



## Cashew processing in Ghana – A case for infant industry support?

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### ABSTRACT

West Africa produces almost half of the world's cashew nuts. With the domestic cashew processing industry still in its infancy, however, most of it is exported as raw material and processed in India and Vietnam. In Ghana, this is provoking discussions about market interventions to support domestic processing. Since different price policies have diverging implications for farmers and processors, the choice of the policy instrument leads to conflicts of interest between the two groups. In this study, we analyse the short- and long-term economic impacts of enhancing cashew processing through (i.) a temporary export tax on raw cashew nuts, (ii.) a temporary subsidy to cashew processors, and (iii.) a temporary export tax on raw cashew nuts, with government revenues passed on to cashew growers. For this purpose, we develop a partial equilibrium model for the Ghanaian cashew market including the processing from raw cashew nuts to kernels. We find that in the short run, all price policies lead to a substantial increase in processing at the expense of net welfare. We argue, however, that the sector may experience productivity gains through learning by doing and thus, after price policies are phased out, stick to its increased level of output such that short-term welfare losses could be recouped. Therefore, temporarily introduced price policies could help the infant cashew processing industry to grow up, promote the development of the domestic cashew sector, and be welfare-enhancing in the long run. A subsidy to processors is the most appropriate option to achieve this.

### 1. Introduction

West Africa is presently accounting for 46% of global raw cashew nut (RCN) production (FAO, 2021). Harvested during the lean season – the period between the harvest of the region's main staples such as maize, sorghum or rice – RCNs are an important source of revenue in a period with otherwise low income (CABRI, 2019) for more than 1.8 million families in West Africa (ACA, 2020a). The importance of cashews in West Africa, a tree crop traditionally planted to mitigate soil erosion, is still quite recent (Ajayi and Place, 2012). It was only in the wake of planting projects in the 1990s that farmers in West Africa became increasingly aware of the low opportunity costs and potentially high income they could earn from growing cashew trees (Fitzpatrick, 2011). At the turn of the millennium, the region became the dominant driver of global RCN production and its importance for global supply is increasing further (FAO, 2021).

However, the growth in RCN production has not been accompanied by the development of a competitive domestic processing industry. At

present, of the 1.7 million metric tons (MT) of RCNs harvested annually in West Africa, only about 8.3% are processed to cashew kernels (ACA Cashew Barometer, 2021). With around 93% of global RCN processing located in India and Vietnam (ACA, 2021a), West African cashews are mainly exported in their raw state (ITC, 2021a), meaning that employment opportunities, the potential to increase and diversify export revenues, and possibilities of fostering farmers' linkage to the market remain largely unexploited (ITC, 2015). The predominance in processing of Vietnam and India can be explained by extensively accumulated knowledge in processing, internal and external economies of scale, government support to the sector, and a lack of global competitors (USDA, 2018). Apart from Vietnam and India being attractive export markets, awareness is growing in West Africa of the untapped opportunities for value addition in their domestic cashew sectors and the socio-economic benefits that could result (UNCTAD, 2021), and processing is growing slowly (Fig. A1).

The lack of competitiveness<sup>1</sup> of the West African cashew processing industry vis-à-vis its main competitors can be attributed to various

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<sup>1</sup> Measured in terms of the sector's ability to achieve RCN processing cost and/or kernel price advantages over its competitors.

shortcomings. While Indian and Vietnamese traders follow the RCN harvest around the world and buy RCNs almost all year round, West African processors source their entire RCN stocks for one year's processing during the domestic harvest season – which leads to liquidity bottlenecks and higher storage costs (Tilton, 2021). Volatile RCN and kernel prices, banks' scepticism about possible credit defaults by debtors, and insufficient information and understanding of the complexity of the sector ultimately make access to credit scarce and interest rates high (Gonzalez, 2021). Inadequate financial markets are a market failure of particular significance for the West African cashew sector, preventing local processors from buying higher quantities of RCNs for processing. The nature of the cashew market renders this market failure particularly relevant, as the once-a-year window to buy RCNs, combined with the volatile prices, mean that if processors buy too many RCNs but the price of kernels is poor over the course of the next year, they may go bankrupt. Furthermore, West African processors face poor infrastructure, including a lack of storage facilities, high electricity costs, and intermittent power outages. According to the World Bank's *Ease of Doing Business ranking*, Benin is 149th, Ghana is 118th, Côte d'Ivoire 110th, Vietnam 70th, and India 63rd, indicating a less conducive business environment in West Africa (World Bank, 2020). Additionally, comparatively low labour productivity, poor management of processing plants, and the need to import processing machinery from abroad, mainly from Vietnam and Italy, affect the profitability (World Bank, 2018a; ACA, 2021b).

As a matter of fact, Vietnam's domestically produced modern machinery is considered one of the main reasons that have enabled cashew processing at low cost and made Vietnam the number one processor in the world (Antech, 2020). While India's cashew industry benefits from the domestic market, which is an important outlet for both high- and low-quality broken kernels, Vietnam is by far the most important supplier of kernels to the world's principal importers, Europe and North America, with lower quality kernels sold to the Chinese market (ITC, 2021a; Crandall, 2018). Europe and North America are also the main buyers of West African kernels, but West African processors lack markets that absorb lower quality (broken) kernels (Crandall, 2018). In addition, processing of cashew shells<sup>2</sup>, a by-product generated during the shelling of RCNs, is currently not (yet) profitable in West Africa due to the low quantities of RCNs processed and is therefore hardly realised, unlike in Vietnam and India (ACA, 2019).

The infant industry argument states that an industry in an early development stage could develop a comparative advantage if high initial production costs and already well-established foreign competitors did not prevent it from doing so. Reasons, why a new industry may face high costs in its inception stage can be attributed to a lack of knowledge and experience, a small size of the sector, and a lack of complementary activities (Krueger and Tuncer, 1982). Alexander Hamilton was one of the first to argue that temporary protection from foreign competitors may allow domestic industrialists to lower their production costs through productivity gains so that they could compete with more advanced manufacturing industries from abroad (Hamilton, 1791). As suggested by Krugman (1987), comparative advantage is not static but can be developed through dynamic economies of scale. In fact, the introduction of price policies could contribute to developing a comparative advantage in a currently immature processing sector (Piermartini, 2004). Melitz (2005) compares the implications of different policy instruments for infant industry protection, including their impacts on welfare levels. Arrow (1962) pointed out that learning is endogenous to experience;

<sup>2</sup> Cashew shells can be processed to obtain cashew nut shell liquid (CNSL). Primary applications of CNSL are in the polymer industry, where it is used as a chemical compound in brake linings, paints, varnishes, and surface coatings (Kumar et al., 2002). They can also be used to generate heat needed for shelling RCNs, partially helping processors to compensate for intermittent power outages.

thus, the present level of productivity is not fixed but may increase with cumulative production. Accordingly, the degree to which Ghana succeeds in moving from being a cheap supplier of RCNs to an exporter of kernels that command higher prices could be understood as a function of learning by doing and the emergence of external economies of scale. High initial costs associated with the development of a new industry, however, are not sufficient justification for government intervention; instead, a market failure must be in place that discourages private entrepreneurs from investing in a new sector (Meade, 1955; Krugman et al., 2018).

Interventions to promote fledging industries have shown mixed results in Ghana and West Africa. For example, Ghana's market interventions to promote cocoa production and processing had an overall positive impact on the sector (Ansu, 2013), whereas supportive policies for the sugar and tomato paste industries (Boamah and Sumberg, 2019), and domestic poultry production (Sumberg et al., 2017; Banson et al., 2015) did not contribute to competitive domestic industries. Evidence from Nigeria is also ambiguous. Policy incentives have contributed to the growth of the cement industry (Karkare et al., 2022) and increased sugar refining, but have been ineffective to substitute raw sugar imports (Itaman and Wolf, 2021), and insufficient to achieve the aspired self-sufficiency in rice and pharmaceuticals (Karkare et al., 2022). However, even if a protected industry performs well, this is insufficient evidence for the effectiveness of the intervention, as it may be that the industry would have performed well anyway (Juhász, 2018). Studies such as those by Head (1994) or Irwin (2000), who examine the impact of protection for the tinsplate and steel rail industries in the USA by modelling counterfactual situations with no protection, can help to assess the relevance of protection. Yet, to the best of our knowledge, such studies do not exist for West Africa.

Today, cashew processing in Ghana is in its inception stage and considered a candidate for infant industry support to generate welfare gains in the long run. In 2020, the country established a long-awaited regulatory authority considering market interventions to enhance cashew processing (ACA, 2020b). To support identifying the right strategies for the sustainable development of the sector, in this paper, after providing a market overview, we develop a partial equilibrium (PE) model to analyse the impacts of political support to cashew processing. We then present our modelling approach and results. Finally, we discuss whether price policies may be an effective measure to help the infant processing industry grow up and generate welfare gains in the long run, and derive policy implications before drawing summarising conclusions.

## 2. Market overview

### 2.1. Market regulations

Costa and Delgado (2019) described the cashew market as one of the most regulated in the world, where governments commonly supported processing in its early stages and where many support measures are still in place today.

In India, government institutions like the *Directorate of Cashew Research*, the *Directorate of Cashew Nut & Cocoa Development*, and the *Cashew Export Promotion Council* assist the sector in developing cashew production and processing and promote the export of kernels and by-products (ICAR, 2021; CEPPI, 2021; DCCD, 2021). In Vietnam, after the government recognised cashews as an industrial crop in 1989, the *Viet Nam Cashew Association* was founded to support RCN production, processing, trade, and marketing (VINACAS, 2017; FAO, 1997). While India incentivises kernel exports through the *Merchandise Exports from India Scheme* (PIB Delhi, 2019), Vietnam has been depressing its domestic RCN price below the world market price for the past 20 years: in 2019, the *Producer Nominal Protection Coefficient* was at 0.7 (OECD-FAO, 2020).

In addition, to shield their domestic processing industries from foreign competition, India and Vietnam impose an import tax on kernels

of 30% and 25%, respectively, while RCN imports are subject to a tax of 2.5% and 5.0%, respectively (ITC, 2021b). Tariff escalation is one reason why India, the world’s top consumer of kernels, is not a kernel outlet for foreign processors (ITC, 2021a). Against this backdrop, in 2016 and 2017, Côte d’Ivoire and Benin introduced an export tax on RCNs of US\$ 230 and US\$ 130 per MT of RCNs, respectively, with Côte d’Ivoire paying processors a subsidy of US\$ 170 per MT of RCNs processed over a period of five years (ACA Cashew Barometer, 2021; Equal Times, 2021; Africa News, 2019). The Ministry of Trade and Industry of Ghana came up with an even more drastic measure, banning the export of RCNs during the 2016 harvest season (Graphic Online, 2016). However, due to opposition from Members of Parliament who viewed cashew growers at the mercy of domestic processors arguing that this would destroy domestic production, the export ban remained short-lived (Pulse Ghana, 2016; Business Day, 2016). Most recently, Benin announced that it will ban the export of RCNs from 1 April 2024 (ACA, 2022).

The European Union and United States of America account for about 85% of the world’s kernel import demand (ITC, 2021a) and with Most Favoured Nation tariff rates of 0% no countries are advantaged over others (TARIC, 2021; ITC, 2021b).

### 2.2. Cost benchmarking

In a detailed benchmarking evaluation, Pal (2021a) analyses the economics of cashew processing based on primary data obtained from processors in the respective countries. Fig. 1 derives data from this evaluation and presents the RCN price, the processing costs consisting of variable costs, average fixed costs, financial costs (interest charged by financial institutions for borrowing funds, e.g., for the purchase of RCNs), corporate tax, the revenue per MT of RCNs processed, and the net profit for Ghana, Côte d’Ivoire, Benin, Vietnam, and India in 2020. To

ensure a like-for-like comparison, it was assumed that processing plants of all market peers have the same characteristics, that is, a semi-mechanised processing plant installed with the latest technologies, a processing capacity of 15,000 MT of RCN per year, and a utilization rate of 80% (Pal, 2021a). Thus, the only variable is the country where processing takes place.

While processing in West Africa has historically been a labour-intensive activity, nowadays processing steps that were once carried out by factory workers are increasingly mechanised (USDA, 2018). In effect, a semi-mechanised factory has become a prerequisite for processing at competitive costs (Pal, 2021a). The relatively low share of variable costs (Fig. 1) stems from the few workers employed: 137 workers are needed to process 5,000 MT of RCNs annually (ACA, 2021b).

The average processing costs in Ghana, Côte d’Ivoire, and Benin are US\$ 350 per MT of RCNs, versus US\$ 210 per MT of RCNs in Vietnam. This cost disadvantage of US\$ 140 per MT of RCNs processed vis-à-vis Vietnam is more than offset by the lower price at which West African processors purchase RCNs due to their proximity to the raw material. Vietnamese processors pay a high price for imported RCNs from Africa, which accounts for 60% of Vietnam’s RCN demand (ACA, 2021c), and drive their business by low margins but high volumes. With approximately 2 million MT of RCNs processed annually in Vietnam, some factories have a processing capacity of over 15,000 MT of RCNs per year and benefit from internal economies of scale that make their operations even more cost-efficient, reducing fixed and variable costs by a further 11% as compared to a plant with a processing capacity of 15,000 MT of RCNs (ACA, 2021g; Spindle and Agarwal, 2017; Pal, 2021a). With processing costs in Ghana, Côte d’Ivoire, and Benin comparable, it depends on the RCN and kernel prices whether the break-even point is reached. In Benin (and Côte d’Ivoire), processing costs are offset by the

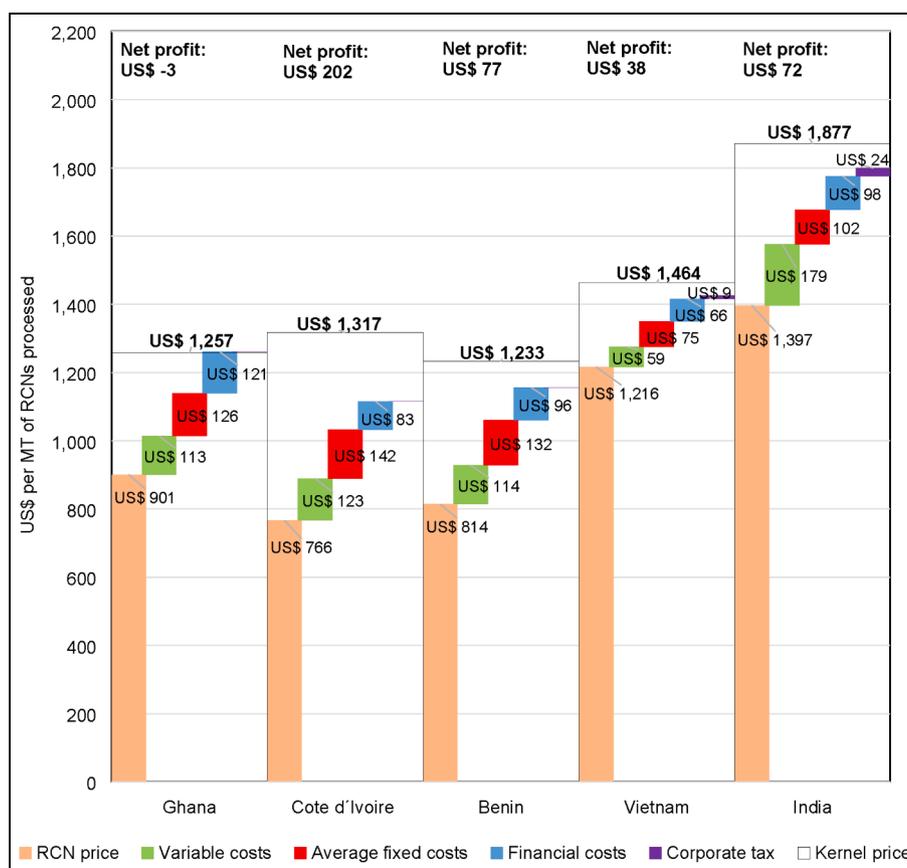


Fig. 1. Comparison of the processing profitability for Ghana, Côte d’Ivoire, Benin, Vietnam, and India in 2020. Source: Own visualisation, based on Pal (2021a).

export tax on RCNs (and the kernel subsidy paid to processors), artificially increasing the price margins of processors<sup>3</sup>. That being said, the kernel price, which is higher in Vietnam, and even much higher in India, is a key determinant of profitability. West African processors built their factories under the belief that buyers would come of their own accord, without realising what it takes to become a qualified processor, giving little thought to the sale of kernels in advance (ACA, 2021e). Consequently, imperfectly informed kernel buyers perceive, although often unfounded, that sourcing from West Africa may be riskier and kernels of lower quality, and that local processors lack understanding of food safety and contracts (ACA, 2021e). Ultimately, market prices depend on the vendor's reputation, certification as well as the vendor's relationship with the customer. Low levels of trust between business partners translate into lower kernel prices owing to higher transaction costs resulting from more certifications, audits, and other proofs of quality. We argue that Indian processors, paying the highest RCN price, having high processing costs, and receiving the highest kernel price, should be regarded as an exemption. They operate in a highly regulated market with high domestic consumption of kernels, hardly suitable for comparison with other markets.

### 2.3. The Ghanaian cashew sector

Historically, Ghana's exports have been narrowly focused on cocoa, timber, and mineral resources (Agyemang and Adanu, 2003). Volatile world market prices and increasingly deteriorating terms of trade, however, have incentivised export diversification, and Ghana began to promote other agricultural products, including cashew trees (Addo and Marshall, 2000). Since 1991, when Ghana's first RCN export was recorded (ADF, 2000), RCN production has grown rapidly. Today, Ghana is the world's 15th largest producer of RCNs and its third largest exporter (FAO, 2021; ITC, 2021a). Cashews – also known as “Poor Man's Crop and Rich Man's Food” – are experiencing steadily increasing global demand (Dubbart, 2019), and have become the country's second most important cash crop after cocoa in terms of export value (ITC, 2021a). Bannor et al. (2019) used the domestic resource cost ratio to show that Ghana has a comparative advantage in cashew production, whereas Bojang and Gibba (2021) reported a revealed comparative advantage for the tree crop – findings which are both linked to Ghana's natural resource endowment. Due to climate change, suitability for cashew cultivation will further improve in the future, while increasingly unfavourable climatic conditions are predicted for cocoa cultivation (CIAT, 2011). Considering this, together with estimates that of the total 13.6 million hectares suitable for agriculture in Ghana currently only 46.6% is cultivated (MoFA, 2016), RCNs have the potential to become an even more important cash crop for Ghana.

Today, the crop provides the main source of income for about 125,000 smallholder farmers (ComCashew, 2019a), who face low opportunity costs and cultivate an average of 0.8 to 2.5 hectares (Bromley and Foltz, 2011) with an average yield of 400 kg per hectare (ACA Cashew Barometer, 2021). In this context, cashews have the potential to develop backward regions, alleviate poverty among the rural poor, contribute to rural development as well as the resilience of the agricultural sector to climate change, and thus to the country's sustainable

economic growth (Heinrich, 2012; Fitzpatrick, 2010). Agricultural households are on average poorer than non-agricultural households (Diao et al., 2019) and significant regional differences in poverty rates exist (World Bank, 2018b). While 5.6% of the population in Greater Accra lives below the poverty line, the figures for the main RCN growing areas, the Brong Ahafo Region and the Northern Region, are 27.9% and 50.4%, respectively (Cooke et al., 2016). Therefore, the government and international stakeholders emphasise the need to promote the competitiveness of the Ghanaian cashew sector, increase RCN production, create sustainable market linkages, and, most importantly, move from exporting RCNs to domestic processing to retain a greater share of value addition in the country (TCDA, 2020; ACA, 2021d). The country's *National Export Development Strategy* focuses on 17 products, including cashews, and aims to move from a commodity-based export economy to a manufacturing, industrial export economy (GEPA, 2020). Ghana's *10-year Cashew Development Plan* aims to increase export revenues from RCNs and kernels from US\$ 243 million in 2019 to US\$ 1 billion by 2027. The potential economic gains of locally processed RCNs are expressed by Kwadzo and Kuwornu (2010) by multiplier effects of regional income and employment of 2.43 and 0.12, respectively.

Fig. 2 shows the processing capacity, the RCN processed, and the RCN supply from 2015 to 2020. While the RCN supply has grown by 50% from 70,000 MT in 2015 to 105,000 MT in 2020, processing lags far behind, using at most 30% of available capacity in 2020. Although it is quite costly to build processing plants and leave their capacity largely underutilised, processing capacity in Ghana has been significantly expanded, rising from 530 MT in 2006 (USAID, 2007), to 2,137 MT in 2011 (Fitzpatrick, 2011), reaching 65,000 MT around 2016 (ComCashew, 2019a), and then falling back to 45,000 MT in 2019 and 2020 (ComCashew, 2021)<sup>4</sup>. Mozambique and Tanzania, which were once the world's leading RCN producers and processors (FAO, 2021), created a gold-rush atmosphere in West Africa<sup>5</sup>. Ghana, considered the gateway to West Africa, wanted to follow the same path with processing plants built by private investors (Kuntze-Fechner, 2021).

Interestingly, as a response to the export ban on RCNs during 2016 and the resulting domestic RCN oversupply, processing almost tripled from 2015 to 2016. Over the following three years, RCN processing remained relatively constant – at around 10,000 MT. In 2020, due to the closure of processing plants in India to contain the COVID-19 pandemic, Indian import demand fell, Ghanaian RCN exports declined (ACA, 2020d), and processing increased by a third.

The obstacles to scaling up local processing across West African countries are similar to those for Ghana (Bannor et al., 2019). In addition to educational and technological development potentials and missing external as well as internal economies of scale, two characteristics specific to Ghana pose above-average challenges to break even with current price margins. First, inadequate financial services lead to comparatively high credit costs. Second, the political environment of its competitors creates a challenge for developing domestic processing. The domestic RCN price is relatively high in Ghana compared to Côte d'Ivoire and Benin, where RCN prices are artificially depressed due to the export tax. Considered an RCN *export heaven*, Ghana exported a total of 236,291 MT of RCNs worth US\$ 222 million in 2019 (ITC, 2021a) at an annual production of 100,000 MT (ACA Cashew Barometer, 2021).

<sup>3</sup> Benin accounts for 5% of world RCN export supply (ITC, 2021a), making it a “small country” with an imperceptible influence on world supply. An infinitely elastic world demand curve for RCN is the result, that is, the level of the export tax is fully reflected in the domestic RCN price. For Côte d'Ivoire, which exports 34% of the world's RCNs (ITC, 2021a), we assume that its RCN export tax has some impact on the RCN world market price. Consequently, the domestic price of RCN in Côte d'Ivoire is not reduced by the full amount of the export tax, as part of the tax is converted into higher RCN world market prices. Conversely, the subsidy paid to processors has no effect on the world supply of kernels and is therefore entirely reflected in the domestic price of kernels.

<sup>4</sup> Some (mainly small) processors, against the trend of the time, continued to operate their processing facilities overwhelmingly manually instead of semi-mechanising them. Missing out on the efficiency gains, but also not making the considerable higher investments required for semi-mechanisation (Farayola et al. 2013), they lost out on competitiveness (Frimpong and Kudjo, 2020). This non-investment allowed them to dismantle their processing facilities to potentially use them for other activities.

<sup>5</sup> The business model of the two East African countries, however, functioned exclusively with government support and eventually collapsed due to political unrest, wars, as well as tree diseases (Technoserve, 2015).

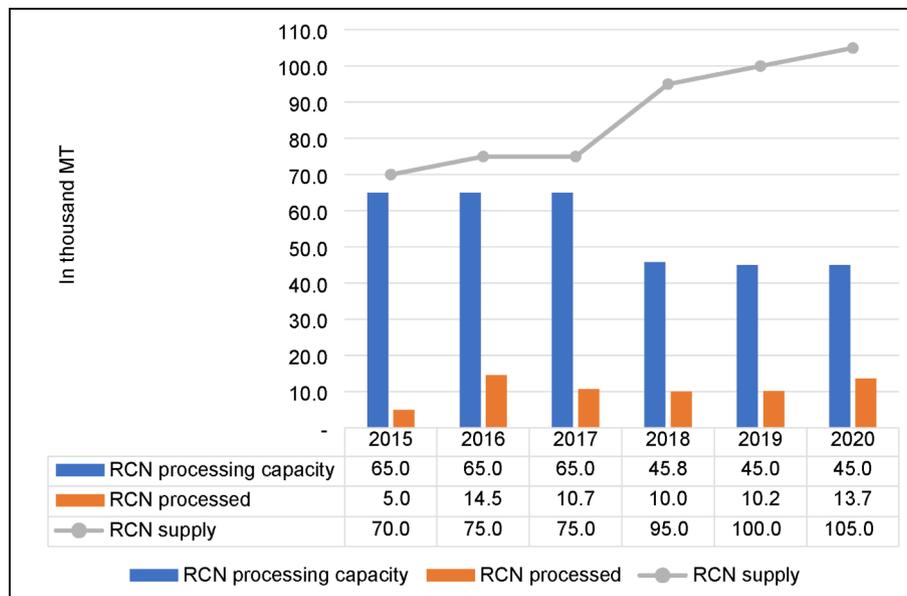


Fig. 2. RCN processing capacity, RCNs processed, and RCN supply. Source: Own visualisation, based on data from ACA Cashew Barometer (2021); ComCashew (2019a); ComCashew (2021).

This can be explained by the combination of RCN price differences and porous land borders, resulting in significant smuggling of RCNs into Ghana (Nitidae, 2018). A significant proportion of RCNs exported from Ghana originates from Côte d’Ivoire, from where 200,000 MT of RCNs were smuggled in 2019 (Reuters, 2020).

Local processors and the state organisation *Ghana Export Promotion Authority* are increasingly calling for protectionist trade policy measures to enable processors to compete with export traders for RCNs, promote processing, and close the competitiveness gap between the Asian and domestic processing industry (Graphic Online, 2020; Joy News, 2020; Ghana Web, 2021). Nevertheless, cashew farmers also struggle to earn a living income, and highly volatile farm gate prices, which fell by 54% from US\$ 1,299 per MT of RCNs in 2018 to US\$ 604 per MT of RCNs in 2019 (ACA Cashew Barometer, 2021), meant that some RCNs were not harvested as the associated costs exceeded market prices (Graphic Online, 2019; Pulse Ghana, 2019).

After many years of traders buying and exporting RCNs in an unregulated environment, considerations about government regulation have been institutionalised. The *Tree Crop Development Authority* (TCDA), which was established in 2020, serves as a regulatory institution mandated to formulate policies for the sector (TCDA, 2020; B&FT, 2020). The following model analysis reflects this political development and models the economic impact of supportive price policies for cashew processing.

### 3. Modelling approach

#### 3.1. A model for the Ghanaian cashew sector

To model the economic impact of trade policies on the Ghanaian cashew sector, we developed a PE model of the country’s cashew sector including the processing stage from RCNs to kernels. Our model design is based on Roningen (1997), who analyses the linkage between meat (downstream) and feed grain (upstream) markets. To account for the interdependencies between the RCN and kernel markets, we follow Roningen (1997) and Jechlitschka et al. (2007), who link downstream supply (in our case, kernels) and upstream demand (in our case, RCNs) to their respective input and output markets. Given Ghana’s small share in world exports of RCNs and kernels and due to the homogeneous character of the products, we adopt the “small country” assumption, assuming that the country is a price taker facing infinitively elastic import demand at world market price levels.

In our model, kernel supply ( $S_K$ ) is positively dependent on the kernel price and negatively dependent on the RCN price, variable, and financial costs:

$$S_K = \alpha_{S_K} \times (p^K)^\epsilon \times (p^R - \text{texp} - \text{sub}_{\text{proc}})^\eta \times \text{AFC}^\rho \times (\text{VC} \times \Delta \text{prod})^\mu \times \text{FINC}^\omega \tag{1}$$

$\alpha_{S_K}$  denotes a calibrated parameter,  $p^K$  is the world market price for kernels, and  $\epsilon$  is the price elasticity of  $S_K$ . Following Roningen (1997), we link  $S_K$  to the upstream RCN market by incorporating  $p^R$ , representing the world market price for RCNs,  $\text{texp}$  the export tax on RCNs,  $\text{sub}_{\text{proc}}$  the processing subsidy, and  $\eta$  the elasticity of  $S_K$  with respect to the domestic RCN price for processors. Average fixed costs are denoted by AFC, variable costs by VC, and financial costs by FINC, their respective input price elasticities are represented by  $\rho$ ,  $\mu$ , and  $\omega$ . Changes in factor productivity are implicitly incorporated into the model by adjusting VC with the term  $\Delta \text{prod}$ , expressing long run VC in percentage points compared to its level in the short run. By incorporating input costs and their price elasticities we assume  $S_K$  to be *iso-elastic*, allowing processors to substitute between the different inputs used to process RCNs.

We assume that Ghanaian processors demand domestic RCNs only and that RCNs are used exclusively for downstream processing into kernels. Domestic RCN demand ( $D_R$ ) is directly dependent on  $S_K$ . Hence, we set the elasticity of  $D_R$  with respect to  $S_K$  equal 1, that is, any change in  $S_K$  is accompanied by a 1:1 proportional adjustment in  $D_R$ <sup>6</sup>.

The RCN supply ( $S_R$ ) function consists of a calibrated parameter  $\alpha_{S_R}$ , the effective producer price being the sum of  $p^R$ ,  $\text{texp}$ , and a producer subsidy ( $\text{sub}_{\text{prod}}$ ), to the power of  $\beta$  representing the own price elasticity of  $S_R$ :

$$S_R = \alpha_{S_R} \times (p^R - \text{texp} + \text{sub}_{\text{prod}})^\beta \tag{2}$$

The net export of RCN ( $NX_R$ ) is calculated as  $S_R$  minus  $D_R$ :

$$NX_R = S_R - D_R \tag{3}$$

Due to the negligible demand for kernels in Ghana of around 100 MT (Nitidae, 2018), we assume that the entire kernel supply is exported.

<sup>6</sup> We used the ratio of 0.23 to convert the weight of kernels into RCN equivalents (that is, 1,000 MT of RCNs = 230 MT of kernels).

**Table 1**

Processing cost categories, percentage share of the cost category in total processing costs, and the values of  $\eta$ ,  $\mu$ , and  $\omega$ .

Cost category	% of cost category in total processing costs	Input-price elasticity	Value
$p^R$	79%	$\eta$	-3.97
VC	10%	$\mu$	-0.5
FINC	11%	$\omega$	-0.53

**Table 2**

Comparison of  $p^K$ ,  $p^R$ , VC, FINC, AFC, average total costs, and economic profits in US\$ from 2015 to 2020 in Ghana.

Year	2015	2016	2017	2018	2019	2020
$p^K$	1,739	2,037	2,414	2,047	1,693	1,257
$p^R$ , VC, FINC	1,532	1,772	2,283	2,257	1,536	1,135
Short run economic profits	207	265	131	-210	157	122
AFC	1,312	453	613	462	445	332
Average total costs	2,844	2,225	2,896	2,719	1,981	1,467
Long run economic profits	-1,105	-188	-482	-672	-288	-210

### 3.2. Parameterization

#### 3.2.1. Price elasticity of kernel supply

Our hypothesis is that the utilization of processing capacity in Ghana is a function of  $p^R$ , as well as  $p^K$ , and any price wedges caused by policies, assuming constant processing costs except for  $p^R$ , which is the most influential processing cost category (Fig. 1). From 2015 to 2020, however, the data show no relation between the price (margins), profitability, and processor’s decision on the quantity to process (Table A1). This can be explained by the fact that Ghanaian processors source their entire year’s supply for processing during the domestic harvest season from March to June. Due to the volatile nature of the kernel prices, it is very risky to forecast price margins for the end of the year and adjust RCN demand accordingly (Tilton, 2021). Because of this uncertainty about realisable price margins,  $D_R$  is shaped by experience and long-term decisions.

Processors in Côte d’Ivoire and Benin operate in a similar business environment but have in contrast been encouraged by price policies. According to Pal (2022), price incentives in Côte d’Ivoire and Benin are a determining factor in the growth of processing and explain the increase of processing (Fig. A1). As Fig. 2 shows, processing in Ghana responded with a sharp increase to the export ban, which was introduced only for a short period in 2016. Similarly, the prospect of an export ban in Benin is already prompting processors to undertake new investments to process more RCNs in the future (GDIZ, 2022). These case examples illustrate that incentivisation leads to increased processing, suggesting a fairly high price elasticity of kernel supply. In the absence of econometric estimates, we set  $\epsilon = 5$ .

#### 3.2.2. Input price elasticities of kernel supply

For  $S_K$  to be homogeneous of degree 0 in all prices, the sum of the input price elasticities must match the value of  $\epsilon$ . We assume that the relevance of a percentage change in a processing cost factor depends on its share in total processing costs. Hence, in Table 1, we weight the values of  $\eta$ ,  $\mu$ , and  $\omega$  according to their respective cost shares in total processing costs.

#### 3.2.3. Price elasticity of RCN supply

Cashew trees have long production cycles and estimates for Mozambique suggest that the price elasticity of RCN supply is 0.25 for a 5-year period (World Bank, 1995). We assume that Ghana has comparable scope for routine cashew tree management (fertilisation, pest control, weeding and grubbing), reintroduction of abandoned trees, and use of underutilised trees, and set  $\beta = 0.25$  likewise.

#### 3.2.4. The role of average fixed costs in the kernel supply function

In the short run,  $\rho = 0$ , since the fixed costs have already been spent – hence are irrelevant for deciding whether to process RCNs or not. RCNs are processed if  $p^K$  is (expected to be) higher than the sum of  $p^R$ , VC, and FINC, as this ensures a sufficient revenue to partly offset the AFC. In the long run, however, it is unprofitable to process RCN if  $p^K$  is lower than the average total costs. Therefore, AFC should become relevant – and  $\rho$  adjusted to the share of AFC in average total costs.

As shown in Table 2,  $p^K$  has consistently been below average total costs, resulting in negative long run economic profits, but processing capacity has declined only slowly (Fig. 2). Our hypothesis in this regard is that alternative uses are absent, market exit costs are high, and therefore the idle capacity is to be thought of as sunk costs. This implies keeping  $\rho = 0$  in the long run until capacity limits are reached and considering excess processing capacity a *white elephant*. Therefore, instead of treating the total fixed costs in the long run as a variable that adjusts to  $S_K$  (as microeconomic theory suggests), we maintain total fixed costs as a parameter.

### 3.3. Model scenarios

To dynamically analyse the economic impact of price policies on the development of RCN production and processing, we divided our model scenarios into three consecutive stages of the process. The base scenario reflects the prices and quantities with no price policy prevailing in 2020 (Table 3)<sup>7</sup>. Starting from this base, we then model two periods, a “short run” in which we implement supportive price policies, and a “long run” in which (i.) the price policies are removed, and (ii.) the temporary support granted to the infant industry in the short run is assumed to have brought about the productivity increase required to compensate for the welfare losses in the short run. As such, our approach is consistent with the modelling concepts of Leahy and Neary (1999) and Hoff (1997), where productivity remains exogenous within a period but learning by doing during one period rises productivity in the next period. Given the widely acknowledged uncertainties about learning processes (Rauch, 1992; Lewis, 1955; List, 1841), the advantage of our approach lies precisely in dispensing with additional assumptions about non-predictable gradual productivity growth.

<sup>7</sup> These prices may be influenced by terms of trade effects resulting from policy measures of other RCN exporting countries. Yet, these policies are independent from changes in the Ghanaian cashew market and hence considered as exogenous and fixed in our model.

**Table 3**  
Supply quantities  $S_R$ ,  $S_K$  in MT, and the prices/costs  $p^R$ ,  $p^K$ , VC, FINC, AFC in US\$ in the base.

Year 2020	$S_R$	$S_K$	$p^R$	$p^K$	VC	FINC	AFC
Base parameters	105,000	13,658	901	1,257	112.8	121.1	331.6

3.3.1. Short run scenarios

There are three different short run scenarios simulating different price policies. First, the “RCN export tax” scenario simulates the introduction of a temporary ad valorem export tax on RCN of 12.5% of the RCN f.o.b. export price. As such, we apply the country-specific recommendations of the [Sunyani Stakeholder Workshop \(2015\)](#), which advocates an export tax of 5% to 15%<sup>8</sup>, since it is assumed that very little, if any, smuggling would take place until the upper limit of this range. This pushes the domestic RCN price to match the average of the domestic RCN prices of Côte d’Ivoire and Benin. Second, the “Processor subsidy” scenario introduces a processing subsidy of 12.5%, reducing the purchasing price for processors to the same level as an equivalent export tax on RCNs. Third, in the “RCN export tax + farmers’ subsidy” scenario the government passes on its export tax (12.5%) revenues to farmers in the form of a producer subsidy such that the government budget is kept neutral.

3.3.2. Long run scenarios

The *Mill-Bastable test* states three conditions to justify infant industry protection. First, the sector will learn from experience, second, protection for the industry is only temporary, and third, ultimate welfare gains exceed initial welfare losses ([Kemp, 1960](#)). We designed the scenarios taking these three aspects into consideration: for the long run scenarios, we made VC in  $S_K$  a variable, letting it adjust to compensate the average welfare loss of the respective “short run” scenario. This way VC become a measure for how much processors would have to increase productivity through learning by doing so that the “short run” welfare losses are offset by “long run” welfare gains. We selected a time horizon of 10 years, during which support measures are implemented over the initial 5 years (“short run”), followed by a subsequent 5-year period where the corresponding productivity increase takes effect (“long run”). Further, we discounted welfare effects, using the current real interest rate of 3.6% in Ghana ([Trading Economics, 2021](#); [Statista, 2021](#)). As a result, we have three long-run scenarios: the “Post-RCN export tax” scenario compensates welfare losses from the “RCN export tax” scenario, the “Post-processor subsidy” scenario compensates welfare losses from the “Processor subsidy” scenario, and the “Post-RCN export tax + farmers’ subsidy” scenario compensates welfare losses from the “RCN export tax + farmers’ subsidy” scenario.

3.4. Calculation of welfare effects

We calculate the partial equilibrium welfare effects for cashew farmers and cashew processors as well as for the government. Their total welfare is to be maximised in the respective scenarios and the objective function is as follows:

$$Total\ welfare = farmer\ surplus + processor\ surplus + government\ budget. \tag{4}$$

In the “short run” scenarios, the farmer (producer) surplus is calculated as the size of the area under the producer price and above the RCN supply curve, a concept where the production costs are subtracted from

farmers’ total revenues<sup>9</sup>. The processor (consumer) surplus is calculated as the area above the consumer price and below the RCN demand curve<sup>10</sup>, thereby measuring processor gains as the difference between the actual price and their willingness to pay.

In the “long run” scenarios, the change in processor surplus is calculated as the difference between the variable costs in the base and the variable costs in the respective “long run” scenario, multiplied by the kernel supply; indicating the amount by which the processors’ profit has increased due to increased productivity.

Welfare effects for farmers and traders are aggregated in the farmer surplus as price changes are usually passed on to cashew farmers in West Africa ([ACA, 2021a](#)). In this context, [Bromley and Foltz \(2011\)](#) point to the many independent operators in the trucking sector, many of whom operate unofficially and with minimal barriers to entry – indicators of a highly competitive cashew value chain.

In the case of an export tax, the government budget is calculated by multiplying the RCN exports by the level of the specific tax; in the case of a subsidy for processors, government expenditure equals the subsidy multiplied by the domestic RCN demand.

4. Results

4.1. RCN prices and variable costs

[Table 4](#) shows the RCN producer price, the RCN processor price, and the VC, along with the respective deviations from the base in percentage points for each scenario. If, as in the “RCN export tax” and “RCN export tax + farmers’ subsidy” scenarios, an export tax is levied on RCNs, reduced demand from exporters leads to more supply of RCNs to the domestic market, causing the domestic RCN price (producer and

**Table 4**  
RCN producer price, RCN processor price, and VC in US\$, and the percentage changes in each scenario compared to the base.

Scenario	RCN producer price	RCN processor price	VC
RCN export tax	US\$ 788.37 -12.50%	US\$ 788.37 -12.50%	US\$ 112.80 0%
Processor subsidy	US\$ 901 0%	US\$ 788.37 -12.50%	US\$ 112.80 0%
RCN export tax + farmers’ subsidy	US\$ 875.93 -2.78%	US\$ 788.37 -12.50%	US\$ 112.80 0%
Post-RCN export tax	US\$ 901 0%	US\$ 901 0%	US\$ 61.43 -45.54%
Post-processor subsidy	US\$ 901 0%	US\$ 901 0%	US\$ 71.23 -36.85%
Post-RCN export tax + farmers’ subsidy	US\$ 901 0%	US\$ 901 0%	US\$ 70.73 -37.30%

<sup>9</sup> This widespread measure for assessing the benefits from exchange in markets approximates profit.

<sup>10</sup> Conceptually, the RCN demand curve is a derived demand curve, that is, a marginal revenue product curve.

<sup>8</sup> Note: In 2015, neither Côte d’Ivoire nor Benin had levied an export tax. With such policies now put in place in both countries, it can be assumed that the critical level is higher now.

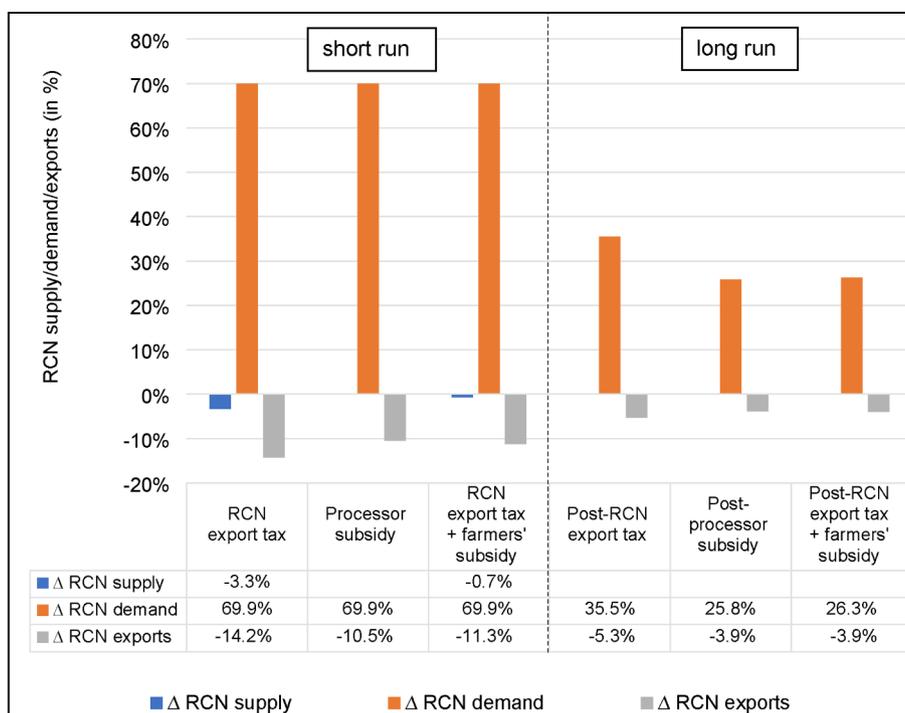


Fig. 3. Percentage changes of RCN supply, RCN demand, and RCN exports in the different model scenarios compared to the base.

processor price) to fall to the point where the domestic price plus the tax equals the world market price. In contrast, in the “Processor subsidy” scenario only the RCN processor price is lowered. In the “RCN export tax + farmers’ subsidy” scenario, the export tax on RCNs lowers the processor price by 12.5%, whereas the producer price drops by 2.78%, cushioned by the producer subsidy financed from tax revenues. In the “long run”, VC are modelled as a function of the welfare losses in the “short run” caused by the artificially lowered RCN prices. In fact, the change in VC can be seen as a measure for the productivity gains required in order to compensate the welfare losses caused by price policies in the “short run”; consequently, VC decrease the most in the “Post-RCN export tax” scenario and the least in the “Post-processor subsidy” scenario. Due to the assumed abolishment of policy measures after five years, domestic RCN prices in the “long run” equate world market price levels.

#### 4.2. Supply, demand, and exports of RCNs

Fig. 3 shows that in the “RCN export tax” and “RCN export tax + farmers’ subsidy” scenarios, producers respond to a decrease in the producer price of 12.5% and 2.78% with fairly modest reductions of RCN supply of 3.3% and 0.7%, respectively. With no change in the RCN producer price in the “Processor subsidy” scenario, RCN supply remains unchanged. RCN demand increases by 70% across the three model scenarios in the “short run”. RCN exports decrease due to the policy measures in all “short run” scenarios by up to 14.2% in the “RCN export tax” scenario. Whilst the low responsiveness of RCN supply is due to the low price elasticity of RCN supply, the high responsiveness of RCN demand is attributable to its high price elasticity.

In the “long run”, in the “Post-RCN export tax”, “Post-processor subsidy”, and “Post-RCN export tax + farmers’ subsidy” scenarios, RCN demand increases by 35.5%, 25.8%, and 26.3%, respectively. These increases originate from the assumed price policy-induced productivity shift of the kernel supply curve. With homogeneous RCN supply quantities across the “long run” scenarios, the different RCN export quantities are solely driven by the increasing domestic RCN demand: they decrease

the most in the “Post-RCN export tax” scenario (-5.3%), and the least in the “Post-processor subsidy” scenario (-3.9%).

Table A2 quantifies RCN supply, RCN demand (that is, kernel supply), and RCN exports in absolute terms for each model scenario, as well as the monetary value of RCN supply, the value added of RCNs processed, and the value of RCN exports.

#### 4.3. Welfare changes in the Ghanaian cashew sector

Fig. 4 quantifies the redistribution of welfare between producers, processors, and the government that occurs when the price policies are introduced and productivity increases materialise. In the “short run”, the scenarios have net welfare-reducing effects, but the extent to which actors benefit or suffer differs. While the “RCN export tax” scenario generates US\$ 8.8 million in tax revenues for the government, and the processors surplus is increased by around US\$ 2 million, the producer surplus decreases by US\$ 11.6 million. The result is a net welfare level of US\$ -0.8 million, which is the most negative across all scenarios. If, as in the “Processor subsidy” scenario, the government financially supports each unit of RCN purchased by domestic processors, there are no unintended side effects on the producer side. This comes at a cost of US\$ 2.6 million to the government budget but is the least market-distorting scenario. Due to the elimination of the production distortion, the net welfare losses fall by US\$ 0.2 million, that is, 25% compared to the “RCN export tax” scenario. In the “RCN export tax + farmers’ subsidy” scenario, processors reach the same welfare level as in the previous two scenarios, the government budget remains untouched, and producers suffer a welfare loss of US\$ 2.6 million despite the entire revenue from the export tax being passed on to them. This is because part of the producer surplus is lost due to the inefficient allocation of resources as a result of the export tax, whereas another part of the loss in the producer surplus becomes part of the processors surplus. In the “short run”, producers’ possibilities to escape the tax are limited as they can hardly switch to production in another sector, implying that they bear the brunt of the export tax on RCNs. In contrast, the relatively elastic RCN demand implies that artificially lowered RCN consumer prices generate a lot of

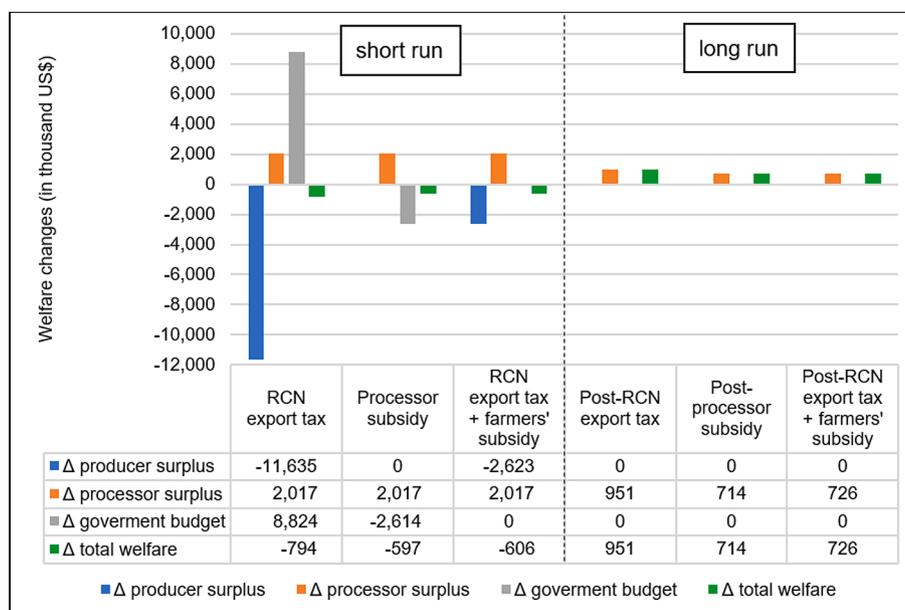


Fig. 4. Welfare changes compared to the base in thousand US\$.

additional welfare for processors. On the other hand, however, a large amount of additional net welfare could be generated by eliminating the consumption distortion, which is comparably high due to the elastic demand. In the “long run” scenarios, as the price policies are phased out, the producer surplus and government budget fall back to their base-values. Due to the (assumed) decrease in variable costs (Table 4), the processor surplus increases.

#### 4.4. Sensitivity analysis

To assess the robustness of the model results, we carried out a sensitivity analysis, in which all elasticities ( $\epsilon$ ,  $\beta$ ,  $\eta$ ,  $\mu$ ,  $\omega$ ,  $\rho$ ) were halved and doubled. We find that the responsiveness of RCN supply, RCN demand, and RCN exports to price policy-induced price changes increases significantly when elasticities are doubled and decreases significantly when elasticities are halved. Noteworthy, none of the variables change signs. Fig. A2 presents the deviations of the welfare effects in the “short run” scenarios resulting from a doubling and halving of all elasticities. The “long run” scenarios are set up such that welfare changes correspond to the net welfare changes of the respective scenario in the “short run”, discounted and with the opposite +/- sign. In general, doubling elasticities increases net welfare losses, while halving elasticities decreases net welfare losses. Interestingly, changing the elasticities shows that the previous conclusion that an inelastic supply of RCN hurts farmers is situation-dependent. In the “RCN export tax + farmers’ subsidy” scenario, if all elasticities are halved, the consumption and production distortions decrease and the government funds available for a producer subsidy increase. Hence, the positive effect of a producer subsidy offsets the negative effect of an export tax on producer surplus to a greater extent.

### 5. Discussion

#### 5.1. Potential decline of variable costs

To offset the welfare losses incurred in the “short run” scenarios with welfare gains in the “long run” scenarios, variable costs would have to fall from US\$ 112.8 to between US\$ 71 and US\$ 61 (Table 4), bringing

them to a level slightly above that in Vietnam (Fig. 1). Assuming the minimum wage for factory workers, labour costs in Ghana are not much higher than in Vietnam (Salery Explorer, 2021; GPMI, 2021), but labour productivity in West Africa compared to Asia is only about half as high (Ton et al., 2018). As variable costs, that is, labour productivity, is considered a matter of experience and training, this should not be an insurmountable problem. Conversely, low labour productivity constitutes a long-term structural challenge in Sub-Saharan Africa (Calderón, 2022). In the past, price policies provided incentives for increasing cashew processing and ensured the survival of processors during the period of support programmes. However, their effectiveness in terms of productivity gains that enabled processors to stand on their own feet once protection was lifted proved limited on the African continent. In Mozambique, the abolition of the export tax on RCNs had a devastating effect on the processing industry (McMillan et al., 2002), similarly to Nigeria, which saw a sharp downturn in processing following the abolition of the *Export Expansion Grant* in 2015 (Pal, 2021b). Presently, policy support for processors in Côte d’Ivoire and Benin notwithstanding, variable costs in both countries are comparable to Ghana (Fig. 1), where *laissez-faire* rules.

Today, processing is a capital-intensive activity – with a relatively minor share of variable costs. Thus, even if the shape of the learning curve in Ghana were to suggest that factory workers could catch up with labour productivity levels in Vietnam, the reductions in variable costs would be insufficient to compete directly with Vietnam on the processing cost side due to the low share of variable costs in total processing costs. Besides the steepness of the learning curve, the time required to bring variable costs down to Vietnamese levels is also a function of the extent to which the experience of Vietnamese processors is transferable. If Vietnam’s decades-long head start in knowledge accumulation could be copied, it would be justifiable to assume a closing of the gap in variable costs between both countries in the foreseeable future.

That said, the current difference in variable costs between Vietnam and Ghana is not the only factor standing in the way of a competitive manufacturing industry in Ghana. It is also not the only issue where Ghanaian industrialists have the potential to learn and improve over time.

## 5.2. Other costs

With increasing mechanisation of processing, management skills become a complex system of entrepreneurial decisions. In the past, African processors have made unrealistic business projections, ad hoc decisions about technologies, and inappropriate factory layouts that were not matched to processing volumes, and workers' skill levels, and incompatible with credit conditions (UNCTAD, 2021; ACA, 2021e). Therefore, publications of manuals such as the *Guidebook to Cashew Nut Processing Equipment*, which challenges processors to choose between 170 different equipment suppliers for different processing stages (ComCashew, 2019b), should be accompanied by the provision of technical advice and mechanics.

One part of the competitiveness in processing costs is attributable to tacit knowledge, another part is the right machinery – a prerequisite to achieving productivity growth. Indeed, low-cost access to machinery and spare parts is recognised as a critical factor in increasing productivity (Amiti and Konings, 2007). Currently, demand for machines, maintenance work, and spare parts from the West African processing sector is still too low to make it economically viable for engineers to manufacture processing equipment locally (Pal, 2021b). In West Africa, importing machinery and equipment complicates procurement and results in fixed costs that are 68% higher than in Vietnam (Fig. 1). Against this backdrop, the *Cotton and Cashew Council of Côte d'Ivoire* is cooperating with the Vietnamese *Technical University Ho Chi Minh*, which provides local processors with knowledge and access to processing technology (Tessmann, 2017). However, Vietnamese processors called on the government to protect their intellectual property and minimise the technological spillovers arising from the export of Vietnamese machinery (Spindle and Agarwal, 2017). To maintain the technology transfer, Côte d'Ivoire entered a reciprocal relationship with Vietnam and signed a Memorandum of Understanding with the Vietnam Cashew Association, granting Vietnam priority access to part of its harvest by reserving 200,000 MT of RCNs for exports to Vietnam and providing Vietnamese companies with information on reliable RCN exporters (Tessmann, 2020). For Ghana, given the eight times lower RCN production, a comparable deal seems less probable. *Inter alia*, because Vietnam's willingness to make concessions would be lower. First, due to the higher transaction costs associated with a new agreement compared to an extension of the existing agreement, and second, due to the lower quantity of RCNs that Ghana could reserve in return. Moreover, Ghana, among other West African countries, is already cooperating with international development organisations to properly manage processing equipment and spare parts (ACA, 2021f).

To summarise, the development of an industry goes beyond the process of training workers and then running some factories, but it also requires a critical mass that allows the emergence of an industrial cluster of specialised suppliers offering complementary services.

Another relevant cost component are the financial costs, which are even 83% higher in Ghana as compared to Vietnam (Fig. 1). Inadequate financial services reflect the general credit situation in Ghana and are not easily remedied in the sector. However, they might specifically affect the cashew sector due to its high-risk profile and the fact that investors might be fearful of venturing into infant industries (Kafka, 1962). Price policies can only be a second-best response to this obstacle, whilst the first-best policy would be to create more efficient financial markets.

By far the most important cost component, the RCN price, is the only cost advantage for Ghanaian processors over the Vietnamese and Indian processors. While Vietnamese processors import around 60% of their RCN demand from Africa, local RCN supply is easily accessible for Ghanaian processors (yet often not affordable to them) (ACA, 2021c).

## 5.3. Kernel prices

There is growing interest in reliable African kernel suppliers from buyers in Europe and the United States of America (ACA, 2021f). One of

the main reasons behind this is the increasing social and environmental awareness of consumers, and new legislations such as the German Supply Chain Act, holding buyers responsible for what occurs in their supply chain. As news of labour rights violations in cashew processing factories in Vietnam and India have come to public attention (Slow Food, 2020), USDA (2018) stresses that traceability and food safety standards could be more easily addressed under the local sourcing model in West Africa. Therefore, when processors manage to become a reliable business partner, professionalise their marketing, and succeed in communicating to their customers the social impact of cashews in African countries, the benefits from saving thousands of unnecessary transport kilometres, and the advantages from diversifying the highly concentrated supply chain, higher kernel prices are achievable (ACA, 2020c).

Yet, according to Pal (2021b), two scale issues would remain. First, Ghana exports containers of mixed kernel qualities, driving down prices by about US\$ 50 per MT of RCNs processed compared to graded quality. Second, processing of cashew shells could generate an additional US\$ 110 per MT of RCNs in revenues, but this turns profitable only at consolidated processing volumes that exceed the total current Ghanaian kernel supply.

## 5.4. RCN production

Krugman (2000) associated export taxes on RCNs in Mozambique with the strong political influence of urban processors and the low influence of farmers – a situation described by Lipton (1977) as *urban bias*, which he identified as one of the major institutional obstacles to poverty reduction in developing countries. Mozambique serves as a cautionary tale of how a lack of compensation for the export tax on RCNs can financially disincentivise farmers to invest in new cashew trees or to maintain existing ones, which, together with tree diseases, led to a deterioration in quality and a reduction in quantity of the domestic crop (Costa and Delgado 2019; Cramer, 1999).

Therefore, to mitigate the income transfer from smallholders to processors, a time-bound compensation mechanism would be needed for the duration of the export tax. First, this would counteract a deterioration of living conditions in the cashew-growing regions and thus a further worsening of regional disparities. Second, this would contribute to ensuring domestic RCN production in sufficient quantity and quality – the backbone for the development of a domestic cashew processing industry. To increase the profitability of cashew cultivation in Ghana, Danso-Abbeam et al. (2021) make the case for providing technical and farm management trainings on pest and weed control and promoting farmers' access to an efficient distribution system. Furthermore, Akyereko et al. (2022) point to the low utilisation rate of cashew apples<sup>11</sup> of only 10% and suggest their commercialisation as a means whereby farmers could supplement their incomes.

In the currently prevailing market setup, which has been described as a *trader-driven* chain (Fitzpatrick, 2011), RCN traders come once a year and only collect the raw material, without encouraging RCN growers to improve the crop quality and without creating any knowledge spillovers (Tessmann, 2017); hence, no upgrading opportunities arise for farmers (Humphrey and Schmitz, 2002). In fact, one of the main advantages of local processing is that it creates opportunities to better connect farmers to downstream actors and make them knowledgeable about the supply and demand picture and market conditions (Klijn, 2022).

In Côte d'Ivoire, local processors support farmers by rewarding quality and loyalty as well as by helping them to improve farm management and by providing inputs (World Bank, 2018a). While Ghana's

<sup>11</sup> The cashew apple that carries the cashew nut, has a high vitamin C content, and a high perishability. Only within hours after harvest, it can be consumed raw or can be processed into juices, soft drinks, alcoholic beverages, vinegar, and jam (Dendena and Corsi, 2014).

largest processor is located in the Greater Accra region, other factories are situated in the country's cashew-growing areas. Partnering with farmers could, as [Greenwald and Stiglitz \(2006\)](#) argue, create a more dynamic rural sector and multiplier effects. For example, the benefits of increased processing might be transferred to the rural sector by employing family members of cashew-producing households and the increased labour demand in downstream activities could drive up wages in agriculture.

Moreover, the food system shock caused by the COVID-19 pandemic highlighted, among other things, the risk arising for the sector from dependence on only two countries for processing. Unlike India, Vietnam – due to its low infection rates – was able to keep its processing plants operational ([ACA, 2020c](#)). However, if the Vietnamese factories had also been forced to close, much of the West African RCN harvest would not have found buyers due to a lack of alternative processing facilities or warehouses. This would have had a devastating impact on the entire sector. Increased regional value-addition would diversify the origin of buyers, improve the resilience of the sector to shocks, and reduce its strategic vulnerability to *black swans*. Thus, issues of industrial development on the one hand and farmers' welfare, rural development, and poverty alleviation on the other hand do not represent irresolvable conflicts of objectives, but could go hand in hand.

## 5.5. Policy implications

### 5.5.1. The business environment

Ghana is currently leaving the cashew sector to its market forces. [Tilton \(2021\)](#) described the situation as follows:

*"I could be an Indian tourist coming to Ghana, not having a registered company, not paying taxes but buying RCN. So, it is really difficult for legal businesses to compete."*

The combination of providing a very favourable business environment for RCN traders and foreign competitors who tilt the playing field makes Ghanaian processors feel inferior. While some RCNs are currently processed in Ghana, the lack of political support stands in the way of state-of-the-art mechanisation, increased processing, and associated productivity gains. [Pal \(2021b\)](#) put it this way:

*"...labour productivity is low... The possible answer would be to mechanise more, but then there is pressure to use capacity appropriately, and that is only possible if you buy enough RCNs, and for that, you have to compete with exporters, and that is only possible if at least the perception of risk of not being able to compete is mitigated by policy."*

Why do processors in Ghana perceive their business as risky? Because Indian processors pay high RCN prices due to their highly protected market, whereas Vietnamese processors have been supported for 25 years and today have a remarkable superiority in processing technology. Therefore, Ghanaian processors feel that they lack the leeway that allows India and Vietnam to pay higher prices for RCNs and, in a cashew-world shaped by government intervention, they lack the confidence that RCN prices will reach workable levels for them. Against this background, government support may work as a signal that it is economically rational to invest into processing in Ghana.

Given the distortive trade policies of Ghana's trading partners in the cashew sector, the first-best option to level the playing field would be to abolish these policies. As this is not in the hands of the Ghanaian government, following the rationale of [Bhagwati and Ramaswami \(1963\)](#) for an optimal intervention at the point of distortion, the second-best response appears to be a (differentiated) export tax on RCNs, as discussed by [Bouët et al. \(2014\)](#) for the oilseeds value chain.

### 5.5.2. A case for an export quota

When it comes to creating space for a nascent industry to develop, [Melitz \(2005\)](#) advocates an import quota, whose advantage lies in automatically lowering the level of protection and thus the foregone welfare as the learning process progresses. In the case of an export tax or a processing subsidy, the level of protection would have to be adjusted in line with the industry's learning process. In practice, it is hard to conceive of a scenario in which such manual adjustment could come about because until the learning process is complete, governments normally have no information based on which to predict the learning curve ([Rauch, 1992](#)). Another advantage of a quota over an export tax and subsidy would be that, provided the industry becomes more efficient over time, the quota would not need to be removed but be self-abolishing.

Concerning our simulations, in the short run, prior to productivity increases and assuming that the export quotas are sold efficiently, the results of the "RCN export tax" scenario are equivalent to a quota. Whenever the learning phase commences, the short-run net welfare losses would decline more under a quota than they would under the "RCN export tax" scenario, which means that the required long-run productivity increases would also be lower under a quota scenario. In short: the results of the "RCN export tax" scenario could be regarded as an upper bound for those that would arise in the case of an RCN export quota.

### 5.5.3. Political economy considerations

Because the introduction of price policies affects the distribution of resources in all scenarios and associated political economy considerations, the self-phasing out of a quota is a desirable feature. It is a well-known challenge for the implementation of successful industrial policies that the beneficiaries of the policy, in our case the processors, could form a lobby to capture the political process ([Melitz, 2005](#)). Maximising national welfare is not always the government's priority *per se* and policymakers may be caught up in self-interest ([Aghion et al., 2015](#)). [Grossman and Helpman's \(1994\)](#) lobbying model, where protection is endogenous and politicians act in pursuit of their selfish interests, posits that policymaker's valuation of actor's welfare is relative to their contributions. Their protection for sale model was extended by [Gawande and Bandyopadhyay \(2000\)](#) by including intermediate goods to assess upstream and downstream lobbying. In the Ghanaian cocoa sector, processors, unlike the many smallholders, have managed to overcome the issue of collective action and have formed an interest group ([Whitfield and Buur, 2014](#)) – a necessary condition for effective lobbying where processor's contributions could be traded for supportive price policies. Thus, in contrast to our model, once introduced, a price policy might not be temporary but become self-perpetuating by means of positive policy feedback ([Pierson, 1993](#)). In addition to the fact that policies can create self-reinforcing effects, [Boamah and Sumberg \(2019\)](#) point to Ghana's tomato paste and sugar sector, in whose agro-industrial development the state began intervening six decades ago and has not withdrawn to date, regardless of the effectiveness of the interventions.

Ghana's two dominant political parties, the *National Democratic Congress* and the *New Patriotic Party*, have had tight battles for the presidency in recent elections. Swing voters are central to winning national elections, consequently the ruling party tries to shape policy in ways that retain party loyalists, attract swing voters, and do not disadvantage larger groups of the population ([Whitfield, 2011](#)). This observation resonates with the politically influential opposition to the RCN export ban – 125,000 cashew growers are a considerable potential electorate who saw a direct link between the export ban and their welfare losses. A comparable backlash is not to be expected in the "Processor subsidy" scenario, as its costs are less visible and traceable to

taxpayers, two preconditions for their activation (Arnold, 1990). Also, the Ghanaian government expenditure of US\$ 17.4 billion in 2020 (MoFEP, 2021) would increase only insignificantly by the cost of the subsidy (US\$ 2.6 million) and thus not result in a significant increase in the tax burden.

#### 5.5.4. Which price policy to select?

No matter which of the three scenarios is implemented, there will be backlash from stakeholders that are worse off, implying that compromises may be unavoidable for the interim.

If more learning by doing through the increased quantity of RCN processed during price policies has a causal effect on productivity growth, a first-best argument could be made for a processor subsidy, while the export tax on RCN would be a second-best solution. The superiority of a subsidy over an export tax lies in the more efficiently achieved policy objective of increasing processing without having unintended consequences on RCN production.

Ghana's fiscal deficit in 2020 was 15.2% of GDP (IMF, 2021). Notably, the "Processor subsidy" scenario would lead to additional government expenditure, with spending increasing as processing grows. However, to strategically align Ghana's tree crop sector with future climatic conditions, it should be considered that the country's comparative advantage in RCN cultivation will further increase under climate change, while areas suitable for cocoa cultivation will decrease (CIAT, 2011). Above all, what is needed is a paradigm shift in the allocation of public funds: Ghana allocates 5% of its national budget to the agricultural sector (OECD-FAO, 2016), well below the *Comprehensive Africa Agriculture Development Programme* commitment of 10%, and half of this support goes to the cocoa sector (World Bank, 2017). Furthermore, the Ghanaian economy faces a mineral resource curse – gold and crude petroleum accounted for almost 66% of the export value in 2020 (OEC, 2023). The resulting phenomenon of Dutch disease leads to a reduction of the international competitiveness of the agricultural and manufacturing sectors (Asumadu et al., 2021). One proposed method to alleviate the impact of Dutch disease is to impose taxes on mineral resource exports and redistribute the tax revenues to support the affected sectors (Mien and Goujon, 2022). Against this background, the "processor subsidy" scenario gains additional legitimacy.

Besides, cashew processing may generate social benefits, *inter alia*, a knowledge externality which is not captured in the producer surplus but has a positive impact on the efficiency of the rest of the industry. Bardhan (1971), for instance, models learning as an externality that depends on the cumulative output of the learning industry, that is, the learning of one company is the learning of the industry as a whole. However, not all knowledge leading to productivity growth is simply a by-product of the activity itself. Baldwin (1969) suggests that there may be certain other costs associated with acquiring knowledge that lead to market failure because they are not appropriable. Baldwin (1969) therefore advocates subsidies aimed at knowledge acquisition. In this regard, the provision of technical advisors to the processors could complement the price policies to ensure targeted learning by doing, accelerate productivity growth and, if applicable, would reduce the externality problem and the reluctance to invest in knowledge acquisition.

The "RCN export tax" scenario would lead to a 12.5% drop in the RCN price and a deterioration of the producer surplus of US\$ 11.6 million – corresponding to a substantial average welfare loss of US\$ 93 annually per smallholder farmer. Therefore, it would not only raise questions of equity but also lead to a decline in the large volumes of

Ghana's RCN exports. Also, the government revenue from the export tax of US\$ 8.8 million appears relatively insignificant when compared to its total revenue of US\$ 9.6 billion generated in 2020 (MoFEP, 2021). The "RCN export tax" scenario would, in addition to a relatively minor decline in the price inelastic RCN supply, manifest itself far more in a decline in smuggling of RCNs into Ghana. Arguably, the concomitant negative impact of the decrease in the value of RCN exports could significantly exceed the positive impact of the increased export value of kernels. With a constantly depreciating Ghanaian Cedi, foreign exchange is a national interest. Yet, as the total export value of RCNs in 2019 accounts for only 1.34% of Ghana's overall exports of US\$ 16.8 billion (ITC, 2021a), the foregone foreign currency would be relatively small. The same would hold true for an export quota, but unlike an export tax, a quota would have the virtue of reducing the burden on smallholder farmers as soon as processors begin to learn. In summary, although the "RCN export tax" scenario generates direct tariff revenues, indirect effects render it unattractive to the government. These indirect implications include the unpopularity among the 125,000 cashew growers and value chain actors that benefit from the existing market regime, as well as the potential decline in the overall value of cashew exports.

The "RCN export tax + farmers' subsidy" scenario offers a hybrid solution between the "RCN export tax" and "Processor subsidy" scenario, since the government budget is not strained and, more importantly, some sense of fairness is maintained by mitigating the negative impact on farmers.

## 6. Conclusions

Ghana's self-perception as an economic power in West Africa, its ambition to create more value and to participate more gainfully in the cashew trade result in a political receptivity for regulating the sector. The process of structural transformation will involve trade-offs between policy objectives, and there will initially be winners and losers. Existing interests in continuing to export RCNs as a raw material need to be balanced against the potential long-term benefits that would accrue from processing. This analysis shows the potential for cashew processing to increase significantly with temporary political support. Yet, this leads to net welfare losses – like any price policy in a "small country" in a neoclassical market model where externalities are absent. Such welfare losses in the short run could be justified by overcoming the factors hindering the development of a competitive domestic processing industry in the long run. This seems feasible for Ghana.

While there is some potential for savings in processing costs, Ghana is unlikely to be able to compete directly with Vietnam on processing costs in the foreseeable future. Cost reductions are possible due to learning by doing, emerging internal and external economies of scale, and a lower risk profile of the sector, leading to lower financing costs. It is, however, doubtful that processing costs will be reduced to the Vietnamese level, also because the high financing costs are a problem that affects not only the sector but the entire economy.

But there is no need to compete directly with Vietnam on processing costs. In the end, the difference between processing costs, RCN prices, and kernel prices must be matched for the industry to reach the tipping point where domestic processing becomes self-sustaining. Ghana's proximity to the raw material and the major kernel importers is a considerable advantage. Finally, there is a catch-up potential in kernel prices, especially if the sustainability of the value chain can successfully be communicated to final kernel customers.

The degree to which price support effectively contributes to increasing processors' competitiveness is a function of the steepness of their learning curve, their entrepreneurial skills, the emergence of economies of scale, as well as the responsiveness of RCN supply, the quality of the infrastructure, the conduciveness of the business environment, and the financial markets. Due to these multidimensional drivers, price policies should not be seen as a silver bullet to overcome the sector's obstacles but just as a temporary framework condition that can level the political playing field and the associated risk perception. Such policies are much more likely to be successful if accompanied by government interventions addressing the fundamental infrastructure and credit issues that impede the sector's development. In case of a successful implementation of such a policy mix, a higher value addition in processing would not only imply higher, more diversified, and less volatile export earnings, but also a more dynamic and market-connected agricultural sector being more resilient to external shocks.

To mitigate the conflicting goals of alleviating rural poverty and promoting value addition arising from an RCN export tax, a policy mix would allow to consider Ghana's cashew sector holistically and to reflect the interdependence of cashew production and processing. It should have the mandate to transfer the benefits of a larger industrial sector to the rural sector, ensuring that long-term gains ultimately spill over to those that have sacrificed welfare in the beginning, so that everyone in the sector is better off in the long run.

Concerning the choice of price policy, a processors subsidy would be the first best option: it would not result in a loss of income for the 125,000 smallholders who form the backbone of the cashew industry, would not exacerbate regional poverty disparities, and would not risk

losing foreign exchange earnings from RCN exports.

Scale issues such as the lack of specialised suppliers and heterogeneous container loads of kernels would best be addressed in the context of (West) African cooperation. The *Consultative International Cashew Council*, which many ECOWAS members have already joined and other African countries are expected to join, can provide a platform for strategic cooperation. In particular, the integration of the hitherto national cashew value chains across Africa would have a strong potential. To achieve this, national trade policies would have to be replaced by a unified regional approach. The African Continental Free Trade Area could then allow existing processors to access partner countries' RCN harvests, thus providing them with more stable access to RCNs.

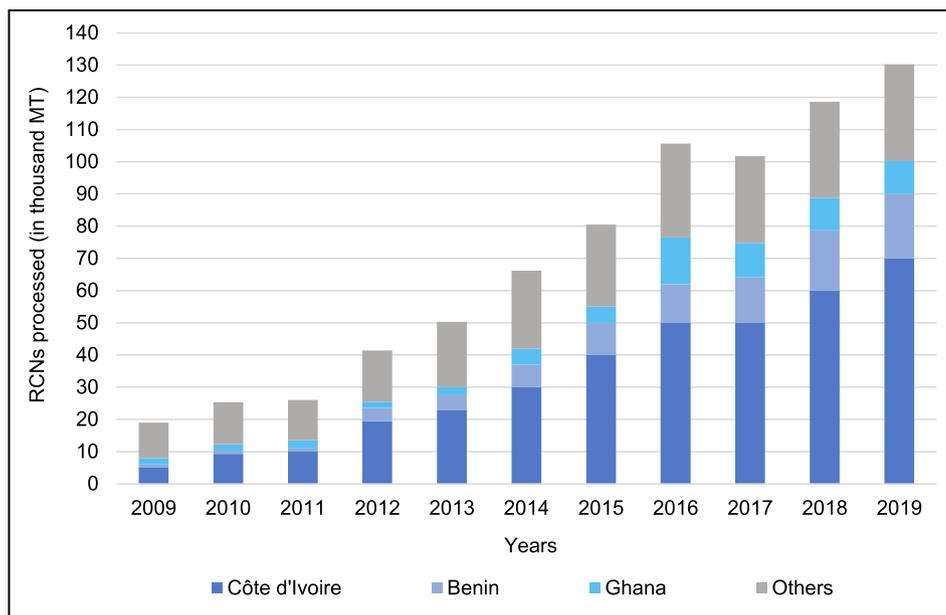
**CRedit authorship contribution statement**

**Jonas Wittern:** Conceptualization, Methodology, Software, Investigation, Data curation, Visualization, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Jonas Luckmann:** Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing. **Harald Grethe:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Appendix A**



**Fig. A1.** Volume of RCN processed, differentiated by leading processors in West Africa. Source: Own visualisation, based on data from [ACA Cashew Barometer \(2021\)](#).

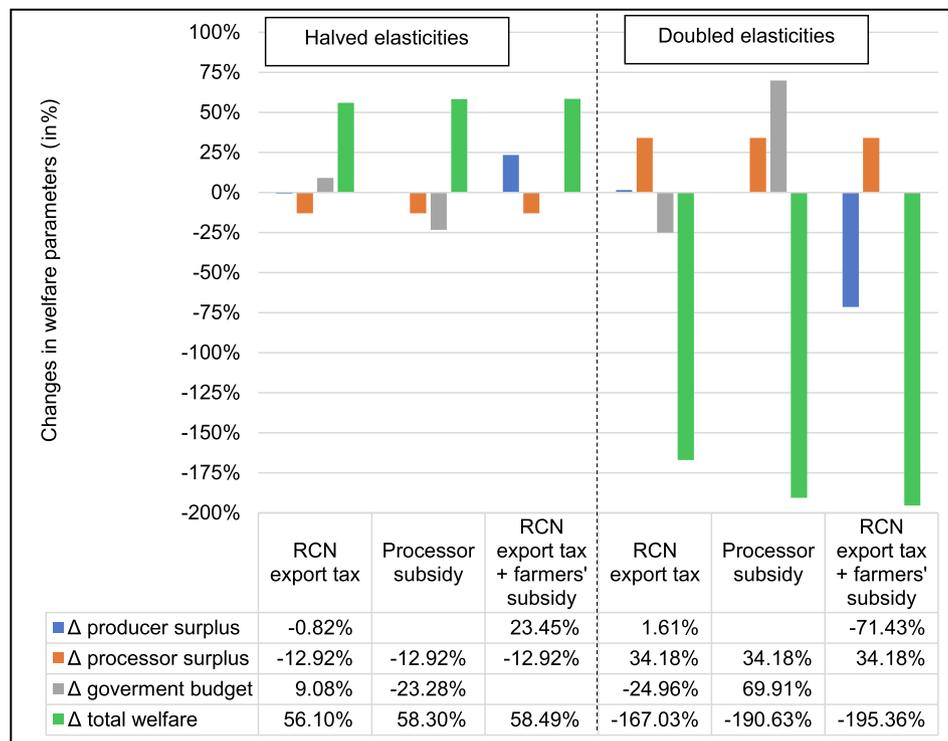


Fig. A2. Percentage deviations of welfare parameters for the “short run” scenarios with all price elasticities halved and doubled.

Table A1

Average RCN prices and average kernel prices per MT of RCN equivalent, the difference between both (price margin), and the quantity of RCN processed in Ghana from 2015 to 2020. Source: Own visualisation based on data from ACA Cashew Barometer (2021); ComCashew (2019a); ComCashew (2021).

Year	2015	2016	2017	2018	2019	2020
RCN import price CFR (US\$/MT) Vietnam/India	1,298	1,538	2,049	2,023	1,302	N/A
RCN export price FOB (US\$/MT) Ghana	N/A	N/A	N/A	N/A	N/A	901
Kernel export prices FOB (US\$/MT of RCN equivalent) Vietnam/India	1,739	2,037	2,414	2,047	1,693	N/A
Kernel export price FOB (US\$/MT of RCN equivalent) Ghana	N/A	N/A	N/A	N/A	N/A	1,257
Price margins (US\$/MT of RCN)	441	499	365	24	391	356
Processed RCNs (MT) in Ghana	5,000	14,500	10,700	10,005	10,174	13,658

Table A2

RCN supply, RCN demand, and RCN exports (in thousand MT) in the different model scenarios, as well as the value of RCN supply, RCNs processed, and RCN exports (in thousand US\$).

	Scenarios						
	Base	RCN export tax/ quota	Processor subsidy	RCN export tax + farmers' subsidy	Post-RCN export tax/quota	Post-processor subsidy	Post-RCN export tax + farmers' subsidy
RCN supply (thousand MT)	105.0	101.6	105.0	104.3	105.0	105.0	105.0
RCN demand (thousand MT)	13.7	23.2	23.2	23.2	18.5	17.2	17.2
RCN exports (thousand MT)	91.3	78.3	81.8	81.1	86.5	87.8	87.8
Value of RCN supply (thousand US\$)	94,605.0	91,498.9	94,605.0	93,940.0	94,605.0	94,605.0	94,605.0
Value of RCNs processed (thousand US\$)	17,168.1	29,170.9	29,170.9	29,170.9	23,264.2	21,604.7	21,680.7
Value of RCN exports (thousand US\$)	82,299.1	70,589.6	73,695.7	73,030.7	77,929.5	79,119.1	79,064.6

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