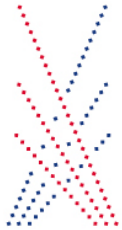

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Learning from afar: gatekeepers of innovation in Ghana's food processing clusters

Abstract

Development, prosperity and sustainable livelihoods in Africa requires knowledge generation, adaptation and transmission. This paper argues that technology entrepreneur gatekeepers can become potent conduits for the transmission of new knowledge and technology within clusters, particularly in developing economies. Yet, most research in the context of the Sub-Saharan African region overlook the role of entrepreneur gatekeepers working with the small formal and informal sector enterprises. This study therefore addresses this knowledge gap through a qualitative empirical study of two food processing clusters in Ghana. Gatekeepers are identified as those entrepreneurs who decodify the codified knowledge while also bringing in tacit knowledge that can be shared throughout a cluster. The informal nature of the African economy shapes these processes with key relationships being based on personal trust rather than written agreements, and institutional weaknesses limiting the rigorous implementation of intellectual property right law allowing micro enterprise artisan engineers to freely adapt technology.

Key words: Technology; Entrepreneur gatekeepers; Food processing; Informal sector; Trust; Cluster; Africa; Ghana; Governmental agencies; Multinational companies; Artisans adapting machinery;

1. Introduction

As African economies seek to reach their potential and develop sustainable industries, there is a need to understand the role that entrepreneur gatekeepers play in the process of acquisition, adaptation and diffusion of new knowledge and technologies. The main proposition forwarded in the paper is that 'local' entrepreneur gatekeepers can be well equipped to capture, adapt and diffuse external knowledge within clusters, complementing and renovating the existing pool of knowledge which they generally master (Balland et al., 2016). The importance of knowledge gatekeepers and their external networks within this process is recognised as a key element to boost clusters' dynamics and the competitive advantage of co-located firms in the international market place (Morrison, 2008; Harorimana, 2009; Giuliani, 2011; Morrison et al., 2013). This research also addresses concerns over the constraints that restrict innovation within firms across Africa (McCormick, 1999; Sonobe et al., 2014; Danquah and Amankwah-Amoah, 2017).

However, much literature in this area suggests that new external knowledge is predominantly 'codified knowledge' and this is captured by 'qualified decoding gatekeepers' who then transfer it to firms within clusters (Morrison et al., 2013; Todtling et al., 2013; Pina and Tether, 2016). In developing economies, there has been much research on MNCs and large R&D government bodies as the conduits for capturing, decoding and transferring external knowledge (McDermott and Rocha, 2010; Clarke and Ramirez, 2014; Amankwah-Amoah, 2016; Knorringa and Nadvi, 2016). In this paper, we show how the process is not cast in stone (Asheim, 2001; Asheim and Hansen, 2009; Balland et al., 2016), and that individual gatekeepers can also play key roles in this sense, particularly in a context of prevalent

informal economic relationships, and sometimes in collaboration with public sector and/or MNCs.

The proposed research on entrepreneur gatekeepers in Ghana is therefore a timely contribution to address a gap in research literature on the role played by these gatekeepers and their external networks in supporting the adoption and adaption of both coded and non-coded 'tacit' knowledge and technology within clusters, particularly in developing countries. This paper shows how artisan engineers and the movement of labour between firms can play a key role in diffusion within sectors where the informal economy is dominant. However, these gatekeepers also face constraints that shape their activities.

This paper also contributes to understanding innovation in the context of institutional weaknesses such as the limited recourse to law courts and lack of rigorous enforcement of intellectual property rights. This may prevent traditional R&D public agencies and large private corporations from playing the coordination role that they play elsewhere as innovation gatekeepers (Costantini and Liberati, 2014; Yoon et al., 2015). Hence the presence of entrepreneur gatekeepers and their appreciation and understanding of both the international knowledge circuits and networks, and the local business environment, strategically position them to fill this role and turn into vehicles for cluster innovation. The research is informed by scholarly work on both cluster networks and knowledge transfer (Granovetter, 1983; Becattini et al., 2010) and entrepreneur gatekeepers' studies (Allen, 1977; Morrison, 2008) to elucidate how economic actors in clusters are able to draw on external knowledge and adapt this knowledge for the benefit of local clustered firms.

This paper therefore seeks to answer the following questions: Who are the main gatekeepers of knowledge and technology within processing business clusters in Ghana? How are gatekeepers able to combine codified and tacit knowledge generation? And how do these gatekeepers identify, adapt and transfer new knowledge and technologies within this context? The study adopts a qualitative methodology based on an original empirical study carried out within two food processing and exporting clusters in the Eastern region of Ghana, the small-scale palm growing and processing cluster and the pineapple cluster. These two clusters were chosen due to the fact that palm processing businesses in the region are estimated to have contributed substantially to Ghana's annual palm oil production and exports (Osei-Amponsah et al., 2012; MoTI, 2015). A similar situation is observed in the case of the pineapple cluster, whose exports have also grown substantially over the last few years (MoTI, 2015) to meet the conventional and fair-trade markets in Europe. The two clusters are situated within agricultural communities where several processing businesses are actively operating for local and international market communities. Most importantly, a very intrinsic sociocultural value chain seems to exist involving local communities, farmers, local and international processors and supporting institutions (Osei-Amponsah et al., 2012).

The paper begins with a review of extant literature on networking and knowledge transfer more generally, and knowledge and entrepreneur gatekeepers in particular, from where three research questions that lead the empirical study were extrapolated. The next section explains the methodological approach adopted to answer the research questions. The main findings of the research are presented in the following section, which is followed by a discussion of the main findings and implications of the study to theory and practice.

2. **Literature review**

In a context of increasingly globalised market economies, knowledge that is captured from international circuits of knowledge flows is of supreme importance for the competitiveness of local firms and clusters within developed and developing countries (Morrison et al, 2013; Arif and Sonobe, 2012). In order to immerse and embed local businesses into global production and commercialisation structures, these external networks can in fact serve as 'global pipelines' (Morrison et al., 2013) in transferring new knowledge into local production system and structures leading to innovation (Klumbies, 2011).

The literature on innovation in clusters also makes a strong case for the need to incorporate external knowledge through external networking strategies so as to meet technological standards of international trade and be able to compete in global markets (Munari et al., 2011; Alvarez and Iske, 2015). Firms often build external networks to access knowledge that is not already part of their repertoire. These external networks are the channels used to access distant relationships which complement the more localised information and communication ecology created by the co-location of people and firms within clusters. Bathelt et al. (2004) argue that the build-up of trans-local 'pipelines' allows more information and news about markets and technologies to be 'pumped' into internal networks from afar. The balance of external knowledge and dense local interaction shapes the dynamism and 'the buzz' which assists in both decoding the codified knowledge captured from such global pipelines and diffusing it within clusters.

A key issue, however, highlighted in recent works by Munari et al (2011) and Morrison et al (2013), is that there is an 'unique' tacit knowledge aspect associated with these innovations that may come through the pipelines external to the firm clusters and that makes technological diffusion a bottle neck for knowledge adaptation and adoption process. There is

therefore a recognition that recipients, translators and diffusers of this non-codified tacit knowledge, otherwise called knowledge 'gatekeepers', play a critical role in absorbing and defusing knowledge 'acquired' in the buzz (Munari et al., 2011; Morrison et al., 2013). The key issue then is to understand how gatekeepers' absorptive and diffusive capacities operate (Cohen and Levinthal, 1990), and how different locations and clusters can harness the different forms of external knowledge attracted and its diffusion, especially through informal and formal networks of co-located firms, and entrepreneur gatekeepers among them.

Previous research has focused on the key roles for MNCs, government agencies and other international organisations (Universities, research organisations, international organisations among others) as pivotal in the gatekeeping activities in developing and emerging economies. In the cases of salmon and tomatoes clusters in Chile, collective action and cooperation among firms have led to the establishment of a formal *institutional framework* through which production is coordinated and ideas, new knowledge flows among co-located firms (Perez-Aleman, 2005). The Chilean government played a central coordinating role in this process leading to the establishment of the product brand and clusters' reputation in the international market. A similar situation is observed in both the Peruvian mango cluster and the wine cluster in Argentina which have undergone upgrading by using local-based knowledge as well as knowledge brought by multinational companies and public agencies (McDermott and Rocha, 2010; Clarke and Ramirez, 2014).

In this paper, we focus on the roles of entrepreneur gatekeepers and how they capture, diffuse and adapt knowledge, combining codified and uncodified knowledge generation. In a seminal paper published in 1977, Allen introduced the idea of knowledge 'gatekeepers' and established that they are the privileged channels for effectively transferring external

technology into an organisation. Gatekeepers are a group of individuals central to the information network. Morrison (2008) explained that gatekeepers have typically been exposed to external sources of information as a result of their formal and informal links that they build with external actors. Building upon Allen (1977), Giuliani (2011) studied technological gatekeepers in the context of clusters and argued that they are often related to firms with strong external connections which contribute to the acquisition and diffusion of external knowledge within the local business environment. Critical to these gatekeepers is their ability to search and extract external knowledge and, as a result, adapt and transfer new techniques within the local environment. By so doing, gatekeepers ensure that external knowledge is locally diffused, enabling local firms with no external connections to access and use new knowledge, acting thus as central nodes of local networks.

Gatekeepers have also been linked to leading businesses in clusters that play a dominant role in vertical supply chain networks (Boschma and Ter Wal, 2007; Morrison, 2008). Suppliers of leading firms benefit from extensive knowledge exchange in order to ensure that they are able to produce quality products that fulfil international standards. In effect, these leading firms may become the catalyst in driving and creating new knowledge into other businesses (Albino et al., 1998; Giuliani 2011). The introduction and adaption of new technology will benefit these gatekeepers by improving suppliers' product quality (Mesquita and Lazarini, 2008). Over time, these leading firms in the vertical supply network may seek to maintain their roles as gatekeepers particularly when their linkages ensure a reduction in the cost of doing business and encourage learning opportunities and the developing of synergies between suppliers and producers (Lorenzoni and Lipparini, 1999; Giuliani, 2011).

Gatekeepers in clusters are not limited to vertical relationships only. Firms in developing economies have to compete in the global market with considerable levels of heterogeneity. In order to survive, they may cooperate with one another within similar horizontal networks to facilitate the flow of knowledge into the cluster (Schmitz and Nadvi, 1999; Clarke and Ramirez, 2014). Cooperation plays a crucial role in the operation and survival of clusters in developing economies, particularly in relation to the development of collective efficiencies (Schmitz and Nadvi, 1999; Arif and Sonobe, 2012). In a Sub-Saharan African context, the activities of key knowledge gatekeepers and their ability to adopt and adapt external knowledge for the benefit of other firms in the cluster have not been studied in depth.

Most importantly, firms may not share their acquired new knowledge among their horizontal networks since protecting new knowledge benefits them in terms of competition that occurs within the clusters. In fact, Porter (1998) and Harorimana (2009) have both argued that when there is considerable costs and risks associated in the sharing of knowledge among co-located firms, firms may prevent free circulation of knowledge acquired, particularly if it is central to their competitive advantage. However, several studies have shown that clusters in developing economies thrive on knowledge sharing among local firms and therefore, the collective efforts of firms in the cluster may ensure that they can assess new knowledge from these potential gatekeepers (Schmitz and Nadvi, 1999; Dyer and Hatch, 2006; Harorimana, 2013). It is also said that more embedded social and trust-based relationships are needed to successfully transfer new knowledge among local firms (Harorimana, 2013).

Considering that knowledge diffusion in clusters involves an interactive process between the bearer and the receiver, studies show that, gatekeepers have to be interactive and learn through formal and informal relationships with external sources (Allen, 1977; Morrison,

2008; Harorimana, 2013 Balland et al., 2016). This ensures that they are able to transfer codified and tacit information through their business networks in clusters. Acquired external knowledge may be embedded with location-specific attributes or techniques which may impede its transfer and adaption. During transfer, these peculiar tacit practices have to be addressed by recipients of this decoded knowledge. Also, it is important to note that the transfer of knowledge by gatekeepers may be smoother if businesses operate with homogeneous operational structures although this is far from being the norm within developing economies (Giuliani, 2011). The critical issue is thus to identify how local firms are able to adopt and adapt external codified and non-codified knowledge from gatekeepers, considering the differences in their structure of operation.

This paper argues that the definition of a gatekeeper of knowledge and technology within clustered businesses is not cast in stone. We explore how particular local actors, through their exposure to international markets, can become an important source through which external knowledge and technologies are acquired and hence they can be classed as gatekeepers. The mechanism by which these entrepreneur gatekeepers are able to generate knowledge and technology (through both tacit and codified means) may however vary among clustered businesses. As a result, it may have a significant level of influence on the way technologies are adopted and adapted to in developing economy's clusters and for that matter their innovative activities.

3. Research methodology

This paper adopts a qualitative and an exploratory research approach which is based on 21 case studies of clustered food production and processing businesses. The study also included 9 interviews with artisans supporting enterprises, and a sample of institutions from the local system of innovation. Interviews and observations were conducted in order to collect empirical evidence about the external sources of knowledge and technology the processors draw upon, and the transfer, adoption and adaption of such knowledge and technologies. This approach ensures that an in-depth appreciation of the state of affairs in two food processing clusters is presented (Silverman, 2013) and allows for further conceptualisation of current dominant theories (Guest et al., 2006). This research is timely because in Sub-Saharan Africa, and particularly in Ghana, the specialised literature shows no empirical work on gatekeepers' activities in local clusters.

Purposeful sampling was used to identify a cross section of types of businesses representative of the two clusters. The process started with interviews of key informants and local business organisations which provided information on processing businesses as well as farmers. A 'long list' of potential cases was identified as there was an absence of an updated database comprising information about local fruit processing firms in both clusters. A snowball sampling technique was used to extend this list and then to identify and recruit 21 food producing and processing businesses as participants. Personal referrals contributed to minimise the number of rejections to invitations to participate in the study. Only 2 processors and 1 farmer rejected the invitation. The final sample of participants included: farmers (n=5), processing business owners (n=16), as well as heads of research institutions and government agencies (n=7) and machine artisans (n=2) (see Table 1).

In the first phase of data collection, interviews were conducted with processors, suppliers and other key informants in order to identify key gatekeepers who have sought out and adapted new technologies and their sources, within two exporting and thriving food processing clusters, the palm and pineapple clusters. Semi-structured interviews were conducted to ensure that there is some level of standardisation for cross-case comparability (Cassell and Symon, 2004). A second phase of data collection involved follow up interviews with the case studies to explore some of the arising issues in more depth. A third phase of interviews was conducted after detailed analysis in order to probe issues related to gatekeepers.

[INSERT TABLE 1]

Interviews were recorded upon the consent of the interviewees. In all, about 85 percent of the 30 participants permitted the use of audio recorders – notes were taken for the remaining participants' interviews. Interviews were conducted by the researcher in English or Akan (a local language mostly known as 'Twi'). Transcripts in Akan were all translated into English and systematically analysed using NVivo 10 software. The first round of interview data analysis identified key themes such as international access to tacit technology; collaboration between gatekeepers; reengineering technologies and social ties in technology sharing. In a second stage of analysis involving all three authors, commonalities and differences within and between each cluster were extracted in order to uncover further themes for this study. This led to a further round of interviews to probe these issues in more depth and a final stag

of analysis to draw out issues related to the types of gatekeeper, codified and tacit knowledge and the adaptation of technology.

4. Findings and empirical data

4.1 Identifying key gatekeepers in clusters

The first part of the empirical section identifies who the main gatekeepers are in the two clusters (RQ1) through the eyes of processing businesses and other institutions. As a result, the respondents were specifically asked how they acquired technical knowledge in order to enhance their operations. Each of the two fruit processing clusters studied had a distinctive feature that clearly distinguishes its gatekeepers as discussed below.

Gatekeepers in the pineapple cluster

The critical knowledge and technology introduced in this cluster relates to a new variety of pineapple seed. Four out of the seven interviewees reported that the first few seedlings brought into the cluster came from one single pineapple farmer (pineapple case study 4). The owner of a pineapple processing business (pineapple case study 7) explained how case study 4 played a key introducer role and this entrepreneur: “brought MD2 pineapple from Costa Rica and planted it in Ghana”. Five of the seven pineapple processing businesses interviewed also reported that the Ministry of Food and Agriculture (MoFA) played a key role as the main institution through which the knowledge of this new variety of pineapple was widely introduced to the other pineapple growers in the cluster, beyond the original firm (pineapple

case study 4). The processing businesses explained that MoFA had helped them from the onset in procuring and planting the MD2 variety after it had been brought into Ghana by pineapple case study 4.

> [MoFA] has provided us the seedlings […and] supported us with information on how to plant the MD2 in the initial cycle was done. In our second cycle of planting, they only came to observe and inquire if we have any problems' (pineapple case study 2; Nsawam, 2014)

The success of the introduction of this technology and the new external knowledge is attributed to collaborative efforts involving pineapple case study 4, their contacts in Costa Rica and MoFA. Further collaboration with other local businesses in the cluster resulted in the sharing of knowledge about the cultivation of this new variety. The extract from pineapple case study 4 illustrates this statement:

> My boss invited [Costa Ricans] here and they came to educate us on the planting, the structuring, the fertilisation, and everything on it…[and]… [MoFA] also came into the initiative and took over the initiative till the MD2 pineapple became widely planted (pineapple case study 4; Nsawam, 2014)

The collaborative effort was particularly necessary since the MoFA's department in the municipality indicated in the interview that they had a good appreciation of the local environment, ensuring the successful cultivation of the MD2 pineapples in the cluster. The

head of the MoFA at Nsawam explains that "the ministry […] have the officers who understand the climatic, topographic as well as the agri-business activities of Nsawam and have been active in cultivation of MD2 variety". The collaboration of these gatekeepers - that is, the Costa Rican and Ghanaian farmers and the MoFA - have thus been instrumental in the introduction and cultivation of MD2 pineapple variety in the processing cluster.

Gatekeepers in the palm cluster

All the participants in the palm cluster shared the view that the original introduction of palm processing technology in the palm cluster is linked to the work of a Dutch engineer named 'Mr. Kramer'. The interviewees in this cluster explained, that this engineer introduced the first mechanical palm processing machine back in the 1980s, in the wake of palm fruit and palm oil trading boom that occurred at that time.

> [As a result of this boom], a lot of people began to develop machines to extract these essential palm oils. This led to the proliferation of machine called 'Kramer Kramer Kramer' [which] is named after some Dutch engineer who started the extractor up in the district. As a result, people refer to any location where extraction is being done as Kramers. Extraction firms: Kramers, can be found all over the towns in the Kwaebibirem districts. Some towns have 10, others have 15, and 13 or more. In effect, every town has a pool of Kramers operating and taking advantage of the abundance of palm fruit in the district to produce palm oil' (Palm case study 1, Kwaebibirem, 2014)

Thereafter, several ‘machine artisans’ produced machinery which was adapted to the local context and that supported the fruit processing activities within the cluster. Interestingly, the name ‘Kramer’ has since then been used to refer to any palm processing units which adopts locally manufactured machinery in their operations. There are a range of different machines now available to meet different local needs. A ‘machine artisan’, explained that machines vary based on the quality of work to be done, whether manual or electronic, and the cost of producing them. The explanation offered by artisan case study 1 illustrates this point:

> We have more than four types of machine. The first one is [made] by adding some other parts to the pounding component which we adopt through manual means, to extract the oil for the processors. We also have another one that we make that processes and extracts the oil but the oil it brings out is not clear, it comes mixed with the sludge, which requires further cooking, like the refinery, before you are able to get the oil. We also have another machine that follows. For that machine, the method in the second machine is applied in a different form... [Also] ... there is a new one I am still working on. For that one I have manufactured it for about four businesses. That new one is very huge and also expensive, very big, for industrial [use]. This new one is based on different things (Artisan case study 1; Kwaebibirem, 2014)

Another key finding relates to the role that ‘artisans’ played in this local technological process of innovation. The majority of palm processing businesses interviewed indicated that

their machinery needs are met by these local 'artisans' or the local producers of the machinery, as they refer to them. Palm case study 9 explains: "…the machine producers around are able to make new machines for most of us in this town". Interviewees highlighted that these 'machine artisans' have not travelled abroad to acquire this new knowledge and machine technology, but have been able to develop their manufacturing skills locally, by learning from imported new technologies and adapting it to the local context. In this way, these artisans are themselves gatekeepers. Artisan case study 2 argues that through their manufacturing skills and dexterity, they have been able to replicate imported machinery by large and medium-scale MNC locally. He reported that artisans did not have to travel or be trained abroad to do this job but that their skills are somehow innate as "we are born with the skills, [and] are able to mould and create machines for processors". In effect, all these artisans require is their ability to observe the imported technology locally in order to replicate intricate machine technology relevant to processors in the palm cluster.

In time, these 'artisans' have become the main source of new types of machines which are said to successfully meet the needs of local fruit processing businesses and they are even offering technical advice and information to local businesses. The artisans are an integral part of their business community as they are the source of affordable and suitable technology within the cluster. One palm processor explained that '[the artisans] are our friends and part of us, we know them, and we call on them when we need them' (Artisan case study 2, Kwaebibirem).

To summarise, by being located in the cluster and being part of the community, the artisans are well placed to appreciate the needs of the palm fruit processing businesses and at the

same time, they are strategically placed as a technology gatekeepers who can address the machine needs of processing businesses in the cluster, by learning from afar.

4.2 Unifying Codified Knowledge and Tacit Knowledge Generation in Fruit Processing Clusters

There were several ways through which businesses in the cluster were able to acquire new technologies and in both the pineapple and palm processing clusters, there is evidence of the gatekeepers and other key stakeholders combining the codified and tacit knowledge, and then sharing this knowledge through informal channels and social relationships.

Codified and tacit knowledge for new pineapple technology

The findings show that tacit sources of knowledge have become the main means through which crop technology has been transferred into the pineapple cluster studied. For example, by working in Europe, the director of Pineapple case study 4 identified the MD2 breed of pineapple which had a growing international market demand. As the interceptor of such knowledge, this entrepreneur decoded the new knowledge on MD2 pineapple variety through training and direct participation in the cultivation in its country of origin, Costa Rica. Thereafter this business supported the adaptation and transfer of the new variety to Ghana by making them accessible to other farmers. The manager of this firm explains how the director embarked on the search for the MD2 pineapple variety from Costa Rica to make it available to farmers in the cluster:

> Our director, Mr Koranteng, was staying in Europe by then and he discovered the variety when he was in Italy. So, he read about the crop and tracked it from its source and [found out] that it was originally from Costa Rica, so he followed up to that country for more information. He went there, saw the farmers and they gave him every training on it. They taught him how to produce the crops and everything that accompanies it …. So ever since [MD2 variety] came we also didn't keep everything to ourselves; we gave it to our sister farmers so that they can grow it as well. So we spread the [MD2] variety... (Pineapple case study 4; Nsawam, 2014)

The gatekeeping partnership of Ghanaian pineapple farmer, MoFA and Costa Rican farmers also helped share the technology more widely. The manager in pineapple case study 4 explained that through their initiative, the Costa Rican farmers were invited to train pineapple producers within the Ghana cluster on how to prepare and cultivate this new variety of pineapple. This form of external interaction with farmers in the cluster serves not only to transfer coded knowledge about the cultivation of pineapples but also some unwritten knowledge acquired over the years in the cultivation of the product (e.g. learning by doing). Interacting in this way minimises the bottlenecks associated with the transmission and absorption of external knowledge observed in Africa.

Codified and tacit knowledge for new palm processing technology

Analysis of the interviews also showed that the artisanal engineer gatekeepers in the palm processing cluster combine the codified knowledge of imported processing machines, arriving with manuals, with their tacit knowledge of local manufacturing processes. The three

larger palm processing businesses interviewed reported that in their businesses coded knowledge is introduced by buying imported machinery arriving operation manuals. This is explained by the manager of palm case study 2, a large-scale palm processing business:

> We import them [the machinery]. Our importers come with the machines. We import them from Malaysia and more recently we have imported some machines from Britain. Some by sea some by air, so we get the information (Palm case study 2; Kwaebibirem, 2014).

These imported machines have become the basis on which 'machine artisans' are able to sustain their flows of new knowledge and introduce new machines which have been adjusted to the needs of local palm processing businesses. Critically artisans are able to reengineer and adapt manual and electronic operated pressing machines that extract palm oil, the steam boilers for cooking the fruits, loading ramps and palm fruit hoppers that strip the product from the palm bunches. These and many other machines were observed at 'machinery artisan' workshops in the cluster (as shown in Figures 1 and 2).

Artisan case study 1, reveals how his innovative manufacturing activities are supported by his ability to replicate machines which have been imported by larger firms and MNCs. He refers to the tacit skills of the local artisanal engineers who use their existing 'intelligence' and tacit knowledge to replicate new imported technology and adapt it to the local market conditions to benefit particularly smaller businesses:

> We have people who are more intelligent already … [for instance], we are repairing Malaysia and Italian machines recently … and even produce more of them. …when [MNCs] bring it, we can repair and cut that pattern [so] I have built one of the machine here for sale to businesses (Artisan 1, Kwaebibirem, 2014).

Hence the technologies reengineered by the local artisans have been adapted for local use, primarily for the benefit of small-scale and some medium-scale processors.

[INSERT FIGURE ONE]

[INSERT FIGURE TWO]

Movement of labour between businesses within the palm processing business cluster is also a way of sharing further tacit knowledge. The evidence from the interviews in the palm cluster showed that most of the processing businesses (seven out of nine) acquired processing technical knowledge from their past experiences while working in other processing businesses within the cluster. These individuals then take the tacit knowledge they have gained through working with the artisans and diffuse it to other businesses. It is this

movement of labour between processing businesses that allows codified information to be shared along with the tacit knowledge held by key staff who move jobs, particularly among businesses within the palm cluster. Owner-managers explained that unwritten information and operating techniques had been transferred as a result of the movement of labour. In particular, all medium to small-scale businesses in the palm cluster said they relied on skilled labour from large companies to fill their knowledge/skill gaps. They explained that this labour pull is the source of relevant information and skills for their operations, with ex-workers playing key roles as knowledge carriers both within and beyond the cluster.

> Most of us have worked in other companies before starting our business. You may have the farm, but the machine and the operations require someone who understands the operations to make sure you are making enough palm oil... the machines are there but you need a good miller to run your business (Palm case study 7; Kwaebibirem, 2014)

Informal apprenticeships are also seen as a way of combining tacit and codified knowledge. The artisan engineers were found to be providing apprenticeship training schemes to the youth, thereby disseminating their innovations. The artisan case study 2 explains how apprenticeships are offered and the rise of several artisanal workshops in the cluster.

> I have developed a lot of machines and I have a lot of experience… [So]... students from secondary school serve as my apprentice to learn innovations and I work with them. So, we have people like these students who are born with talents, like talented engineers […] Soon, they will also become independent artisans (Palm case study 2, Kwaebibirem, 2014).

The process of sharing and diffusion from gatekeepers is also aided by family based networks. Family relationships were at the centre of tacit knowledge and technology sharing in the palm processing cluster and an important source of business creation. Four of the palm processing businesses interviewed explained that their family members are an integral part of their operations, particularly in the context of small-scale businesses. Palm case study 2 (a family-based enterprise) offered training and knowledge on technologies used in the operation of the palm business to all their family members. The recent rise in the number of small-scale processors (mostly ex-farmers) is associated with gaining tacit and codified knowledge from family ties. They explained that, the new entrants master valuable knowledge on running their family-based processing businesses due to their relationships with other processors, which is also facilitated by family relationships within the cluster.

4.3 Gatekeepers develop and adapt to new knowledge and technologies in clusters

Developing and adapting knowledge in the pineapple cluster

The development and the adaptation of external technology have been acknowledged to require collaborative efforts of several stakeholders. Most of the pineapple processors explained that the farmer gatekeeper set in motion the processes to adapt the MD2 variety of pineapple. As the interceptor of such knowledge, this entrepreneur decoded the new knowledge by learning how to cultivate the crop in Costa Rica. However, he/she required collaborative efforts from public sector research institutions such as MoFA to acclimatise the MD2 variety within Ghana and adapt the crop for businesses, within the pineapple cluster.

The interview with pineapple case study 4 revealed that, for effective adaptation of the new technology, actors in the pineapple cluster worked with the farmers in Costa Rica to transfer knowledge on the production of the MD2 pineapple variety. By so doing, gatekeepers were able to bring in tacit knowledge that is unique to the Costa Rican environment. However, in order to successfully adapt the MD2 pineapple variety in Ghana the gatekeeper, Costa Rican farmers and the MoFA had to work together. Pineapple case study 4 offers an explanation as to how the MD2 breed of pineapple was adapted in the cluster (see Figure 3).

> [IMD2] initially it wasn't favourable with the climate over here. So, we acclimatised it. That is where the Ghanaian agronomists [from MoFA] came in to help. My boss invited the Costa Ricans here and they came to educate [our sister farmers and ourselves] on the planting, the structuring, the fertilisation, and everything about it. We did the first training at our farms … before the Ministry of Food and Agriculture came into the initiative... [And] ...we have benefitted hugely from them and people have benefited hugely from it (Pineapple case study 4; Nsawam, 2014)

[INSERT FIGURE THREE]

Developing and adapting knowledge in the palm cluster

The process of knowledge adaptation that took place was also acknowledged by the palm processor. Eight out of the nine palm processing businesses interviewed indicated that they rely on 'machinery artisans' not only in repairing machines, but also to adapt their machines to changing market needs and clients' specifications.

> The first machines were brought in by a man called Kramer. When he brought it and built it, Ghanaian artisans have been able to replicate them all and advanced them … so much such that we can replicate any machine from abroad (Artisan 2; Kwaebibirem, 2014)

The artisans or 'machine artisans' were specifically asked about how they had developed their skills in the first place. They reported that they have a special way to develop their manufacturing skills and are able to replicate the creation of machinery after briefly viewing them. A machine artisan described this skill as his 'inbuilt intuition' which assists him in producing imageries of (imported) machines he has seen around. He believes that these images return to him in the form of 'visions' which are then translated into drawings and eventually produced into prototypes. He further explains these 'in-built things':

> If you see any artisan, there is some sort of inbuilt things which the 'Obroni' [foreigners] referred to as science. There is something within [them] that triggers design in the mind even when you are sleeping. So, when the person rises he is able to capture those images and transform them into drawings. That

> is the basic truth...it appears like a vision. Even now if someone passes by with a machine, I am able to take a mental picture of it, or visualise it, and then replicate it (Artisan 1; Kwaebibirem, 2014)

This artisan also believes that their ability to create machinery has a spiritual dimension with creativity associated with 'something within given by God':

> … [I] visualise it, it comes within a twinkling of an eye. [I] internalise it and immediately begin to draw. For such individuals if they combine their talent with education, then they become extraordinary. That is how I am; I was not an apprentice, I didn't have any master, but [it] is just that I enjoy doing the work of God. [...] For I believe that anything that is science is from nature, God has created everything and we are just refining and exploring it to get something from it (Artisan case study 1; Kwaebibirem, 2014).

All the artisans interviewed explained that the 'gift' of innovation is theirs to give to society as it is given by God. By relating their creations to 'God', the innovation loses ownership and becomes socialised. In this sense, innovative ideas and reengineering practices do not subscribe to international norms of Intellectual Property Right (IPR) issues. This is directly linked with the rather weak legal institutional structures observed in Ghana as well as a lack of enforcement of IPR regulatory frameworks. By linking spirituality to reengineering of external technologies, gatekeepers are able to normalise the loose interpretation of intellectual property regulations in order to make machines available for smaller businesses owned by poorer members of the cluster. This in turn leads to the proliferation of these machines.

5. Discussion

Our first research question explored the identity of the gatekeepers. The evidence reveals that gatekeeping in developing economies like Ghana goes beyond the activities of MNC and public sector institutional collaborations, and can also be related to the roles that entrepreneur gatekeepers play in new knowledge adoption, adaptation and transference, particularly within business clusters. Based on the analysis of the evidence presented, gatekeepers in the two Ghanaian clusters fall into two main categories: there are those gatekeepers who, by their international exposure, serve as the 'pipeline' for introducing new technologies such as the engineer introducing palm processing machinery or the farmer introducing MD2 pineapples; and there are also those who reengineer or adapt newly 'imported' technologies for local businesses. There is also a third group that can assist the above, notably public institutions that collaborate with local businesses in order to decode, adapt, and transfer external knowledge within clusters, showing the multiplicity of gatekeeping activities in developing economy clusters. This distinctiveness in the nature of gatekeepers in these clusters have implications relating the ability of gatekeepers to integrate and generate tacit and coded knowledge and to adopt and adapt to new technologies – otherwise beyond the reach of small businesses in developing countries.

The second research question examined how gatekeepers combine codified and tacit knowledge. The evidence demonstrates that entrepreneur gatekeepers in Ghana have been able to acquire new knowledge tacitly and in codified form. In doing so, they have served as the 'pipeline' through which production techniques were generated (Bathelt et al., 2004; Balland et al., 2015). This process was further supported by collaborations between local and international institutions so as to decode more codified knowledge and make the externally

acquired knowledge accessible to local businesses. As a result, the study moves away from models of simple technology diffusion and adoption to highlighting gatekeepers' abilities to merge both tacit and codified knowledge in the diffusing process, placing them at the heart of the innovation process. This ensures that bottlenecks that Munari et al. (2011) and Morrison et al. (2013) said to limit the adoption of internationally acquired tacit knowledge are minimised, if not eliminated completely. Such a merger of these forms of knowledge is critical for developing economies that seek to harness gatekeepers' capabilities in transferring technology and adapting them to local circumstances.

More importantly, gatekeepers are able to create a critical opportunity for collaboration so as harness the strength of local institutions and support the blend of tacit and coded knowledge acquired. Hence, by combining the gatekeepers' appreciation of the business environment, the embedded socio-cultural milieu, and the weak IPR regulatory frame, the artisans are able to reengineer new machines appropriate for the local economy. Even though some of these gatekeepers have no international exposure, their earlier interactions with external engineers helped to create an enabling environment to decode knowledge that is embodied into imported machinery from large-scale processing operatives.

Our third research question explored the process of adapting and transferring technology in the Ghanaian context. Even though the pineapple cluster is more outward looking with direct sales to foreign markets and the palm cluster is more inward looking, the findings revealed that newly imported technology was adapted in both clusters. In the case of the pineapple cluster, this occurred through one entrepreneur's exposure to the international market, his efforts to trace the source of the new variety and its adaptation to make it better fit the local

context and accessible to other businesses in the cluster. The pineapple processor moved to Costa Rica and tacitly learnt how to produce the MD2 pineapple and then introduced the knowledge to Ghana (Balland et al., 2013; Maskell, 2015; Tortoreillo; 2015). In the palm cluster, 'artisans' served as mediators for processing technology from abroad. The artisans in the palm cluster created appropriate palm processing technology by imitating technologies from abroad (Leamer and Stopper, 2001; Stopper and Venables, 2004; Gertler and Levitte, 2005). Thus, the study provides a different perspective on how external knowledge can be transferred into clusters in developing economies.

The evidence also reveals that gatekeeping goes beyond serving as 'pipelines' for transferring knowledge and technologies to include the ability to adapt the technology to meet the needs of other local businesses. Gatekeepers worked together towards acclimatising the MD2 pineapple and training farmers on the cultivating skills peculiar to Costa Rica in order to adapt to the MD2 variety. In the palm cluster, the ability of gatekeepers to replicate and adapt technology from abroad has led to the emergence of indigenous innovative systems that thrive on providing machinery to meet the processing needs of businesses such as in the palm cluster. Hence these gatekeepers do not only replicate but consciously work to adapt technologies by building machines of different shape, size, and purpose to meet the specifications of local businesses which, over recent years, have been critical in securing the local farming community a livelihood for their families (Sarkar and Pansera, 2017). While some farmers have struggled with growing the cash crop, further innovation has led to more attention to sustainability such as reducing agrochemical use in pineapple production and getting fair trade status for the products by ensuring good working conditions and higher pay to their workers. (World Bank, 2016).

Finally, linking belief system to reengineering technologies by gatekeepers offers a different appreciation on mainstream discussions on IP and regulatory frameworks in developing economies, particularly in Africa. The palm oil processing artisans referred to their ability to understand and adapt new technologies as a gift from God and thus, provides them with a moral justification to break international regulations and so provides internationally competitive technology that supports the livelihoods of the poorest. Informality allows many in poverty to access technology and thereby add value to their produce and create sustainable livelihoods. However, lax enforcement of IPR regulations is also a disincentive to some investors and hence it may limit other opportunities in the future. There is also the risk of future litigation against the more vulnerable businesses.

Conclusion

In the face of limited information on entrepreneurial gatekeepers within developing economy clusters, this study enhances our understanding of the role that business entrepreneurs can play in knowledge and technology transfer and its potential outcomes in terms of economic development and public policy.

This paper also sets out the importance of combining tacit and codified knowledge. The evidence demonstrates that importing of technology requires gatekeepers to be able to travel and gain exposure to new ideas, and have the opportunity to build up their tacit knowledge in other countries before returning. However, there is high degree of serendipity in the process of identifying potentially successful innovations. The diffusion of knowledge from the

gatekeepers to other businesses is also shown to be based on combining tacit and codified knowledge – sometimes it is in collaboration with the public sector or large companies. Innovation strategies can support the existing apprenticeship structures that are found in many parts of Africa, usually operating without any public sector support.

These findings have a significant practical implication for business start-ups and sustainable economic growth in developing economies. In principle, it is therefore imperative to move policy makers' attention and support for traditional forms of knowledge and technological drive, which are certainly important, to that of entrepreneur gatekeepers. This can engender innovativeness among businesses towards a more sustainable growth in developing countries. Future innovation strategies in African economies need to recognise the roles of these entrepreneurial gatekeepers as well as the roles of public agencies and MNCs in technology development. Innovation policies can be focused on identifying the potential key gatekeepers and supporting them. Innovation strategy does not necessarily have to be focused on the most expensive technology and larger formal sector businesses, as there is room for rapid increases in productivity and added value from technology, developed and adapted by local artisans for businesses operating in the informal economy. There is therefore a need for a focus on providing artisans with appropriate technology that can be adapted. Public policy and philanthropic foundations can help enable artisans by reducing the limiting factor of intellectual property rights and ensuring that there are not any barriers for the poorest to access technology that will provide them with livelihoods.

The study also has some implications for future research. To start with, there is the need for further research beyond a single country case in order to identify best practices in the transfer

of technologies more generally. Unlike East Asian countries, like China, where there is extant research on returnee entrepreneur gatekeepers and their role in technology transfer, there is the need to investigate the peculiar challenges entrepreneur gatekeepers face in the adoption and transference of new knowledge and technology in other Sub Saharan African countries. While this paper focuses on technology, there is also much potential for innovation in the business models behind the products such as growing pineapples in Ghana for fair-trade markets. We also show how there are considerable commodity differences and geographical differences. In the search for sustainable livelihoods and poverty alleviation in Africa, there is therefore the need to understand how indigenous innovation systems operate, the integration of the formal and informal economies and how more sustainable practices can be supported. This may help to inform the establishment of specific support programmes to promote the activities of entrepreneur gatekeepers in the region.

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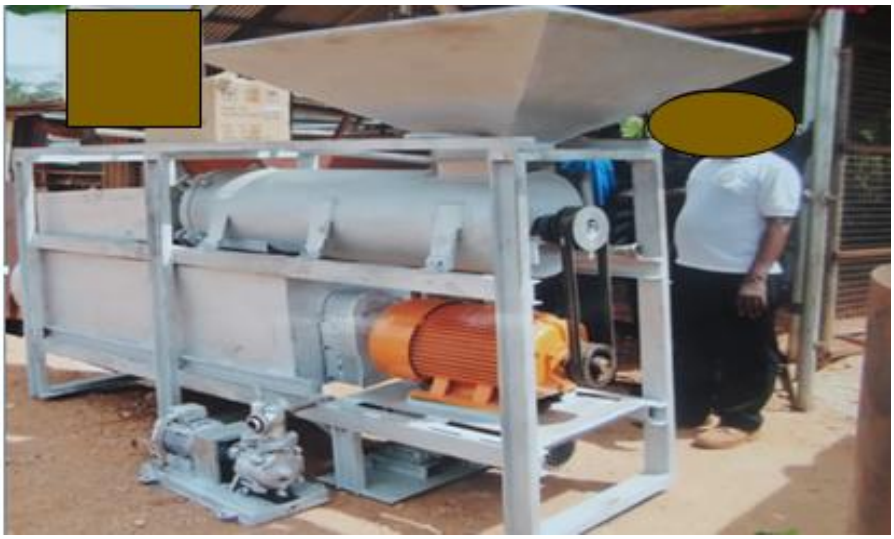
TABLE

Table 1: List of interviewees

	Pineapple Cluster	Palm Cluster
Fruit farmers	3	2
Processing businesses	7	9
Artisans	2	0
Business Advisory Centre (BAC)	1	1
Oil Palm Research Institute (OPRI)	0	1
Ministry of Food and agriculture (MoFA)	1	1
National Board for Small Scale Industry (NBSSI)	1	
Ministry of Trade and Industry (MoTI)	1	

FIGURES

[FIGURE ONE]



Source: (Photograph taken by the author, 2014)

Figure 1: Machine Artisan processing equipment (1)

[FIGURE TWO]

Source: (Photograph taken by the author, 2014)

Figure 2: Machine Artisan processing equipment (2)

[FIGURE THREE]

Source: Photograph taken by the author, 2014

Figure 3: MD2 Pineapples from Costa Rica