Food control and biosecurity roles in the global value chain: supporting producers or safeguarding consumers?

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Abstract. Nowadays, one health awareness in the global value chain is increasing. Since, the threat of global occurrence of zoonotic diseases, and pathogens is higher due to global trade. Therefore, the trend of global food trade is driven by food security, sustainable agriculture, and healthy nutrition to foster the long-lasting well-being of the human population. However, food control and biosecurity as proactive and dynamic strategies were not having a clear aim between supporting producers or safeguarding consumers. These aims had a trade-off in policy impact resulting in possible lapses in food production and economic chaos. This paper aimed to describe the food control and biosecurity policy in the global value chain and its impact on global trade. We reviewed the literature on zoonotic diseases, and pathogens related to food production, biosecurity strategies and practices. Then, a comparative analysis was employed and collated with the value chain governance to match its impact on supporting producers or safeguarding consumers. The results show that food control operational designs were inherently supported by biosecurity procedures. Moreover, the international regimes drove awareness, technical capacity and its impact on the policy dynamic in the global trade. The policy in Indonesia concerned more to support producers competitiveness in the global trade, while safeguarding consumers had less attention. This paper concluded that a more balanced policy is needed to implement food control and biosecurity in the global value chain.

Keywords: global trade, global value chain, chain governance, food control, biosecurity, one health

1 Introduction
Nowadays, one health is getting more attention from society because of several issues related to increasing antimicrobial resistance (AMR) and emerging zoonotic pathogens [1,2]. These issues as part of the global occurrence of zoonotic diseases increase social awareness especially its impacts on the global food trade [3]. The impact is concerning how the food produces and can be safe to consume in the global value chain [4,5]. First, monitoring and control in food production become more complex. Biosecurity and traceability control have been applied along with food certification to ensure safe production. Second, these measures have to guarantee sustainable agriculture. A challenge
between protecting public health and sustainable production with higher production requires support from proper technology development. This is to guarantee food security can be achieved and avoids a trade-off between goals. Thus, food production and consumption can be maintained to protect human health and well-being.

Food production in the global value chain tends to be more dynamic due to irregularity in supplies and qualities. Imposing a regulation does not guarantee the food production can achieve food quality and food safety [6]. Since the production involves a complex chain that consists of many countries with different regulation, implementing food control and biosecurity in the global value chain is a difficult task [7]. It even more difficult, since many food control and biosecurity regulations are not having a clear target between producers and consumers. In some countries, the policy makers often setting up the regulation to support producers to become more competitive in global trade [8]. While in some others, the regulation is focused on safeguarding consumers. The different between regulation objective impacting possible lapses in food production between countries. Moreover, economic chaos often occurs since many countries applied dynamic regulation to protect their producers or consumers. Currently, limited studies focus on food control and biosecurity regulation with regards their aims to producers or consumers. Many available studies focus on the biological and chemical impact of food control and biosecurity in the value chain. Many studies focus on specific types of food control and biosecurity in a certain actor in the production chains, for instance Kiambi et al. [9], Alarcon et al. [10], Indrawan et al. [11]. Moreover, other researchers focus on the implementation of food control and biosecurity in many regulations of international trade, such as Rahmat et al. [12], Herzfeld et al. [13] Unnevehr [14]. However, to our knowledge, there is no study comparing the regulation objective between supporting producers or safeguarding consumers.

A thorough assessment of the policy between supporting producers and safeguarding consumers under Indonesian circumstances has not been performed before. Therefore, this paper is aiming to describe the food control and biosecurity policy in Indonesia with regards to the global value chain and its impact on global trade. First, the study analyzed the current regulations in food control and biosecurity in Indonesia. Second, the study analyzed and grouped the objective of the regulations between supporting producers and safeguarding consumers.

2 Methods
The study was designed based on a qualitative approach framework to examine the existing food control and biosecurity policy. The approach was used to give an overview of the explored policy. It gave insight into the current practices and stakeholders engagements. The data were collected from the available online regulation and extensive literature. We carried out three steps to perform the analysis. First, the literature on zoonotic diseases and pathogens were reviewed based on food production in the global value chain. The comprehensive literature review method was adapted and performed to examine the regulation [15]. The methods consist of several steps as follows: at first, the topics of food production were explored; continued by the search the topics based on food control and biosecurity; we stored and organized information based on the focus of study; continued by selection process; then, expanded search was performed to include more data; we analyzed and synthesized information based on the applied biosecurity strategies and practices by the government of Indonesia; and present the results. Second, a comparative analysis was employed to assess the regulation based on its impact on supporting producers or safeguarding consumers [16]. The comparison was used a side by side examination of two policy impacts to explain differences. The examination was based on criteria as follows: methods, policies, and procedures. This enabled us to interpret the data qualitatively and explained a possible causality between the differences. Finally, we linked details on the regulation of food control and biosecurity with regards its impact to producers and consumers to the value chain governance. The value chain typology according to Gereffi et al. [17] was employed to classified the degree of coordination in the global supply chain. The previous results were mapped and collated based on the value chain governance to match its impact on supporting producers or safeguarding consumers.
3 Results and Discussion
The results show that there were two types of control in Indonesia’s food value chain that follows the governance structure: biosecurity controls for food production and food control for food processing and retailing. The table 1 shows that the level of source of food problem existence was related to the implementation of biosecurity controls and food control in the value chain governance. A higher level of control was leading to a lower food problem existence. The food problem existence was related to the level of one health problem for each of the governance structure.

Table 1. Source of food production problem related to the control measure in governance structures in Indonesia’s food system

| Subject | Governance structure |
|---------|----------------------|
| • Market orientation | Market | Modular | Relational | Captive | Hierarchy |
| | Traditional channel | Modern channel | Modern channel and Export | Modern channel and Export | Modern channel and Export |
| • Source of problem | | | | | |
| o Zoonotic disease risk | High | Medium to high | Medium to low | Medium to low | Low |
| o Pathogen risk | High | Medium to high | Medium to low | Medium to low | Low |
| • Control Measure | | | | | |
| o Food control | Low | Medium to high | Medium to high | Medium to high | High |
| o Biosecurity | Low | Medium to high | Medium to high | Medium to high | High |
| • One health Problem | High | Medium to high | Medium to low | Medium to low | Low |

Table 2 shows that biosecurity controls and food control inherently designed to support the food value chain. The implementation of these controls was varied between each governance structure. The regulatory regime was applied following the level of coordination in the value chain governance. Since the market governance had the lowest coordination between actors, they had the lowest regulatory regime application. The modular governance had a slightly higher level than the market governance. They applied slightly better food control in the processing chain. The relational and the captive governance applied a better regulatory regime from farms to retailers than the two previous governance. Hence, the hierarchy governance had the highest level of a regulatory regime that implemented in their coordination and transaction.

Biosecurity control for food production was mostly applied to the farms level. As at this level, the farmers produced live animals or fresh vegetables, fruits and/ or plants that can be exposed to a disease or can become a carrier of a disease. In some producers or manufactures, the biosecurity was applied before entering the factory. In the receiving area for live animals or fresh vegetables, fruits and/ or plants, the producers set up protocols to apply the biosecurity. In the next process, the biosecurity was integrated with food control. The biosecurity application was found lower in the value chain governance that had low-level coordination and more higher and intense in a more coordinated chain.
Table 2. Regulation regimes and its implementation in governance structures in Indonesia’s food system

| Chain Actors            | Type of control | Governance structure |
|-------------------------|-----------------|----------------------|
|                         |                | Market   | Modular   | Relational | Captive   | Hierarchy |
| End user/consumer       | Food control   | Low      | Low       | Low        | Low       | Low       |
| Retailer                | Food control   | Low      | Medium to low | High to medium | High to medium | High       |
| Wholesaler              | Food control   | Low      | Medium to low | High to medium | High to medium | High       |
| Producer                | Biosecurity/food control | Low | Medium to low | High to medium | High to medium | High       |
| Supplier/farms          | Biosecurity    | Low      | Low       | Medium to low | High to medium | High       |

Table 2 shows that food control regulation was dominating the regulatory regime. It was applied from producers to consumers with different level of implementation for each value chain governance. Food control mostly applied in the producer level, then the longer chain existed in the producer level will imply the higher application of food control.

Table 2 indicates that there was an improvement in the regulation and its application that follows the level of complex codification that exists in the governance structure for each actor except the consumers. In the market governance, there was no codification in the value chain transaction. Thus, there was no incentive to force the actors to follow any regulatory regime. In a more coordinated chain, we found that a level of complex codify transaction due to processing requirement or market demand drives the level of implementation. It was ranging from medium to low and medium to high. For instance, the modular governance had applied a medium to a low regulatory regime that follows their level of codify transaction. The application was medium to high in the relational and captive, since they had a more complex codify transaction. Hence, the hierarchy governance had the highest level of regulatory regime due to their highest level of codification.

Table 3 shows that the international regimes drove awareness in the governance structure. Even the traditional channel had a higher market share than the modern channel and export, the governance structures were influenced by international food control and biosecurity regime. The market governance that operated in the traditional market was regulated under a local regulatory regime that adapted the international food control and biosecurity at the minimal level. The similar situation existed for the modular governance. The awareness level was higher in the governance structure that targeting the export market due to the market requirement, such as relational, captive and hierarchy. Every international issue and regulation in food safety was responded faster in these governances to follow their market orientation.

Table 3. Regulation regimes and its relation to the market in governance structures in Indonesia’s food system

| Subject          | Governance structure |
|------------------|----------------------|
| Market orientation | Traditional channel   | Modern channel and Export | Modern channel and Export | Modern channel and Export |
|                  | Market Share (%)      | 60-70                      | 30-40                        |
| Regulation objective | Local production support | Local production support | Export                        | Export                        |
| Regulatory       | Local                 | Local                       | International                  | International                  |
The findings show that technical capacity in the governance structures varied following their market orientation. As illustrated in Table 2, the market and modular governance applied a technical assessment that was mandatory under a local regulatory regime such as NKV, CBIB and GAP. It had more complex technical assessments for the relational, captive and hierarchy governances due to their market demand. More complex technical assessments were applied following the international regime that not only focuses on food control and biosecurity, but also sustainable development such as fair trade and sustainable certification such as RSPO.

These results show that the policy dynamic in the global trade built the regulatory regime in Indonesia’s food value chain. The policy for the local market was focused on an objective to support the local production. Differently, the global trade had influence in the governance structure that aims the international market, since the policymaker made regulations with an objective to support export capacity. The global trade dynamic had a higher influence in the relational, captive and hierarchy governances.

Table 3 shows that the policy in Indonesia concerned more to support producers competitiveness in global trade. The technical assessment such as ISO, HACCP, Fair trade, Sustainable certification focused on the production traceability and labeling. These technical assessments were the basis to enter the export market. The assessments were demanded to fulfill the purchase order and to guarantee the product can be accepted by quarantine authority in the inspection process at the country of destination. This situation proved that safeguarding consumers had less attention in the regulatory regime. Limited attention to protect consumers was made in the regulation in HACCP. While other assessments were employed to fulfill the market entry barrier.

In this study, our approach was limited by its methods. We implemented a comprehensive literature study as a framework to assess the different actors, given the complexity of food production and its value chains. Although a survey would allow for a more detailed quantitative validation, our goal was to offer a qualitative view of the food control and biosecurity policy in the value chain governance. Hence, resource restraints to fulfill extensive informant-based data collection. Therefore, a comprehensive literature study is justified for this study. As a consequence to compete in the global market, the food industry stakeholders need to be coordinated by the government to have their action in a sustainable consumption and production manner [18]. Therefore understanding the food system and the value chain governance is benefitting the government to establish a strategy to compete in the global market. In this case, the findings justified the complexity of food production follows the degree of transaction and coordination, it also shows how the food systems become complicated for each governance structure. Therefore, the value chain governance and its structure have an impact on the design of regulation. The evolving governance due to the evolving degree of codify transaction was supported by biosecurity and food control that decreased the risk of food safety [11]. This means the regulation was made based on the knowledge of the food system [9,10]. The food value chain in a less coordinated chain implements a local regulatory regime. While, the food value chain in a more coordinated governance is often operated as a complex food system with a complex requirement under the objective to enter the international market. The complex requirement is related to the biological and chemical safety that requires biosecurity and food control to guarantee the sustainable
consumption and production [12]. This requirement is regulated as the sanitary and phytosanitary (SPS) in countries of destination.

The findings highlight that market orientation influences the regulation design [19]. As an export market is the main cause of food regulatory regime, international standards are the main influencer for the policy maker in designing local food safety standard and control as well as SPS. To our knowledge, SPS is having a higher standard for the international market and it is applied to every product that enters the global market. Previous studies claim that many international regulatory regimes were found as a barrier to entry for the product from developing countries [12,20]. The regulation was not based on scientific finding to protect consumers in the developed countries, therefore the product will be less competitive in the international market [12,20,21]. The implementation of SPS as an import barrier is less obvious than tariffs [22]. Many private food quality standards that are applied by the producers in the developing countries to enter the global market are considered as an additional trade barrier [13]. It is supported by the fact that many of the developing countries have a lack of awareness for food standards and quality to take part in global trade [23].

Similar like other developing countries, the study found that the Government of Indonesia objective in SPS and food safety regulations design is by aiming to support producers’ competitiveness to compete in the global market [8,14]. The government endorses the involvement of many private food quality standards to increase awareness and knowledge adoption of the producers. It has an influence on the corporate investment which is driven to improve food quality standard for entering the global value chain [22]. This means the corporate investment by introducing strict standards, such as third-party certifications [24] in their chain governance should be guaranteed the key product attribute in food products such as freshness is applied [25]. This investment is to overcome the potential barriers that exist via Western European supermarkets for producers in developing countries to establish new markets [13]. Such investments that have become more common in recent years vary in the institutional framework and enforcement mechanisms in relation to the forms of value chain governance [24]. On the other hand, protecting consumers is becoming an important issue. FAO in 2014 stated that many people die caused by contamination of food and water [26]. Foodborne diseases create a public health problem in many countries. Hazards such as microbial pathogens; zoonotic diseases; parasites; adulterants; mycotoxins; antibiotic drug residues; pesticide residues; and heavy metals is raising a food borne issue [14]. It raises not only food safety awareness and knowledge but also the issue of one health. Thinking about human health needs to consider the health of animal and plants as the source of food production. However, there are many challenges to protect consumers in policy design. For instance, there are uncertainties and difficulties in attributing illness to specific food sources that lead to uncertainties about the benefits for any specific regulation [27]. Since, it is quite a challenge to identify each of the potential hazards that comes from different sources with different kinds of health risks [14]. Therefore, it is difficult for the Government of Indonesia to consider uncertainties from the food-pathogen combination in their regulation. Moreover, many of the producers are small medium enterprises that have a limited knowledge of food safety and emerging disease. However, food control and biosecurity regulation that moving beyond export objective are needed to be considered [14]. Therefore, the most promising application of safeguarding consumers remains in priority setting by the government.

Safeguarding consumers means defining the Appropriate Level of Protection (ALOP) in food safety law [28]. Defining which level is “appropriate” according to the consumers’ demands may be different between countries that follow different levels of tolerance for risk. The government of Indonesia needs to improve their management to design an effective risk assessment for ALOP according to the needs of public health objective [28]. Since the awareness of food safety is low, therefore the “top-down” approach gives an appropriate policy formulation for a public health goal in Indonesia [28].

In the process of regulation design, ALOP will create more interactions and interdependencies between the public and the government to find solutions in protecting consumers [7]. The product of the interaction between social actors and the government includes the enforcement of compliance control via food safety regulations. Food producers should be able to determine their performance
objective based on ALOP to protect the consumers. This will be done by the sole objective that the proposed ALOP would have required a high level of consumer safety based on the scientific requirement [7].

Since there are no clear boundaries between supporting the producers and safeguarding the consumers, one way out is to balance the objective in the regulation setting. The main goal of balancing policy is protecting the future using one health perspective. One health could be the balancing agent between these two objectives: supporting the producers and safeguarding the consumers. In order to balance the objectives, one health perspective requires the role of multi-stakeholders in policy setting and its implementation [29]. Collaboration and interdisciplinary partnerships across sectors in the food value chain are important for managing food control and biosecurity to avoid the problem from zoonotic diseases, and emerging pathogens for greatest public health concern [30]. Multi-sectoral approaches under one health lead to an efficient policy that regulates the utilization of limited resources [31]. It can be reached if the perspective of one health was internalized in the value chain governance.

In one health perspective, the value chain approach gives a framework for food control and biosecurity related to the actor behavior in each chain governance [32]. Value chain approach gives information about actors’ relative influence towards others’ decision-making [11]. Even though the value creation is the central driver of a transaction, it can give an incentive to the diverse goals in each chain governance such as food safety, animal health and public health. Thus, such an incentive could be scaled up following the type of chain governance. Therefore, by combining the diverse goals as one health, it can lead to the process of designing a set of a comprehensive regulation that has a balanced objective between supporting producers and safeguarding consumers.

4 Conclusion
An extensive assessment of the policy between supporting producers and safeguarding consumers showed that the food control and biosecurity policy in Indonesia differed in five different chain governance. These regulatory regimes in each chain governance differ in food control and biosecurity that applied in Indonesia. The objective of the regulations in Indonesia designed to support producers in the global market competition rather than safeguarding consumers. This paper concluded that a more balanced policy is needed to implement food control and biosecurity in the global value chain. One health that was considered as the balancing agent requires the involvement of multi-stakeholders across sectors in the food value chain. This perspective is important to control zoonotic diseases, and emerging pathogens in the global value chain to protect public health.

References
[1] Cutler SJ, Fooks AR, van der Poel WHM (2010) Public health threat of new, reemerging, and neglected zoonoses in the industrialized world. Emerging infectious diseases 16: 1-7.
[2] Robinson TP, Bu DP, Carrique-Mas J, Fèvre EM, Gilbert M, et al. (2016) Antibiotic resistance is the quintessential One Health issue. Transactions of The Royal Society of Tropical Medicine and Hygiene 110: 377-380.
[3] Cascio A, Bosilkovski M, Rodriguez-Morales AJ, Pappas G (2011) The socio-ecology of zoonotic infections. Clinical Microbiology and Infection 17: 336-342.
[4] Lee J, Gereffi G, Beauvais J (2012) Global value chains and agrifood standards: challenges and possibilities for smallholders in developing countries. Proceedings of the National Academy of Sciences of the United States of America 109: 12326-12331.
[5] Maestre M, Poole N, Henson S (2017) Assessing food value chain pathways, linkages and impacts for better nutrition of vulnerable groups. Food Policy 68: 31-39.
[6] HAVINGA T (2006) Private Regulation of Food Safety by Supermarkets. Law & Policy 28: 515-533.
[7] Wahidin D (2018) Strengthening the food safety control scheme in Indonesia through WTO law and food safety science: Wageningen University.
[8] Wahidin D, Purnhagen K (2018) Improving the level of food safety and market access in developing countries. Heliyon 4: e00683.

[9] Kiambi S, Alarcon P, Rushton J, Murungi MK, Muinde P, et al. (2018) Mapping Nairobi's dairy food system: An essential analysis for policy, industry and research. Agricultural systems 167: 47-60.

[10] Alarcon P, Fèvre EM, Murungi MK, Muinde P, Akoko J, et al. (2017) Mapping of beef, sheep and goat food systems in Nairobi - A framework for policy making and the identification of structural vulnerabilities and deficiencies. Agricultural systems 152: 1-17.

[11] Indrawan D, Rich KM, van Horne P, Daryanto A, Hogeveen H (2018) Linking Supply Chain Governance and Biosecurity in the Context of HPAI Control in Western Java: A Value Chain Perspective. Frontiers in veterinary science 5: 94-94.

[12] Rahmat S, Cheong CB, Hamid MSRB A (2016) Challenges of Developing Countries in Complying Quality and Enhancing Standards in Food Industries. Procedia - Social and Behavioral Sciences 224: 445-451.

[13] Herzfeld T, Drescher LS, Grebitus C (2011) Cross-national adoption of private food quality standards. Food Policy 36: 401-411.

[14] Unnevehr L (2015) Food safety in developing countries: Moving beyond exports. Global Food Security 4: 24-29.

[15] O'Connor A, Anderson K, Goodell C, Sargeant J (2014) Conducting systematic reviews of intervention questions I: writing the review protocol, formulating the question and searching the literature. Zoonoses and public health 61: 28-38.

[16] Rihoux B, Ragin CC (2008) Configurational comparative methods: Qualitative comparative analysis (QCA) and related techniques: Sage Publications.

[17] Gereffi G, Humphrey J, Sturgeon T (2005) The governance of global value chains. Review of international political economy 12: 78-104.

[18] Govindan K (2018) Sustainable consumption and production in the food supply chain: A conceptual framework. International Journal of Production Economics 195: 419-431.

[19] Grunert KG, Fruensgaard Jeppesen L, Risom Jespersen K, Sonne AM, Hansen K, et al. (2005) Market orientation of value chains: A conceptual framework based on four case studies from the food industry. European Journal of Marketing 39: 428-455.

[20] Lamuka P (2014) Public health measures: challenges of developing countries in management of food safety.

[21] Nugroho A (2014) The Impact of Food Safety Standard on Indonesia's Coffee Exports. Procedia Environmental Sciences 20: 425-433.

[22] Jongwanich J (2009) The impact of food safety standards on processed food exports from developing countries. Food Policy 34: 447-457.

[23] Henson S, Loader R (2001) Barriers to Agricultural Exports from Developing Countries: The Role of Sanitary and Phytosanitary Requirements. World Development 29: 85-102.

[24] Rueda X, Garrett RD, Lambin EF (2017) Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry. Journal of Cleaner Production 142: 2480-2492.

[25] Indrawan D, Tacken G, Hogeveen H (2018) What drives the choice of poultry market channel and the change of purchase behavior due to highly pathogenic avian influenza outbreaks? Poultry Science 97: 3652-3660.

[26] Asiegbu CV, Lebelo SL, Tabit FT (2016) The food safety knowledge and microbial hazards awareness of consumers of ready-to-eat street-vended food. Food Control 60: 422-429.

[27] Unnevehr L, Hoffmann V (2015) Food safety management and regulation: International experiences and lessons for China. Journal of Integrative Agriculture 14: 2218-2230.

[28] Wahidin D, Purnhagen KP (2017) Determining a Science-based Food Safety Objective/Appropriate Level of Protection for Application in Developing Countries. European Journal of Risk Regulation 8: 403-413.

[29] Belay ED, Kile JC, Hall AJ, Barton-Behravesh C, Parsons MB, et al. (2017) Zoonotic Disease Programs for Enhancing Global Health Security. Emerging infectious diseases 23: S65-S70.
[30] Gronvall G, Boddie C, Knutsson R, Colby M (2014) One health security: an important component of the global health security agenda. Biosecurity and bioterrorism: biodefense strategy, practice, and science 12: 221-224.

[31] Leibler JH, Dalton K, Pekosz A, Gray GC, Silbergeld EK (2017) Epizootics in Industrial Livestock Production: Preventable Gaps in Biosecurity and Biocontainment. Zoonoses and Public Health 64: 137-145.

[32] Antoine-Moussiaux N, Peyre M, Bonnet P, Bebay C, Bengoumi M, et al. (2017) The Value Chain Approach in One Health: Conceptual Framing and Focus on Present Applications and Challenges. Frontiers in Veterinary Science 4.