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Current practices concerning the environmental management systems among horticultural processing MSMES in Kenya

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Abstract

The horticultural industry in Kenya is a key income earner with intensive utilization of natural resources in water, energy, and production of enormous quantities of agricultural wastes that negatively affect the environment. Despite the increased horticultural production and processing, the current practices in sustainable horticultural processing by the Micro, Small, and Medium Enterprises (MSMEs) concerning efficient use of resources and potential impact on the environment are yet to be established. This study involved a baseline survey in establishing the practices and trends in horticultural processing by MSMEs in Kenya. The digital Open data kit (ODK) platform was used to collect descriptive data from processors (n=122) across 19 counties of Kenya. Results indicated that most of the processors (57.8%) were small-scale enterprises while the micro and medium enterprises were 26.5% and 15.7%, respectively. The processed products include dried fruits and vegetables (64.7%) and frozen products (11.8%). To ensure efficient marketing, processors give out free samples (78.4%) regardless of the processor capacity (χ^2= 6.17, p=0.046), carry out product delivery (60.8%), and offer products on credit to clients (21.6%). There was no association between the type of enterprise and standard certifications (χ^2= 5.6, p=0.061), with most (59.8%) of the organizations lacking local and international certifications. Only 39.4% had certifications from the Kenya Bureau of Standards, although a weak correlation (r=0.225, p=0.023) between the certified firms and auditing was reported. Over 55% of the respondents did not know of ISO 14001 environmental management standards. Awareness of sustainable consumption and production was deficient, and only 24.5% agreed that there is strictness in the implementation of environmental legal requirements and regulations. In conclusion, the survey shows that environmental awareness scored poorly (29.5%) and, therefore, a need to conduct training on the importance of environmental sustainability during processing.

Keywords: *Energy; horticultural; ISO; MSMEs; resources; water; sustainability*

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Introduction

The Micro, Small, and Medium Enterprises (MSMEs) have been an integral part of industrial and economic development for developed and developing countries across the world, employment generation, intensification of product outputs, and significant sources of produce processed products for export. They require significantly low investment but have been shown to effectively contribute to foreign exchange earnings (Farajollahzadeh *et al.,* 2016; IFC, 2013).

The horticultural products subjected to food processing globally include fruits, vegetables, nuts, spices, and aromatic crops (Rathore *et al.,* 2018). Consequently, horticultural crops hold a great potential that can be harnessed to improve the nutrition and national economy, and income (Kachule & Franzel, 2009). Fruits and vegetables are usually subjected to processing, and the derivative products are in the global market (Hossain, 2015). The global trends point towards a rapid shift from the "produce and sell mentality" for products to augmenting predetermined product attributes preferred by consumers for greater profitability (Hossain, 2015). Processing also enhances the bioaccessibility of nutrients and keeping the quality of products (Perera & Smith, 2013); value addition increases such ventures' economic viability.

The horticultural industry plays a significant role in Kenya by contributing to food security, income and employment, provision of raw material for agro-processing, poverty alleviation, and exchange earnings through exports (McCulloch & Ota 2002; GOK 2012). Consequently, the horticultural industry is the fastest growing agricultural sub-sector in Kenya and is ranked third in foreign exchange earnings from exports after tourism and tea export (HCDA, 2009).

Kenya exports mostly semi-processed and low value-added products, which account for 90 percent of horticultural processed products (Fukase & Martin, 2018). However, due to technological limitations and high costs of value addition, underperformance, and under-development of the firms. Moreover, inadequate infrastructure and inconsistent production of horticultural raw materials has resulted in operations below capacity (Fukase & Martin, 2018). Subsequently, the processed products in Kenyan markets are less competitive and lack a comprehensive database of processors. This results in importing processed products that could be processed locally (GOK, 2012) and concurs with a report by the Federal Ministry For Economic Cooperation and Development of Germany (2016). There are subsequently low returns on Kenya's horticultural products due to the low-value addition practices, as 91% of the products are sold in semi-processed or fresh form.

The major fruits cultivated in Kenya include avocado, mango, passion fruit, pineapple, banana, pawpaw, and watermelon. The vegetables consist of tomatoes, kales, cabbages, onions, potatoes, French beans, chillies, snow peas, sugar snaps, runner beans, baby corn, garden peas, and African leafy vegetables, herbs, and spices (Kingdom of the Netherlands, 2017). However, production and processing are mainly carried out by smallholder farmers and MSMEs who produce over 90% of the Kenyan horticultural produce and products, respectively. During production, significant challenges are experienced in postharvest handling and compliance with phytosanitary requirements such as Global gap regulations. Besides, access to capital and efficient technologies by the smallholder producers and processors is challenging, limiting the full potential of this sector in the country (Tschirley & Ayieko, 2009; Tschirley *et al.,* 2004).

Production and processing of horticultural produce and products involve intensive utilization of resources, mainly land and water, and farm chemicals (Bengtsson *et al.,* 2018). Increased demand in both local and export markets has resulted in more use of these resources (Stringer, 1998). However, intensified utilization of these has adverse environmental resource base effects by interfering with sustainable production whose goal is to produce more while using minimal resources (Bengtsson *et al.,* 2018; Chowdhury *et al.,* 2020). In Kenya, assessment of the environmental impact as a

result of horticultural processing practices is significantly low.

Therefore, the current study was based on a baseline survey conducted to establish the practices and trends in horticultural processing among the Micro, Small, and Medium Enterprises (MSMEs) processors in Kenya.

Materials and methods

A descriptive research design was used in the current study to establish and enable the researcher to describe the variables of interest while analyzing the horticultural processing sector (Sekaran, & Bougie, 2010). Four research assistants with a minimum of tertiary education, good communication skills, and ability to interpret the questions into Kiswahili for ease of communication were recruited and trained on the pre-tested semi-structured data collection tool.

The research assistants used the Open data kit (ODK) mobile digital platform using smartphones to collect data on current practices for adopting sustainable consumption and production practices in the Kenyan horticultural processing industries and the support needed to transform an inclusive green economy. The target population was randomly selected Micro Small and Medium Enterprises (MSMEs) in Kenya who undertake the processing of horticultural products, mainly fruits, and vegetables. The European Union defines MSMEs as those enterprises with a headcount of fewer than 250 persons. Their annual turnover does not exceed 50 million euros, and a balance sheet totals not more than 43 million euros (European Commission, 2003). The survey targeted horticultural processing enterprises.

Purposive sampling was used to select the horticultural processors since they were involved in the processing and preservation of fruits and vegetables at the micro, medium, and small-scale operations for commercial purposes, which were the main criterion set by the researcher. A total of 122 processors distributed across 19 counties of Nairobi, Rift Valley, Central, Western, and Eastern Kenya (Table 1) were assessed from 8/7/2018 – 14/12/2018. It was noted that the number of MSMEs involved in horticultural processing was relatively low. Most of the large-scale processors contacted declined to participate in the project compared to small and microenterprises that were more welcoming.

Table 1: Distribution of MSMEs assessed

Region	County	No of processors
Nairobi	Nairobi	11
Central Kenya	Nyeri	32
	Kiambu	6
	Meru	3
	Murang'a	1
	Kirinyaga	1
	Laikipia and Nyandarua	2
Western Kenya	Kisumu	2
	Vihiga	27
	Busia	6
	Bungoma	7
	Kakamega	13
	Kisii and Nyamira	5
Rift Valley and Eastern Kenya	Nakuru	3
	Embu	1
	Kitui	1
	Kajiado	1

(Source: Authors)

Data analysis

Data was collated and retrieved from the servers (Ona.io, 2019), cleaned, and then subjected to analysis using Statistical Package for Social Science (SPSS) Version 25 (IBM, 2017). Descriptive statistics were used to obtain the frequencies, percentages, means, and standard deviations for the variables under study. Inferential statistics were obtained using ANOVA tests and Pearson's correlation coefficient (r) for associations between the continuous data. Chi-square tests (χ^2) were used to find the associations between the categorical variables under study. The *p*-value was set at ≤0.05.

Results

Description of respondents

Most of the processors (57.8%) were small-scale enterprises, the micro-enterprises companies were 26.5%, and medium enterprises were the least (15.7%). The majority (63.7%) of the respondents were females. In comparison, males made up 36.3%, indicating women's high vegetable and fruit value addition involvement. However, there was no significant association between gender and knowledge of ISO 14001 standards (χ^2 = 3.76, p ≥0.05), indicating that the environmental management awareness was relatively low among respondents of either gender. About 46% of the respondents owned the enterprises and the hired managers, while 54% served the firms under different capacities such as project directors, managers, coordinators, chairpersons, among other responsibilities. However, the respondents' ownership or responsibility in the respective processing units significantly influenced their knowledge of ISO 14001 environmental standards and their advantages or disadvantages (χ^2 = 6.91, p=0.032).

The age of respondents ranged from 23 – 77 years old, with an average of 46.4 ± 15.3 years old. Although indicative of the willingness of the youths (18-35-year-olds) to be involved in agricultural-related activities, their number was observed to be relatively low, whereby slightly more than a fifth of the respondents (21.3%) were in this category. A majority (46.1%) of the respondents had attained tertiary education, while 42.2% had secondary education and 11.7% had primary education. There was no significant association between the respondent's education and environmental standards certification (χ^2 = 48.06.3, p=0.237), and therefore a need to create awareness on environmental management systems.

More than 8 in every ten organizations were involved in fruits and vegetable value addition. The specific products processed include dried fruits and vegetables (41.8%), fruit juices (11.2%), banana and pumpkin flours (20.4%), banana and potato crisps (10.1%), and fruit jams (7.1%). In comparison, tomato sauces and frozen products were processed by 9.1% of the processors.

Raw Material acquisition and processing characterization

Most processors (59.8%) do not make any contractual agreement with suppliers for their raw materials, while for those who make agreements, 63.4% of these were informal. During the procurement from suppliers, most processors bought raw materials based on weights (66.4%), gunny bags (10.5%), net bags (4.9%), and others (18.2%) use agreed units of purchase. On average, 463 kg of raw materials are bought and a maximum of 10,000 kg at a given time with the frequency of raw material purchase depending on processing capacity. Most of the processors did so weekly (24.5%) and monthly (23.5%). The remaining had varied procurement: daily (13.7%), weekly (10.8%), and the rest (27.5%) as per demand. A significant proportion of these noted that they plant and harvest their raw materials while some process after harvesting mature crops from their farms and when the raw materials are in surplus in the markets. However, due to a lack of adequate storage techniques, most processors buy in small batches. The current findings agree with Paik *et al.*, (2009), who reported that MSMEs have low purchasing power and suffer from a scarcity of internal resources, competent human resources, and are highly impacted by the supply's dynamic supplier costs chain.

The cost of producing each unit of products varied significantly as determined by one-way ANOVA (F= 1.706, p<0.05) depending on the

product type, and this averaged USD. 2.9 ± 1.5. Most of the respondents (70.6%) noted that lack of efficient and effective equipment had been a limitation in production, resulting in loss of business. Moreover, those relying on solar energy cited low production during rainy seasons as the energy was proportional to the hours the sun energy was tapped.

Marketing of processed products

Most processors (83.4%) sold their products to either consumers or both consumers and retailers, which may be as a result of low production of the respective products that limit adequate supply to retail outlets (11.7%) (Table 2). However, the correlation between buyers' purchase of products and the type of processors was very weak (r= 0.032, p= 0.03).

Table 2. Marketing of processed horticultural products

Buyers	**Percent**
Both consumers and retailers	42.2
Final consumer	41.2
Retailers	11.7
Retailers/Final consumer	2.9
Retailers/ Final consumer /Both consumers and retailers/other processors	2.0

To ensure efficient marketing and distribution of products, processors give out free samples (78.4%), do product delivery (60.8%) to clients who make orders while others offer products on credit to clients (21.6%). There were no significant differences (χ^2 = 6.17, p=0.046) between the type of processor and issuance of free samples to increase the marketing of products regardless of the processing capacity. All respondents agreed to practice this. Furthermore, 55.9% of the firms process products on order compared to 44.1% who processed without. This necessitates building up stock (74.6%) before distribution to the markets, while 28.4% store products for sales in distant markets.

The weather conditions that affected the production of fruits and vegetables resulted in variations in product processing depending on the year's seasons. Consequently, the sales varied among processors across the year (Table 3). However, sales tend to be high during the relatively harsh months (October- March) due to low rainfall and relatively high demand for processing.

Table 3. Product sales in a year

Month	Highest	Lowest
January	66.7	33.3
February	67.3	32.7
March	69.6	30.4
April	54.9	45.1
May	47.1	52.9
June	44.1	55.9
July	47.1	52.9
August	45.1	54.9
September	52.9	47.1
October	66.7	33.3
November	68.6	31.4
December	70.6	29.4

Depending on the end product characteristics, most were sold based on weights (74.5%) and others (26.5%), such as liters for the juices. Products are packaged accordingly, with 55.9% using plastic containers, polypropylene bags (18.6%), and others (25.5%) such as baskets, glass jars, sachets, and brown paper bags.

According to the interviewees, various product quality characteristics significantly influenced their customers purchasing decisions, whereby the nutritional value, appearance, and taste were the most preferred among others (Table 4). The nutritional value and product taste had the highest scores at 66.7% and 65.7%, respectively, indicating that consumers cared about their nutritional well-being while product tastes influence consumer appeal.

Most of the processors faced challenges during the marketing of products attributed to fluctuating market prices (56.9%), irregular products demand (51%), inadequate supply (62.5%), poor quality of raw material (33.3%), and irregular supply of raw materials (32.4%) which affected the end products quality and subsequently, their prices. These, coupled with a lack of effective and efficient equipment, are critical in the transaction of horticultural businesses. Despite the challenges faced, a significant number of the respondents (49%) opined that the supply of processed horticultural products was not adequate to meet the local demand compared to 51% who thought otherwise. However, most respondents (56.9%) agree that the demand for horticultural products in the country is high, while some observed an average demand (39.2%) although 3.9% cited a low demand. The type of processors does not influence the demand for horticultural products, and therefore, consumers would not be biased during purchasing ($\chi^2 = 1.14$, $p=0.49$).

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Table 4 Scores (%) for the characteristics customers consider essential when buying horticultural processed products

Quality	Fairly Important	Not Important	Somewhat Important	Very Important
Size	33.3	1.0	4.9	60.8
Color	23.5	2.9	8.8	64.7
Storability	36.3	1.0	6.9	55.9
Taste	28.4	2.0	3.9	65.7
Nutritive value	25.5	2.0	5.9	66.7
Cookability	29.4	2.0	11.8	56.9
Foreign matter	43.2	1.0	5.9	50.0
Texture	39.2	2.0	8.8	50.0
Maturity	32.4	2.0	14.7	51.0
Disease/pest management	29.4	3.9	18.6	48.0
Packaging	33.3	2.0	5.9	58.8

Certification of horticultural MSMEs in Kenya

Most (59.8%) of these organizations were not certified by the local or international standards. There was also a weak association between the type of enterprise and certifications (χ^2 = 5.6, p=0.061), indicating a generally low level of certification across all types of enterprises. The ones certified were mainly by KEBS and the Public health certification authorities. Moreover, only 39.4% had certifications by the Kenya Bureau of Standards and 1% by the Global gap, occupational safety, and health certifications.

Most respondents (42.2%) indicated that their organizations were determined to acquire the KEBS certification compared to any other since it is mandatory in the country for one to sell goods. Others (22.9%) include the KEBS diamond mark of quality, ISO 14001 and 22000, Global gap, BRC, EPZ, and NEMA. The processors are striving for these certifications to increase market access (45.3%), ensure compliance (14.1%) and be able to export products (9.4%). Interestingly, 35.3% of the respondents were not interested in attaining any certification or did not know of any certifications they would wish to obtain. About 79.4% of the firms had not had auditing by the relevant bodies, which was also indicated by a weak positive correlation between the certified firms and auditing schedules (r=0.225, p=0.023).

Seminars and workshops were the most common sources of information on ISO 14001 standards (38.2%), the internet (8.8%), and colleges and television (5.1%). However, 55.9% of the respondents had never heard of ISO 14001 standards. Only 44.1% of the respondents heard of it between 2016 and 2018 from different sources. About 68% of the respondents did not know any advantages associated with ISO 14001 standards, although 9.4% agreed that it enables access to international markets and sustainable production. Moreover, 76.5% of the respondents didn't know any disadvantages associated with ISO 14001 standard. Only 7.8% agreed that this certification had its disadvantages. There was no association between the respondent's knowledge and advantages of having the ISO 14001 standard (χ^2= 53.55, p=1.153) as compared to the significant association for the knowledge and disadvantages of having it (χ^2=31.34, p=0.05).

Sustainable production practices

The strictness of environmental legal requirements and regulations by horticultural processing industries was shown to be less stringent. Only 24.5% agreed that the implementation of the requirements was stringent compared to 46.1% and 29.4% who said they were somewhat strict. There were no significant differences ($\chi^2 = 4.99$, $p=0.083$) among the processors and their environmental assessment to evaluate the potential impacts of their processing on the environment.

More than 90 % of the processors had installed appropriate measures to curb water pollution and dangerous handling and disposal of waste compliance with EMCA's prohibitions. More than sixty per cent (62.8%) of the processors noted that less than 50 litres of wastewater were generated per week during processing. In contrast, 37.2% indicated that more than 100 litres of wastewater are generated per week. The most commonly used energy forms included electricity (53.9%), firewood (13.7%), gas (15.7%), and others (39.2%), mainly solar energy and charcoal from different sources (Table 5). However, most of the firms did not keep records of water (80.4%) and energy (77.5%) used, and therefore, the usage of these resources may not be accurately quantified (Table 6). Moreover, most of the environmental issues scored poorly (Table 6).

Table 5. Sources of energy and water

Water Sources	**Percent**
Municipal	51.0
Borehole	35.3
River	32.3
Others (Rain, springs)	17.6
Water vendors	7.8
Energy Sources	
Kenya power and lighting company (KPLC)	100.0
Others (firewood/charcoal vendors, sun)	38.2
Gas station	17.6

Table 6: Environmental assessment of Horticultural MSMEs in Kenya

Environmental assessment criteria	No (%)	Yes (%)
Have you ever assessed the environmental situation?	72.5	27.5
Have you defined an environmental policy?	77.5	22.5
Have you implemented an environmental policy?	72.5	27.5
Are the company's employees aware and conversant with the company's environmental policy, if any?	75.5	24.5
Have you established a training plan in environmental governance and management for all the staff of your company?	77.5	22.5
Have you identified and evaluated the legal requirements that apply to your company in terms of the environment?	77.5	22.5
The enforcement of environmental governance and management issues are stringent	78.1	21.9
Do you ask your suppliers to have environmental criteria?	80.4	19.6
Are your products packaged following environmental criteria	60.8	39.2
Do you have a specific register of the types, the amount, the costs, and the origin of the raw materials processed	60.8	39.2
Do you have an exhaustive control of the use and handling of the toxic and dangerous products utilized in your facilities	74.5	25.5
Do you recycle or reuse the rejected products?	51.0	49.0
Are you aware of the 3R system (Reduce, Reuse and Recycle)?	64.7	35.3
Have you sensitized your workers on how to sort and segregate the waste they generate	60.8	39.2
Do you have a monthly water consumption register?	80.4	19.6
Do you recycle and reuse the water from the different processes?	75.5	24.5
Do you take any actions to reduce water consumption?	66.7	33.3
Have you implemented any actions to reduce the generated wastewater?	76.5	23.5
Does the generated wastewater undergo any kind of treatment before discharging it?	81.4	18.6
Are you aware of noise pollution?	56.9	43.1
Is the company compliant with the Noise and excessive vibration control?	59.8	40.2
Do you take any action to reduce noise pollution?	68.6	31.4
Are the chemical products stored in a specific place?	64.7	35.3
Are the chemical product's containers correctly labelled?	63.7	36.3
Do you keep a register of the energy consumption of the company?	77.5	22.5
Have you put any practice actions to reduce energy consumption?	77.5	22.5

Good processing practices

Most of the processors (62.7%) conserved water using various methods. The most common was by use of water tanks (51.6%), recycling (7.8%), and sustainable usage (4.7%), such as minimizing amounts used during processing. Although 42.2% did not treat the water used for processing, the rest did. Chlorination and filtration were the most commonly used methods at 62.7% and 13.7%, respectively. Other methods used, although at minimal levels, included boiling and using municipal water. However, most of the processors (77.5%) did not have appropriately installed wastewater treatment equipment. Those who had them installed cited processing low capacities, breakdowns, and the foul odour emanating from the wastewater as their significant disadvantages.

Most (95.1%) did not store their products with other goods during storage to minimize cross-contamination. Furthermore, 92.2% of the respondents noted that they did not use pesticides on processed products. To ensure that the product quality is maintained, processed products were packaged in boxes (37.3%), shelves (39.2%), racks (27.5%), and other appropriate methods during storage depending on hygienic and convenience features, type of products, and the size of packaged products. Minimum losses were reported as a result of pests (27.5%), molds (20.6%), weather (20.6%), and thieves (5.9%). The damaged/broken horticultural processed products are mostly composted and used or sold as manure (27.5%), while some disposed them off (21.6%). Other processors (21.5%) recycled, repackaged, and sold or gave them free samples. In the case of molded/spoilt products, most processors (>95%) noted that they disposed of them off or composted them for use as manure, while others gave them to animals such as pigs' feeds.

Over 68% of the firms utilized wastes as animal feeds or compositing for organic fertilizers while the wastewater is released into the environment and irrigation of crops. The primary wastes generated included seeds, peels, rind, and pomace. However, lack of appropriate technology may be a limitation, therefore improper disposal of the generated wastes.

Discussion

Description of the respondents

In the current study, there were more females than males in the horticultural processing MSMEs which play a significant role in providing jobs and, subsequently, income generation for participants. This agrees with FAO (2011), who reported that agricultural-related activities are somewhat regarded as more important to women than men in East Asia, North Africa, and sub-Saharan Africa. Gender did not influence the respondents' knowledge of the environmental management systems, which is an indication that both had equal perception and, therefore, a need to create awareness on environmental management systems.

Although the youths' willingness to be involved in agricultural-related activities, their number remained low and made slightly more than a fifth of the respondents (21.3%). These may be attributed to the non-attractiveness of agricultural involvement and, therefore, leaving these to the aging groups in society, which agrees with Ahaibwe *et al.,* (2013). This scenario may also be attributed to limited capital access by the youth (UNDP, 2015).

More than 80% of the respondents had attained secondary and tertiary levels of education. Studies have shown a significant relationship between agricultural productivity and value-addition with educational levels (Das & Sahoo, 2012; Walingo, 2006). Value addition can also be promoted through training and capacity building which can help reduce postharvest losses and knowledge and skills transfer (Roy *et al.,* 2013). The high number of people involved in horticultural MSMEs processing can therefore be regarded as literate, and hence training in official languages will be attainable.

About 80% of the processors were involved in dried fruits and vegetables. This may be attributed to the increased consumption of horticultural products in Kenya, with over 98% of the fruits and 91% of vegetables produced and processed being consumed locally, as observed by Tschirley *et al.,* (2004). The high number of dried products may be probably due to the solar drying techniques adopted by most processors. They involve a relatively low cost of producing

them compared to other processed products. However, most respondents cited marginal returns from the sale of products even though more than 60 % agreed that the demand for horticultural products is high, and the supply of processed horticultural products would not meet the current demand. Lack of adequate processing technologies, capital limitations, cost of value-added products, competition with other established brands, and infrastructural challenges such as cold rooms and marketing channels were cited as the significant challenges by a majority. These challenges have similarly been reported in other studies by Habwe & Walingo (2008) and have been attributed to hinder full exploitation of the small-scale value chains (DESA-UN, 2013).

Raw material acquisition, processing characterization, and marketing

Approximately 60% of the processors acquired raw materials through informal supply chains. However, these may result in a lack of uniformity in the raw materials in small quantities due to a lack of adequate storage techniques. The current findings agree with Paik *et al.,* (2009), who reported that MSMEs have low purchasing power and suffer from a scarcity of internal resources, competent human resources, and are highly impacted by the supply's dynamic supplier costs chain.

A significant number of the current processors were found to use untreated water. However, it is recommended to use potable whose processing qualities are such that there are no microbial loads, solids, and chemical contaminants (Bhagwat, 2019). The cost of energy in production was among the most significant in production given that the unit operations, mainly drying, blanching, milling, and boiling, require high electric paid-for-energy (Kumar, 2020). Since most of the processors were small-scale enterprises, labour was also a high-cost contributor, although coping mechanisms such as hiring and reducing labour depending when necessary are common. Although this can be counteracted with the mechanization of the processing, which could also improve the efficiency, the capital investment required constrains the MSMEs (Gelb *et al.,* 2017).

During marketing, the respondents agreed that the consumer purchasing decisions would not be influenced by the processor type as long as the intended satisfaction was met. This corroborates Chowdhury *et al.,* (2020) findings, who asserted that the manufacturer is often of minor concern to consumers except in brand royalty (Kianpour *et al.,* 2014). The consumer's minimal concerns due to the potential risk of exposure through contamination of products with pesticide residues were evident among 48% who did not consider this critical. However, this may be a food safety concern, especially in the long-term use of contaminated products. The Kenyan government's ban on the use of plastic and polypropylene bags may be a concern in marketing the processor's products (KIPPRA, 2017). This presents new challenges to processors as an adjustment to appropriate packaging will be required by relevant authorities. These findings agree with Bengtsson *et al.,* (2018), Hojnik *et al.,* (2019), and Yue *et al.,* (2020), who report that besides the product quality and nutritional attributes, prices and the environmental concerns due to use and disposal of the product wastes are other determinants that influence the purchasing decisions

Offering free samples was a common practice among the processor, which is an effective method in marketing as it introduces consumers to new products and gets feedback for product improvement (Gurbuz, 2018). The findings on the sale of products varying across the year agreed with Loscalzo (2009), who reported that the seasonal variations in the production of fruits and vegetables are affected by rainfall supply and, therefore, the availability of respective raw materials the production. The challenges faced in the marketing of processed horticultural products stated in the current study concurs with other findings of Singh & Daniel (2017), who reported that MSMEs face many problems, including lack of credit from financial institutions, unavailability of raw materials, among other inputs, poor infrastructure, and lack of distribution of marketing channels to enable more comprehensive market access

Sustainable production practices

Lack of stringent environmental compliance as observed in the current study, may negatively

impact the environment as the relevant authorities may not follow up on implementing these regulations. Although intensification of environmental resources has successfully facilitated increased productivity and horticultural crops, there are adverse effects on the environment. Among these, declining soil structure, wind and water erosion, and increasing soil salinity and acidity levels, and in case of pesticides use, potential pollution and contamination of food are common (Lillywhite *et al.,* 2007; Stringer, 1998). Therefore, it is recommendable that authorities ensure that processors strictly observe environmental legal requirements and regulations. Furthermore, it was observed that the current participants need to be educated on the importance of this water and energy. These resources use among MSMEs are key as their use must be minimized to transition towards a green economy (Koirala, 2018).

Horticultural production and processing have been shown to cause on-site and off-site environmental impacts and, therefore, require strategies to minimize these impacts. Due to their complexity and dynamism, effective control requires stakeholders and the government's joint approach to effectively tackle environmental sustainability (Bengtsson *et al.,* 2018; Colquhoun, 2000). Therefore, to ensure ecological sustainability, all stakeholders and relevant government authorities in the horticultural sector must collabourate effectively

The current results corroborate the findings by other studies (ARSCP, 2016; https://www.businessdailyafrica.com, 2013) that the awareness on sustainability and consumption production is still deficient and that a lot of awareness and sensitization needs to be done akin to spreading the gospel so that the general public can understand what sustainable consumption and production are.

Challenges facing horticultural processors

The participants concurred that they generated significant quantities of organic wastes generated during processing, especially at the washing and peeling stage. However, minimal processing among the current processors may be contributing to environmental problems as wastes decompose in landfills and emit harmful greenhouse gases (de Brito Nogueira *et al.,* 2020).. Substantial losses and waste of up to 25% to 50% from fruits and vegetables processing industries pose nutritional, economic, and environmental challenges (Kiaya, 2014). Although contain significant bioactive compounds, such as carotenoids, polyphenols, dietary fibres, vitamins, enzymes, and oils and can be used to develop functional or enriched foods, pharmaceutical and medical compounds. The textile industry and their extraction require special equipment lacking among the current processors (Sagar *et al.,* 2018).

Data from the assessed firms shows that constraints due to equipment posed the most significant challenge in production. This is compounded by the fact the most equipment is quite expensive, while lack of technical know-how also increases the maintenance costs during breakdowns. Most of them can process low quantities of products, therefore, increasing processing time. Lack of processing facilities and equipment has been a significant constraint that has affected potential horticultural exploitation (http://over-blog.com, 2017). Moreover, inadequate storage facilities limit the marketing of processed horticultural products, especially among small-scale processors. The Horticultural Crops Development Authority (HCDA) Strategic Plan reports that low access to credit to fund purchasing essential inputs and investment in equipment negatively affects productivity and the processing of horticultural goods. Financial institutions impose relatively high-interest rates on borrowed money, hindering efficient processing (Koirala, 2018).

These findings agree with a study by UNDP (2015), which reports that other significant hurdles faced by MSMEs in Kenya are a result of poor adoption of technology and marketing constraints. Additionally, prohibitive administrative rules and regulations as well as high taxation, and the lack of information associated with public programs and policies related to MSMEs are barriers to their success

Conclusion and recommendation

Lack of adequate processing technologies was a significant constraint in processing, and therefore, high postharvest losses are experienced during high fruits and vegetable seasons. The survey shows that environmental awareness scored poorly, and therefore, there is a need to conduct training on the importance of ecological sustainability and consciousness during processing. Thus, it is essential to train processors on postharvest handling knowledge and attitude that promote increased value addition of horticultural produce and the promotion of factors that improve the relevant training and enhance feasible strategies such as offering more training schedules. To ensure sustainable energy and water use, most firms need to be trained on record keeping as most of them did not keep any. The waste and other water generated were not treated before releasing them into the ecosystem, which calls for sensitization of the processors on the importance of conserving biodiversity. Most firms lack KEBS certification, which is a major limiting factor during the marketing of finished products. It was also observed that most processors are unaware of the ISO standardizations and sustainable consumption and production. Therefore, they must be trained and facilitated on the requirements and benefits of having the certification.

Certification of horticultural MSMEs in Kenya

Since it is mandatory to have KEBS certification to market products locally, most processors in the current study have got limited marketing of their products. The respondents cited the costs and long processing time as the primary constraints, lack of knowledge and need for certification, and the stringent measures involved in obtaining certifications. Therefore, there is a need for sensitization on the need and benefits of having these standards, which are either public or private and are adopted to boost consumer trust concerning the safety of food products (Wijayasiri & Jayaratne, 2011). Food safety and quality audit carried out in the food industries evaluate various aspects, including management systems, attain food safety and quality certifications, and assess premises and products to ensure legal compliance for consumer protection against potential risks from foods (Kotsanopoulos & Arvanitoyannis, 2017). The compliance levels for processing requirements may therefore be unknown or below-set standards in the current study. The main reasons were that the respondents considered their firms to be small (50%) for auditing while others lacked awareness of the need for certification and lack of capital for the process.

James and Neil (2012) put forth that international marketing standards have many crucial functions in the economy, support invention, growth, and increase nations' competitive edge. Besides, standards have many advantages for businesses and industries and provide MSMEs with additional competitive power. They further put forth that MSMEs face several challenges such as lack of knowledge on standards that apply to their businesses, the view that standards are only applicable to large businesses, lack of skilled human resources, and finances to develop and employ standards. Consequently, the participation of MSMEs in standardization is relatively low, although these can be overcome through Given that the respondents had low knowledge on ISO 14000 standards training sessions such as seminars which have been shown which have been sown to positively impact knowledge transfer according to Roy *et al.*, (2013) would be well-received should the respondents be well enlightened on the standard requirements and advantages of having them in place

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