and opportunities

1.0 INTRODUCTION

The future of green enterprises is local and dependent on entrepreneurship. This study gives insights on opportunities for and constraints to innovation for sustainable entrepreneurs in rural Uganda. The study combines literature from innovation theory, sustainable development practices and Small and Medium Enterprises (SMEs) studies to establish a basis on which to examine the constraints and opportunities for innovation in green enterprises. This is important in understanding how SMEs can change towards sustainable behavior. The relationship between a firm's ability to innovate and value created for customers is well documented (Jacobides *et al.,* 2006; Walker & Preuss, 2008; Huarng & Hui-Kuang Yu, 2011). This debate is now beyond the economic aspects of value creation; it embraces wider stakeholders' perspectives which consider environmental and social benefits. This line of business thinking envisions a future, where the renewal of products and improvement of practices, technology and services lead to economic, social and environmental performance. This is termed as green innovation. The term green innovation encompasses constructs coined to mean innovations which improve environmental performance, such as sustainable-driven innovation, eco-innovation, and environmental innovation. These terms are used interchangeably, but for the purpose of this study, we adopt eco-innovation because it is well defined in the literature.

1.1 Economic benefits of eco-innovation

According to Oxborrow & Brindley (2013), a number of benefits accrue to innovative green business, such as positive publicity, which improves a business community standing, staff motivation and brand loyalty, based on environmental issues, and market advantage for new products. Furthermore, the process of reducing negative environmental impact, ensuring better resources usage, energy or materials, are veritable catalysts to generation of new services, products and markets. Beyond market advantage, Pinget *et al.* (2015) demonstrate productivity opportunities that could arise from greater efficient use of land, water, material and energy. Eco-innovation also supports SMEs in lowering costs. Therefore, SMEs that adopt green innovative practices are bound to grow.

1.2 Context of the study

This research is set within the context of the agricultural sector in Uganda and focuses on SMEs that are involved in different enterprises within the sector. It is important to study innovation generated by green enterprises within the agriculture sector because agriculture is part of the environmental problem, and a contributor to non-point pollution and environmental degradation (Dumanski, 1997). A number of small entrepreneurs in Uganda are engaged in agriculture and operate informally, but research on green innovation within the agricultural sector is still nascent and limited. The agricultural sector, unlike other resource-based sectors, involves millions of small-scale entrepreneurs, who make individual decisions on investment of capital and management of natural resources. Although the land and water-use decisions of an individual farmer may seem insignificant, these decisions, when repeated over time, collectively, may have a global impact on the environment. In order to minimize the pressure on resources, small scale entrepreneurs have to embrace eco-innovation in their strategic agenda. The constraints to innovation

among SMEs threaten environmental performance. The factors that limit SMEs in Africa include: access to resources and market opportunities, cost of doing business, policy gaps, poor infrastructure, inadequate workforce skills, adverse business start-up climate, low technological environment and innovation. However, many of these challenges happen to be more prevalent in Uganda than any other country in the region (Muhanguzi & Kyobe, 2013). Since innovation remains a major challenge for SMEs in Uganda, this study is timely as it helps to understand what limits innovation in green businesses. In addition, the study explores potential opportunities that can facilitate the integration of sustainable activities into business practices, and the implications for water and land use. Innovativeness is highly context-dependent (Morand, 2008), but the constraints that affect SMEs are sector specific. It is therefore important to focus on SMEs in a single sector. This is in line with Loader's (2010) recommendation that future research on barriers that SMEs face should be investigated by sector.

1.3 Research questions

This paper explores SMEs innovation trends in order to identify the constraints to and potential opportunities for eco-innovation in the agricultural sector, as well as implications on land and water management by addressing the following research questions: (i) what are the constraints to and opportunities for innovation for green enterprises in Uganda?, and (ii) what are the implications for land and water management in rural Uganda?

To answer the above questions, the research employed mixed methods by combining information from secondary data and case study methodology to have in-depth experience of individual entrepreneurs. The paper begins by defining eco-innovation to draw a line between conventional innovation and eco-innovation. The study also examines prior work on eco-innovation and explains the methodological approach. Furthermore, the study presents key findings, a discussion on the implications on land and water management and finally the conclusion and recommendations.

2.0 LITERATURE REVIEW

2.1 Eco-innovation: Conceptual definitions

There is hardly any universal definition of eco-innovation, although several attempts have been made in the literature. According to the European Commission (2008), eco-innovation is the production, assimilation or exploitation of a novelty in products, production processes, services or in management and business methods, which aims, throughout its lifecycle, to prevent or substantially reduce environmental risk, pollution and other negative impacts of resource (including energy) use. Oltra & Jean (2009) broadly define eco-innovation as innovations that consist of new or modified processes, practices, systems and products, which benefit the environment and thus contribute to environmental sustainability. Kemp & Pearson (2008) define innovation as the production, application or exploitation of a good, service, production process, organizational structure, management or business method that is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resource use (including energy), compared to relevant alternatives. Kemp & Pearson's (2008)

definition pays attention to the adoption of innovation previously introduced by others and focuses on environmental effects contrary to the conventional economic perspective of innovation (Schumpeter, 1994), which regards innovation as the first introduction of a new product, process or organizational structure. Therefore, it is important in the African context because SMEs on the continent mainly depend on innovations already developed by other firms. This research explores both the constraints that are related to the creation of new products, processes and organizational methods, as well as those related to the adoption of eco-innovation practices already developed by other firms or individuals. Another distinctive feature of eco-innovation is that it is not limited to innovation in products, processes and organizational methods, but includes innovation in social and institutional structures (OECD, 2009). It is in this context that this paper adopts Kemp & Pearson's (2008) definition of eco-innovation because it is more relevant to the study context.

In general, there is consensus among authors that eco-innovation reduces negative environmental impact caused by consumption and production activities, whether intended or not. However, according to Carrillo-Hermosilla *et al.,* (2010), the definitions that emphasize the intention of the innovator are problematic, as it becomes difficult to establish the relationship between one's intention and environmental performance. Further, authors allude to problems with definitions that focus on environmental impact because it is quite challenging to deduce which innovation actually reduces environmental impact of product and production. In sum, this paper considers the main distinguishing feature of eco-innovation as its likelihood to improve environmental performance. Moreover, it does not matter whether the initial motivation of an entrepreneur to innovate had economic or social considerations, provided the outcome of the activity improves environmental performance.

From a theoretical perspective, eco-innovation is acknowledged as bringing incremental or radical changes to products or systems. However, it is also known that most innovations by SMEs within Africa are a result of incremental changes (Carrillo-Hermosilla *et al*., 2010). The authors define incremental changes as gradual and continuous competence-enhancing modifications that preserve existing production systems and sustain the existing networks, creating added value in the existing system in which innovations are rooted. This is in contrast to radical changes, which are competence-destroying, discontinuous changes that seek the replacement of existing components or entire systems, the creation of new networks and value. In relation to the foregoing distinction, Christensen (1997) draws a line between sustaining innovation and disruptive innovation, by describing the latter as innovation that renders obsolete existing system and structures akin to radical innovation. Unlike incremental innovation, system innovation or radical technology change has often been related to environmental performance (Kemp & Pearson, 2007; Nill & Kemp, 2009). It is observed that more systematic changes can potentially yield higher environmental improvement in the long run, compared to simple modifications in products and process (OECD, 2009). This study examines both mechanisms of innovation to get a clear understanding of the nature of constraints embedded along each path.

The growing importance of eco-innovation demonstrates different lines of research. Whereas the first line focuses on motivations for eco-innovation and related environmental outcomes, the second examines the measurement of eco-innovation and the third explores the dimensions of eco-innovation (Cheng and Shiu, 2012). In order to understand constraints, it is important to focus on the activities that happen in the different dimensions of eco-innovation. In line with this, eco-innovation activities are studied along three main dimensions: target, mechanism and impact of innovation on the environment (Oncioiu, 2015). Target is described as the focus area of eco-innovation, which includes: processes, product, marketing methods, organizations and institutions. Mechanism refers to the way in which changes are made in the target, which may be modification, redesign, alternative and creation, while impact is defined as the effect of eco-innovation on the environment. The discourse on eco-innovation activities suggests that constraints are at every stage of the innovation lifecycle. It is believed that, enabling SMEs to change their environmental behaviors requires weakening the resistant forces to eco-innovation, such as poor eco-literacy, strengthening of the driving forces, such as effective research or preferably a combination of both to encourage a strategic response (Tilley, 1999). Factors driving eco-innovation in SMEs are examined in the next section.

2.2 Drivers of eco-innovation in SMEs

It is well known that SMEs, irrespective of their location, are better placed to adopt eco-innovation because they are more agile and flexible. Therefore, they are a focus for eco-innovation. For instance, decision making in SMEs is often less bureaucratic and often depends on a single person. According to Oxborrow & Brindley (2013), eco-innovation requires a firm's internal capacity to acquire information, absorb knowledge, commitment from teams and organizational learning. Conversely, the Cuerva *et al.,* (2014) study shows that innovation propensity depends on the availability, or the lack of resources and capacity to innovate by firms. Regarding this, knowledge resources, human skills and provision, as well as access to finance are essential drivers of eco-innovation for firms (Cuerva *et al*., 2014). The role played by a firm's internal capacity to acquire information was also emphasized in Pinget *et al.* (2015), which reveals the need for effective research, education and training as major drivers to eco-innovation for small firms. SMEs in Uganda, especially those in the agricultural sector, lack financial resources and consequently rarely employ skilled labor, yet they find difficulty in accessing public extension workers. The current agricultural knowledge system gap in Uganda provides opportunities for entrepreneurs to close this gap.

Furthermore, a firm's capacity to innovate also depends on technology capability. Since Research and Development (R&D) enhances technology capabilities in green firms, SMEs without R&D are likely to face a cost disadvantage in developing innovations. Many SMEs in Uganda are not undertaking R&D. Similarly, their human skills and technological capability is lacking. SMEs often depend on technologies that have been already developed by universities, public research centers and foreign companies, but where such technologies are not easily accessed, the rate of adoption is often negatively affected. The lateness associated with the release of biotechnology policy in Uganda may account for low levels of eco-innovation activities in the country. According to Lewis & Cassells (2010), the factors that drive SMEs to adopt green practices in-

clude: government legislation, the need to expand market share, employee motivation and eco-efficiency. Eco-efficiency is described in relation to cost reduction due to efficient use of such resources as water, materials, improvements in quality of products and more effective management of risks. Since SMEs have a more reactive stance to innovation, they are more inclined towards eco-efficiency as a first step to eco-innovation (Klewitz, *et al.,* 2012), a development that affirms the importance of economic benefits as critical drivers of eco-innovation in SMEs. In light of this, since SMEs adapt easily to opportunities in their external environment, they are more likely to easily adjust to positive environmental behavior, if they are saving a cost or making a gain, as opposed to improving image or becoming legitimate in the community.

The analysis of the SME sector in Uganda suggests that some of the drivers highlighted above may not apply in the context where SMEs operate informally. Therefore, any effort to influence SMEs' positive behavior towards environment performance should focus on the drivers relevant to sub-Saharan Africa. For instance, Uganda, like many Sub-Saharan countries, lacks a dedicated eco-innovation policy, and measures to promote eco-innovation are often framed under the national environmental policy. SMEs that operate informally may not easily respond to government regulations, especially where there is no dedicated policy to guide enforcement. Therefore, using environmental laws to initiate eco-innovation is bound to fail. For this reason, Uganda's legal environment may not effectively influence SMEs' behavior towards green practices. It is on this basis that this paper explores additional information to understand the nature of opportunities to exploit in accelerating adoption of eco-innovation for SMEs.

Another body of knowledge demonstrates the relationship between the drivers of eco-innovation and environmental performance, but most of the work has been done in formal economies. For example, there is evidence that government regulation is particularly important with regard to rebating air, water and noise pollution, increasing recyclability and avoiding hazardous substances (Horbach *et al.,* 2012). Furthermore, cost-saving is important in reducing energy and material use and customer requirements is important with regard to products with improved environmental performance and process innovation, increases in material efficiency, reduction in energy consumption, waste and the use of dangerous substance. This discourse suggests that the drivers for eco-innovation are linked to this type of innovation – product, process, organization and institution. For example, market-based forces are related to products and process innovation. Likewise, regulatory drivers are linked to resource-use hence product innovation. By demonstrating a clear linkage between the drivers of eco-innovation and the type of innovation, there is no doubt that different drivers of eco-innovation ultimately have different areas of environmental impact.

3.0 METHODOLOGY

Since research on the constraints to and opportunities for innovation in green SMEs within the agricultural sector in Uganda is limited, the study employed mixed methods. First, using existing survey data and extensive literature review, various constraints to innovations of Ugandan SMEs are examined. Subsequently, a comparative case study analysis of three green enterprises was done to allow for a more detailed and contextualized investigation of the opportunities for innovation and implications for water and land management. The use of case studies is in line with Yin (2003), who advocates for case studies in the early stages of developing a theory. Compara-

tive case studies are particularly useful for understanding and explaining how context influences the success of a phenomenon and how to better tailor the phenomenon to the specific context to achieve intended outcomes. Therefore, the case study approach provided deep insights of owner-manager experiences, a deeper understanding of opportunities for each of the cases, and the implications for resources management.

3.1 Research Sample

The case study participants were selected based on the three motivations of corporate sustainability: eco-centric orientation, value creation and compliance (Keijzers, 2002, 2005). According to Hamann *et al.*, (2015), a manager who is motivated by the compliance driver is concerned about cleanup or health and safety efforts of a company. Managers who hold the eco-centric view worry about adequate environmental and social management, while those who are driven by value creation care about integrating all ecological and social issues into all business decision-making (Hamann, 2015). Using purposive sampling, the three companies that were found with characteristics that fit the above criteria produce organic products. A preliminary interview was conducted with the owner-managers from the selected enterprises to establish the level of innovation and whether the enterprises meet both customer and environmental needs. The study finds that the managers, who were selected for interviews had a reputation among their customers, based on eco-brand. These companies were recommended at the Food Technology and Business Incubation Centre in Makerere University.

3.2 Data collection

3.2.1 Secondary data

Secondary data, retrieved from Uganda National Council for Science and Technology (UNCST), is the Uganda National Innovation Survey conducted in 2014. The survey was conducted by Uganda National Bureau of Statistics (UBoS), together with UNCST. The questions were adopted from the Community Innovation Survey (European Commission, 2000). The Community Innovation Survey was conducted by national statistical offices in the European Union to provide information on innovativeness of different sectors and regions. The Uganda National Innovation Survey was designed to cover all sectors, including agriculture. The questionnaire raised questions from companies about their innovation activities and expenditures, types of innovation, sources of information, collaborative partners for innovation, effects of innovation, factors hampering innovation and intellectual property rights and the impact of innovation on environmental performance. The latter was important in assessing the extent to which the innovation in the companies selected can be described as eco-innovation.

3.2.2 Primary data

The data from the three case studies was collected in two stages, using interviews, observation, document analysis (industry statistics, reports, media, and government environmental regulation reports), targeting the most knowledgeable informants. A combination of group and in-depth interviews for the business owners was employed for the study. Six in-depth interviews were carried out among managers and workers to understand the nature and constraints to innovation in

the selected firms. The interview sessions were recorded to get an accurate summary of the interview and to help in transcribing the answers. In the first stage of the interview, emphasis was mainly on examining the opportunities and barriers, while in the second phase monitoring the impacts that innovative activities of green enterprises have on water and land management was conducted. The study used semi-structured interview within pre-defined topics. The interview was guided by the stages of eco-innovation along its life cycle, including idea generation, innovation, investment decision, invention, as well as adaptation process and commercialization. Therefore, constraints were examined at each of these stages. Any error at any of these stages had potential to fuel delay, abandonment at concept level or after the activity had begun.

3.3 Data analysis

The first set of empirical analysis for which results are presented is based on data collected during the 2014 National Innovation Survey. It involved 423 firms selected based on random sampling. Tables, charts and figures are generated based on the analysis of the data.

A thematic approach to data analysis was used in order to identify commonalities and differences between responses of people in the same position (Stebbins, 2001). An iterative approach was followed in order to identify any emerging patterns and themes in the data. The data were assigned codes, and counted to determine how often each code was repeated by the respondents. This process was carried out by the second author and verified by the first author to achieve greater objectivity. In order to assess the implications that the activities of green SMEs have on water and land management, an evaluation approach was adopted, using a set of short term indicators but with a sound theoretical path since the duration of the research project was only six months. The evaluation model followed a clear scientific protocol to ascertain the implications that green innovations have on land and water management.

4.0 RESEARCH FINDINGS

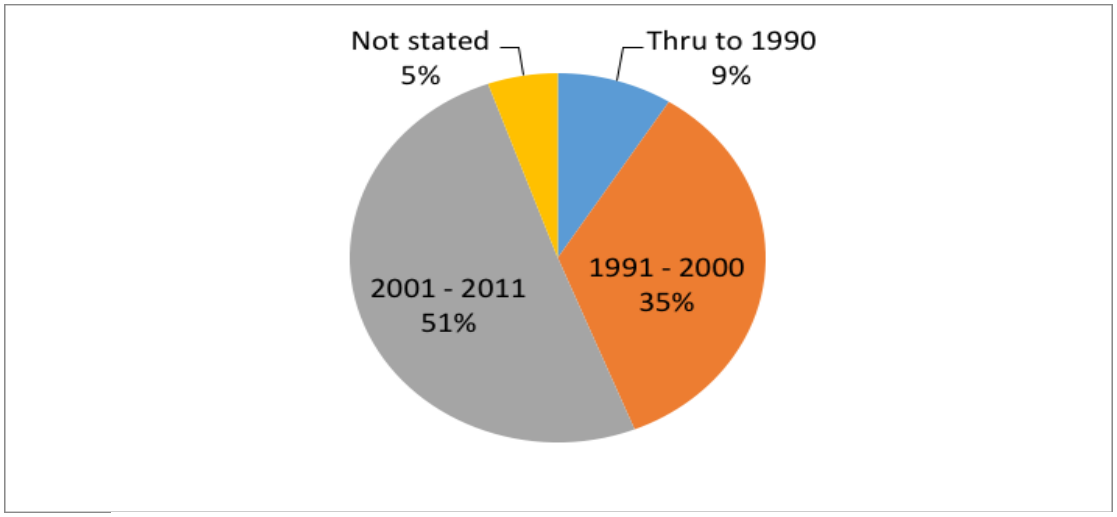
The research findings are structured in two parts: firstly, a quantitative analysis of secondary data to get the nature of SMEs' practices in innovation and the constraints they face was provided. It is important to note that the constraints that SMEs face in innovation are contextual. This implies that green enterprises, in the same study area as other SMEs, share the same constraints that other SMEs meet along the innovation path. In fact eco-innovation only differs from traditional innovation (Schumpeter, 1994) on the assumption that eco-innovation has a positive impact on the environment. Therefore, the quantitative analysis provided a good basis to interrogate the constraints to innovation, using a large sample size. Secondly, a qualitative contextualized analysis was made to provide an accurate position of opportunities for eco-innovation and the implications for water and land management. The presentation of results from secondary data starts with the characteristics of firms covered.

4.1 Characteristics of study companies

4.1.1 Period of establishment

The key inclusion and definition of SME was that the company has not more than 250 employees. In total, 423 companies were retrieved from secondary data. Majority of these companies were established between 2001 and 2011 (51%), with those established before 2001 constituting about 35 percent. On average, the companies had been operating for 14.4 years (95% ci=13.7-15.1 years). This implies that the majority of the companies have a fairly long life to have ventured into innovation. Therefore, their inability to innovate is more likely to be caused by constraints and not necessarily time, as illustrated in Figure 1.

Figure 1 Period of establishment



Data Source: UNCST and UBoS 2014

About 3 out of any ten companies were part of a larger group, with operations outside Uganda (29%). This is typical of most SMEs in Uganda, given that majority operates on an informal basis, which in itself limits innovation. Considering the countries which are part of a larger group, majority of them (74%) had their head offices in Uganda, with the remaining 26 percent in other countries (other country in the EAC[1]=7.4%, other African country[2]=3.3%, USA=6.6%, and other country in the world outside Africa and USA=9%). This suggests that the majority of all the sampled companies had their head offices in Uganda. Table 1 shows the details of the proportions of companies by origin.

[1] This was mainly Kenya

[2] Countries mainly included South Africa, Ghana and Nigeria

Table 1 Proportion of companies by origin

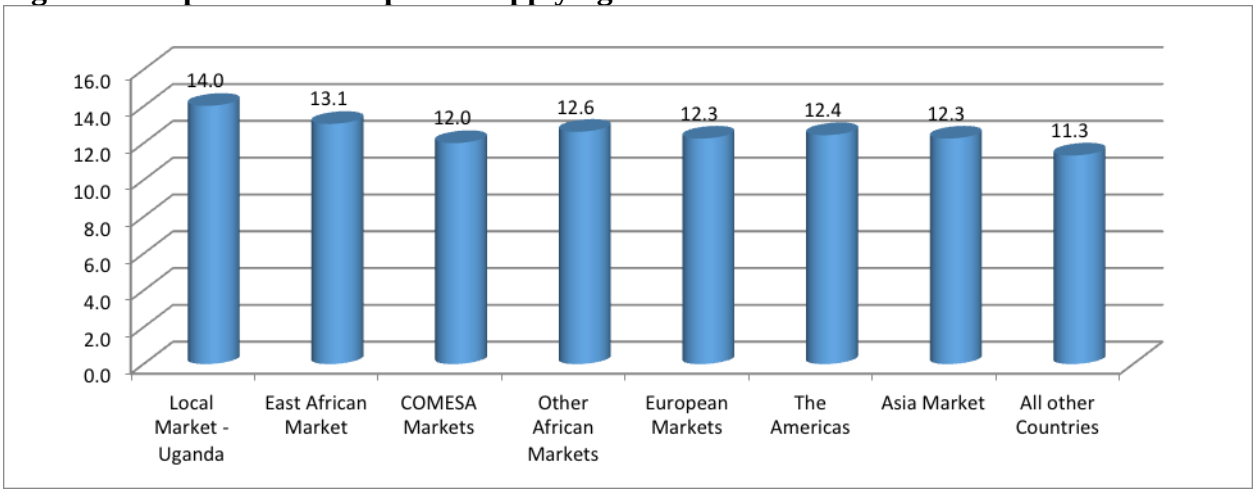
	Thru to 1990 N=38	1991 – 2000 N=148	2001 - 2011 N=214	Not stated N=23	Total N=423
	Whether the enterprise is part of a larger group				
Yes	28.9	31.8	26.2	34.8	28.8
No	71.1	68.2	73.8	65.2	71.2
Total	100	100	100	100	100
	If part of larger group, country where the head office is located				
	N=11	N=47	N=56	N=8	N=122
Uganda	90.9	72.3	69.6	97.5	73.8
Other EAC country	0.0	10.6	7.1	0.0	7.4
Other African Country	0.0	0.0	7.1	0.0	3.3
USA	9.1	6.4	7.1	0.0	6.6
Others	0.0	10.6	8.9	0.5	9.0
Total	100	100	100	100	100
	Country where the head office is located – All companies considered				
Uganda	97.4	91.2	92.1	95.7	92.4
Other EAC Country	0.0	3.4	1.9	0.0	2.1
Other African Country	0.0	0.0	1.9	0.0	0.9
USA	2.6	2.0	1.9	0.0	1.9
Others	0.0	3.4	2.3	4.3	2.6
Total	100	100	100	100	100

Data Source: UNCST and UBoS, 2014

4.1.2 Geographical markets supplied by Ugandan SMEs

The main geographical markets, where the companies sold products in the time period of 2011 – 2014, included Uganda (14%), East African Markets (13%), Common Market of Eastern and Southern Africa (COMESA) (12%), other African countries other than those in East Africa and COMESA (13%), European countries (12%), United States (12%), Asia (12%) and other countries (11%). The structure of the markets for the products is spread among the different segments of the market with the largest concentration in regional markets.

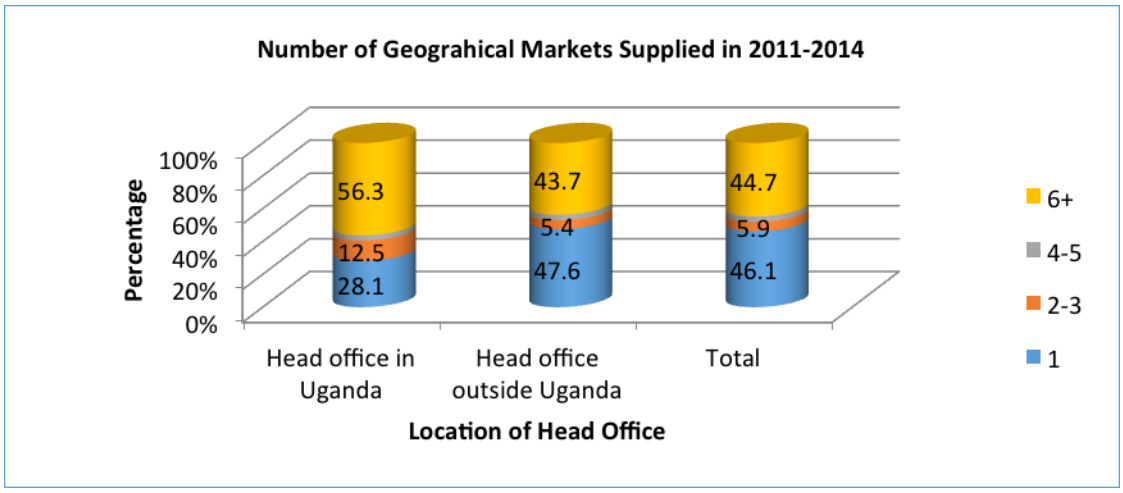
Figure 2 Proportion of companies supplying different markets



Data Source: UNCST and UBoS, 2014

Furthermore, Figure 3 indicates that majority of the companies (46 %) supplied only one of the geographical markets; while about 45 percent supplied at least six of the geographical markets. The number of geographical markets supplied had neither significant relationship with the number of years the companies had been in existence nor whether the company had their head offices in Uganda or outside.

Figure 3 Number of geographical market served

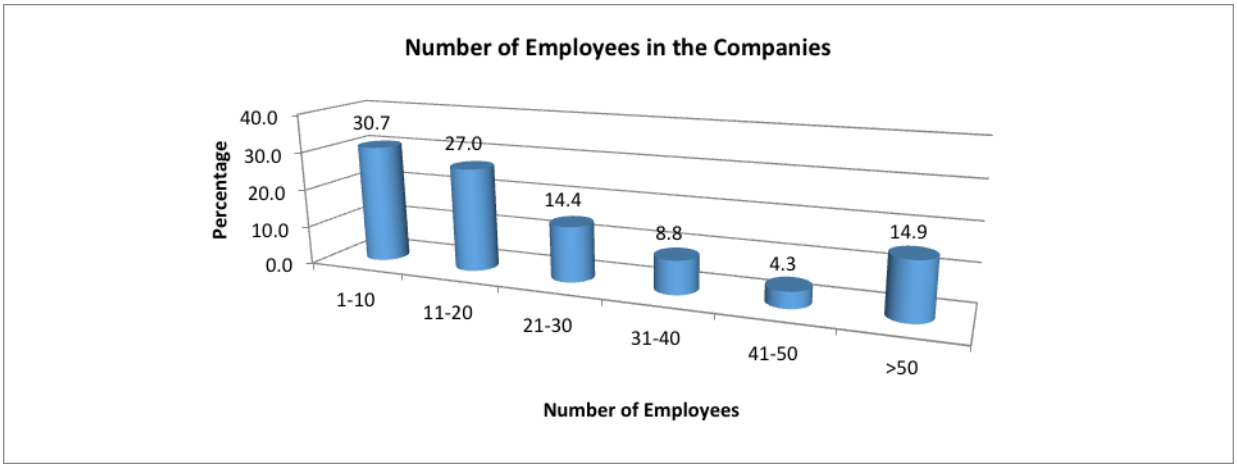


Data Source: UNCST and UBoS, 2014

4.1.3 Employee composition and characteristics

In total, the companies had about 33, 300 employees (males=70.4%, females=29.6%) but with the numbers varying across companies. The results presented in Figure 4 show that 31 percent of the companies have no more than 10 employees, 27 percent had 11-20 employees, while 14 percent had 21-30 employees. Only 15 percent of the companies had more than 50 employees. This is typical of SMEs in developing countries.

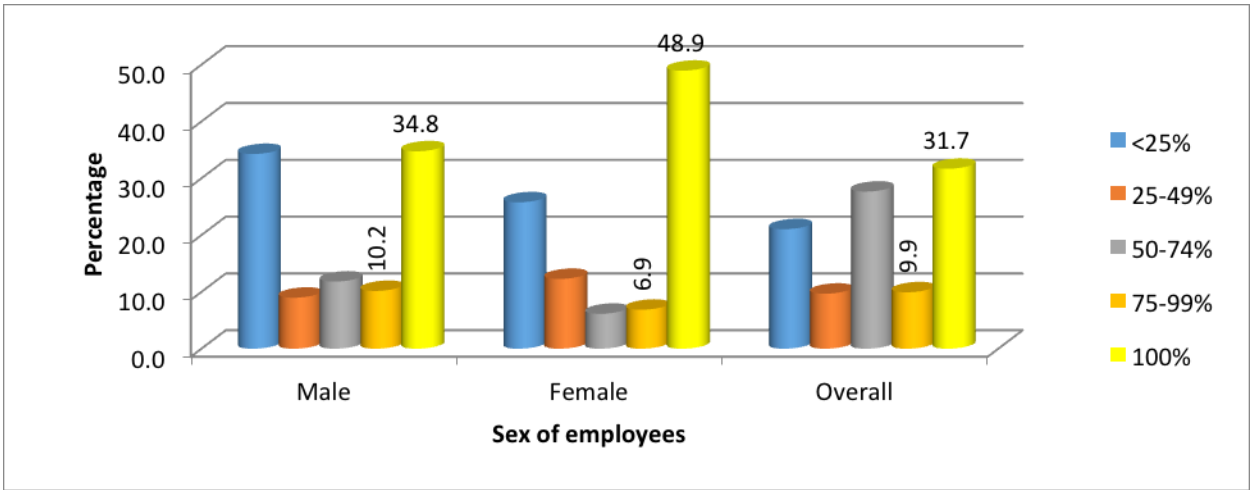
Figure 4 Number of employees in the companies



Data Source: UNCST and UBoS, 2014

The employee's level of education influences the company's capacity to absorb information, hence innovation. On exploring the proportion of company employees with a university degree, results presented in Figure 5 illustrate that about 37 percent of the companies had all their employees holding a university degree.

Figure 5 Number of employees with university education



Data Source: UNCST and UBoS, 2014

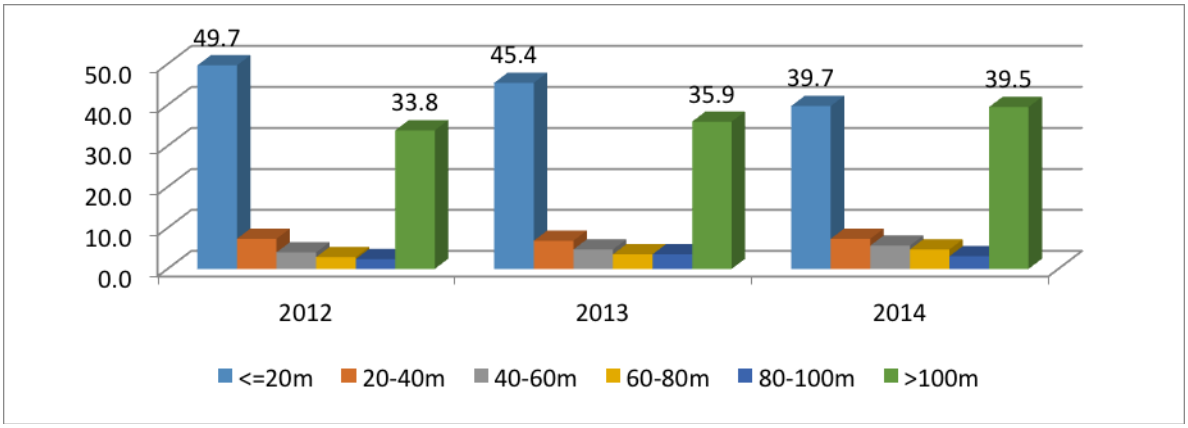
Overall, about 69 percent of the companies had at least half of their employees holding university degrees.

4.1.4 Turnover

Figure 6 depicts a growth in turnover [3]of companies. The proportion of companies with a turnover exceeding UGX100m (the exchange rate in 2014 was UGX2800 per US$1) increased from 34 percent in 2012 to 36 percent in 2013 and 40 percent in 2014. The companies had an average growth rate in their turnover of about 15.4 percent between 2012 and 2013; which reduced to 12.4 percent between 2013 and 2014. This suggests a moderate, if unimpressive, growth in turnover.

[3] Turnover is defined as the market sales of goods and services (Include all taxes except VAT).

Figure 6 Distribution of sales revenue for the three year period



Data Source: UNCST and UBoS, 2014

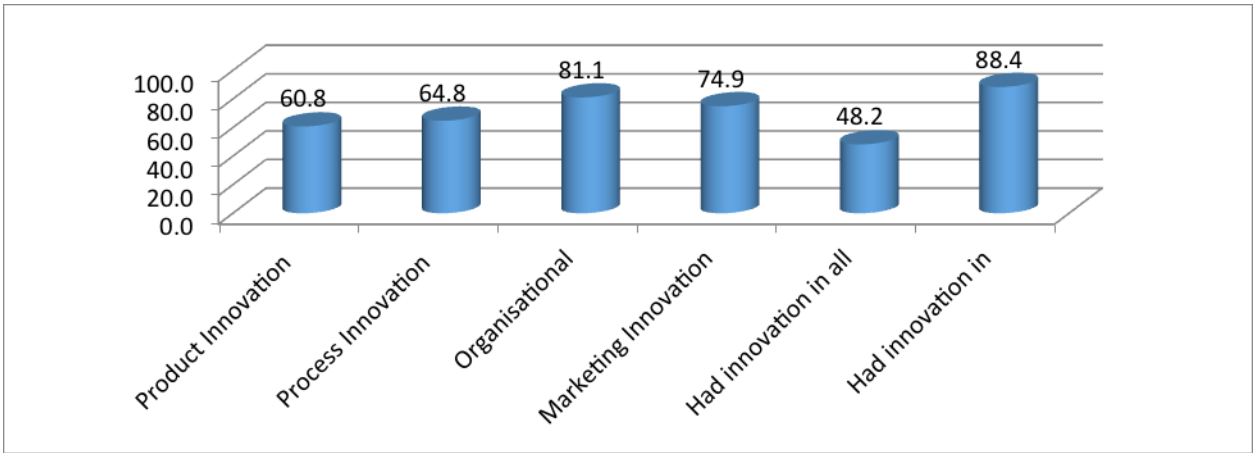
4.1.5 Types of Innovation undertaken by Uganda SMEs

Figure 7 shows the proportion of SMEs that had innovations in the different areas – product, process, organization and marketing during the time period 2011 and 2014. Of the total companies, the proportion of SMEs that had organizational[4], marketing, process and product[5] innovation constituted 81 percent, 75 percent, 65 percent and 61 percent, respectively. Whereas about 88 percent of the companies had an innovation in at least one of the areas (product, process, organization and marketing), only 48 percent had innovations in all these areas. Given the fact that innovation is multidimensional, the statistics suggest that inadequate innovation is experienced by the sampled firms.

[4] Included New business practices for organizing procedures, New methods of organizing work responsibilities and decision making or New methods of organizing external relations with other firms or public institutions

[5] A product innovation is the introduction to market of a new or significantly improved good or service with respect to its capabilities, such as improved user-friendliness, components, software or sub-systems. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your industry sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.

Figure 7 Types of innovations introduced by companies



Data Source: UNCST and UBoS, 2014

4.1.6 Product innovation

Product innovation is associated with the introduction to market of a new or significantly improved good or service with respect to its capabilities, such as improved user-friendliness, components, software or sub-systems. Whereas about 41 percent of the companies introduced either a service (41%) or product innovation (42%), only 22 percent had both product and service innovation during the three years 2011 to 2014 (Table 2).

Table 2 Proportion of firms that introduced product and services innovations

Theme	**Particulars**	%
Proportion of SMEs that had New or significantly improved	• Goods	41.8
	• Services	41.1
	• Both product and service	22.2
By who were these product (goods and services) innovations developed?	1. Mainly your enterprise	59.7
	2. Mainly your enterprise group	19.8
	3. Mainly your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions	13.1
	4. Your enterprise together with other enterprises or institutions	7.4
	Total	100
Did these innovations originate mainly in Uganda or abroad?	1. In Uganda	81.5
	2. From outside Uganda	18.5
	Total	100
Whether innovations were new to your market or new to your firm	New to the market	43.5
	Only new to your firm	56.5
	Total	100

Data Source: UNCST and UBoS, 2014

The innovations were mainly developed/generated within the enterprises (60%), with the enterprise group constituting 20 percent, other enterprises – 13percent and institution/SME in partnership with other institutions – 7 percent. The statistics suggest that firms conduct own innovation with limited interaction with firms outside their systems. Given the constraints to innovation, this trend implies that limited innovation takes place among these firms. This is further underpinned by the fact that about 81 percent of the enterprises had innovation ideas originated from within Uganda while 19 percent originated from outside the country. Given that firms in Uganda hardly conduct R&D, they are not likely to innovate with landmark outcomes and effects, hence the limited innovation. However, most of the firms noted that the ideas were not new to the markets but rather new to their firms.

4.1.7 Process innovation

Process innovation is the use of new or significantly improved methods for the production or supply of goods or services. The innovation (new or improved) must be new to the enterprise, but it does not need to be new to the industry sector or market. It does not matter if the innovation was originally developed by the owner's enterprise or by other enterprises. The results presented in Table 3 show that within the reference period of 2011 to 2014, more than half of the SMEs had new or significantly improved methods of manufacturing or producing goods or services (52%). About 46 percent improved on logistics, delivery or distribution methods for inputs, goods or services, while 43 percent introduced or significantly improved operating systems for purchasing, accounting and computing. Only 27 percent had new or significant improvements in all the three process innovations. The process innovations were mainly originated by the enterprises themselves (63%), enterprise groups (11%), and other enterprises (11%), and in partnership with other institutions (7%).

Table 3: Proportion of firms that introduced process innovation

Item	Innovation attributes	%
Proportion of SMEs that have new or significantly improved	• Methods of manufacturing or producing goods or services	51.5
	• Logistics, delivery or distribution methods for your inputs, goods or service	45.6
	• Supporting activities for your processes, such as maintenance and operating systems for purchasing, accounting or computing	42.8
	• All the three Process Innovations	27
By who were these product (goods and services) innovations devel-	• Mainly your enterprise	62.9
	• Mainly your enterprise group	18.4
	• Mainly your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions	11.4

oped?	• Your enterprise together with other enterprises or institutions	7.4
	Total	100
Did these innovations originate mainly in Uganda or abroad?	In Uganda	81.5
	From outside Uganda	18.4
	Total	100

Data Source: UNCST and UBoS, 2014

Majority of the process innovation ideas originated from within Uganda (82%), with those originating from outside countries constituting about 18 percent. Like the case of product innovation, process innovation was dominated by ideas originating from within Uganda, with limited interaction from outside the country.

4.1.8 Organizational innovation

An organizational innovation is a new organizational method in the enterprise's business practices (including knowledge management), workplace organization or external relations that has not been previously used by an enterprise. It must be the result of strategic decisions taken by management. Results in Table 4 reveal that about 64 percent, 74 percent and 48 percent of the SMEs introduced new or significantly improved on their business practices, methods for organizing work responsibilities, decision making, and methods for organizing external relationships with other firms, respectively. It is noted that only 39 percent of the firms carried out all the three organization innovation, a rather small proportion. Organizational innovation is imperative in the current competitive world of business, where telecommunications technology is at the core of management discourse and therefore critical to the survival of firms.

Table 4 Proportion of firms that introduced organizational innovation

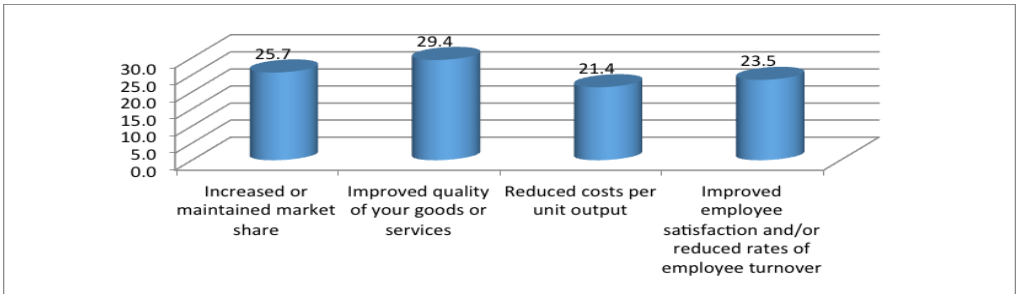
Proportion of SMEs that introduced new or significantly improved…	% of SMEs
• Business practices for organizing procedures (i.e. supply chain management, business re-engineering, knowledge management, lean production, quality management, etc.)	64.3
• Methods of organizing work responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems, etc.)	73.5

• Methods of organizing external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc.)	48.2
• Innovation in all the three Organizational areas	38.5

Data Source: UNCST and UBoS, 2014

Figure 8 shows the performance index of organization innovations on various outcomes, including increase/maintenance of market share, improvement in the quality of goods and services, reduction in the costs of production per unit output and improvement in employee satisfaction. The main areas where the organizational innovations were rated to have contributed significantly included improving quality of goods and services (29%), increasing or maintaining market share (26), improvement of employee satisfaction (24%) and reduction of production costs per unit output (21%). Note that firms that reported organizational innovations did not reduce time taken to serve customers or client needs. This implies that firms were only able to serve a few customers, which affects sales margins.

Figure 8 Performance index of organization innovations



Data Source: UNCST and UBoS, 2014

4.1.9 Marketing innovations

A market innovation is the implementation of a new marketing concept or strategy that differs significantly from the enterprise's existing marketing methods, and which has not been used before. It requires significant changes in product design or packaging, product placement, product promotion or pricing. Within the reference time period of 2011 to 2014, 57 percent of the SMEs changed or improved on their packaging for commodities: 40 percent considered better methods for product promotion, 39 percent improved on their distribution channel, and 57 percent adjusted their pricing for goods and services in order to place themselves in a more competitive position. We noted that because of the costs associated with placement and promotion innovations, only 20 percent were able to implement all the four areas of marketing innovations, an extremely small proportion of the firms in the sample.

Table 5 Proportion of firms that introduced marketing innovation

Proportion of SMEs that knew or significantly improved…	% of SMEs
• The aesthetic design or packaging of a good or service (exclude changes that alter the product's functional or user characteristics – these are product innovations)	56.5
• Media or techniques for product promotion (i.e. the first time use of a new advertising media, a new brand image, introduction of loyalty cards, etc.)	39.7
• Methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation, etc.)	39
• Methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems, etc.)	56.5
• In all the above market innovations	20.3

Data Source: UNCST and UBoS, 2014

4.2 Sources of information used for product and service innovations

The results presented in Table 6 indicate the ratings for the various information sources on innovation. Clearly, the results reveal limited use of education and research institutions, conferences and trade fairs, scientific publications and professional and industry associations in acquiring information on process and product innovations. Information sources mainly used include: internal sources within the enterprise and its networks, clients/customers, suppliers and competitors. There is limited consideration for interactive approaches to innovate. Instead, firms concentrated on internal approaches which may not be the best strategy. This development may arise from lack of opportunities or funds.

Table 6 Proportion of firms by source of information used for innovation

		High	Medium	Low	Not Used	Total
Internal sources	• Sources within your enterprise or enterprise group	43.3	24.8	5.2	26.7	100
Market sources	• Clients or customers	42.3	22.9	7.8	27.0	100
	• Suppliers of equipment, materials, components or software	21.5	27.4	13.5	37.6	100
	• Competitors or other enterpris-	19.9	24.3	20.6	35.2	100

	es in industry					
	• Consultants and commercial laboratories	12.5	12.8	13.9	60.8	100
Education & research institutes	• Government, public or private research institutes	5.0	10.2	15.1	69.7	100
	• Universities or other higher education institutions	4.5	9.9	17.7	67.8	100
Other sources	• Conferences, trade fairs, exhibitions	13.7	21.0	14.4	50.8	100
	• Professional and industry associations	11.1	14.4	16.8	57.7	100
	• Scientific journals and trade/ technical publications	7.3	18.0	16.3	58.4	100

Data Source: UNCST and UBoS, 2014

For the sources of information outside a firm, only one in three SMEs collaborated with other enterprises or institutions on any of its innovation activities during the reference time period 2011 to 2014, as illustrated in Table 7. The main partners associated with included clients/customers (20%), suppliers (17%), other enterprises in the group (16%), competitors (15%), consultants (12%), government and research institutes (10%) and universities or institutes of higher learning (10%). It should be noted that the most valued partners that collaborations happened with were clients or customers, as illustrated in table 7. Majority (55%) of the enterprises considered clients/customers as their most valuable partners, while 13 percent considered the other enterprises in the group to be the most valuable for their enterprises, with 11 percent considering suppliers.

Table 7 Most valued partner for the enterprise

Institution/Partner	Partner cooperated with (%)	Most valuable partner for the enterprise (%)
Clients or customers	19.5	55.2
Suppliers of equipment, materials, components or software	16.7	11.0
Other enterprises within your enterprise group	16.2	13.1
Competitors	15.2	7.6
Consultants, commercial labs	11.7	5.5
Government, public or private research institutes	10.4	4.1
Universities or other higher education institutions	10.2	3.5
Total	**100.0**	**100**

Data Source: UNCST and UBoS, 2014

4.3 Effects of product and process innovations

The objective of innovation introduced by a firm is related to the outcome (Horbach *et al.*, 2012). Figure 8 presents the rating scores of effects rising from the product and service innovations that were taken during the reference time period of 2011 and 2014. The leading effects from the product and process innovations include improvement on the quality of goods and services (13%), increase in the range of goods and services (11.3%), increased capacity for producing goods and services (10.3%), improved flexibility in production (10.3%), increased market share (9.8%) and penetration into new markets (10.3%). Other benefits include reduction of production costs (8.8 %) and replacement of outdated products or processes (9.2 %) as well as reduction of environmental impact (7%). The fact that only 7 percent of the effects reduced negative environmental impacts demonstrates that innovations are not primarily geared towards mitigating negative environmental impacts.

Table 8 Importance of the effects of the products and process innovations during period 2011 to 2014

	Effect	Percentage
1	Improve quality of goods or services	12.8
2	Increased range of goods or services	11.4
3	Entered new markets	10.3
4	Improve flexibility for producing goods or services	10.3
5	Improve capacity for producing goods and services	10.3
6	Increased market share	9.8
7	Improved working conditions on health and safety	9.2
8	Reduce production costs per unit output	8.8
9	Reduced environmental impacts	7.0
10	Meet governmental regulatory requirements	10.0
	Total	100.0

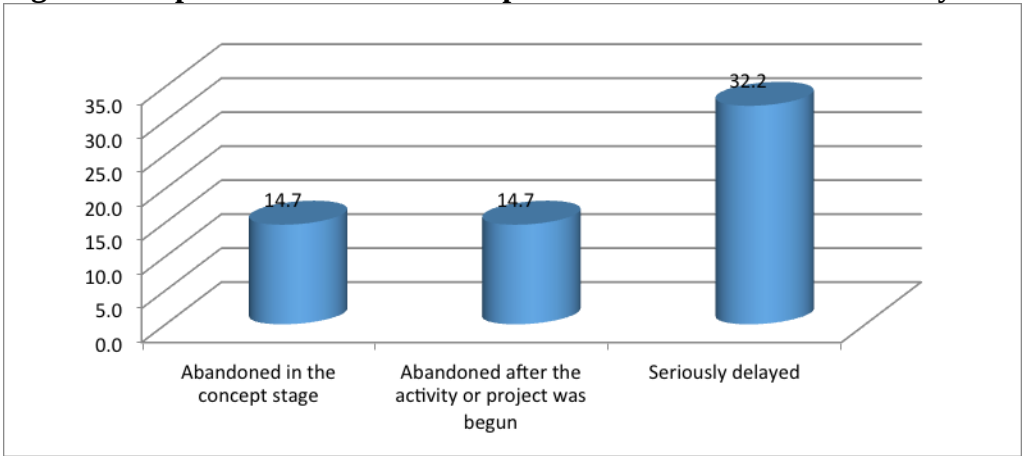
Data Source: UNCST and UBoS, 2014

4.4 Factors hampering innovation activities

Constraints are considered as evolving and changing at the various stages of the eco-innovation process. The constraints experienced by a firm at any of the stages may mean a company has to abandon the innovation or may face serious delay as a result of failure in addressing a particular constraint. This may result in firms dropping the idea at concept stage or dropping an idea that is ongoing or sometimes delayed. Figure 9 presents the proportion of Ugandan SMEs that experienced failure at concept stage, after the activity begun and those that faced serious delay due to innovation constraints. The results reveal that within the reference period of 2011 to 2014, 32 percent of the SMEs delayed some of their innovation activities while 15 percent abandoned some activities after initiating their implementation, with a similar proportion abandoning activities while still in their conceptualization stages. Although it is evident that more firms are able to

overcome the constraints compared to those that fail, it is also true that abandonment and delay in execution of innovations is of reasonable proportion.

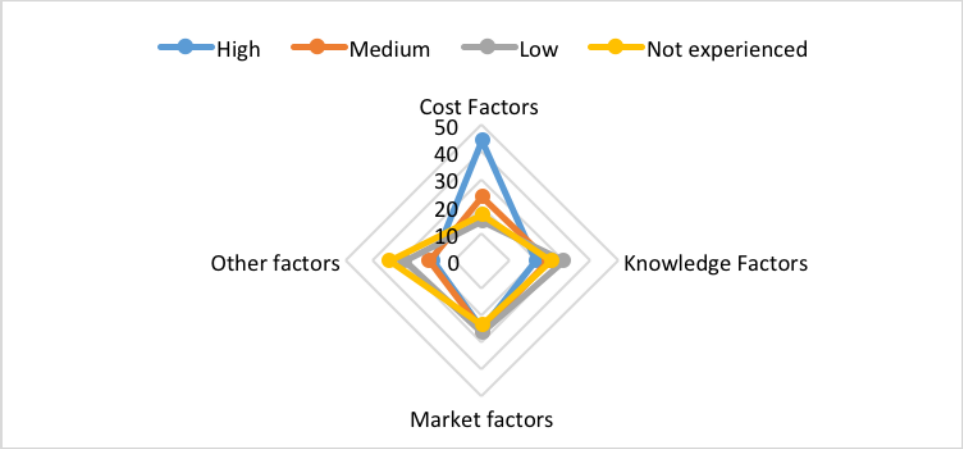
Figure 9 Proportion of SMEs that experienced failure and those delayed



Data Source: UNCST and UBoS, 2014

The factors that limit enterprises from introducing an innovation or influence decisions to abandon innovation activities are divided into four: market, knowledge, cost and other factors. These factors were further divided into sixteen subcategories. The entrepreneurs were asked to evaluate the importance of each factor on a Likert scale. The sample average value of the Likert scores of the firms that experienced constraints are presented in the study. Figure 10 demonstrates the importance of innovation obstacles perceived by Ugandan SMEs owners, irrespective of the outcome from their innovation. The most severely deterring factor to innovation is the 'cost factor', more specifically lack of finance from sources outside a firm. It further illustrates the intensity of factors that deter innovation in Uganda SMEs. The results indicate that the financial system in Uganda imposes serious barriers for SMEs that need funding for innovation. Financing innovation is a general problem, which also affects innovation in developed countries.

Figure 10 Importance of obstacles to innovation in Ugandan SMEs



Data Source: UNCST and UBoS, 2014

In addition to cost factors, market factors also pose serious challenges to Ugandan SMEs. The knowledge-related factors, such as difficulty in finding collaborative partners for innovation and lack of qualified personnel were also regularly mentioned as important factors deterring SME innovation in Uganda. The data also reveal reasons for a firm not to innovate. This demonstrates the proportion of firms that did not venture into innovation. A small number of firms indicated lack of involvement in innovation, which is an indication that majority of Ugandan SMEs try to be innovative. A more detailed description of the factors that influence SME behavior to abandon or delay innovation is presented in the descriptive statistics given in Table 9.

Table 9 Importance of obstacles hampering innovation for Ugandan SMEs

	Hampering factors	%	Cumulative %
Cost factors	• Lack of funds within your enterprise or group	10.1	
	• Innovation costs too high	9.6	
	• Lack of finance from sources outside your enterprise	8.1	
	• Excessive perceived economic risks	7.5	35.4
Knowledge factors	• Difficulty in finding co-operation partners for innovation	6.7	
	• Lack of information on technology	6.5	
	• Lack of qualified personnel	6.2	
	• Lack of information on markets	6.0	25.4
Market factors	• Market dominated by established enterprises	7.9	
	• Uncertain demand for innovative goods or services	7.1	
	• Innovation is easy to imitate	5.5	20.5
Reasons not to innovate	• No need because of no demand for innovations	4.0	
	• No need due to prior innovations	3.7	7.7
	• Limitations of science and technology public policies	5.9	
Other factors	• Organizational rigidities within the enterprise	5.0	10.9
	Total	100.0	100

Data Source: UNCST and UBoS, 2014

The factors presented were categorized as internal and external factors to the organization. Internal factors relate to firm characteristics, management structure and human resources; while external factors include institutional factors, access to finance, access to information on technologies, among others. The top three factors constraining innovation among SMEs are 'cost factors'. Cost factors include lack of funds within the enterprise, high innovation costs, lack of finances from sources outside the enterprise and excessive perceived economic risks constituted the highest percentage of factors hindering innovation (35%). Cost factors were followed by knowledge factors, such as difficulty in finding co-operation partners for innovation, lack of information on technology, lack of skilled personnel and lack of information on markets, which cumulatively accounted for about 25 percent. These constraints are attributable to the weak education system that is not producing graduates, with the requisite skills to promote innovation, cost and time of collecting information on technologies.

The external factors that were perceived as important in deterring innovation relate to markets and other institutional factors. Under the category of markets, dominance of established firms, uncertain demand for innovative goods and services and the tendency by firms to imitate innova-

tion developed by other firms were perceived as major constraints for innovation. The factors related to institutional barriers, include: limitation of science and technology, public policies and insufficient flexibility of regulation or standards. A question was asked regarding whether organization rigidities within enterprise constrain innovation among firms. The fact that SMEs are more flexible, organization rigidities had minor effect on firm innovation behavior.

4.5 Case study analysis

4.5.1 Characteristics of firms

The firms that participated in the interview are described using codes. Company one (C1) is owned by female entrepreneurs, who are involved in producing organic mushroom. The firm produces different products, including: mushroom powder, confectionery, jelly and nutritious porridge for babies. The market for their product is mainly local. Besides, C1 offers two main services – training and massaging using organic products. Company two (C2) is owned by a group of female entrepreneurs in their youthful age. The company produces two products: organic fertilizer made out of urine and cooking bananas, which they sell on the local market. Also, company two (C2) offers training to its clients. Company three (C3) is owned by a male entrepreneur and produces mainly organic vegetables for the local and international market. Table 10 gives more details about the companies. Two people in each of the companies were interviewed: the owner/manager and one senior staff.

Table 10 Characteristics of companies

Company code	Industry	Number of employees	Products/services	Market or customer focus
C1	Agriculture	9	Organic mushroom products, medicinal products from mushrooms, massage and training	Niche market
C2	Agriculture	12	Organic cooking bananas, Organic fertilizer and training	Competitive market with national customers
C3	Agriculture	25	Organic vegetables, fruits and training	Competitive market with national customers

4.5.2 Opportunities for innovation

There are factors that present opportunities to entrepreneurs in Uganda to participate in eco-friendly business practices. Interviews for the study reveals a number of factors, including: new customers demanding eco-friendly products, suppliers mainly from the Brazil, Russia, India, China and South Africa (BRICS), cost saving technologies and indigenous knowledge. Table 11 identifies opportunities for innovation and the decision taken by the entrepreneurs to exploit the opportunity. Two respondents were interviewed from each firm.

Table 11: Opportunities for innovation in green enterprises

Identified opportunities	Examples
New clients demanding eco-efficient products	• Customer guided us to start weekly farmer market at his restaurant for the fresh organic vegetables (C3) • Adopted Asian vegetables because customers from China prefer that type(C3) • New customers are interested in the medicinal benefits of using mushrooms(C1) • The demand for our organic fertilizer is growing each day (C2)
New suppliers offering eco-efficient materials	• We use organic pesticides prepared by our supplier (C3) • We use cockpit husks from Asian suppliers to improve germination rate(C3) • We depend on a company from China for already made mushroom kits (C1) • The emergence of urine separating toilets (Ecosan project) helped us to maintain our big clients (C2)
Local Indigenous knowledge	• It is cheaper to control banana weevils using wood ash and red chili (C3) • We use tobacco to control snakes that carry a virus which destroys mushroom (C1) • It is cheaper to use urine from cows than industrial fertilizer(C3) • The locally fabricated solar dryers are cheaper and easy to get(C1) • Urine is readily available and affordable compared to industrial fertilizer (C2) • Urine and ash are readily available and natural fertilizer(C2) • We use dogs to scare away monkeys from our gardens (C2, C3)
Farmer led demonstration units and local production networks	• Money from training on mushrooms significantly improved our revenues (C1) • We work with the horticulture associations to develop new products (C3) • A member of the association offered to demonstrate for the group to learn (C2) • Groups in our association meet once a month to share knowledge (C3) • We scaled down production, improved the demonstration units to focus more on training and advisory services (C1)
Potential for local fertilizer market and cottage industry	• The substrate used in growing mushrooms is decomposed for selling (C1) • Urine is the single option for nitrogen, potassium and phosphorus (C2) • We use animal urine and compost manure to improve soil fertility(C3) • We make compost from cow dung and wood ash (C3) • We experimented industrial fertilizer on mushroom and we lost everything (C1)

4.5.3 New clients demanding eco-efficient products

From the analysis of secondary data, it is evident that SMEs mainly depend on customers for innovation. The same trend is associated with the case studies. However, for green enterprises, not all customers matter. The main market for green products in Uganda is largely customers from Europe and Asia. This implies that the customers from foreign countries have great potential to influence the behaviors of firms towards eco-innovation. With the increasing number of foreign companies, especially from Brazil, Russia, India, China and South Africa (BRICS), local demand for organic products greatly increased, yet supply did not grow at the same rate. There are imports of ecofriendly products, mainly from Kenya and South Africa, but local products still have space on the shelves. According to the owners of company C3, one of their customers requested them to open up a weekly market for fresh vegetables at his restaurant. The idea improved company C3's sales, and was very much appreciated. In addition, the owner-manager (C3) also realized that their clients preferred Asian vegetables. Therefore, they adjusted the production mix by introducing the new varieties to match customer preferences. On the other hand, Company C1 diversified into medicinal products, having interacted with medical doctors at one of the hospitals where they sell their products. According to an employee in C1, "mushrooms are very nutritious and are good as '*antibiotics*'. This is the main reason why their customers opted for the medicinal products. For company C2, the owner was proud about the high demand for urine - organic fertilizers- which continued to grow, with the new packaging. The new clients, especially from Asia created a market niche, which the companies are taking over by introducing new products, packaging and management strategies. Overall, most of the innovations were initiated by customer market which, again, confirms earlier findings from the secondary data.

4.5.4 New suppliers offering eco-efficient inputs

The results of this study suggest that most of the innovations in Ugandan SMEs are incremental, and mainly based on adaptation and learning. There is great opportunity for local entrepreneurs to learn from both foreign and local suppliers that produce low cost inputs. The new innovative suppliers, who have introduced more efficient technologies with the advantage of shortening the long production cycles, are reaping a lot from local SMEs. For example, a new technology – use of *hydrated lime*- for neutralizing the substrate for growing mushroom adapted by C1, was introduced by a supplier from China. This technology has been widely adopted by mushroom growers in Uganda. There are more examples of local innovative suppliers, such as the producers of solar dryers used by C1 and suppliers of organic pesticides used by C3 in the management of strawberries and vegetables. In view of the above, the study found out that SMEs have a great potential to exploit partnerships with suppliers, both local and foreign, who have invested in affordable eco-friendly solutions.

4.5.5 Indigenous knowledge and technologies

Indigenous knowledge is an important national resource that offers new models for business performance. All the entrepreneurs visited introduced locally available technologies in their production process. The three companies used indigenous knowledge to stimulate process innovation and experiments because it was a cheaper option than other alternatives. For example, companies C2 and C3, found the cost of organic fertilizer made out of urine cheaper than industrial fertilizer. Tobacco and cats were introduced to control snakes and rodents respectively. According to the owners of company C1, rodents and snakes carry a virus that destroys mushroom gardens. According to the owner-manager of C3, "snakes feed on strawberries, and other fruits, so it was necessary to get rid of them by planting tobacco, which is more permanent solution to maintain productivity". In addition, two of the companies owned dogs they used to control monkeys from destroying their gardens. These innovations reduced the cost of production while at the same time, conserving nature. The role of indigenous knowledge is not new; several authors have acknowledged its role in conserving biodiversity (Warren, 1996; Ford and Martinez, 2000; Berkes, 2004). The companies covered in this study show a clear demonstration of how this knowledge is being used to create economic value, improve food security and environmental performance. According to the feedback from interviews, the use of indigenous knowledge tackles both the cost and knowledge constraints to innovation.

4.5.6 High demand for knowledge on organic farming

The study found that there is potential to exploit the knowledge gap on green farming practices in the farming communities of Uganda. Until recently, the Government of Uganda was financing the private-sector led agricultural extension system which created model farmers (farmers that formed a nucleus for other farmers to learn from) across the country. The model farmer method reinforced confidence in farmer-to-farmer learning. However the recent decision by government to revert to public extension system created a vacuum in the agricultural knowledge extension system that is being exploited by entrepreneurs. All the entrepreneurs interviewed had a knowledge transfer component as part of their business. Company C1 had provided more services to its client compared to the rest. Company C1's services include massaging, using mushroom therapy, training on mushroom growing and agribusiness. Company C3, advised their clients on agronomy for vegetables and fruits, general management and irrigation. Company C2's services were mainly on general management for bananas and application of organic fertilizer made out of urine. So the high demand for knowledge on organic farming practices implies that there is potential to harness service innovation in farming practices of local entrepreneurs.

4.5.7 Potential for local fertilizer market and cottage industry

Uganda is ranked the lowest consumer of industrial fertilizer in the East African region. The low consumption of artificial fertilizer is attributed to the dominance of subsistence farming, where majority of farmers cannot afford to buy fertilizer for their gardens. However, with the land in most parts of the country over ploughed, productivity has declined, which is a threat to food se-

curity. To reclaim soil fertility, subsistence farmers have to try out the affordable options that are locally available. As a result, the demand for organic fertilizer is steadily growing. The entrepreneurs introduced low cost alternatives, including: earthworms, compost manure and human excreta in trying to improve soil fertility. According to C3, the use of human excreta in the food industry, especially vegetables had a lot of resistance among local communities. However, we found that the fertilizer from human urine had potential demand from banana farmers and in the flower industry because of its compatibility with the greenhouse fertigation system. The emergence of urine separating toilets is a great opportunity for entrepreneurs, who want to use urine on large commercial farms. Due to the increased demand for manure, company C1 produces compost manure from the substrates that remain after harvesting mushrooms. The heaps of residues were left to decompose for a while, before farmers bought it as compost manure.

4.6 Implications for water and land management

4.6.1 Application of urine as a fertilizer

The organic fertilizer that is made out of urine has a considerable component of water that is required by plants. For example, in the green houses, farmers who use urine in fertigation system require less liters of water than what is required when solid fertilizer is used. The study found that less water was needed to dilute urine during the process of applying fertilizer for plants in the greenhouse.

4.6.2 Application of organic pesticides

The use of indigenous technologies, such as tobacco, red chili and wood ash does not have negative effect on land. The use of local technologies did not disrupt microorganisms in the ecosystem thereby maintaining soil structure and fertility. In fact, farmers reported that spraying urine maintained soil fertility and controlled banana weevils and grasshopper infestation. However, there were fears among farmers about the long term impact that may result from continuous application of urine on their farms. Andersson (2015) noted that continuous application of urine creates high deposits of phosphorous and nitrogen content, hence suggesting a residual buildup of these nutrients following urine application.

4.6.3 The use of hydrated lime for–neutralization

The use of hydrated lime for neutralizing the mushroom substrate improved soil productivity. In addition, the use up substrate was left for some time to decompose. This was later sold to farmers as composed manure. Alternatively some farmers used the substrate to make charcoal briquette for cooking. These innovations not only served the purposes but significantly reduced the costs that firms incurred.

4.6.4 The use of plastic bags for mushroom growing

The evaluation found the use of plastics bags in making the growing bags for mushrooms very risky for the environment. We found that when plastic dries up, it breaks down into small pieces which remain in the residue that is decomposed and sold as compost manure. Since plastic cannot be decomposed by microorganism, plastic pollution undermines lands and waterways. Plastic bags are typically used for a short period of time in mushroom growing but take hundreds of years to break down in the garden. The large pieces of plastic bags were picked out for burning, with implications for increased greenhouse gases. The burning of plastic releases carbon dioxide into the atmosphere, which degrades the environment; therefore, it is important to look for replacement materials, such as the new forms of polymer, made from renewable materials that are digestible by microorganisms.

5.0 DISCUSSION OF FINDINGS

UGANDAN SMEs encounter serious obstacles to innovation but the majority does not give up. The main hindrances that deter innovation in SMEs include costs, knowledge and market factors. The cost factors relate to limited resources to fund innovation, yet access to credit is still a problem for small companies in sub-Saharan Africa. There are uncertainties regarding the outcomes of innovation, which obstruct decisions to invest in new knowledge and technology. The factors that deter innovation mirror the most common type of innovation undertaken by Ugandan SMEs. The most common type of innovation was organizational innovation, followed by marketing because both types of innovation are less costly, compared to process and product innovations. According to the findings, product innovation was very uncommon, followed by process innovation. It is acknowledged that product innovation stems from new technologies and skills, which are lacking in Ugandan SMEs. Elsewhere, SMEs that lack resources often depend on collaborating partners with potential to invest in innovation, but Ugandan SMEs find a lot of difficulty in finding co-operating partners for innovation. This implies that green SMEs have to depend on locally available knowledge and affordable sources of information, such as customers and suppliers as a strategy to promote eco-innovation. This significantly limits meaningful innovation that ensures competitiveness beyond national borders.

Knowledge constraints, such as the lack of skills and information about technologies are significant because very few Ugandan SMEs are partnering with universities, consultants and research institutions, where they could access new knowledge. The tendency to use trade fairs and journals as sources of information for innovation is also low. The lack of resources to initiate innovations within firms means that Ugandan SMEs have to rely on external parties. However, the most valued external partner for innovation among Ugandan SMEs is the customer. Customer requirements have been found to influence eco-innovation (Horbach *et al*., 2012), but where firms lack resources to invest in innovation, they tend to respond to customer needs by imitating other firms. Imitative innovation is largely incremental innovation. Ugandan SMEs need partners with new technologies to improve product and process innovation; however the new technologies should be affordable. The lack of information on new eco-friendly technologies is therefore a

great opportunity for partnerships to support knowledge creation critical to the national innovations system. It is therefore important to support the creation of knowledge on organic farming, as part of the national innovation system.

The research reveals that green SMEs in the agricultural sector depend on indigenous knowledge and technologies to undertake innovation. This is mainly because local knowledge and technologies are cheaper to adapt. Indigenous knowledge has become a major component of process and product innovation, because it reduces the costs of production and improves environmental performance; therefore, innovation among green SMEs in low-income countries can be supported by tapping into existing knowledge and knowhow.

It is evident from the study that the biggest barrier for market innovation is dominance of established companies. Firms that lack skills and new knowledge struggle to undertake market innovation. Consequently, they are more likely to imitate innovations introduced by other companies. This also explains why most innovation activities undertaken by Ugandan SMEs are incremental and based on experimentation. However, incremental innovation is not often linked to environmental performance (Smith *et al*., 2005; Nill & Kemp, 2009). However, the multiplier effect of these innovations ultimately has cumulative impact on the environmental outcome. The study shows that incremental innovations are easier, and used by poor people because they are socially and economically appropriate.

The study also found that most of the technologies employed by green SMEs have a positive impact on the environment. However the use of plastic bags for mushroom growing was accompanied by traces of polymer materials, which were introduced as part of process innovation. They inevitably have a negative impact on soil and waterways. This requires more innovative technologies, like the digestible polymer to replace plastic, which take years to decompose. On the other hand, the use of urine and other materials as organic fertilizer not only demonstrate a high demand for organic option but contribute water that is required by plants. The adoption of tobacco, red chili and wood ash as pesticides was found to be a cheaper option for controlling pest infestation. In addition, mushroom farmers used hydrated lime and maize bran to neutralize the substrate which improved productivity.

6.0 CONCLUSION AND POLICY IMPLICATIONS

In conclusion, in order to empower SMEs to change their environmental behaviors, there is need to strengthen the driving forces or weaken the resistant forces to eco-innovation, or a combination of both. The study concludes that Ugandan SMEs are involved in incremental innovation because of the high multiplier effect of the cumulative actions of individual farmers. To this end incremental innovation is likely to have a large and gradual effect that will impact significantly on environmental performance, contrary to earlier findings (Smith *et al.,* 2005; Nill & Kemp, 2009).

The study illustrates that customer requirements form a driving force for innovation in Ugandan SMEs. There is need to strengthen this driver through training of customers and promotion of eco-literacy, as a potential option to stimulate eco-innovation among SMEs in Uganda.

The main hindrances to innovation in SMEs are the high costs, inadequate knowledge and market factors. This has led to perpetuation of the least costly type of innovation undertaken by SMEs. The government should consider using its existing research institutions to assist SME to innovate.

It is noted that product innovation is very uncommon, followed by process innovation, owing to limited new technologies and skills. This implies that investments into new technologies and development of skills are critical to firms undertaking product innovation.

Since SMEs lack resources and may have to depend on collaboration with partners to invest in innovation, private sector apex and umbrella institutions, like Uganda National Farmers Federation, Uganda Private Sector Foundation, among others, should come in to foster these linkages and cooperation.

Given that local and indigenous knowledge plays a critical role and is accessible to farmers undertaking innovation, strategies should be developed to promote its expansion and exploitation through policies, frameworks and regulations.

In addition, there is great opportunity for potential suppliers, especially foreign firms to tap into existing knowledge systems, including indigenous knowledge to develop more affordable and efficient technologies, such as degradable polymer to replace plastic bags.

In order to mitigate the knowledge constraints, such as the lack of skills and information about technologies, SME should partner with universities, consultants and research institutions, where they could access new knowledge.

The lack of information on new eco-friendly technologies creates an opportunity for partnerships to support knowledge creation on organic farming, as part of the national innovation system.

Although most of the technologies employed by green SMEs have a positive impact on the environment, the traces of polymer materials that were introduced as part of process innovation should be addressed through legislation. Farmers should be encouraged to use environmentally friendly materials instead.

The use of urine and other materials as organic fertilizer and organic pesticides, which has high demand, should be scaled up through formulation of appropriate policies by the government.

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