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More details/abstract:

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Value chain governance, power and negative externalities: what influences efforts to control pig diseases in Myanmar?

Ayako Ebata, Hayley MacGregor, Michael Loevinsohn, Khine Su Win, Alexander W Tucker

Abstract

Livestock diseases are examples of negative externalities that affect livelihoods and health of poor people across the world. We investigate how the governance and power relationships along a value chain can contribute to reducing the negative effects of livestock diseases. We conducted a case study of Myanmar's pig value chains and examined the relationship between power and efforts to minimize the risks of pig-borne diseases. We find that power relationships along the value chains are not directly linked to value chain actors' effort to control negative externalities unless powerful actors 1) understand the effects of negative externalities on the wider society, 2) monitor others' practices, and 3) could hold those who generate negative externalities accountable. Satisfying these conditions requires effective coordination between governments, value chain actors and civil societies in order to mobilize value chain actors to help improve public health.

Keywords: value chain; animal diseases; Asia; Myanmar (Burma); public health; livestock farming

1. Introduction

Livestock diseases threaten the lives and livelihoods of poor and marginalized people in low- and middle-income countries (LMICs). Animal specific diseases, such as classical swine fever, reduce farm productivity through animal illness and therefore jeopardize livelihoods (Otte & Mcleod, 2004). Moreover, animals may carry zoonoses, organisms that can transmit to humans and damage human health by impeding long-term cognitive and physical

development for those who live in close proximity to animals (Mai et al., 2008; Randolph et al., 2002). Enteric zoonoses are particularly widespread and endemic in Southeast Asia (Coyle et al., 2012; ILRI, 2012). Because such zoonoses affect poor and marginalized people disproportionately (ILRI, 2012), they threaten achievement of health-related Sustainable Development Goals.

Value chain (VC) analysis is seen as a powerful tool to control livestock diseases (Rich & Perry, 2011; Rushton, 2008). Veterinary scientists and practitioners have analyzed VCs to trace the flow of animals and animal products and inform efforts to identify points of risk for disease occurrence and transmission (FAO, 2012; Rushton et al., 2005). This, in turn, helps policy makers to focus interventions on practices and arrangements which pose high risks of transmission of diseases between animals and to humans. Moreover, VC analysis allows policy makers to identify actors beyond farmers, such as slaughterers, animal traders, and retailers, who are negatively affected by livestock diseases (Baluka, 2016; Rich & Wanyoike, 2010)¹¹. However, existing studies remain descriptive and do not scrutinize how governance and power relationships of livestock value chain influence individual efforts to control livestock diseases.

Livestock diseases, both zoonotic and non-zoonotic, are an example of *negative externalities* – unintended negative consequences of livestock production, trade and consumption (Bolwig et al., 2013). To date, research into how VC governance and power relationships influence externalities is scarce. Instead, the focus so far has predominantly been on understanding how VC governance influences cost competitiveness and economic positions of individual enterprises in LMICs (for example, Giuliani et al., 2005; Humphrey & Schmitz, 2002; Kaplinsky, 2004; Navas-Alemán, 2011; Schmitz, 2006). In recent years, VC researchers have extended VC analysis to include externality issues such as labor rights (Barrientos et al., 2011; Gereffi & Lee, 2016), occupational health (ILO, 2017), gender equality, and

¹ For examples, see Carron et al. (2017) and Alarcon et al. (2016).

environmental degradation (Mitchell & Coles, 2013). However, their focus is limited to negative effects on those who participate in VC transactions and they do not address externalities that affect the wider public such as in the case of livestock diseases.

Based on a case study of pig diseases in Myanmar, we investigate to what extent analyzing the governance of livestock VCs and existing power relationships can help to understand how VC actors act to prevent the spread of livestock diseases, negative externalities with major impacts on public health and livelihood. This paper draws on empirical data collected as part of an interdisciplinary project that documents the prevalence of zoonotic disease in the pig value chains in Myanmar, and how social, economic, and political factors affect zoonotic diseases risks. We selected Myanmar's pig sector because of its importance in that country and the risks that pig diseases pose for people whose livelihood depends on pigs. Pork is one of the most popular sources of animal protein in Myanmar and its consumption and production have rapidly increased (FAO, 2017). As pigs are an important reservoir for many zoonotic diseases (Webster et al., 2016), Myanmar's rapid increase in pig production and consumption pose a high risk of zoonotic diseases (ILRI, 2012). Its experience of rapid intensification can hopefully inform other LMICs where livestock production and consumption are similarly increasing.

This paper has three primary objectives. First, we characterize power relationships that shape the transactions along Myanmar's pig value chains, based on the VC governance (VCG) framework (Gereffi et al., 2005). This provides an analytical tool to understand how power relationships and arrangements among VC actors influence their product quality and production practices (Gereffi et al., 2005; Humphrey & Schmitz, 2000). Second, we identify how power is obtained and exercised to influence individual or collective behavior of VC actors. Third, we identify how the identified power relationships influence VC actors' effort to improve *biosecurity*, practices that aim to curtail transmission of pathogenic organisms. The

specific biosecurity practices considered in this study are defined in Section 2. Biosecurity is one of the most important means to prevent transmission of livestock diseases (FAO/OIE/WB, 2010; OIE, 2015). Yet, biosecurity practices are poorly implemented in LMICs (Alawneh et al., 2014; Carron et al., 2017; Grace, 2015; Leslie et al., 2015), and their importance is not well understood among small-scale pig farmers in Southeast Asia (Tornimbene et al., 2014).

The paper is organized as follows. We first define biosecurity practices evaluated in Section 2. In Section 3, we present academic debates regarding how the governance and power relationships along VCs influence firm behavior and explain how we link VCG and power relationships to biosecurity practices in our study. In Section 4, we outline the methods of study sites selection and data collection. Then, we describe the pig VCs in Myanmar (Section 5) and addresses the three objectives (Section 6) before concluding in Section 7.

2. Biosecurity

Biosecurity practices aim at limiting transmission of infectious diseases among animals (FAO/OIE/WB, 2010). For the purpose of our study, we focus on the practices listed in Table 1 when evaluating VC actors' biosecurity practices. The list is not exhaustive and limited to actions that are relevant for our study. In addition, we do not suggest that VC actors understand biosecurity in the way outlined in these guidelines.

3. Value chain governance and its influence on value chain actors' behaviors

Governance of value chains

Before embarking on understanding how VCG influences value chain actors, a clear definition of VCG is necessary. VCG refers to the ways in which VC actors control production, knowledge, and resources, and how the relationships among these actors are structured (Humphrey & Schmitz, 2002). The actors who control transactions along the VC are considered *powerful*, and are often referred to as *lead firms* (McCormick & Schmitz, 2001). The way in

which lead firms control production, knowledge, and resources determines how profits and risks are distributed across the VCs (Gereffi, 2014). As a result, lead firms enjoy a high share of profits generated from VC transactions while the less powerful tend to struggle in doing so (Kaplinsky, 2000). Firms in our context refer to farmers, pig buyers, slaughterers, and pork vendors.

Gereffi et al. (2005) categorize VCG according to the degree to which a lead firm exercises power in controlling VC transactions. The level of control depends on 1) the complexity of information and knowledge required to complete inter-firm transactions, 2) the ability to effectively transmit the required information and knowledge, and 3) the capabilities of suppliers to complete the transactions. Table 2 shows the VCG framework that we use in our analysis. The power exercised by the lead firm increases as VCG moves from *Market governance* to *Hierarchy governance*. Specifically, in the Market governance, buyers and suppliers exchange undifferentiated commodities that can be produced by many suppliers. Information about product quality is solely reflected in prices (Ponte & Sturgeon, 2013) and no specific lead firm exists. By contrast, *Modular* and *Relational governance* types handle more sophisticated, usually higher-quality, products than in Market governance. However, buyers and suppliers have an equal relationship because they depend on each other.

VCG and behaviors of participating firms: *upgrading*

In order to understand how VCG influences biosecurity practices of pig-related businesses, we now discuss how individual firms' behavior is linked to VCG. VC research has extensively documented how firms respond to different types of VCG in order to remain economically competitive. This response is called *upgrading* (Humphrey & Schmitz, 2002), or economic upgrading.

Captive chains encourage firms in LMICs to improve production efficiency (*product upgrading*) and/or products (*process upgrading*). However, lead firms typically discourage

these firms to move to different stages or functions along the VC (*functional upgrading*), and thereby capture higher profit margin (Giuliani et al., 2005; Humphrey & Schmitz, 2002; Navas-Alemán, 2011; Schmitz, 2006). On the contrary, Market governance encourages functional upgrading (Bazan & Navas-Alemán, 2003; Hubert Schmitz, 2004; Tewari, 1999) while process and product upgrading tend to be harder for these firms as these types of upgrading are not encouraged by powerful buyers (Humphrey & Schmitz, 2002). Modular and Relational governance types encourage suppliers to undertake all types of upgrading (Humphrey & Schmitz, 2002). However, in these governance types, the cost of investment in upgrading has to be incurred by LMIC firms themselves as the buyer does not support their upgrading (Pietrobelli & Rabellotti, 2011).

Do for-profit firms respond to negative externalities? Research to date shows that firms' behaviors regarding externalities cannot be as easily explained by different types of VCG as economic upgrading. Instead, firms' motivation to mitigate externality depends on whether or not there are standards to adhere to, the (lead) firms will be held accountable if the standards are not met, and/or officials visit the production sites for inspection (Barrientos et al., 2011). Also, the difference in labor conditions is attributed to the types of employment contracts (e.g. short- vs long-term) as well as laborers' skill rather than VCG (ibid). Lund-Thomsen et al. (2016) show the importance of firms in LMICs to be integrated into global VCs where labor or environmental standards are higher and monitoring is more rigorous than domestic VCs. This implies, though, that the segments of the VCs that do not handle international transactions rarely adhere to these standards. Similar findings were discussed by Jespersen et al. (2014) on environmental degradation due to intensifying aquaculture. They discuss the effects of private and public product quality and production standards, and civil society that demands increased environmental standards in the industry.

Influence of external actors: exercising *power*

The aforementioned studies indicate that reducing negative externalities may not depend on VCG, but rather how firms are assessed, monitored, and pressured to reduce negative externalities. Multiple actors influence firms such as governments of countries that import or export a particular commodity and civil society organizations that are interested in reducing negative externalities. This is consistent with the economic theory that controlling negative externalities will require intervention by a third party (usually the national state) who is interested in public wellbeing (Just et al., 2005). Infectious animal diseases have implications on public health on account of zoonoses and the wider economy through, for instance, loss of international trade (Torgerson et al., 2018). For-profit value chain actors would not act on controlling this negative externality by, for instance, increasing biosecurity measures, unless there is (economic) reward or penalty imposed by a third party.

LMICs face a number of challenges in incentivizing firms to reduce and/or punishing them for generating negative externalities. First, state-led enforcement of product and production standards are limited in LMICs (Jespersen et al., 2014). In other words, firms are not held accountable for the negative effects of their business activities. Second, LMICs have limited capacity to trace product origins and differentiate products that do and do not comply with these standards (Gibbon, 2001). As a result, product quality is not well communicated between buyers and sellers (Minten et al., 2016). In such situations, buyers are hesitant to pay more for products marketed as high-quality (Dolan & Humphrey, 2000) and sellers have no economic incentive to improve product quality.

Various groups of actors with distinct interests try to exert influence over behaviors of VC actors to reduce negative externalities. This is referred to as “multipolar” chains where a number of actors exercise *power* over VC actors based on their subjective opinions about product *quality* (Ponte & Gibbon, 2005; Ponte & Sturgeon, 2013). Depending on their interests

and the means available, these actors exercise power on an *individual* or *collective* basis, in either a *direct* or *diffusive* way (Dallas et al., 2017) to achieve a particular objective (Table 3). For example, pork consumers may exercise *constitutive power* and determine meat quality based on subjective opinions about pork safety. National governments may exercise *institutional power* to mandate biosecurity practices to minimize the risk of diseases that affect public health and the pork market.

Our contribution

To date, much of VC research focuses on direct form of power exercised by individuals (i.e. *bargaining power* in Table 3). However, as mentioned above, other forms of power are equally, if not more, important when controlling externalities and when the national state struggles to enforce laws concerned with public health. Therefore, our analysis will go beyond documenting bargaining power between VC actors and consider collective forms of power. This includes the influence of government regulations and their enforcement, socio-cultural practices and understandings, and consumer preferences that influence VC actors' biosecurity practices.

4. Data collection methods

Study sites and participants selection

We collected data in Myanmar's Yangon Region, which has the highest pig population density and the fourth largest number of pigs in the country (LBVD, 2014). Within Yangon Region, three townships were selected: Taikkyi, Hlegu and South Dagon. All three are active in pig farming and represent different scales of production as well as distance to the country's largest city, Yangon. We selected Taikkyi, a rural township located about 70 km from Yangon, Hlegu, a peri-urban township about 40km from Yangon, and South Dagon, 30 km from Yangon in an urban area. Farmers in Taikkyi are predominantly medium-scale with between 30 and 70

pigs, those in Hlegu are large-scale farmers with 70 to several thousands of pigs, and most farmers in South Dagon are small in scale with between 1 and 30 pigs.

We collected data from the following entities: 1) private companies that produce pig feed, live pigs, and veterinary drugs, 2) feed shops, 3) drug shops, 4) farmers, 5) pig buyers, 6) slaughterers, 7) pork vendors, and 8) pork consumers. First, we selected farms that represent the type of pig farming that is typical in terms of the number of pigs raised in the township. In addition, selected farmers needed to consider pig farming as an important income source. Diversity was sought in terms of farmers' gender and farm size to reflect different perspectives. Second, other stakeholders were selected to provide context for farmers' practices. For instance, pig feed and drug shops were selected based on information provided by the farmers as to where they purchase their inputs.

Data collection strategies

We conducted individual semi-structured interviews, focus group discussions (FGDs), and participant observation. Between June and October 2016, 28 farmers, 12 slaughterers, 12 pork vendors and 12 pork consumers were interviewed and a total of 12 and 6 FGDs were conducted with farmers and consumers, respectively. The interviews addressed participants' practices regarding their livelihoods, veterinary healthcare, understandings of pig diseases and biosecurity, and the implication of these diseases on their livelihood. In addition, between December 2016 and February 2017, participant observation was conducted at 24 farms². Two authors spent two days per farm, observing their farming practices and investigated rationales behind each action and household-level economic trade-offs.

In May 2017, additional data were collected to obtain information about the VCs. In total, we interviewed 4 livestock company representatives, 6 veterinary drug shopkeepers, 8 feed shopkeepers, 3 traders, and 3 slaughterers. In addition, we conducted 6 community, 1 vendor, and 4 slaughterer FGDs in total. We also gathered data from other individuals who held relevant

information such as brokers. Questions addressed the quality of pig products exchanged, how VC actors judge product quality, the number of VC actors, how information regarding pig products is communicated, cost of switching to a new partner, and the number of suppliers who can produce the required pig products (Table 2).

These data collection methods were employed to obtain detailed understandings of common practices by VC actors. We selected the number of interviewees to reach a point of data saturation where researchers do not gain new insights from interacting with an additional participant (Creswell, 1998).

5. Yangon region's pig value chains and their characteristics

Across our study sites, we identified three value chains, which we refer to as 1) *Village*, 2) *Township*, and 3) *Regional* Chains in the rest of this paper (see Figure 1). The Village Chain exchanges pig products for religious and non-religious purposes within a community. Pork is traded for religious purposes (referred to as “religious pork” hereafter) when a community member slaughters pigs to offer to gods. All other exchanges of pig products in the Village Chain are for everyday consumption and does not serve religious purposes. Township Chain involves pork sold at wet markets in rural and peri-urban townships (i.e. Taikkyi and Hlegu) while Regional Chain caters to consumers who purchase pork at wet markets in urban townships (i.e. South Dagon).

The exchange of pig products along the three VCs demonstrated considerable overlap. Small- and medium-scale farmers sold their pigs to slaughterers and buyers from all three VCs. At the time of the fieldwork, there was no legal requirement to ensure the pig products sold in official wet markets meet specific quality standards by, for example, laboratory-based prevalence testing of zoonotic pathogens. As a result, little information or knowledge on biological traits of pig products passed along all three VCs and many farmers and slaughterers

were involved in the transactions. As long as farmers could find a buyer, anyone could sell their pigs to any of the three chains without improving product quality.

In addition to the overlap, we noted differences among the three VCs regarding 1) the interaction between VC actors and official regulations, and 2) the ways in which consumers judged product quality. All transactions along the Village Chain were *informal*, meaning that slaughterers and vendors were unregistered and received no government oversight. In contrast, slaughterers and vendors in Township and Regional Chains were registered by the local City Development Committees (CDCs) and received inspection from CDC officials. Slaughtering premises closer to the local CDC offices were inspected more than those further afield, regardless of which VCs they belonged to. Slaughterers in the Township and Regional Chains were subject to the “licensee policy”, which limits the number authorized to slaughter pigs³ and sell pork at official wet markets. The license was given out by CDCs in Taikkyi and Hlegu and Yangon CDC (YCDC) in South Dagon. This policy restricted the number of official slaughterers⁴. This was in contrast to the Village Chain where every village had one to two informal slaughterers.

Even though there was no quality requirement mandated by the government, consumers in all Chains judged pig product quality in one way or another. Religious pork was common among the Kayin ethnic minority group. Kayin consumers closely monitored the production and slaughtering process so that no sick pig was slaughtered:

“[Farmers] will carefully raise pigs and when [pigs] are ready and healthy, they will sacrifice and offer the pigs to the deity.” (An informal slaughterer)

Consumers strongly influenced product quality through close monitoring based on a location-specific ethnic tie. In the case of Township and Regional Chains, consumers were unsure if pork came from sick pigs and could only judge pork quality based on subjective observations:

“Pork from healthy pigs has red color. Meat (from sick pigs) is brown, smelly and loose... [But] I cannot know the exact [meat quality]. [Slaughterers] buy pigs and those pigs may die on the way [to the slaughterhouse] from disease. Some farmers sell pigs when they think the pigs have diseases. [Slaughterers] buy, slaughter and sell those pigs. How can we know if some of these pigs were sick and died?” (A consumer)

To mitigate this uncertainty, some consumers had a trusted vendor in an official market:

“I think vendors [in general] mix dead or sick pigs’ meat with healthy pigs’ meat...[But] I believe that [the vendor I always go to] always sell fresh meat.” (A consumer)

6. Factors influencing VC actors and their biosecurity practices

In this section, let us return to the three objectives of this paper and identify: 1) power relationships that govern the VCs and their economic transactions, 2) how powerful actors obtained what kind of power, and how they used the power to influence others’ behaviors, and 3) how the identified power relationships influence VC actors’ biosecurity practices or effort to help control negative externalities.

Who are powerful actors along the three VCs?

Following Gereffi et al. (2005), we evaluated power relationships based on four indicators: 1) the complexity of knowledge and information required, 2) the ability to transmit information and knowledge, 3) the number of VC actors, and 4) supplier capabilities to produce the required products (see Table 4 for a summary).

From biological point of view, little knowledge and information was required to complete any of the transactions along all VCs. We observed no official quality standards on pig products at any stage of the VCs, imposing, for example, a specific level of bacterial prevalence in meat or health status of live pigs. The typologies by Gereffi et al. (2005) would imply that no VCG types other than Market could emerge.

We argue, on the contrary, that other types of VCG emerged because the absence of official quality standards was replaced by people's subjective judgement about product quality. Consumers made judgement mostly based on observable characteristics of meat (as described above), as well as production and slaughtering processes. This was particularly pronounced in the case of religious pork exchange in the Village Chains where consumers monitored the production and slaughtering process of healthy pigs to be sacrificed for religious purposes. Collectively, consumers exercised *constitutive power* (Dallas et al., 2017) over other actors and determined what pig products could enter the religious Village VC. Because consumers had to monitor the practices of farmers and slaughterers closely, it was not easy to find other suppliers. Therefore, we argue that religious Village VC demonstrated Relational VCG where consumers were the powerful actors.

In other VCs, consumers' influence over other actors was observed, but to a lesser extent. Because the other VCs involved many actors across a wide area, consumers were unable to monitor how pigs were raised and slaughtered. Although consumers wished to purchase pork from healthy pigs, they had fewer means to judge pork quality than along the religious Village VC. Therefore, we judged that the transactions along all VCs except religious Village VC required little information and knowledge, and thus demonstrated Market governance.

We refrained from defining Township and Regional Chains as also governed by Market VCG for several reasons. First, the number of slaughterers in Township and Regional Chains were restricted by the aforementioned licensee policy. This meant that only handful of individuals per township could supply official pig products even though the biological attributes of their products were not different from unofficial products. Because these individuals had stalls in official wet markets, consumers could easily differentiate them from unofficial vendors and slaughterers. These are characteristics of Modular VCG instead of Market VCG. Second, although these official VC actors would be considered as lead firms

under the framework of Gereffi et al. (2005), they could not increase the price or the number of pigs to slaughter to maximize profit. This was because the licensee policy controlled the price and quantity of pork to be sold at official markets. Therefore, we concluded that Township and Regional Chains demonstrated both Market and Modular types of VCG with an influence by *institutional power* of Myanmar's government (i.e. the licensee policy).

Along the Regional Chain, we observed that pig buyers had a closer relationship with large-scale farmers than with small- and medium-scale farmers. Buyers preferred trading with large-scale farmers not because their pigs were superior quality but because they could buy a large number of pigs at once. As there was a limited number of large-scale pig producers in Myanmar, switching to a new partner was difficult. The comment below by a pig buyer indicates that large-scale farmers and pig buyers had an equal relationship:

“The large-scale farm usually sells me pigs twice a week, on Friday and the owner allows me to come when I want for the second time. They can sell me 90 to 100 pigs per week, 400 pigs a month. Plus, there are other people (pig buyers) who buy like I do from their farm...I don't have a contract with the farmer, but I am very friendly with the farmer, so he allows me to receive pigs twice a week.” (A trader)

We determined this relationship as Relational where large-scale farmers had *bargaining power* toward pig buyers because of their scale of production that buyers valued.

How is power obtained and exercised along the VCs?

For consumers to obtain and exercise *constitutive power*, three conditions needed to be met. First, consumers needed to be interested in ensuring certain practices by other VCs. In the case of religious pork exchange, consumers cared that no sick pig was slaughtered. Second, consumers needed to be able to monitor other VC actors to ensure that these desired practices were implemented. Because consumers lived in the same village as farmers and slaughterers,

close monitoring of the production and slaughtering process was possible. Third, consumers needed to be able to hold others accountable for non-compliance. If farmers and/or slaughterers offered sick pigs for religious ceremonies, other villagers would notice immediately and there would be serious social consequences within the community. On the contrary, consumers in other VCs and suppliers (i.e. farmers or slaughterers) rarely lived in the same community. Because of the physical divide, consumers were unable to monitor and challenge other VC actors' practices.

Naturally, the government has *institutional power* to shape rules of the society through developing and enforcing laws. In the case of pig VCs in Myanmar, the licensee policy structured the pork market by restricting the number of official slaughterers and vendors. However, informal slaughters and vendors without official licenses existed across all study sites. Official slaughterers perceived that the informal market competed with their business:

“There is a village (informal) market (around here)...If I don't arrest (illegal vendors), I will suffer a loss since I have to pay the slaughtering license fee...It is difficult to arrest these people because village administrators protect their villagers. And there are many villages. Some villages would gather villagers and slaughter themselves, sometimes because there is a charity feast or funerals and leftovers are sold...We have to ignore these problems.” (A formal slaughterer from the Regional Chain)

“People should not sell the pork without license...(but) The government cannot monitor illegal activities. Now there are lots of (illegal) sellers on the road side and market. We are running this business with (official) license. (If these problems persist), official slaughterers will not want to run this business anymore.” (A formal slaughterer from the Regional Chain)

This indicates that, even though a policy is in place to control the supply of pork, institutional power to enforce the policy was limited. This, in turn, led to decreased profit and frustration by official actors.

Large-scale farmers gained bargaining power over pig buyers based on timely transactions of pigs in a large quantity. This is in line with findings by Ponte and Ewert (2009), who documented that suppliers of agricultural products could exercise power over buyers based on timely and bulky sales of a commodity. From the farmers' perspective, because a large number of pigs needs to be sold in a short time frame, they relied on specific buyers to purchase them at a given time. Therefore, even though large-scale farmers did not necessarily produce better quality pigs than small- and medium-scale farmers, they had more equal and mutually-dependent relationships with pig buyers than small- and medium-scale farmers.

How do the power relationships influence biosecurity practices?

Large-scale farmers succeeded in convincing buyers to disinfect their vehicles used for transporting pigs. Typically, buyers cleaned their trucks only with water and detergent. However, because pig buyers were interested in maintaining a good relationship with large-scale farmers, and farmers could provide disinfectant solution to buyers, these farmers convinced pig buyers to clean their vehicles:

“We don't [disinfect vehicles] but big pig farms do clean with bacteria killers...I don't think [other truck drivers] clean their trucks either because they normally get to their place at around 10pm or 11pm. They have to move pigs from the truck and it can take until 1am or 2am in the morning....So I don't think they clean the truck every day.” (A pig buyer)

In contrast, medium-scale farmers were unable to influence biosecurity practices of pig buyers. Not all medium- and small-scale farmers understood the finer points of disease transmission and control, in terms of implementing practices that might equate to scientific

notions of “biosecurity”. Some found it difficult to implement good biosecurity practices due to limited access to financial⁵ and physical resources⁶. However, all farmers implemented practices that they perceived as preventing pig illness and increasing profitability, such as cleaning pigs and pig pens, disinfecting the farm with lime powder, burying carcasses, and sprinkling lime around farms. Notably, many medium-scale farmers were aware of the importance of movement control:

“Here, we have a rule. If an outbreak happens on our farm, we never visit other farms to prevent disease from spreading.” (A farmer)

One village even organized to prevent pig illness by imposing movement restrictions on people and ill pigs, and disinfecting people when entering other households during disease outbreaks:

“Once, the village administrator warned us not to eat or buy sick pigs. There was a boy who brought a dead pig from another village and he was not allowed to enter the village.” (Consumer FGD)

However, they lacked bargaining power over pig buyers due to their small-volume transactions. This was evident in our interview with a wholesaler who would not apply disinfectant to the vehicle when moving from one (small- or medium-scale) farm to another. However, she would do so when entering her own farm during disease outbreaks as this would affect her own profit. In our fieldwork, we observed no mechanism for collective pig marketing by small- and medium-scale farmers. Therefore, these farmers’ influence on pig buyers’ practices remained limited.

Consumers in the Village Chain strictly enforced that no sick pigs were slaughtered for religious purposes. However, they were not concerned about other aspects of biosecurity that could pose health risks for farmers and slaughterers (e.g. hygiene of farms and slaughtering

premises). All VC actors had limited knowledge regarding public health risks of pig diseases due to limited information availability. While consumers' preference for healthy pigs indirectly encouraged biosecurity along VCs, it was widely believed that thorough cooking was sufficient to protect people from the ill-effects of consuming sick pigs' meat:

“(To avoid getting sick from eating pork) The main thing is to cook completely, for all types of meat. If you cook [it] completely, you can keep your family healthy.”(A consumer)

Also, consumers in all VCs except the religious Village Chain could not easily observe other actors' practices due to physical distance. As a result, consumers were only concerned about particular understandings of food safety based on limited information. Consumers' influence was based on limited information, primarily sensory, and sufficient to influence only a few aspects of biosecurity.

The implementation and enforcement of biosecurity-related laws varied across the VCs. Slaughterers in the Regional Chain were provided with daily ante-mortem and post-mortem inspection services by YCDC officials, who also provided cleaning services to all slaughterers. Waste products such as rejected meat from clearly sick pigs, feces and blood were burned by YCDC staff. One slaughterhouse worker mentioned that vehicles needed to be cleaned before transporting pork from the slaughterhouse. However, it was not clear that this was always done. In contrast, slaughterers in the Township Chain mostly worked without regular supervision by the local CDC and the frequency of CDC inspection varied. Their cleaning practices were limited to controlling visible contamination and odor:

“When we remove hair (from the pig), there is some bad smell and dirt in the drain. So we throw the dirt into a hole at the corner of our backyard. And we spread quicklime on it. It is quite safe.” (A Township Chain slaughterer)

Slaughterers in the Village Chain did not have fixed premises for their operation which was often done in a backyard with limited biosecurity.

In all VCs, there was limited government oversight of the details of slaughtering practices. Personal hygiene or occupational health practices of slaughterhouse workers, including handwashing and protective washable clothing, were not evident during the fieldwork. Slaughterhouse workers in the Regional Chain were observed without any clothing except a pair of shorts. The potential for cross contamination between carcasses was evident in all slaughter premises, notably with absence of hot-water sterilization of knives between carcasses, extensive manual handling of carcasses, and the use of floor surfaces or wooden tables for cutting up carcasses.

In the absence of objective means to judge (biological) characteristics of pig products and effective law enforcement, VC actors had limited incentive to improve biosecurity. Some poor consumers knowingly purchased pork from ill or dead pigs because it was cheaper:

“If pigs died because of sickness or injury, their meat would be sold to consumers who buy at a lower price.” (A Regional Chain slaughterer)

As a result, there was a ready market for this source of cheap pork and slaughterers and pig buyers were economically rewarded by trading in sick pigs:

“We buy pigs that cannot move. They would be worth 200,000MMK, but we only pay 150,000MMK. We make profit as long as the pigs do not die.”(A pig buyer)

In order not to incur financial loss, slaughterers killed pigs immediately when they became ill:

“If a pig stops eating today, we slaughter it tomorrow. Then there won’t be any problem.”(A Township Chain slaughterer)

While all actors recognized that this is prohibited, different understandings about severity of diseases influenced their practices. Pig buyers determined prices based on their understandings of pig illness. For instance, a pig that lost appetite for a few days was considered to have “minor illness”, and therefore was traded at a small discount:

“If a pig just started to get ill and was not eating, pig buyers would not drop their price much.”
(A farmer)

This incentivized farmers to sell pigs that were becoming visibly ill as soon as possible.

As previous research has shown, our analysis points to the importance as well as limitations of collective forms of power in influencing biosecurity practices of VC actors. Powerful actors first needed to have particular *intention* for which they use the power to make others do what they would not have done otherwise (Dallas et al., 2017): in our case, biosecurity practices. Secondly, they needed the ability to visibly observe and monitor other VC actors’ biosecurity practices. This ability was lacking in all VCs but the religious Village Chain. Likewise, the government’s institutional power was insufficient to either enforce biosecurity practices along the VCs or incentivize VC actors’ behaviors to improve biosecurity through, for instance, product differentiation or imposing penalty on those who compromise biosecurity. This is a common challenge across many LMICs (Gibbon, 2001).

An important difference between previous studies and ours is that the externality we addressed, infectious livestock diseases with zoonotic potential, negatively affects not only VC participants but also the wider public. Economic theory predicts (Just et al., 2005) that the optimal level of efforts to control negative externalities for the whole society is higher than the level of efforts made by individual parties affected by the externalities. In our study context, powerful actors were, understandably, concerned about particular aspects of livestock diseases that directly affected them. While their individual interests contributed to improving others’

biosecurity practices to an extent, interventions by the government are crucial to reach the optimal level of biosecurity for the whole society.

7. Conclusions

This paper shows that the governance of value chains and power relationships are not directly linked to individual actors' effort to control negative externalities. While Relational governance can be associated with improved control of negative externalities, several conditions need to be met. First, those who possess power over others need to understand the effects of negative externalities on not only themselves but also the wider public. Gaining such understandings crucially depends on the availability of information. Second, powerful actors need to be able to monitor others' practices. When value chains become long and complex, it is challenging to monitor all steps between consumers and producers. Third, powerful actors need mechanisms to hold those who generate negative externalities accountable. Generally speaking, this is a challenge that many government entities in LMICs face. Last, but not least, individual value chain actors require adequate financial and production resources to be able to invest in controlling externalities. This is not an easy task for many resource-poor people whose livelihoods depend on livestock.

While analyzing livestock value chains is argued as an effective tool to understand ways to reduce the increasing risks of animal diseases, our research demonstrates that this framework has limitations in understanding the interaction between power and individual efforts to control negative externalities. Effective biosecurity can improve both individual livelihoods and public health, a wider public good. Incentivizing and/or regulating individuals to act for both their own benefits and greater public interest requires effective coordination between governments, value chain actors and civil societies to mobilize value chain actors to achieve wider public health. Therefore, future research may consider the complex interactions of all these factors

and address how value chain analysis can contribute to developing interventions and policies that can help control animal diseases and their negative implications on poor people.

8. Notes

1. For examples, see Carron et al. (2017) and Alarcon et al. (2016).
2. Two large-scale farms did not allow the research team to access their farms. Moreover, two farmers were replaced: one passed away and another migrated after the initial interview was conducted.
3. These slaughterers pay an annual fee to the CDCs and YCDC for a license to slaughter pigs and sell pork at an official market. Licenses are issued for a specific area of a township and awarded through an auction. The cost of the license can be high. Two slaughterers mentioned that they each paid approximately 10,000USD in 2017.
4. At the time of the fieldwork, there were less than 10 official slaughterers per township and 30 slaughterers in one of the two large-scale slaughterhouses in Yangon, Ywarthargyi.
5. Livestock farmers are not entitled to receive the government-backed low-interest loans (approximately 0.2%/month) available to arable farmers. As a result, many rural livestock farmers rely on informal loan providers who can charge up to 20%/month.
6. For instance, there was no facilities where farmers could conduct artificial insemination instead of renting boars from other farmers, which is considered a risky practice (FAO/OIE/WB, 2010).

10. Tables and figures

Table 1. Recommended biosecurity practices

Value chain actor	Biosecurity practices
Farmers	Introducing only healthy pigs into the village Use artificial insemination instead of moving sows or boars No trading of sick or dead pigs No consumption of sick pigs Regular and thorough cleaning and disinfecting of pig pens Removing manure from pig pens every day Restricting and disinfecting visitors to the farm Avoiding feeding pigs with uncooked leftover human food (swill) Burying, composting or burning pig carcasses Reporting unusual death of animals to veterinary authorities
Pig buyers	No transportation of pigs that are sick or come from farms affected by diseases Cleaning and disinfecting vehicles used to transport pigs Wearing protective clothing and footwear if entering pig farms Cleaning clothing and footwear or appropriately disposing them
Slaughterers	Ante-mortem and post-mortem inspection Appropriate disposal of diseased carcasses identified at post-mortem inspection Cleaning and disinfecting the entire slaughtering premises every day Cleaning and disinfecting vehicles used to transport live pigs, and wheels and undercarriages of other vehicles

Source: Adapted from FAO/OIE/WB (2010) and Livestock Breeding and Veterinary Department (LBVD) (2017) of the Ministry of Agriculture, Livestock and Irrigation of Myanmar

Table 2. Five types of VCG

Governance types	Characteristics	Complexity of information and knowledge required	Ability to transmit information and knowledge	Capabilities in the suppliers to produce the required products	Cost of switching to a new partner
Market	Buyers and suppliers interact based on market transactions dictated by price. The transactions are mainly “arms-length” and are not coordinated.	Low	High	High	Low
Modular	Buyers specify products to be supplied. Suppliers are responsible for delivering the specified products. Often, suppliers use generic machinery to limit buyer/transaction-specific investment.	High	High	High	Low
Relational	Complex interactions are observed between buyers and suppliers who are mutually dependent on each other. The interactions may be bound to trust and reputation, and therefore bound to a specific geographical location.	High	Low	High	High
Captive	A group of small suppliers are controlled by lead firms.	High	High	Low	High
Hierarchy	Buyers and suppliers are vertically integrated where the lead firm controls most, if not all, transactions.	High	Low	Low	High

Source: adapted from Gereffi et al. (2005), Humphrey and Schmitz (2002), and McCormick and Schmitz (2001)

Table 3. Typology of power in global value chains

	Direct	Diffuse
Individual	<p>Bargaining power</p> <ul style="list-style-type: none"> • Firm to firm relationships • Different degrees of power in hierarchy, captive, relational, modular, and market VCG 	<p>Demonstrative power</p> <ul style="list-style-type: none"> • Informal ‘transmission’ mechanisms and/or competitive mimicry among suppliers • Shaped by quality conventions
Collective	<p>Institutional power</p> <ul style="list-style-type: none"> • Government regulations and/or multi-stakeholder initiatives or other institutionalized forms • Industrial standards and codified good practices • Locally-generated collective action by VC actors 	<p>Constitutive power</p> <ul style="list-style-type: none"> • Broadly accepted norms, conventions, expectations and good practices • Consumer and social movements

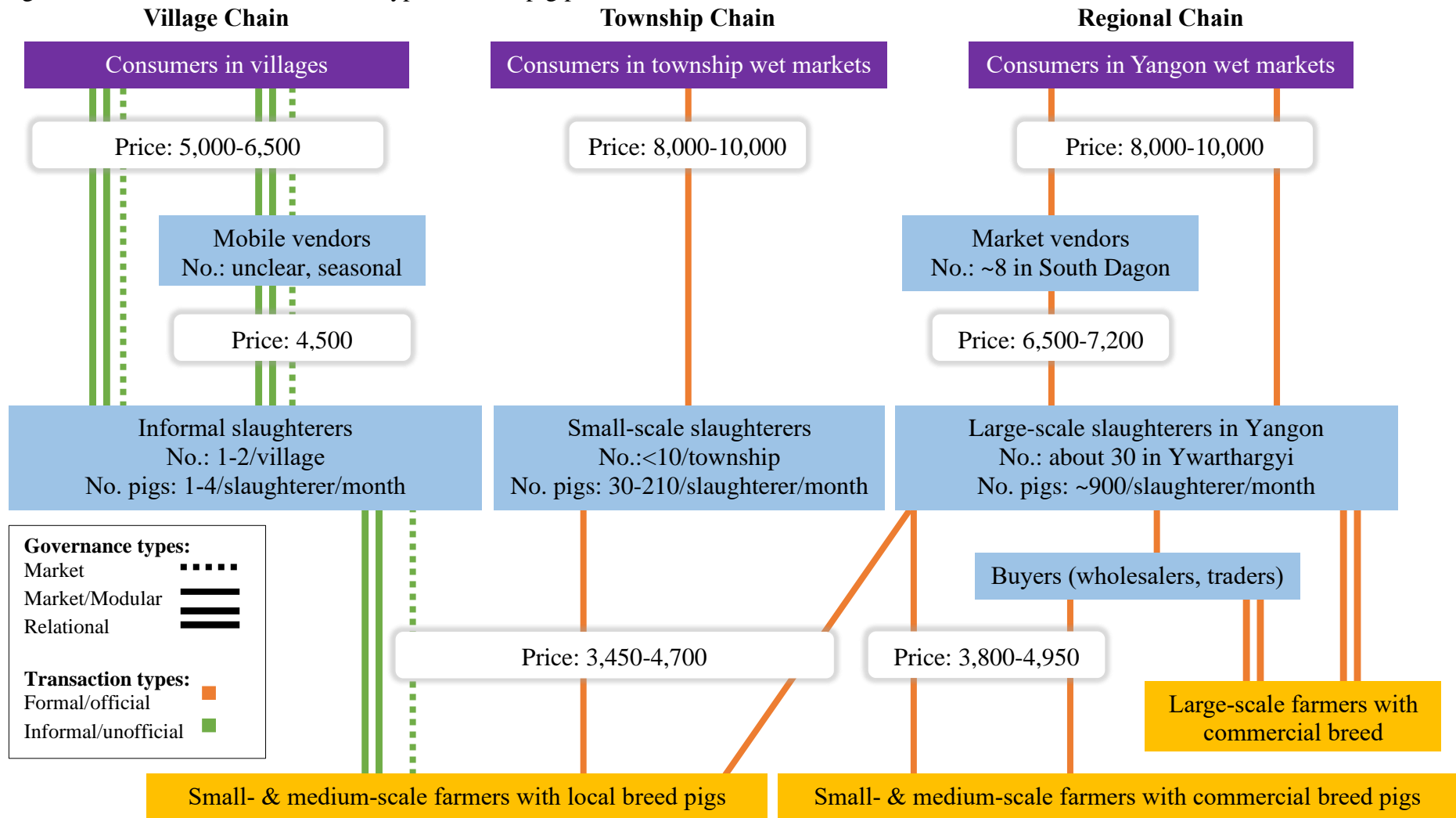
Source: adapted from Dallas et al. (2017)

Table 4. VCG analysis of pig product value chains in the Yangon region of Myanmar

Value chains	Transaction characteristics	Complexity of information and knowledge required	Ability to transmit information related to product quality	Capabilities in the suppliers to produce the required products	Cost of switching to a new partner (# of VC actors)	VCG
Village Chain	Non-religious pig products	Low	High	High	Low	Market
	Religious pig products	High	Low	Low	High	Relational
Township Chain	Pig products at rural wet markets	High	High	High	Low	Market or Modular
Yangon Regional Chain	Pig products at urban wet markets, small-volume transactions	High	High	High	Low	Market or Modular
	Pig products at urban wet markets, large-volume transactions	High	High	Low	High	Relational

Source: Authors

Figure 1. Governance and transaction types of three pig product VCs



Source: Authors

Note: prices indicated are Myanmar kyats per viss of either live pigs or pork. (1viss=0.67kg)

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