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European Exports of Poultry and Milk Products to Ghana and Senegal: A Blessing or a Curse?

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1 Introduction

This paper focuses on the impact of German and European exports of livestock products on the agri-food sectors in Ghana and Senegal. It summarizes the concept and the previous findings of the IMMPEX “Impact of Meat and Milk Product Exports on Developing Countries” project.

Like many other African countries, Ghana and Senegal import large quantities of meat and dairy products from overseas. As this trend rises, together with critical discussions about the consequences for local producers and food security, the role of exports from Europe to African countries has become an intensively discussed topic. It is often argued that imported products are lowering or impeding domestic production due to increased competition in Africa. In this context, the EU agricultural and trade policies are often criticized. We aim to develop and evaluate measures to avoid or reduce the undesirable effects of these exports. In the group of livestock products, we focus on poultry meat and milk products. We investigate the above-mentioned issues in the areas of politics, trade, production technology, value chains, and consumer preferences. So far, studies can be found in literature that considers one or two of these issues. As far as we know, no comprehensive study covering the upstream industry, the producers, the consumers as well as agricultural and trade policies is yet available.

In our project we first of all investigate the trade flows of poultry meat and milk from Germany to the project countries Ghana and Senegal. For this purpose, we prepare the necessary data and analyse them with regard to the developments of production and consumption. In addition, the existing agricultural and trade policies in Ghana and Senegal are described. Secondly, we present collected data of typical production systems and farms for the production of poultry meat and milk in Ghana and Senegal. This includes physical and economic performance, profitability, and competitiveness in the international context. The methods and tools of the global network Agri benchmark are applied for this analysis. Additionally, we analyse local value chains. The main focus is on organization and infrastructure as well as marketing channels and value generation of local and imported products. Since there is limited information on this subject in existing literature, we collect the necessary information through qualitative surveys on-site. The third part of the project focuses on consumers in Ghana and Senegal - especially their attitudes and preferences with regard to domestic and imported meat and dairy products. Here, we conduct focus group discussions, one-to-one interviews, and consumer surveys. The collected data will be analysed using qualitative and quantitative methods. The fourth part shows that the institutional frameworks in Ghana and Senegal are of fundamental importance for trade and the resulting market effects. Therefore, we compare the different policy measures of the respective countries and subject them to impact analysis. Here, we examine the question of which measures are necessary to avoid or mitigate

possible undesired effects of exports. For this analysis, we combine various methods like Delphi-methods, partial and general equilibrium models.

This paper will provide the background for the following papers of the organized session and focus on the following key areas:

First, we describe how the countries and products for our case studies were selected. Here, an analysis of trade data shows that the import volume and market share of German or European livestock products for Ghana and Senegal is particularly high. In both countries, media and NGOs report problems with European imports. The reporting focuses especially on poultry meat imports in Ghana and milk product imports in Senegal. Additionally, the analysis of agricultural and trade policy measures encouraged us to choose these countries for our analysis. Here, for example, Ghana implements a tariff rate of 35% for poultry imports. In contrast to this, Senegal has completely banned poultry imports since 2006. Thus, the Senegalese poultry sector currently develops in a completely protected market. Finally, we used additional criteria like feasibility, existing contacts, data availability and accuracy as well as previous studies for the selection of our case studies. Secondly, we discuss the agricultural and trade policies of Ghana and Senegal and put the policy objectives of both countries in a broader context. Here, we identify synergies and conflicts between domestic agricultural and trade policies. Thirdly, we give an overview of the methodological framework. We present the methods that are applied in the project and how they are combined. More insights into the other methods applied in the project will be presented in the following papers of the session that concentrate on one or two methods each and add e.g. the consumer perspective to the research question. Finally, we summarize the first results available in our project.

2 Trade Data Analysis

Based on various criteria, we selected the poultry and dairy sectors of Ghana and Senegal for our research. An analysis of trade data shows for both countries that the import volume and market share of German or European livestock products are particularly high. For both countries, media and NGOs report problems with European imports. The reporting especially focuses on poultry meat imports in Ghana and milk product imports in Senegal. Moreover, the analysis of policy measures encouraged us to choose these countries for our research. Ghana, for instance, implements a tariff rate of 35% on poultry imports. In contrast to this, Senegal has completely banned poultry imports since 2006. Finally, we used additional criteria like feasibility, data availability and accuracy as well as previous studies to select our research countries.

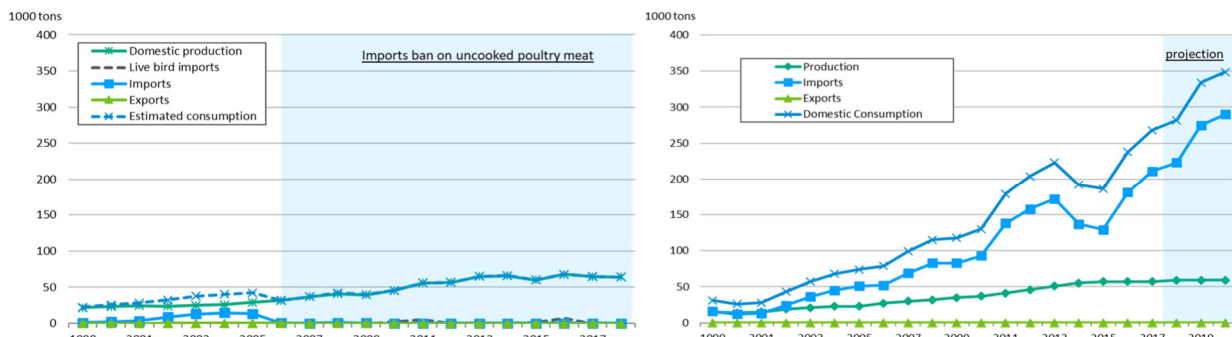
The EU is the main supplier of poultry meat to West Africa, ahead of the USA and Brazil. Among different types of poultry meat, frozen chicken cuts and frozen whole chicken accounted for 84% of the quantity of all poultry exports to West Africa in 2017. According to the United Nations trade statistics, poultry meat exports of the Netherlands and Belgium make up nearly half of the quantity of all EU poultry meat exports to West Africa.

Germany exported 8 thousand tonnes of poultry meat to West Africa in 2017. Ghana and Benin are the main importers of German poultry meat. However, the lion's share of Benin's poultry meat imports is formally and informally diverted to neighbouring countries such as Nigeria. Additionally, Germany exports 547 thousand tonnes of live fowls to the Netherlands for slaughtering. Mainly boneless parts and whole chicken are re-exported from the Netherlands to Germany. It is likely that the remaining parts, including legs and wings, are being exported as Dutch exports to West Africa.

Total imports in Ghana accounted for 78.7% of the Ghanaian poultry meat consumption in 2017. The share of imports in domestic consumption of poultry meat in Ghana has increased sharply during the last decade. While domestic production has increased by 118%, imports rose to a much higher degree from 2006 to 2018 (Figure 1). In this way, the self-sufficiency rate has fallen steadily from 34% in 2006 to 21% in 2018.

We found an opposite pattern in Senegal. Since 2006, Senegal implements an import ban on uncooked poultry meat. As a consequence, the self-sufficiency rate in the poultry meat market has reached almost 100% since then. In the protected market in Senegal, growth took place in the last decade. Between 2006 and 2018, domestic production increased by 103% which is slightly lower than in Ghana in the same period.

Figure 1: Development of the Poultry Meat Sector in Senegal (left) and Ghana (right)



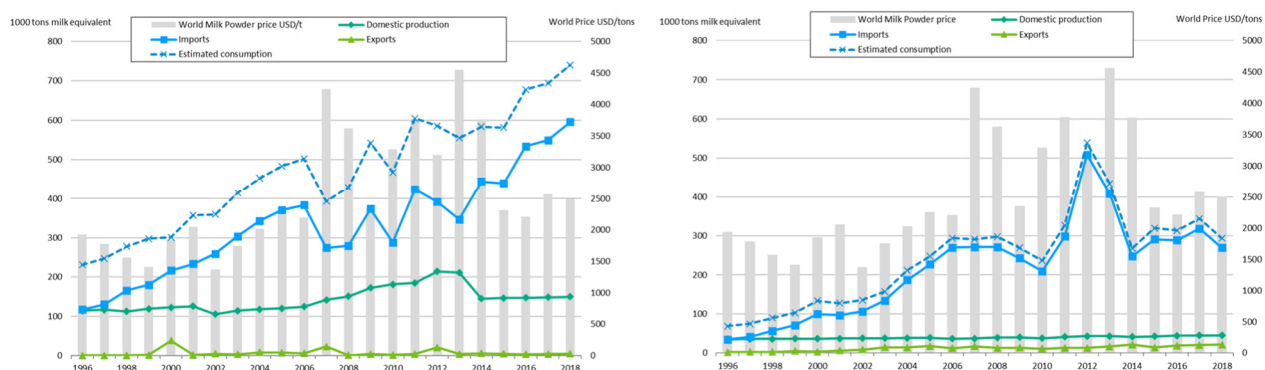
Source: Zamani et al. (2021)

Due to its rising population and consumption, milk and dairy products are becoming increasingly important in West Africa. Official statistics highlight that over 65% (equal to 1,078 million USD) of West Africa's dairy imports originated from the EU in 2017. Among dairy products, milk powder and full-fat milk make up the lion's share of the total dairy exports from the EU to West Africa. They accounted for 73% (equal to 884 million USD) of all dairy exports in 2017.

Nigeria, Senegal, and Ghana were the largest importers of German dairy products (excluding milk powder and full-fat milk), with USD 3.9, 2.2 and 2.2 million, respectively (UN Comtrade, 2017). Total dairy imports of Senegal amounted up to USD 240 million (equal to 550 million tons milk equivalent) in 2017, out of which 85% was milk powder and full-fat milk by value (UN Comtrade database, 2017). The significant increase in imports was mainly driven by rising domestic consumption. The milk equivalent consumption per capita almost doubled from 25.9 to 47.7 kg

milk equivalent from 1996 to 2018. Based on our estimation, the self-sufficiency rate in the dairy sector of Senegal decreased steadily until 2018 (Figure 2). Data of more than two decades show for both countries a strong increase on the import side and no growth in the area of domestic milk production. However, a country comparison shows that local milk production is more important in Senegal and starts from a higher level than in Ghana, where domestic production is marginal (Zamani et al. 2022b).

Figure 2: Development of the Dairy Sector in Senegal (left) and Ghana (right) in 1000 tonnes milk equivalent



Source: Zamani et al. (2021)

3 Agricultural and Trade Policies

3.1 Dairy and Poultry Policies in Ghana

Since its independence in 1957, Ghana has implemented various policies aimed at supporting the poultry sector. These policies can be generally categorized into poultry trade policies and non-trade-related poultry policies. The poultry trade policies have mainly aimed to limit poultry meat imports (tariffs) and also protect the domestic poultry sector against Avian Influenza (partial bans). While the non-trade-related poultry policies have aimed to increase domestic production of poultry meat. In this section, we explore the two categories of policies that have been implemented since 1998.

3.1.1 Poultry Trade Policies

The Ghanaian government has extensively intervened in the trade of poultry products since the 90s. In 1998, a 12.5% VAT was added to the duty inclusive value of all imports in Ghana (Yahuza 2008). Ghana's parliament raised the poultry tariff in reaction to the growing level of imports in the 1990s. Import tariffs on poultry meat were initially implemented at a rate of 20% in 1999 with the proposal that "all veterinary drugs and ingredients for the manufacture of poultry feed be exempt from import duty" (Sumberg et al. 2017). However, this policy was not sustained as the government over the years revised it downwards to 10% and later scrapped it totally in 2002 with the adoption of a policy on trade liberalization. Later, in 2003, the Government of Ghana re-

introduced an import tariff rate set at 40 percent after the parliament passed what was called Act 641 in April 2003 from its previous level of 20 percent (Sumberg et al. 2017). This action was in response to mounting pressure from poultry farmers who considered imported chicken as a threat to their business (Johnson 2011). Nevertheless, the International Monetary Fund (IMF) and the World Bank through the WTO's trade liberalization agreement with Ghana stepped in leading to the revocation of the policy barely two months after it was enacted (Naggujja et al., 2020). The tariff rate was lowered back to 20 percent. Consequently, imports of frozen chicken cuts to Ghana continued under the liberalized agreement leading to the influx of cheap frozen cuts.

The Ghanaian government has also imposed short-term partial poultry import bans. For instance, in response to the Avian Influenza outbreak in 2006, the government placed a partial ban on poultry product imports from countries that had reported outbreaks (Akunzule et al. 2009). More recently, in 2020, the government also imposed a partial ban on poultry product imports from countries that reported outbreaks of Avian Influenza. The countries included the Netherlands, Germany, Russia, Denmark, and the United Kingdom (Zamani et al. 2022a). In both cases, the key objective of the partial bans was to protect the domestic poultry sector from Avian Influenza. Therefore, they were subsequently lifted when the threat of Avian Influenza outbreaks decreased.

The implementation of Ghana's trade agenda has generally been consistent with the Economic Community of West African States (ECOWAS), WTO regulations, and Ghana's long-term vision. Being a member of the ECOWAS, the government of Ghana adopted the 20% Common External Tariff (CET) rate in 2005. However, this did not lead either to an increase in domestic production or to a decline in poultry imports. In 2015, Ghana fully implemented ECOWAS CET, in which the tariff rate of poultry meat was revised upwards to 35 percent (Naggujja et al., 2020). Although the member states of ECOWAS should bound their tariffs at the levels identified by WTO, the bound tariffs of Ghana (99%) are typically higher than ECOWAS CET. The most recent trade policy is related to a bilateral interim Economic Partnership Agreement (iEPA) with the EU according to which Ghana will gradually remove its import duties for 78% of EU exports in the period from 2020 to 2029. Based on Ghana's iEPA, poultry meat is a sensitive product being excluded from liberalization (Zamani et al. 2022).

3.1.2 Domestic Poultry Policies

The Ghanaian government has implemented a wide range of domestic poultry policies that aim to boost local production. The policies include programs combating poultry diseases, subsidies to feed production, training and extension programs, and the distribution of day-old chicks. Sumberg et al (2017) argue that among these policies, combating poultry diseases has been the only consistent poultry policy that has been pursued by the Ghanaian government. More specifically, the government has consistently conducted mass vaccination campaigns, supported the local production of vaccines and disease surveillance (Sumberg et al. 2017). However, it is important to note that these programs aimed at combatting poultry diseases have primarily benefitted backyard producers who typically did not have access to vaccines.

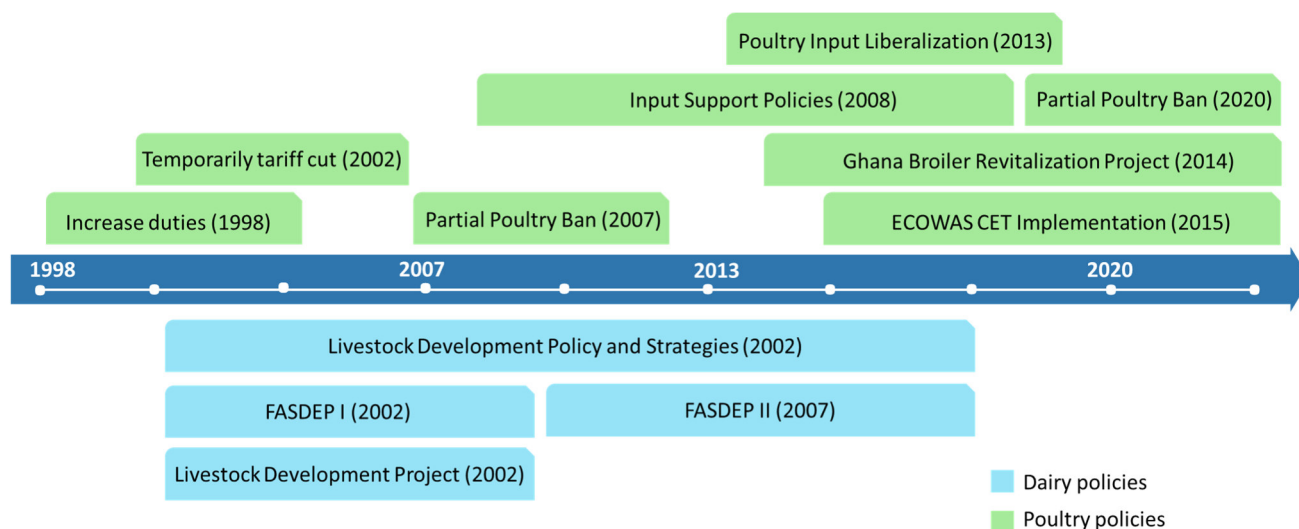
High feed costs are another key challenge facing the poultry sector. The country's inability to produce a consistent surplus of maize, which is a primary ingredient for poultry feed, has been frequently cited as a key constraint to the development of the poultry sector in Ghana (Sumberg et al. 2017). To address this issue, several initiatives have been implemented since 2007-2008. More specifically, the Ghanaian government introduced agricultural input support policies by investing an average of GHS 7.9 million annually from 2007 to 2008 (Benin, 2019). The input support policies include three main programs; Fertilizer Subsidy Program (in 2007-2008), Block Farms Program (in 2009), and the National Food Buffer Stock Program (in 2010). These policy schemes generally affected the livestock sector by improving the yield of domestic maize production through different policy instruments, including a guaranteed ceiling price (the National Food Buffer Stock Program), modern technologies and extension service provisions (Block Farms Program), and fertilizer subsidy (Fertilizer Subsidy Program). The empirical evidence implies that these interventions have improved the average maize yield, alleviating poverty, farmers' productivity, and incomes in the covered farms (Benin et al. 2013; Donkoh et al., 2016; Abokyi et al. 2019). However, they may lead to domestic price reduction through positive supply shifts in the long run (Benin et al. 2013). Despite numerous initiatives, there is a long-standing concern regarding the seasonality of white maize production and the lack of a significant surplus after the demand for human consumption has been met (Sumberg et al. 2017). From 2013 to 2019, the government launched four policies to support local poultry producers. In 2013, the Ghanaian government removed the customs duties on the main inputs of poultry products such as feed, drugs, and vaccines (Netherlands Enterprise Agency, 2019). Further in 2014, the Ghana Broiler Revitalization Project (GHABROP) was launched to regulate imports of meat products aimed at protecting domestic broiler production in ten years (FAO, 2015). Under this policy, the imports of poultry meat were limited to 60 percent, and the importers were committed to buying 40 percent of their products from local producers. Although this project has not significantly affected the sector, the chicken meat imports were reduced in 2015 and 2016 (Netherlands Enterprise Agency, 2019). Additionally, the Ministry of Food and Agriculture is supposed to produce 20-million-day-old chicks in a five-year collaboration with the Ghana National Association of Poultry Farmers (Acheampong, 2019). Although the expected promises cannot be seen in the import trend (Figure 1), there is a slight short-run change in the imports which might be explained by these policies. Moreover, the "Planting for Food and Jobs (PFJ)" program was launched by the government in 2017, aimed at improving food security and producing intermediate inputs to feed the agro-processing industries while creating jobs in the process. Further, in 2019, the government launched the "Rearing for Food and Jobs" campaign aimed at boosting domestic production, creating job and poultry imports reduction through infrastructure improvement. According to this program, farmers will be provided with the required inputs to produce more feed for the poultry industry (Netherlands Enterprise Agency, 2019).

Due to the high-risk nature of poultry farming, many commercial banks hesitated to give loans to operators in the industry, while the high cost of poultry feed also made the business too expensive to operate. Ghana has now transformed from a major producer to an importer of chicken and chicken products, including eggs. There is a lack of clear domestic policy regulation regarding

domestic poultry production (Sumberg et al., 2017). Additionally, policies are difficult to implement because of vested interest by various power players (Kusi, L.Y., Asabre, P., Kosi, I., Nyarku, 2015).

Figure 3 shows a timeline of policy interventions explained in the previous sections. Looking at the trend of poultry sector policies in Ghana, a set of protection policies have been implemented since the late 90s.

Figure 3: Timeline of poultry and dairy policies in Ghana



Source: own elaboration

3.1.3 Dairy Trade Policies

Although several policies were formulated to promote the performance of the Ghanaian livestock sector, most of the interventions were directed at the poultry sub-sector. As shown in Figure 3, the policies in the dairy sub-sector have been minor over the years. Similar to the poultry market, dairy trade policies are subject to ECOWAS, WTO, and Ghana's development plans. According to ECOWAS CET, imports of fluid milk, milk powder, and full-fat milk are taxed at various rates, from 5% (mainly for powdered milk) to 20% (mainly for fluid milk and processed milk products). This may encourage imports of dairy products into the country. In contrast to the poultry sector, dairy products are supposed to be liberalized according to the interim EPA¹.

3.1.4 Domestic Dairy Policies

Since 2002, the implementation of the dairy policies was majorly based on a roadmap specified in the Ghana Livestock Development Policy and Strategy, which has two main objectives: First, to enhance the supply of meat, livestock, and dairy products from domestic sources, innovation,

¹ For Interim EPA see the previous section or Zamani et al. (2021).

generation and utilization, capacity and entrepreneurship skills of livestock value chain actors. Second, to enhance access to livestock markets, services and value addition (MoFA 2016). This policy set is defined under the first and second Food and Agriculture Sector Development Policy (FASDEP I and II) which were formulated as a policy framework to guide development and interventions in the Ghanaian agricultural sector (MoFA 2007; FAO 2015). The first Food and Agriculture Sector Development Policy (FASDEP I) was developed in 2002 with a focus on strengthening the private sector as the engine of growth. In line with this policy, the Livestock Development Project (2002-2008) was launched with the aim of increasing milk production from 1.5 liters to a minimum of 10 liters per cow per day and an average of 25% increase in the cattle, goats, and sheep selling weight from 2002 to 2008 (African Development Fund 2001). During the implementation phase, a Poverty and Social Impact Analysis (PSIA) was conducted to assess the performance of the policy (FASDEP I) and the findings concluded that the policies would not achieve the desired goals. Therefore, in 2014, FASDEP I was revised resulting in FASDEP II to reflect the gaps.

The second Food and Agriculture Sector Development Policy (FASDEP II) focused on the sustainable utilization of all resources and commercialization of activities in the sector with market-driven growth in mind (MoFA, 2016). Under this policy scheme, the Livestock Development Policy and Strategies (LDPS) was intended to address issues on breed improvement, production and health management, processing, and marketing. Under this policy scheme, two general goals are identified that may directly affect the dairy sector including encouraging the private sector to take up milk production ventures; Educating producers, collectors, and vendors on hygienic milk handling (MoFA, 2016). The LDPS targeted a 30 to 80 percent aggregate domestic production of meat and dairy products, and a reduction in the incidence of poverty among farmers from 59 percent to 30 percent by the year 2015 (MoFA, 2016). However, the official document of MoFA (2016) reports that none of the policy objectives were achieved within the period of the program, which identifies the need to enhance the efficiency and effectiveness of interventions. Milk production, processing, and marketing activities in the dairy sector of Ghana remained underdeveloped during the span of these policies.

As demonstrated in Figure 2, milk production has not witnessed any meaningful growth in Ghana. Additionally, the market statistics illustrated in Figure 2 show a widening gap between domestic production and imports of dairy products over time. The major constraints of the dairy sector include unavailability of good quality and affordable feed, lack of improved breeds with high milk potential, inadequate veterinary services, poor infrastructure (housing, inaccessible roads to milk-producing areas, etc.), and lack of a cold chain for fresh milk (Oppong-Apene, 2016; GOG, 2014) have so far not been addressed by any of the aforementioned policies (MoFA, 2016). More importantly, the lack of feed and portable drinking water in the dry season which are considered the main barriers to milk production in Ghana, have still not been addressed in the policy packages (Boimah et al., 2021).

3.2 Dairy and Poultry Policies in Senegal

The public policies in Senegal are generally formulated to make the agricultural sector a driver for economic growth and improving farmers' livelihood (Demont and Rizzotto, 2012). After an expensive period of state intervention between the 1960s and 1980s, Senegal adopted the structural adjustment programs in agriculture (PASA) in the 1980s intended to remove too much state control in the agricultural sector. In this program privatization and market liberalization were the main components (Weissman, 1990; Birner and Resnick, 2010).

3.2.1 Trade Policies

Since 2006, Senegal has been experiencing a ban on the import of live poultry, edible poultry meat and offal, and poultry products to prevent Avian Influenza from entering the country and supporting local producers. This policy intervention has stimulated domestic production in the years following the import ban.

As in Ghana the ECOWAS CET was implemented in Senegal in 2015. For 115 tariff lines, including poultry products, Senegal applies custom duties exceeding the WTO-bound tariff (WTO, 2017). Senegal's bound tariff allows tariffs of the range between 15% to 30%, but the rate of ECOWAS CET for poultry meat is 35%. The ECOWAS member states are negotiating to find solutions for these inconsistencies (WTO, 2017). Nevertheless, this duty is currently not in application due to the existing import ban.

In the dairy sector, reduction of import dependency through increasing domestic production is a central objective for public interventions that are jointly implemented by the private sector (to carry out livestock vaccination), NGOs, and public projects (Dieye et al., 2005).

3.2.2 Domestic Policies

The policies in the dairy sector cover five thematic areas including institutional policies (e.g. organization of dairy industries, farmers' associations), access to natural resources (e.g. water and land), livestock development (e.g. genetic improvement), economic and trade policies such as tariffs and non-tariff barriers, subsidies and macroeconomics policies (Dieye et al., 2005; Seck et al., 2016).

Adopted in 2004, the Agriculture, Forestry, and Livestock Act (LOASP) represents an important institutional framework for reviving the agricultural sector of Senegal. Aiming at achieving food security and increasing the income sources of farmers, this law constitutes a legal framework for implementing the agricultural development plan in Senegal for the next 20 years (FAO, 2015). This law led to the implementation of several operational plans and projects, including the National Agricultural Development Program, the National Program for Livestock Development (PNDE), and the Grand Agricultural Offensive for Food and Abundance (GOANA). These programs are common

in identifying livestock among the priority sectors that significantly impact the achievement of the Millennium Development Goals (Diouf et al., 2016).

As part of the LOASP, the Ministry of Livestock launched the PNDE as a framework for the implementation of the interventions in the livestock sector (Seck et al., 2016). This plan specifically addresses animal husbandry. More specifically, it seeks to increase the productivity and competitiveness of animal value chains and to reach self-sufficiency in this market by 2026 (Seck et al., 2016; World Bank, 2020). The program became operational in 2013, and it covers five specific pillars namely; improving productivity, developing breeding systems, improving product marketing, and strengthening institutional structure (Seck et al., 2016; World Bank, 2020).

From 2000 to 2005, Senegalese dairy imports grew substantially from 23 to 42 billion CFA (35 to 64 million Euro) (Duteurtre, 2009). However, the 2007-2008 food price spike highlighted the high vulnerability of Senegal's food security to the international food price variations (Seck et al., 2016). As result, on one hand, several contingency policies were taken to control milk price including tax exemptions for powdered milk imports. On the other hand, to reduce Senegal's food dependency, the government implemented GOANA in 2008, which comprise technical elements like animal feed, cross-breeding, and artificial insemination, as well as trade-related policies such as tax exemptions for production inputs and the processing of local milk (Masangi et al., 2015; Demont and Rizzotto, 2012). Nevertheless, due to a lack of finance, only artificial insemination effectively became operational under the GOANA project which finances breeding and genetic improvement (Masangi et al., 2019). Further, the GOANA got replaced by the New Alliance for Food Security and Nutrition in 2012 (FAO, 2015).

In Senegal, as in most tropical countries, genetic improvement has always been the cornerstone of dairy policies. As indicated above, artificial insemination has been widely supported by successive national programs. Subsidized by the public sector, all dairy genetic improvement programs in Senegal² have been implemented at no cost to cattle keepers (Marshall et al., 2016). The main stakeholders of the genetic improvement program include the state, livestock professionals, public services, and private companies, including veterinarians, livestock engineers, and livestock technicians, and the dairy farmers are the main beneficiaries (Diouf et al., 2016).

In 1992, the Livestock Support Project (PAPEL) was launched to improve the production of milk and meat in the Groundnut and Sylvopastoral zones. This project was funded by the Government of Senegal with the support of the African Development Bank (AfDB). Under this project, around 5000 cows located in these production zones were inseminated during 1995 and 2005. The results showed an overall 43.4% pregnancy rate per artificial insemination recorded for the years 1995-1998. A higher pregnancy rate (73.6%) was obtained in 1996, and the lowest rate of 38.8 % was recorded in 1997. The decrease in the pregnancy rate in 1997 was most likely due to the shortage of forage in that year (Seck et al., 2016). The PAPEL project was followed by the Agricultural

² except two campaigns.

Development Project of Matam (PRODAM) in northern Senegal. Under this project also, 768 cows were inseminated in two phases (1996/1997 and 1998/1999) with an average success rate of 31% and 42% recorded for the first and second campaigns, respectively (Bouyer, 2006).

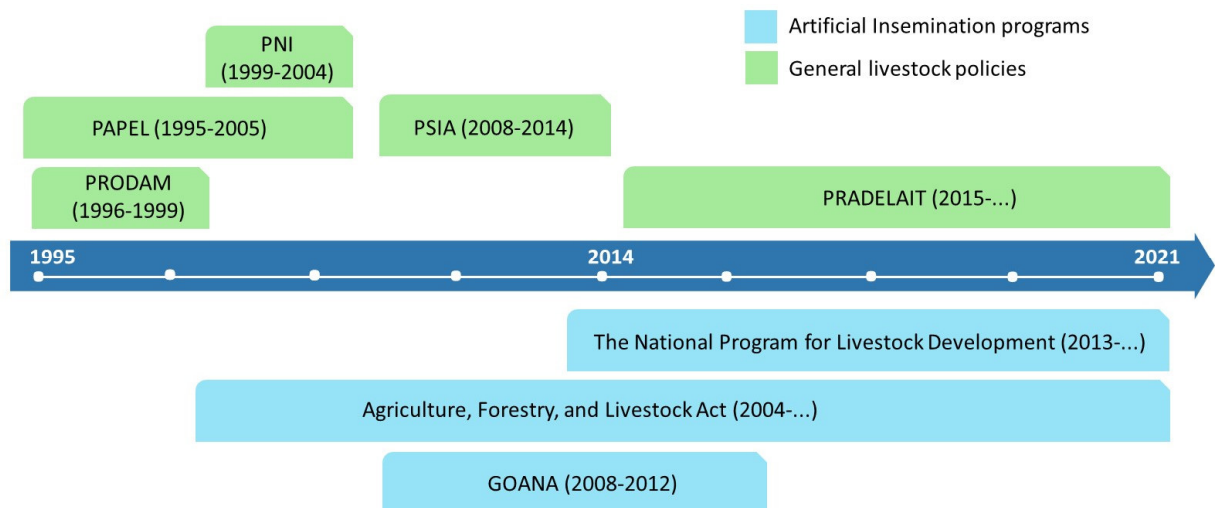
Again, as part of the national milk production development policy, three breeding campaigns were conducted under the national artificial insemination program (PNIA) in 1999, 2001, and 2004. This was done predominantly by private companies using protocols defined based on the specifications of agro-ecological zones. As a result, between 1999 to 2001, the overall insemination success rate enhanced from 31% to 42% (Masangi et al., 2021; Gueye, 2003). Although there was an increment in the success rate, feeding challenges, inadequate experience of artificial insemination technicians, and geographic dispersion of activities were identified as some of the significant barriers that negatively impacted AI programs. This impact can be observed in Figure 1, where the earlier insemination programs (including PAPEL and PNIA) resulted in little changes in domestic production from 1996 to 2004.

Later on, the GOANA program was implemented in 2008 to boost livestock production through the implementation of different genetic improvement initiatives (Cabral, 2016). The GOANA livestock project and the Special Artificial Insemination Program (PSIA) ran simultaneously as autonomous programs of genetic improvement from 2008 to 2014. The production objective of PSIA was to inseminate 500,000 cows by 2012 with the expectation of obtaining 100,000 cross-breed and additional milk production of up to 400 million liters. Under this program, 116,024 cows were inseminated with a success rate of 42.5% from 2008 to 2014 (MEPA, 2012 and 2014). It is as a result of this foresight that the Government of Senegal presented AI as the best technical option to rapidly increase national milk production and reduce imports. Due to some good progress by the government, the insemination programs were made to showcase the presidential commitment to modernity and which testifies to a growing "technicist" attitude in dairy development (Magnani, 2015: 143-158). The goal of the PSIA (2010-2011) insemination program was to inseminate 20,000 cows, out of which 19,209 were inseminated, representing 96% of the targeted population of cattle (Seck et al., 2016). However, the evaluation of PSIA highlights a reduction in pregnancy rate from 47.4% to 44.2% over the implementation period (Seck et al., 2016). Additionally, critics have expressed concern about the lack of effective monitoring of the project outcomes which are necessary for making the profitability evaluation of the project challenges.

In line with its vision and despite the challenges with PSIA, the government decided to continue the genetic improvement plan through the Dairy Industry Development Support Project (PRADELAIT - Projet d'Appui au Développement et à la Modernisation de la Filière Lait). This project was carried out within the framework of the 2014-2018 Emerging Senegalese Plan (PSE) with a budget of 30 million euros (Diouf et al., 2016). The PRADELAIT project shared similar aims with PSIA as it also seeks to improve milk production through the intensification and modernization of production systems. The goal of the project was to contribute to the creation of jobs, income generation and mitigate extreme poverty as well as improve food security, especially in rural areas. Finally, in June 2018, the "my milk is local" campaign was launched in several countries in West Africa by a coalition of organizations of professionals in the dairy sector, NGOs, and research

institutes. This advocacy was aimed at promoting the domestic consumption of milk in producer countries such as Burkina Faso, Mali, Mauritania, Niger, Ghana, and Senegal (GRET, 2019). Figure 4 shows the timelines of artificial insemination and livestock improvement projects implemented in Senegal.

Figure 4: Timeline of different artificial programs and livestock policies in Senegal (1995-2021)

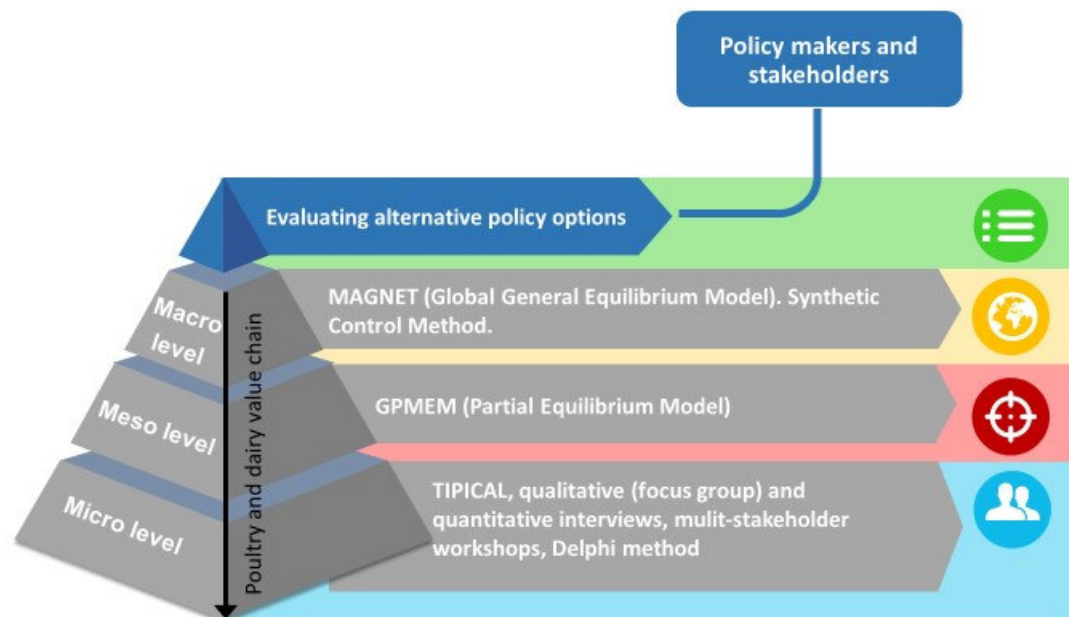


Source: own representation.

4 Methods

We use a holistic framework to analyse different factors at different levels in the dairy and poultry value chain of Ghana. The method framework incorporates different components including global general equilibrium model, partial equilibrium model, consumer survey, farm-level model and comparative analysis. The main advantage of our approach is to capture potential spill-over effects and interactions between various component of the value chains. Figure 5 presents the framework for policy analysis in our analysis.

Figure 5: Methods



Source: Own illustration.

4.1 Typical Farm Approach

The typical farm approach was used to construct, quantify and analyse typical broiler and dairy farms in Ghana, Senegal and Germany. The approach entails the construction of empirically grounded farm data sets for 'typical farms' through the use of semi-structured interviews and focus groups (Chibanda et al. 2020). The approach was implemented through a series of steps proposed by Chibanda et al. (2020). **Step 1:** Entailed the identification of the most important regions in terms of broiler and dairy production in Ghana, Senegal and Germany. This was done through a literature review and consulting local experts. **Step 2:** The most prevalent broiler and dairy production systems in Ghana, Senegal and Germany were identified through conducting a literature review, reviewing national statistics and consulting local experts. **Step 3:** Data was collected through semi-structured interviews and focus group discussions. Broiler and dairy farms with characteristics representing the identified production systems were visited and interviews were conducted with producers. A total of three broiler farms and three dairy farms were visited in Ghana and Senegal. Of which, each farm represented the identified production systems while in Germany, only one broiler farm that represents conventional broiler production was visited. Focus groups were then used in Ghana to construct typical farms through 'recalibrating' the individual farm data collected through the semi-structured interviews (Chibanda et al. 2022). A total of three focus groups were held, one for each of the three identified production systems. In Senegal and Germany, the individual farm data was recalibrated by cross-checking each value provided by the producers with the help of a poultry and dairy experts. **Step 4:** The Technology Impact Policy Impact Calculations

(TIPI-CAL), a computer-based policy impact assessment tool, was used to analyse the typical farm data.

4.2 Consumer Preferences

A mixed methods design was chosen to analyse consumer preferences of Ghanaian and Senegalese households regarding poultry meat and dairy involving the combination of qualitative (focus groups) and quantitative research (face-to-face interviews). The focus group discussions for poultry in Ghana involved 44 participants drawn from Accra in August/September 2017, while that for Senegal involved 38 participants for poultry and 36 for dairy from Dakar and Thiès in February/March 2020. Transcripts from the focus groups were analyzed using content analysis.

In addition, the quantitative survey among Ghanaian poultry consumers included a discrete choice experiment (DCE) and involved 500 respondents selected in March/April 2018 from Accra and Kumasi (Asante-Addo und Weible 2020).

The survey data were analyzed using statistical techniques such as exploratory factor analysis, ordered probit, random parameter logit, and latent class logit models.

4.3 Value Chain Analysis

Several qualitative research methods were applied in order to analyze the broiler and dairy value chains in Ghana and Senegal. The research methods included multi-stakeholder workshops, semi-structured interviews and the Delphi method. The multi-stakeholder workshops were used for engaging value chain actors to map the value chain and identify the key activities in the value chain. While semi-structured interviews with value chain actors (key informants) were conducted to gain in-depth information about the activities of the various value chain actors and how they are interconnected. Lastly, the Delphi method was used to identify and rank the key issues confronting the Ghanaian broiler value chain. The Delphi study was composed of 21 poultry experts from Ghana that included researchers (academia), input suppliers (veterinary and medicines), feed millers, hatchery managers, chicken producers, government policy makers, and slaughterhouse managers.

For the primary data, a snowball sampling procedure was employed to identify key actors in both the fresh milk and milk powder value chains in Ghana and Senegal. A total of 59 key actors at different levels of the value chain were selected and interviewed either face-to-face or via telephone and included - input suppliers, producers/farmers, collectors, processors, street vendors, and marketers (hypermarkets, supermarkets, and street vendors). Farmers were selected purposively to represent the typical production systems of fresh milk in Ghana (confined-cut and carry, agro-pastoral, and pastoral) and Senegal (confined-silage, agropastoral, confined-cut and carry). In Ghana, six producers of fresh milk based on the cattle rearing systems and three milk collectors with capacities of 25, 300, and 2000 litres per day were interviewed. Based on the average volumes processed per month, four groups of dairy processors are identified - large (240 tonnes), medium (120 tonnes), small (15 tonnes), and mini (7 tonnes). The data was collected using

semi-structured personal face-to-face interviews. The interviews were recorded, transcribed and analyzed using content analysis to objectively and systematically identify specified characteristics and patterns in responses (Holsti, 1969).

4.4 Synthetic Control Measures

As a tool for policy evaluation, we use a data-driven synthetic control method (SCM) to investigate the effect of policy interventions in Senegal and Ghana. The comparison group of treated unit includes countries that had not experienced policy intervention whose pre-intervention trend most closely tracks that of the treated unit. SCM has been recently used for estimating the effects of interventions in different contexts (see e.g. Mohan, 2017; Cole et al., 2020; Abadie, 2021). In comparison to similar methods, e.g. propensity score matching (PSM) and difference-in-difference (DID), SCM controls endogenous problems due to selection bias and other factors associated with control group selection and relaxes the parallel trend assumption of the DID method (Olper et al., 2018; Li et al., 2020).

To be more precise, we split our sample into two periods $T = T_0 + T_1$, where T_0 denote a pre-intervention period, and T_1 is the post-intervention period. Denote the number of comparison countries by $k+1$. The first country (i.e. treated unit) was affected by the intervention over the pre-intervention period $T_0 + 1, \dots, T$, and the other K countries is considered as the control samples. The idea of SCM is to estimate the pre-intervention characteristics of the treated unit using a weighted average of control units in the donor pool, known as the synthetic control, that approximate the pre-treatment outcomes for the treated unit (Abadie et al., 2015; Ben-Michale et al., 2021).

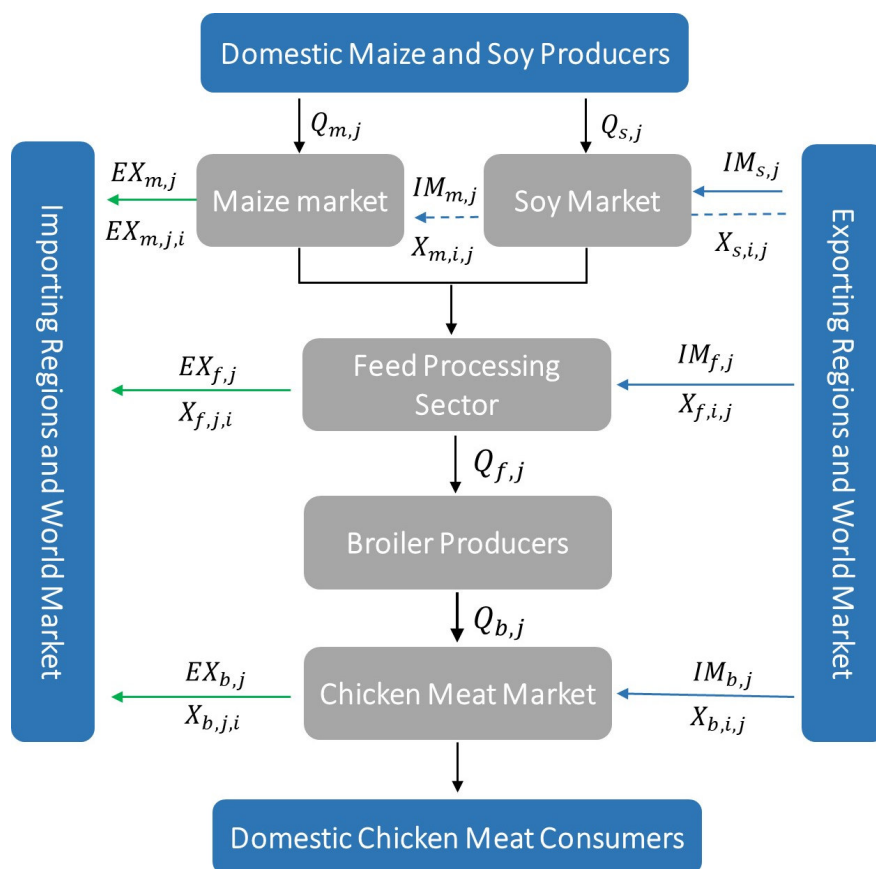
4.5 GPMEM

To evaluate feed cost policies, the processing of maize and soy to livestock feed should be considered in the proposed model. It is notable to say that most general equilibrium models extensively used for analyzing different policy reforms do not consider the feed processing in detail. Moreover, interprovincial trade of the poultry feed and meat driven by the spatial price differences is an important feature of the Ghanaian poultry value chain. We adopt a modified form of equilibrium problem to assess feed cost policies considering the specific features of the Ghanaian poultry value chain. The spatial equilibrium model of Samuelson, Takayama, and Judge (Samuelson, 1952; Takayama and Judge, 1964) was further extended by Chavas et al. (1998) to a vertically integrated dairy value chain incorporating primary inputs as well as final products. This model framework has been used by many studies in the literature to investigate various policy interventions in the agri-food chains (e.g. Cox and Chavas, 2001; Bouamra-Mechemache et al., 2002; Andam et al. 2017). Despite its flexibilities, the proposed model by Chavas et al. (1998) only includes one stage of processing level and thus ignores intermediate products. However, in the Ghanaian poultry value chain, the raw inputs transform to the animal feed and then it is used in the production process of poultry meat. This challenge was addressed by other works in the literature (e.g. Devadoss 2013; Andam et al. 2017). We base our empirical model on Andam et al.

(2017). However, our model majorly focuses on broiler sub-sector including domestic soy production and regional feed conversion ratio. The proposed model is also eligible for considering the national production of soy in Ghana, which is not addressed by Andam et al. (2017). This model is able to consider trade, consumption, production, and price variables endogenously for the entire primary, intermediate and final products and to assess policies at different stage of value chain. Figure 6 presents different markets and their relationship along the Ghanaian Poultry Multi-market Equilibrium Model (GPMEM). The model is designed based on the poultry value chain structure incorporating maize, soy, poultry feed, and chicken meat market for 8 provinces in Ghana.

The spatial equilibrium models are typically solved as a nonlinear optimization problem that maximizes net social welfare subject to transportation costs, a world price for imports, and local supply and demand constraints. The net quasi welfare function is measured as the integrals of the inverse demand and supply functions. In our analysis, we consider both endogenous and exogenous variables to form a mixed complementarity problem. To do so, a Variational Inequality (VI) structure including Karush–Kuhn–Tucker (KKT) optimality conditions combined with the market-clearing conditions is specified, which will be explained in following section.

Figure 6: Product flows in the Ghanaian broiler value chain



Source: Own illustration.

Note that the subscripts m , s , f , b , and i (alias j) refer to maize, soybean, poultry feed, and regions, respectively throughout the paper. We use the Mixed Complementarity Problem (MCP) to solve

the model, as it incorporates both dual and primal variables. Moreover, the MCP is relatively simpler if the modeller knows the equilibrium conditions (Devadoss, 2013). Further, we calibrate the model according to constant terms of supply and demand functions. The final calibrated model is applied to investigate the impact of feed processing capacity and performance of poultry meat production. The base model should reproduce the baseline data. In our analysis, the main advantage of using a partial equilibrium approach compared to general equilibrium is that it permits analysis within the value chain context including feed conversion ratio and processing details.

4.6 MAGNET model

To assess alternative policy measures, we apply a global general equilibrium model. Providing more obvious intersectoral and interregional linkages, a general equilibrium model is a proper approach for assessing the economy-wide effects of policy measures at macro level (Hertel 2013). The MAGNET model is a global general equilibrium model which covers all sectors of the economy (agriculture, manufacturing and services) and all regions and major countries in the world (Helming and Tabeau, 2018). MAGNET is based on the GTAP model and database with a particular focus on agriculture. In comparison to GTAP, MAGNET uses a more general multilevel sector-specific nested constant elasticity of substitution production function, accounting for the imperfect mobility of the return to capital (i.e., wage) and land (i.e., rent) between agricultural and non-agricultural sectors. Thus, the factor transfer over agricultural and non-agricultural sectors is made sluggish (Sartori et al. 2019). In contrast to the standard GTAP models, land supply is assumed endogenous in the MAGNET model. This feature allows describing a supply curve between average real agricultural land rent and the land area in a region that is used for agriculture (Woltjer et al., 2014). In contrast to most of the general equilibrium models, MAGNET assumes differences in technological change across sectors (Woltjer et al., 2014). Moreover, for this analysis, the latest version of MAGNET is applied that disaggregates the poultry sector from other livestock products. Given these advantages, this model has been widely applied by researchers and public institutes to assess the economic implications of agri-food trade policy scenarios (e.g. Boulanger and Philippidis, 2015; Helming and Tabeau, 2018).

In our analysis, MAGNET is used to investigate the effects of trade restrictions and alternative trade policies on the dairy and poultry sectors in Ghana and Senegal.

5 Results – Poultry

5.1 Typical Broiler Production Systems

5.1.1. Ghana

Three typical conventional broiler production systems were identified in Ghana: small-scale, medium-scale and large-scale integrated production systems. Table 1 summarizes the key

characteristics of the production systems. The farm economic analysis which was conducted using typical farms revealed that all farm-types (small, medium and large scale) are inefficient in terms of Feed Conversion Ratio (FCR) and Broiler Farm Economy Index (BFEI). Of which, Chibanda et al (2022) explain that the FCR is a ratio of the amount of feed used to produce a kilogram of meat. While BFEI is a single indicator that combines multiple indicators (FCR, livability, live weight and slaughter age) to highlight the global efficiency of a broiler farm. The inefficiency can be attributed to the use of poor-quality chicks (for typical large scale farms that use locally hatched chicks), poor quality feed and long production cycles (in the case of small-scale farms that do not have a ready market to sell their chickens). Furthermore, the analysis established that all broiler production systems in Ghana are characterized by high production costs. Of which, the costs of feed and day-old chicks (DOCs) are the most significant cost items. Despite the relatively high costs of production, broiler production is profitable for all typical production systems in the short-term.

The farm economic analysis also reveals the following (Chibanda et al., 2022):

- In Ghana, broiler production can be considered seasonal since the typical broiler farms typically raise chickens to sell only during the festive seasons(Christmas, Easter, and Eid al-Fitr).
- Small-scale broiler producers typically have extended feeding periods because they often fail to secure a market for their chickens after the normal feeding period.
- In spite of Ghana's reliance on frozen chicken imports, medium sized broiler farms located in Dormaa sell their chickens to poultry traders from Ivory Coast. The export of live broiler chickens to Ivory Coast by producers in Dormaa at a much lower price than the local one is not economically sustainable.

Table 1: Characteristics of typical broiler production systems in Ghana

	Small-scale commercial	Medium scale commercial	Large-scale integrated
Farm size (birds sold/year)	< 5,000	5,000 - 20,000	> 20,000
Biosecurity measures	Low to moderate	Moderate	Moderate to high
Feed sourcing	Commercial feed-mills		Own feed-mills
Day old chicks (DOCs)	Often imported	Often imported	Own hatchery
Marketing	Live birds sold in local communities, live markets and to small restaurants	Live birds sold in live markets or to traders. Rarely, the birds are slaughtered and sold to fast food shops and restaurants	Birds are slaughtered on the farm and marketed to retailers and restaurants

Source: Chibanda et al. (2022)

5.1.2. Senegal

Similar to Ghana, three conventional broiler production systems were identified in Senegal: small-scale commercial, medium scale commercial and large-scale integrated production systems (see Table 2). The economic analysis of typical small scale and medium scale broiler farms revealed that the medium-scale farms are comparable to farms in key chicken meat exporting countries (i.e. Brazil, USA, Thailand) in terms of farm performance. This implies that the farms have FCRs and BFEI that are comparable to those of farms in countries like Brazil, USA and Thailand. The analysis also established that typical small and medium scale farms in Senegal are profitable. However, the farms have high costs of production, mainly because of the high costs of feed and day-old chicks. Consequently, locally produced chicken meat may not be able to compete with frozen chicken imports if the current import ban is lifted.

Table 2: Characteristics of typical broiler production systems in Senegal

	Small-scale commercial	Medium scale commercial	Large-scale integrated
Farm size	< 10.000 birds per year	10.000- 100.000 birds per year	> 100 000 birds per year
Biosecurity measures	Low to moderate	Moderate	Moderate to high
Feed source	Commercial feed-mills	Commercial feed-mills	Operate their own feed-mills
Day old chicks (DOCs)	DOCs are sourced from local commercial hatcheries.	DOCs are sourced from local commercial hatcheries.	Farms often operate their own hatcheries.
Marketing	Live chickens are often sold to traders (bana-banas), individuals, and small restaurants.	Chickens are either slaughtered on the farm or sold as live birds. The birds are often sold to traders (bana-banas), retailers, restaurants and hotels.	Chickens are often slaughtered on the farm and sold to bana-banas (with refrigerated trucks), retailers and restaurants.

Source: Own survey

5.2 Analysis of Local Value Chains

Multi-stakeholder workshops held in Accra (Ghana) and Dakar (Senegal) with actors in the poultry sector revealed that producers, feed-mills, hatcheries, slaughterhouses, poultry traders (bana-banas), and distributors (retailers) are the key actors in the broiler value chains of the respective countries. In addition, the value chain analysis established that DOCs, feed and veterinary supplies (vaccines and medicines) are the main inputs for broiler production in the two countries. Producers in Ghana rear domestically hatched and imported DOCs. The local hatcheries often prefer to use parent stocks than imported hatching eggs because imported hatching eggs are costly. Some producers rear DOCs imported from the Netherlands, Belgium and the Ivory Coast because they are of a superior quality than the locally hatched ones. In contrast, producers in Senegal do not use imported DOCs because the domestic hatcheries hatch high quality chicks. The hatcheries mostly use imported broiler hatching-eggs and to a lesser extent use imported breeder stocks.

Overall, the value chain analysis revealed that the broiler value chains in Ghana and Senegal are facing a wide range of similar challenges such as limited access to credit, limited investments in processing facilities, limited cold chain facilities and high costs of production. However, unlike Senegal, frozen chicken imports are perceived to be the most important challenge facing the chicken meat value chain in Ghana. The analysis also established that producers, hatcheries, feed-mills and poultry traders (bana banas) in Senegal are faring well under the poultry meat import ban which is protecting domestically produced chicken meat from competition from low-cost frozen

chicken imports. For instance, the number of formal hatcheries has increased from 10 hatcheries in 2004 to 70 hatcheries in 2021. Most importantly, the hatcheries are producing good quality chicks which have relatively low mortalities and FCRs. In contrast, there are reports of broiler farm closures in Ghana and hatcheries are struggling to produce good quality chicks.

Despite the achievements made by the Senegalese poultry production sector, processing and other value addition activities remain limited. According to Arnoldus et al. (2020), about 70% of chickens produced in Senegal are sold out as live birds. In cases where processing is done, it remains whole dressed with very few traders offering cut portions (breast, wings, back, etc.). Besides, the majority of farms who offer dressed chickens do manual slaughtering and dressing with bare hands. Meanwhile, manual processing takes a longer time compared to automated processing and due to the high tropical temperatures of above 25°C the meat quality begins to go down before it is stored in a refrigerator or transported to customers.

After processing, carcasses must be kept refrigerated until they are sold out to retailers and catering businesses. This reduces the multiplication of bacteria and other pathogens (Gonçalves-Tenório et al., 2018). However, processed chicken meat in Senegal is generally transported to market centers by vehicles without refrigerators exposing the meat to bacteria and other pathogens. Dressed whole chickens sold in open markets are exhibited on bare tables without any form of packaging, refrigeration or chilling from morning till evening. The raw meat is exposed to warm tropical temperatures. Being a highly perishable product, bacteria and other foodborne pathogens begin to grow in the meat. In addition, meat left unrefrigerated for over two hours begins to decompose, losing its quality and taste. To delay decomposition and to prevent flies from settling on the raw meat, traders often apply chemicals. One popular chemical in use is formalin which is used in embalming dead bodies and which has been classified as highly carcinogenic to humans by the World Health Organisation (WHO) (Suwanaruang, 2018). This brings the safety of chicken meat consumed in Senegal into question.

Domestic chicken retailed in Senegalese supermarkets on the other hand are packaged with labels bearing dates of production and expiry, and are kept frozen. Nevertheless, the majority of consumers perceive chicken sold in traditional markets as fresher and cheaper (Boimah & Weible, 2021). Furthermore, there is often a scarcity of chicken during festive seasons due to high demand leading to higher prices in these periods. As mentioned by participants in a study conducted by Boimah & Weible (2021) chicken meat was more available in Senegal before the import ban even in times of demand peaks.

In Ghana, imported chicken constitutes more than half the total volume of poultry meat consumed annually because of the domestic industry's inability to meet the growing demands. Imported chicken vary from domestic ones in various ways. Firstly, import flows are constant without any form of interruptions and traders are able to meet the demands of their customers. Imported chicken is always available with traders (importers, wholesalers and retailers). However, the same story cannot be told of live chicken trade which is faced with frequent shortages. Secondly, the continuous growth in demand for processed chicken meat shows that imported chicken is more

convenient to consumers as it saves time spent on preparation and cooking, explaining in part the low patronage of domestic live chicken by Ghanaians. Imported chicken largely comes in cut parts (thighs/drumstick, wings, back, feet, gizzard, etc.), well packaged in cartons and frozen with labels providing information on its origin, and expiry date. The domestic chicken market on the other hand is nearly a live bird market. Thirdly, imported chicken is retailed in smaller portions (e.g., in kilogrammes) offering consumers the opportunity to buy what they can afford, but not so with domestic chicken which is often sold live or in its whole processed state. On request from customers, live birds bought are slaughtered and dressed by retailers, however, these customers would have to wait for about an hour or more for the chickens to be slaughtered and de-feathered. Lastly, taking price into account, imported chicken are cheaper than domestic chicken. For instance, a kilo of imported chicken sells between Gh¢ 12-14 (\$1.58-1.84), while live fowls and dressed domestic chicken are sold between Gh¢ 30-70 (\$3.94-9.18) and between Gh¢ 80-90 (\$10.50-11.81) during festive seasons such as Christmas and Easter.

To maintain the growth of the domestic poultry industry in Senegal, it is necessary for stakeholders in the industry to consider the following;

- Modernization and improvement of infrastructure and activities along the value chain, in particular at the stages of processing, packaging, transportation, and marketing are essential
- Also, education and training are required for actors on hygiene in the meat distribution chain
- Poultry farming can lead to adverse environmental effects which should not be ignored if the ban goes longer

5.3 Consumer Preferences

5.3.1 Ghana

Focus group discussions among Ghanaian chicken meat consumers revealed that origin, price, taste, freshness, ease of preparation (convenience), safety and health, availability, tenderness, and meat color are the main factors consumers consider when selecting chicken meat. Regarding imported and domestic chicken, consumers hold positive perceptions about the quality of domestic chicken on aspects such as freshness, taste, and healthiness compared to imported chicken. In contrast, the focus group participants evaluated the price, convenience, and availability of domestic chicken less favorably than imported chicken. According to the results of the quantitative survey (face-to-face interviews), approx. 45% of respondents claim to consume chicken meat at least weekly or more. However, domestic chicken meat is consumed less frequently compared to imported chicken. A regression analysis shows that these two products are more often consumed exclusively than in conjunction, and can be regarded as (weak) substitutes. The findings further reveal that consumer attitudes and perceptions about food safety, price, and convenience reduce regular consumption of domestic chicken, while perceived quality and ethnocentrism as well as higher income increase regular consumption. On the other hand, frequent consumption of imported chicken is driven by attitudes toward price, availability and convenience. Finally, results indicate that consumers prefer domestic to imported chicken and are willing to pay

a premium for domestic chicken. In addition, they prefer and are willing to pay for antibiotic-free, fresh, and chicken cuts, with antibiotic-free claim having the highest impact on choices. However, since preferences are heterogeneous among consumers, we identified four main consumer segments based on the preferences for these attributes, namely domestic chicken advocates, foreign chicken lovers, claim (safety) conscious, and random choosers. The domestic chicken advocates are willing to pay premiums more than twice the average that the entire sample of consumers is willing to pay, suggesting a potential and hope for domestic chicken (Asante-Addo et al. 2020).

5.3.2 Senegal

The focus group discussions showed that Senegalese have a strong preference for domestic chicken even before the import ban because they perceive it as fresher, tastier, healthier, of higher quality, and are assured of the conditions under which the fowls are raised domestically. Discussants mentioned that chicken imported into the country before the ban were mostly in cut portions, packaged in cartons, and were frozen with labels providing information such as the origin of the product and expiry dates. However, domestic chicken is sold mostly as live birds or in a whole dressed form (fresh or frozen) rendering it less convenient compared to imported cuts, and inaccessible to households with low purchasing power as well as restricting consumers in their freedom of choice. Some participants also expressed concerns about the lack of organization in the domestic poultry industry, which poses risks to human and food safety.

For some households, chicken is frequently eaten, at least four times a week, while for other households it is eaten on average once a week. Generally, chicken is perceived as having a high social value in Senegal, is often served to guests and is seen as meat that can be easily shared by large families. The ban on imports is seen as a good protectionist policy leading to the development of national production and the creation of employment. A section of participants expressed satisfaction with the ban, urging the government to maintain this policy. Others are concerned that the government needs to support free trade and refrain from imposing regulations that restrict the free flow of products between nations. Yet, a few of the participants are of the view that the ban is impacting negatively on low-income households and therefore opined, that the ban should be lifted. Overall, discussants perceive chicken produced domestically is now more available and cheaper compared to the era before the ban. A kilogram of imported chicken was sold at FCFA 400 while domestic chicken went for FCFA 3000/kg. However, the ban has had a positive impact on domestic prices, and after 14 years a whole chicken is sold at FCFA 3000/kg.

Regardless of the gains in domestic production, there are still issues with processing, packaging, storage, safety, and marketing of chicken meat in Senegal. The manual processing and lack of cooling units of vehicles that transport processed chicken to venues for marketing are a source of concern. Also, the display of fresh meat on bare tables in open markets can potentially lead to microbial contamination and other food-borne diseases with grave consequences for human health. As noted by participants, safety to a large extent is lacking in the domestic poultry industry.

Nevertheless, to a large extent, the lack of confidence in imported chicken meat leads to consumer ethnocentrism which may influence attitudes and purchase intentions should the ban be lifted.

Should the ban be lifted, this study indicates that those consumers who currently strongly prefer domestic products would continue to consume it, while more households could access chicken meat in general. However, substitution effects are not completely impossible since price is a major reason in the purchase-decisions of Senegalese (Boimah and Weible 2021).

6 Results - Dairy

6.1 Typical Dairy Production Systems

6.1.1. Ghana

The confined-cut and carry, agro-pastoral, and pastoral production systems were identified as the most common "typical" production systems in Ghana. The Agbogba, Tema, and Tamale regions were identified as the most important regions in terms of dairy production in Ghana. The typical farms that were selected were named according to the country code and the number of milking cows. They are GH-03, GH-35, and GH-27 representing confined-cut and carry, agro pastoral, and pastoral production systems, respectively. The key characteristics of three production systems are summarized in the Table 3.

GH-03: The farm is small, and the farm keeps three milking cows and one bull, generally Jersey breed, Friesian-Sanga crossbred, and local breeds. The land size is 0.2 ha, including two unsophisticated cow barns and the farmer's house. They have no separate pasture land for grazing. The cows are feed with purchased concentrates such as wheat bran, cassava peels, and brewers' grain during six months of the dry season and kept under a zero-grazing system. In the wet season, purchased grass and plantain leaves are used for feeding. Farm tasks are carried out almost entirely by family labor.

GH-35: In this typical farm 35 milking cows and one bull are kept. The land base of this farm is 0.4 ha, including the cattle kraal and the home of the Fulani family that tends to the animals. The farm has the cross-bred cows from the Jersey breed, Nigerian cows, and local cows. During the wet season, animals are allowed to graze in any open fields under city council control. The wet season usually lasts six months but, animals are allowed to graze for as long as possible. Farms use only a low amount of concentrates such as wheat bran, cassava peels, salt, and minerals only during the dry season.

GH-27: The typical extensive farm keeps 27 milking cows and three bulls, those are cross-bred cows from the West African shorthorn and the white Fulani called Sanga. The Sanga cattle breed is well adapted to the arid conditions of northern Ghana. The cattle owner, in most cases, doesn't have

to be a farmer, but he has another off-farm business in the city area. He is not live and work on their farm. Fulani keeps and entirely responsible for herd management. The main responsibility of the cattle owner is to decide on selling animals (cull cows, heifers, and young bulls).

Table 3: Characteristics of typical dairy farms in Ghana

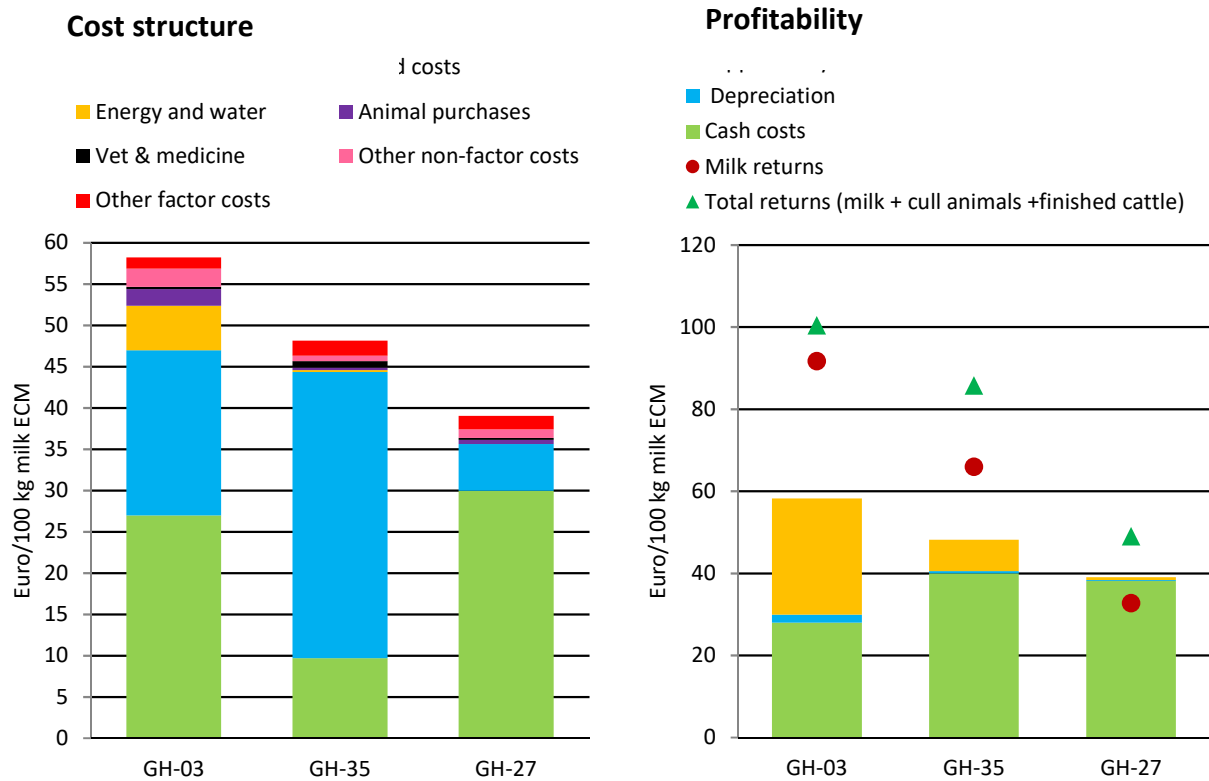
Production systems	GH_03	GH_35	GH_27
	Confined-cut and carry	Agro pastoral	Pastoral
Breeds	Jersey breed, Friesian x Sanga crossbred, local breeds	Jersey x local crossbred, local breeds	Sanga
Milking cows	3	35	27
Farm land (ha)	0.2	0.4	1.6
Milk yield kg/cow/year	4160	1063	963
Cattle sold	Calves	Finished cattle	Finished cattle
Labour (hours/year)	1,008	4,592	2,080
Feed ration	Cut grass, Wheat bran, Brewers grain	Grazing, Wheat bran, Cassava peels	Grazing, Cow-pea, Cassava peels

Source: Gunaratne et al (2022).

Figure 7 indicates that the confined-cut and carry system represented by GH-03 has the highest production costs, followed by the agro-pastoral GH-35 and the pastoral GH-27. Moreover, labour costs represent 50% of the total farm costs for GH-03, 37% for GH-35, and 84% for GH-27. Furthermore, feed costs account for up to 29% of total costs in the GH-03 and up to 46% in the GH-35. The cost of milk production for GH-03, GH-35, and GH-27 was €58.22/100kg Energy Corrected Milk (ECM)³, €48.13/100kg ECM, and €39.01/100kg ECM, respectively. Figure 7 shows that GH-03 makes a very high return from milk, corresponding to 91% of total returns, followed by GH-35 (77%) and GH-27 (78%) farming systems. All farms had a positive entrepreneur's profit and covered total production costs in the short-term, medium-term, and long-term because total returns cover the total costs.

³ Energy Corrected Milk (ECM) expresses the amount of energy in the milk based upon milk, fat, and protein and is adjusted to 4.0 percent fat and 3.3 percent protein. This standardization allows us to compare the farms' efficiency and profitability accurately and improves decision-making over time.

Figure 7: Comparison of the cost structure and profitability of dairy and finished cattle (Ghana)



6.1.2. Senegal

Similar to Ghana, three dairy production systems were identified in Senegal. They are SN-90, SN-15, and SN-19 indicating confined silage, agro-pastoral and confined – cut and carry production systems (Table 4).

Table 4: Characteristics of typical dairy farms in Senegal

Production systems	SN_90 Confined sliage	SN_15 Agro pastoral	SN_19 Confined-cut and carry
Breeds	Holstein, Normande	Gobra, Ndama, Diakore	Holstein
Milking cows	90	15	19
Farm land (ha)	73	1	7
Milk yield kg/cow/year	3150	600	714
Cattle sold	Calves	Finished cattle	Calves
Labour (hours/year)	37,440	6,760	11,232
Feed ration	Sorghum, Maize silage, Maize grain, Panicum, Rice bran	Grazing, Crop residues, Cotton seed, Peanut hay	Panicum, Alfaalfa, Cut grass, Rye grass, Maize silage, Maize grain, Concentrates

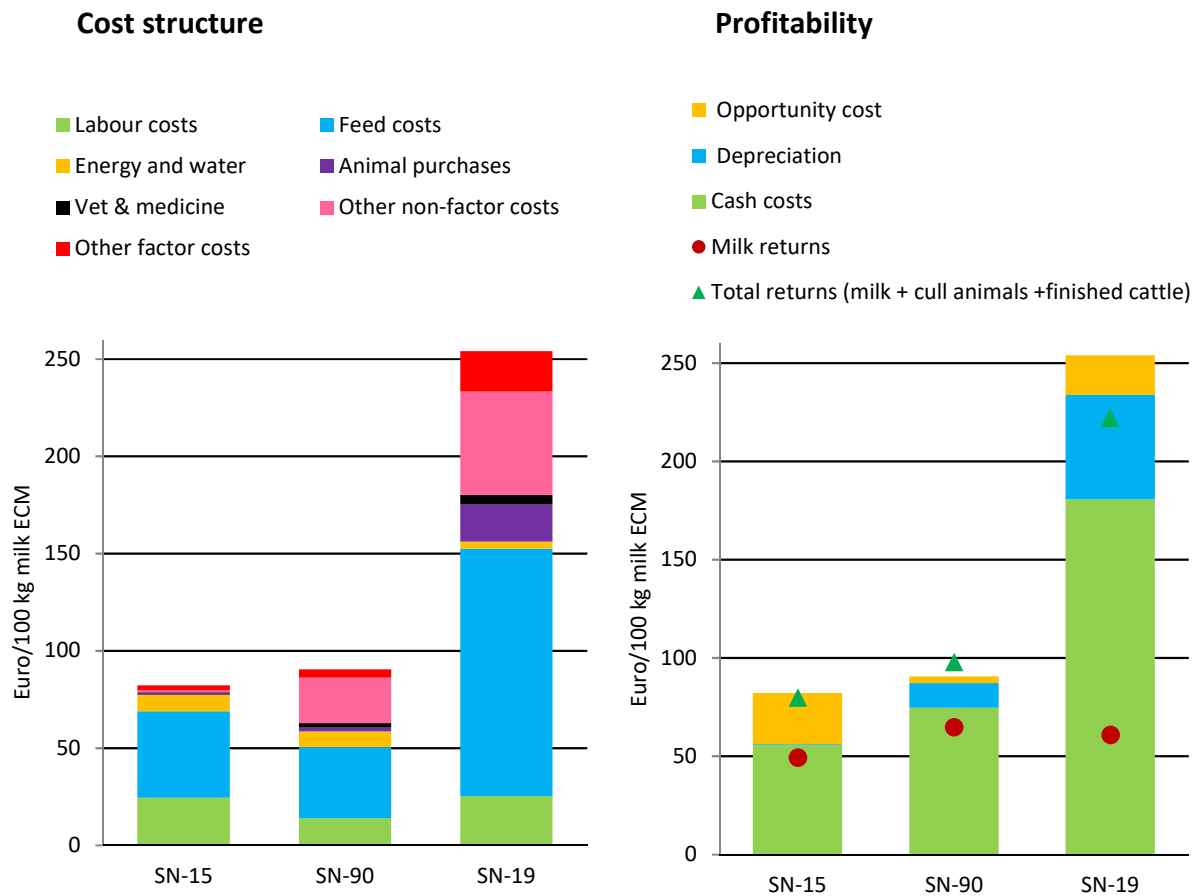
Source: Gunarathne et al (2022).

SN-90: This farm is located in Dakar, and it keeps 90 dairy cows and two breeding bulls. Breeds are Holstein and Normande. The farm produces forage crops on 73 hectares like sorghum and Panicum grass. The cows are also fed with purchased concentrates such as maize grain, peanut extraction meal, peanut fat, and rice bran. A higher proportion of work is carried out by 15 permanent employees plus a number of seasonal workers during one harvest month per year.

SN-15: This farm has a total of 15 dairy cows plus its own replacement and one breeding bull. The farm has three breeds, including, Gobra, Ndama, and their cross Diakore. The farm produces crops like millet, maize, and peanut for human consumption, and the peanut straw is used as forage for the cattle in the dry season. Feeding in the wet season is exclusively grazing in pastures on common land with a distance of up to 6 km from the village. After crop harvest, cattle graze on stubbles close to the village. Three family members entirely run this farm.

SN-19: This farm is located in the area of Dahar with 19 Holstein dairy cows plus their own replacement and one breeding bull. Breeds are Holstein. The farm produces forage crops on 7 hectares like Panicum, Alfaalfa, and maize silage. During the dry season, animals are fed with purchased feeds such as concentrates, maize grain, and Ryegrass.

Figure 8: Comparison of the cost structure and profitability of dairy and finished cattle (Senegal)



Source: Own presentation.

Figure 8 indicates that the confined-cut and carry system represented by SN-19 has the highest production costs, followed by the agro-pastoral system SN-90 and the confined-silage system SN-15. Moreover, labour costs represent 30% of the total farm costs for SN-15, 15% for SN-90, and 10% for SN-19. The feed cost represented the largest cost in all three farms and it accounts for up to 54% of the total farm costs for SN-15, 40% for SN-90, and 50% for SN-19. Therefore, reducing the feed cost with proper management is the largest driver for increasing farm profitability. SN-90 farm had a positive entrepreneur's profit and covered total production costs in the short-term, medium-term, and long-term. SN-15 and SN-19 are economically unviable in the medium and long term because total returns cannot cover costs.

6.2 Analysis of Local Value Chains

The study results reveal that the local fresh milk value chain in Ghana is entirely separated from the milk powder value chain. Ghana's local milk value chain is informal, simple, and not well-developed compared to the imported milk powder value chain. The main actors in the fresh milk value chains are the input suppliers, producers, collectors, processors, street vendors, financial and other services providers. The flow of milk along the local fresh milk marketing channels shows the

highest amount of 67% of milk flow from dairy farmers to milk collectors, followed by 20% flow to wagashi processing and street vendors as well as direct flow from dairy farmers to consumers (1%). The study further estimated 12% flow of milk to mini and small-scale processors, and only 1% flow of fresh milk goes to street vendors. The collectors gather the milk from producers only (100%). They collect milk from several producers at the farm gate and bring it directly to processors such as Emadom Yoghurt, Nanee Yoghurt, Dafa Dairy Products, and the general public. They sell 75% of the milk to mini and small-scale processors and the remaining 25% to fresh milk street vendors. The collectors usually gather the milk bought using Jerry cans. They usually do not have milk storage facilities such as refrigerators and as a result, they sell the fresh milk directly to processors and vendors. The purchased price of fresh milk ranges between € 0.40 and € 0.60. Milk collectors mainly utilize their motorbikes as a means of transportation. The current selling price per litre of milk ranges between € 0.80 to 0.86.

The value chain that depends on imported milk powder is extensive compared to the local milk value chain. Its key players are importers, re-packagers, re-constitutors, processors, distributors, wholesalers, and retailers. Local milk supply is very low, especially in Ghana. As a result, the processing industry relies largely on imported milk powder. Main products in the milk powder value chain therefore yoghurts (plain, with cereals or fruits), evaporated milk, flavoured milk drinks, “burkina” (yoghurt mixed with millet), and milk powder (re-packaged, re-branded, flavoured) in smaller units such as sachets and tins. At the national level, lower tariffs (5%) and the absence of non-tariff barriers evidently are favourable conditions for milk powder imports into Ghana. Milk powder is thus cheaper, more available at all times and has a longer shelf life when compared to local fresh milk. Additionally, there are no existing barriers to entering Ghana’s dairy processing sector in exception of the mandatory requirements of registering the firm and obtaining product certification from the appropriate authorities.

In Senegal, the key actors are limited in number and include input suppliers, producers, collectors, processors, importers, wholesalers, small retailers (small kiosks, shops etc.). Milk collectors collect fresh milk from different farmers and directly sell them to the mini and small processors. The collection capacity of fresh milk per day ranges from 80 litres to 400 litres. Like in Ghana, bikes and motorbikes are used to transport milk from the farm gate to milk processing units. The current purchase price and selling price per litre of fresh milk varies between €0.53 to €0.76 and €0.61 to €0.91, respectively. The processing industry of Senegal produces pasteurised milk, yoghurts, curdled milk, Thiakry and cottage cheese. Small, medium and large-scale processors produce under hygienic conditions and use modern equipment. Their products have good packaging (tetra packs, bowls, and small buckets) and labeling detailing product composition including certification stamps. End products of these processors i.e., small, medium and large reach consumers through hypermarkets, supermarkets and boutiques. Mini processors also process yoghurt and curdled milk from milk powder. These firms do artisanal (traditional) processing with the use of unmodernized equipment. Furthermore, mini processors operate under poor hygienic conditions and their products are usually marketed in open markets, streets, and in boutiques (small grocery shops). Their products do not have traceable information such as dates of production and expiry.

The primary constraints identified in both countries are an insufficient supply of fresh milk in the dry season, high transport fares due to long distances to the milk collectors, lack of storage facilities, lack of credit facilities to the dairy value chain actors, insufficient extension support, poor road networks, and competition from imported milk.

In both countries, local milk yields are very low and are unstable due to constraints related to (i) low genetic potential of local breeds for milk production, (ii) the extensive system of feeding herds, especially during the dry season with incessant movements that do not facilitate the collection of milk, (iii) and seasonal variations. During the dry season, milk yield per cow is very low and the small quantities of milk collected spoils easily due to a lack of refrigerators. Also, most farmers in rural pastoral and agro-pastoral areas do not have access to electricity supply and refrigeration equipment, and practically, it is a challenge to chill the milk on the farm. Milk yields are much higher in the rainy season compared to the dry seasons but due to a lack of storage facilities as mentioned early on farmers are forced to discard significant quantities when it becomes difficult to find buyers. Fresh milk, collected in plastic buckets, is transported under the sun without cooling equipment. The transportation of curdled milk and other dairy products, and their subsequent sale without adequate packaging and cooling systems pose a risk of deterioration of the sanitary qualities of the milk. Furthermore, the tropical temperatures of above 25°C hastens a reduction in the quality of milk before it gets to the market or to the processor. It is costly for middlemen and buyers to travel to milk producing areas which are located far from urban and city centers. Moreover, during the rainy season, roads are not traversable due to flooding as the roads linking milk producing areas are not tarred which makes milk collection difficult.

As identified, the local fresh milk value chains are informal and short. Local milk handling and processing practices are purely traditional and are not hygienic. The processing methods used by mini and small-scale fresh milk processors are limited to few dairy products (wagashi and yoghurt). Furthermore, mini and small-scale processors lack adequate quality testing infrastructure. Almost all local value chain actors interviewed do not have any form of training on milk handling, processing and marketing. Also, local dairy products are characterized by poor packaging and labelling, making it difficult to compete against domestically processed and imported products.

The milk powder processing industry in both countries is witnessing continual growth as milk powder is readily available in desired quantities. The ability to store milk powder for longer periods also gives it an advantage over fresh local milk. Moreover, milk powder is cheaper compared to local milk.

6.3 Consumer Preferences

From the focus group discussions, local dairy products are perceived as natural and tastier when compared to imported and domestically processed products. In addition, local dairy products are appreciated for their texture (smoother) and colour (brighter). Notwithstanding, they are scarce to find and are also expensive. Furthermore, diversity in local dairy products as the participants point

out is low, while processing remains to a large extent traditional and unmodernized. People identify local dairy products in two main forms, fresh milk, and curdled milk.

Both domestically processed and imported products are perceived as unnatural, i.e., adulterated with fat from vegetable sources however they are more affordable and more diverse, especially with imported products which are found on the Senegalese market in a wide variety of forms (powdered, sweetened or unsweetened, concentrate, skimmed, whole, liquid, etc.) as yoghurts, ice cream, evaporated milk, milk powder, UHT, cheese, butter, etc. Furthermore, there has never been a shortage of both imported and domestically processed dairy products on the market.

Despite the safety risks, majority of the discussants prefer local milk and its products to imported milk and its products due to the positive perceptions accorded to local milk (natural and tastier). Nevertheless, “price” emerged as the most important factor influencing consumers’ purchase decisions. Based on this, imported products, especially milk powder and domestically processed products are largely purchased. Consumers often opt for cheaper products in line with their purchasing power. This shows that “perceptions” and “preferences” do not necessarily play key roles in consumers’ final purchase decisions, particularly, in a developing country context. Other important factors influencing the purchase of imported and domestically processed dairy products are availability, safety, packaging, traceability, and diversity.

7 Trade and Agricultural Policy Analysis

To analyse trade and agricultural policies we elaborate on the potential synergies and tradeoffs between the policy objectives in Ghana and Senegal. In this line, we provide empirical evidence for the effects of policy interventions on dairy and poultry production in Ghana. Further, we elaborate on the possible interaction between different policy challenges in order to evaluate policy coherence in the agricultural sector of Ghana. To do so, we use a holistic framework including a Synthetic Control Method (SCM) to estimate the contribution of policy interventions in the trajectory of dairy and poultry production. Further, the interconnection between the main policy challenges is projected using panel simultaneous equations. Our findings highlight the positive effects of policy interventions in the poultry market from 1998 to 2019. Nevertheless, the growth in domestic production as witnessed is remarkably lower than the increasing volume of imports of frozen chicken meat to Ghana. Moreover, the effect of post-2002 dairy policies on production is minor and tends to be negative, which is explained by the lower attention of policymakers to this market in terms of support policies. The coherence analysis suggests a positive (i.e. synergy) and bilateral relationship between domestic production, food security as well as rural development while a unilateral relationship between rural development and domestic production. Our findings imply that lowering the cost of production and increasing productivity will go a long way to have a positive spillover effect on food security and rural development in Ghana.

Moreover, we estimated the potential effects of the artificial insemination (AI) projects on milk production in Senegal over the 2008-2018 period. In this line, we evaluate the major barriers and challenges of genetic improvement policies in the development of the Senegalese dairy sector. To

do so, we employ the data-driven Synthetic Control Method (SCM) for comparative case studies which allows comparison between the trajectories of post-intervention production of milk in Senegal with a combination of similar but untreated countries. The findings indicate that AI projects increased the national production of milk by 35% which might be positively correlated with food security. However, this may put significant pressure on water resources in Senegal. Thus, the negative externality of these projects on water resources should be considered to achieve a more efficient outcome.

We evaluate various trade and agricultural policies in both countries and sub-sectors. The question that we address in one of our studies e.g. in Zamani et al. (2022a) is the potential effect of trade restrictions and alternative trade policies on the Ghanaian poultry sector. While the scenarios of MAGNET are defined on the basis of a Delphi Study, the estimated production changes are used as inputs into the typical farm analysis that projects the effects on different broiler farm types in Ghana. Trade restrictions in form of e.g. a partial ban on European imports show a low effect on trade, as imports from other world regions fill the market gap. Expanding the tariff wedge between final and intermediate products by 5%, either through increasing the tariff rates of the final product or abolishing the tariffs on feed products, is small in our case. However, increasing the tariff rate of the final product to the maximum level of bound tariff (i.e., 99%) or introducing a complete ban has a higher effect on the poultry production than the other scenarios. The study also reveals that in the short-term, large-scale farms are better positioned to take advantage of the tariff increase or a complete import ban. While small and medium farm types are expected to gradually increase their production (Zamani et al., 2022a).

In the next analysis, we focus on the main drivers of high feed costs in the broiler sector in Ghana. To accomplish this, we design a model framework including a partial equilibrium model, a general equilibrium model, and a farm-level analysis to evaluate four scenario options. The scenarios cover optimal feed conversion ratio, exchange rate, and feed capacity in Ghana. Two scenarios are defined to evaluate exchange rate depreciation. These two scenarios explicitly evaluate the effects of exchange rate depreciation of the Cedi over the US dollar by 10% and 50% respectively. The third and fourth scenarios focus on reducing feed conversion ratio (i.e. improving poultry meat production) and doubling feed capacity in Ghana. More specifically, scenario 3 analyzes the effects of the optimal feed conversion ratio equal to 1.65.

We begin with exchange rate depreciation as a policy instrument to reduce the price of domestic products relative to the imported ones. As shown, exchange rate increases have the expected effect of raising domestic market prices for all products within the poultry value chain. However, the changes in soybean and chicken meat prices are slightly larger than in other products. The price changes are more obvious when the exchange rate rises by 50%. Exchange rate depreciation makes the domestic products cheaper relative to the imported ones which in turn promotes the domestic producers to increase supply. The final effects on the intermediate input (i.e. maize, soy, and feed) are determined by the interaction between the changes in the household demand and the derived demand for chicken meat. This policy drives demand for production inputs including maize, soy, and feed. However, as our results imply, the consumption of maize drops, which is explained by

the larger effects of household consumption on the maize demand. The higher price of domestic products will lead to a reduction in the consumption of final products including chicken meat and maize. Moreover, the interaction between total domestic supply and consumption determines the demand for imports. In this regard, the exchange rate depreciation puts upward pressure on the demand for domestic soy production. Additionally, higher demand for soy by the feed industry substantially drives up the demand for soy imports.

What if the public or private investments were launched to improve the capacity of the feed industry? This is what the fourth and fifth simulations are supposed to capture. Doubling feed capacity has the effect of reducing feed prices as supply increases. The reduction in production costs finally will be passed through to the broiler industry. Our findings imply that doubling the capacity of feed production may lead to decreasing the chicken meat price by around 30%.

8 Conclusions

Poultry

- In Ghana and in Senegal farms have high costs of production, mainly because of high costs of feed and day-old chicks. Consequently, locally produced chicken meat may not be able to compete with frozen chicken imports.
- The broiler value chains in Ghana and Senegal are facing a wide range of similar challenges such as limited access to credit, limited investments in processing facilities, limited cold chain facilities and high production costs at the farm level.
- In Ghana imported and domestic chicken meat are often consumed exclusively than in conjunction, and can be described as (weak) substitutes.
- Consumers in Ghana and Senegal prefer domestic to imported chicken and are willing to pay a premium for domestic chicken.
- In Senegal the ban on imports is seen as a good protectionist policy leading to the development of national production and the creation of employment. Chicken produced domestically is now more available and cheaper compared to the era before the ban.
- So far, we could show that domestic agricultural policies in Ghana, had positive effects on the poultry market in the period 1998 to 2019. Nevertheless, the growth in domestic production remains lower than the increase in imports of frozen chicken meat.
- We analysed alternative trade policies like imports bans, tariff increases and change the tariff wedge between final and intermediate products. Here, domestic production could be increased most by a tariff increase to the level of 99% (bound rate) or a complete ban. Here, large farms are better positioned to take advantage of this trade policies in the short run. However, these policies would result in macroeconomic losses due to falling GDP and increased consumer prices of poultry.
- In Ghana we found that doubling feed production would decrease the price of chicken meat by around 30%.

Dairy

- In Ghana all analysed typical dairy farms show a positive entrepreneur's profit and cover total production costs. In Senegal two out of three typical farms are economically unviable in the medium and long term because total returns cannot cover costs.
- In Ghana the local fresh milk value chain is separated from the milk powder value chain.
- The primary local constraints in both countries are an insufficient supply of fresh milk in the dry season, high transport fares due to long distances to the milk collectors, lack of storage facilities, lack of credit facilities to the dairy value chain actors, insufficient extension support, poor road networks, little hygiene by the local milk handling and traditional processing practices, no training on milk handling, processing and marketing.
- Consumers prefer local dairy products. They perceive them as natural and tastier compared to imported products. But the most important factor influencing the purchase decision is the price.
- Artificial Insemination programs aim to increase milk production of local breeds. The findings indicate that these programs in Senegal increased the national production of milk by 35% in the period from 2008-2018 while the effect of dairy policies in Ghana is minor or even negative.
- In Senegal the imported breeds (Holstein Cows) are not profitable in terms of heat stress, low access to water and the need for a certain quality of feed. Therefore, also in terms of animal welfare, it is not advantageous to use these breeds here.
- In Senegal we have economies of scale at the farm level. In Ghana we do not have economies of scale. In Ghana main product is meat and milk is a by-product.

9 Literature

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