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Table of contents

Introduction

Developing countries' agricultural markets are characterized by unique challenges such as limited infrastructure, low technological advancements, fragmented production systems, and information asymmetry. These factors contribute to price volatility, inefficient market structures, and unfair bargaining power among market participants. As a result, governments, with the aim of promoting agricultural development and ensuring food security, often intervene to establish price setting mechanisms that strike a balance between the interests of producers and consumers.

One common price setting mechanism in developing countries is government intervention through direct price controls or subsidies. Governments may set minimum support prices (MSP) to provide a guaranteed floor price for certain agricultural commodities, protecting farmers from extreme price fluctuations. By ensuring a fair price, governments incentivize farmers to produce staple crops, enhance income stability, and encourage investment in agriculture. Additionally, subsidies on inputs such as fertilizers, seeds, or irrigation can reduce production costs and ultimately influence market prices.

The first chapter undertakes a review of Rwanda's coffee value chain and analyses the mechanism used to set up the minimum price for coffee cherries. The analysis discusses the way in which minimum cherry coffee prices are determined in Rwanda, and points out potential areas of improvement. The price setting mechanism currently utilized has some important limitations, namely data reliability, international coffee price volatility and rents repartition along the chain. To address these issues, the chapter recommends to i) use more recent cost data on wet milling, dry milling and exporting in the price setting table; ii) use adjustment factor to account for international price volatility. The introduction of average future prices, when used jointly with the more recent cost data, allows floor prices to become more sensitive to international market conditions, and iii) identify rents for each actor along the coffee value chain. The identification of mark-ups for each stakeholder allows to a more equitable distribution of rents along the chain. The proposed mechanism showed that, even in the case of unfavorable conditions in the international market, producers would have been able to gain some profit in the presence of fixed and more fair mark-ups for both mills and exporters.

The second chapter analyzes the mechanism used to set up the farm-gate price for Irish potatoes in Rwanda. Similar to the coffee price setting mechanism, that for Irish potatoes presents some limitations. To address these issues, the chapter suggests three main recommendations i) introduce wholesale and retail prices: taking into account wholesale and retail costs and prices in the price setting formula would be a necessary condition for each actor to benefit from potato sales and to provide incentives for farmers for increased productivity; ii) meeting schedule: furthermore, since a single price is determined for the whole year and the potato prices are highly volatile within the year and even the season, addressing price volatility is of crucial importance to drive investment in the sector. At present, there is one meeting per year. iii) update cost figures: given that the cost data used in the price setting table has a strong influence on the computed farm-gate prices, it is essential to regularly measure and revise the production costs used as inputs in the mechanism. It would be useful to take into account a simple inflation adjustment

Finally, the third chapter comments on proposed changes to Mozambique's cotton pricing system as well as the establishment of a cotton price smoothing fund, focusing especially on issues related to dealing with exchange rate risk, the management of the price smoothing fund, and futures pricing. Several remarks and recommendations were made, such as improved exchange rate forecasting methods should be used (e.g., futures exchange rates) in the estimation of minimum prices and, if a smoothing fund is eventually established, a more flexible price band should be adopted.

In conclusion, price setting mechanisms in developing countries' agricultural markets play a critical role in determining the welfare of farmers, ensuring food security, and promoting sustainable agricultural development. Governments, through direct interventions or market-based mechanisms, aim to strike a balance between the interests of producers and consumers. However, the effectiveness of these mechanisms depends on various factors unique to each context. By examining the complexities of price setting mechanisms, policymakers and stakeholders can design targeted interventions to enhance market efficiency, reduce price volatility, and promote inclusive growth in developing countries' agricultural sectors.

Chapter 1

Rwanda's cherry coffee price setting mechanism

1. Overview

In Rwanda, coffee is one of the main export crops since the late 1930s, when became widespread following five waves of mandatory coffee-tree planting imposed by the Belgian colonial administration (Blouin, 2014). At independence, in 1962, coffee represented more than half of Rwanda's exports. Coffee exports started to decline only in the mid 1980s, due to the collapse of coffee prices in the global market, and reached its peak with the political instability in the '90s (Macchiavello and Morjaria, 2017). Since then, a liberalisation process induced a large increase in investments at the processing stages and, subsequently, a specialisation policy, consistent with the country's agroecological conditions, was introduced to favor the production of high value arabica coffee.

Currently, coffee is one of Rwanda's two main export crops and a major source of foreign currency for the country. It is grown by more than 350 000 farmers, which represents about 20-25 percent of all farmers and it accounts for between 12 and 15 percent of Rwanda's GDP. Coffee cherry is a vital source of cash for households, which they rely on to pay for health services, school fees, clothing or food.

Yet, the sector faces several challenges, as activities in the coffee value chain has been rather stagnant over the last decade. While, green coffee output fluctuated between 15000 and 26000 tonnes per year over 2005-18, its production decreased by 7.9% during 2016-2017 (from 20,029MT to 18,439MT) and went up to 21,000MT in 2018. Export data for coffee harvested in 2018 show that only 64% of the exported coffee volumes was washed, i.e. processed through the mill, and export revenues peaked around 70 million of USD in 2011, but have been declining to 60 million USD yearly since and increased again to 69 million of USD in 2018. Thus, the value of Rwanda's exported coffee has remained highly unstable in the past decade. Moreover, in recent years, despite further entry of Coffee Washing Stations (CWSs), which increased from around 90 in 2000 to 187 in 2009 and 299 in 2018 (WB, 2012; NAEB, 2016b), the number of operating mills has remained stable, with a capacity utilization rate of 84% in 2018 (NAEB, 2019).

Against this background, the government has been using floor prices in an attempt to guarantee a minimal level of income for farmers. Since 2011, the National Agricultural Exports Development Board (NAEB) implements the minimum price policy by determining the minimum price each year, in collaboration with sector stakeholders.

Given the role cherry prices have in driving coffee supply and the whole activity of the value chain, it is crucial to take a close look at the way in which floor prices are set. This chapter aims to provide a detailed analysis of the mechanism used by NAEB to determine minimum cherry prices. It starts by providing a description of the current price setting mechanism used by NAEB, in order to point out potential areas of improvements. In section 3, some experiences from other coffee producing countries are analyzed, while section 4 shows data on costs and margins of mills and exporters in the coffee value chain. These figures are confronted with the numbers currently used by NAEB to compute the minimum price. Section 5 introduces adjustment factors. An alternative price setting mechanism, which includes several adaptations and improvements with respect to the current system, is proposed in section 6. Recommendations and suggestions for next steps are summarized in section 7 which concludes the chapter.

2. NAEB's minimum price setting table

In collaboration with sector stakeholders, NAEB determines minimum cherry prices end of January or early February each year, before plucking starts end of February and continues unto June. Since 2011, NAEB uses a specific price-setting table to compute the cherry floor price. The price computed with the table is submitted to the stakeholders in a meeting, for

negotiation before the official price is endorsed. Currently, the price is only indicative and may be revised subsequently if wide variations in the export price are recorded.

Between 2013 and 2016, NAEB has been determining cherry floor prices using a table containing profit and cost figures. Processing costs (dry mill, wet mill and export charges) were deducted from the average export revenue to compute a minimum farm gate price. Before 2013, the table structure could slightly differ but still relied on the general principle of subtracting cost estimates for CWSs, dry millers and exporters from average revenues to compute the cherry floor price.

In January 2017, NAEB introduced a new table, which has been used to set the minimum cherry price since (see Table 1). Its method is different from that used across 2013-16. It computes the difference between the total cost of production (which includes farmers' production costs, processing costs and export costs) and total export revenues. Once farmers, processors and exporters have recovered their costs, the remaining profit is shared among all stakeholders, according to the relative proportion of each agent's costs.

The following paragraphs describe NAEB's January 2017 price setting table in detail, as during the following years (including 2020 and 2022), the minimum price table remained unchanged. The only differences from the 2017 table are the updated international reference price and the exchange rate, and transport costs for mills in 2020 and 2022. The table is divided into three sections: total cost of production, total revenue and calculated producer price.

2.1. Total cost of production

This section of the January 2017 price-setting table has three components: (i) farmer's cost, (ii) wet mill charges and (iii) dry mill and export charges (see Table 1).

The farmer's production cost is estimated to be 177000 Rwf per tonne of cherry coffee. This estimate was produced using the survey results of Clay et al. (2016), which collected data on coffee production using a sample of 1024 households randomly selected from the listings of 16 geographically representative CWSs. Their results show Rwanda's coffee producers can be divided in three groups: smallholders (106 trees on average), mid-range producers (457 trees on average) and large holders (2200 trees on average). While producers having 1000 trees or more farm about 56 percent of all coffee trees in the country and are responsible for about half of the seasonal cherry production, they only represent 18 percent of all farmers. The authors find that low cherry prices result in large holders investing only minimally in production. Accordingly, they have a very low productivity of 1.08 kg of cherries per tree. By contrast, smallholders who invest in labour out of necessity achieve yields of 2.17 kg per tree. However, these smallholders farm less than 10 percent of all coffee trees. Low prices imply all categories of farmers may face punctual losses.[1] As above mentioned, Clay et al. estimate the current average production cost to stand around 177 Rwf per kilo of cherries. Early 2016, the cherry price stood at 150 Rwf per kilo, which means a large (although not precisely known) proportion of coffee growers did register losses during that season. In the price-setting table, the farmer's cost is multiplied by 6.7 (cherry-to-green transformation ratio) to obtain the farmer's production cost per tonne of green coffee.

The wet mill charges are the costs incurred to obtain parchment coffee from the cherries, per tonne of green coffee. The transport costs to Kigali and the bank interests paid by CWSs are added to these costs. The wet mill charges that are reported in the table have remained unchanged since 2013.

The dry milling and export charges encompass different items, namely contributions to fertilizer and insecticide funds, dry milling costs, logistical costs, bank transfers and overheads. While the contributions to fertilizer and insecticide funds remained unchanged since 2013, dry milling and logistical cost figures increased from 2016 to 2017. The bank transfer rate, which was set at 2 percent of total revenues in 2013-16, went down to 1 percent in 2017. The overhead sub-section (2 percent of total dry milling and exporting charges) was added in 2017.

Overall, in this table the total cost of wet milling amounts to 331875 Rwf per tonne of green coffee, and the total cost of dry milling and exporting (combined) amounts to 273611 Rwf per tonne of green coffee. In fact, fixed dry milling and

[1] However, smallholders can do little but continue to invest as much as they can in production since coffee is an important source of cash for them.

exporting costs amount to 200871 Rwf and 39833 Rwf respectively, but by adding bank transfer and overhead charges the final cost ends up reaching 273611 Rwf. The total cost of production per tonne of green coffee of 1,791,386 is obtained by adding up the farmer's cost, the wet mill charges and the dry mill and export charges.

2.2. Total revenue

This section of the January 2017 price-setting table estimates total average revenue per tonne of green coffee sold. Starting from the average Kigali Free-On-Truck (FOT) price, which is taken as the sum of the New York Coffee C futures contract (NYC) first-nearby price and a price differential. FOT prices in Rwf are calculated for 3 different coffee grades: (i) grade A and B, (ii) grade C (A, B and C grades are the fully washed coffee) and (iii) 'TRIAGE' coffee (not fully washed) (see Table 1).[2]

In the January 2017 table, the grade A and B price is equal to the average FOT Kigali price (175 cents/lb or about 3.85 USD/kg[3]), the grade C price is equal to 0.9 USD/pound (or about 2 USD/kg) and the 'TRIAGE' coffee price is equal to 0.6 USD/pound (or about 1.3 USD/kg). It should be noted that the grade C price changed from 0.7 USD/pound in 2013-16 to 0.9 USD/pound in 2017. Using the prices for each coffee grade, the table computes an average price (or 'revenue') per tonne of green coffee, based on the relative proportions of the different grades in total production. The relative proportion of coffee types in total production changed with the table update, going from 0.75 (grade A and B)/0.18 (grade C)/0.07 (TRIAGE) in 2013-16 to 0.8 (grade A and B)/0.15 (grade C)/0.05 (TRIAGE) in 2017. These numbers were again changed with the 2020 update, going back to 0.75, 0.18 and 0.07, respectively. The share of high quality coffee in the average revenue per tonne of green coffee thus increased. All other things being equal, this increases revenues and leads to higher producer prices. A summary of data and method changes introduced in the table between 2013-16, 2017 and 2020 is given in Table 10 in Appendix.

2.3. Calculated producer price

In this section of the January 2017 price setting table, the total cost of production is deducted from total revenues to obtain the average profit per tonne of Rwandan green coffee sold. The cherry floor price is then computed according to the following formula:

$$p_{fg} = \left(\frac{FC}{TC}\right) * \pi * \frac{1}{6.7}$$

Where p_{fg} is the minimum farm gate price in Rwf/kg of cherries, *FC* is the farmer's production cost in Rwf/kg of cherries, *TC* is the total production cost (including wet mill and dry mill charges) in Rwf/kg of green coffee, π is the computed average revenues in Rwf/kg of green coffee and 6.7 is the cherry-to-green transformation factor.

Therefore the minimum price for coffee cherries is equal to: (1,185,900/1,791,386)* (2,754,211/1000) *1/6.7=272.13

The January 2017 reform of the mechanism aims to share profits fairly across the value chain. However, a clearer identification of the profits between all stakeholders would be a necessary condition for each actor to benefit from coffee sales. Secondly, such a scheme is very demanding in data, both in terms of quantity, as each cost at each stage of the value chain should be known, and reliability as each actor may be tempted to artificially increase its costs to capture a higher share of the value-added. Finally, since a single cherry floor price is determined in January or early February for the whole season and the world coffee prices are highly volatile even within each season, addressing international price volatility is of crucial importance to drive investment in the coffee sector.

[2] Table 9 in Appendix shows the same figures for 2020.
[3] The lb/kg conversion rate is 0.45.

Table 1. Price setting table for cherry coffee used by NAEB in January 2017 (beginning of harvesting season).

FARM GATE PRICE - ARABICA CHERRIES 2017			
Item	**Unit**	**C.T**	
I. Farmer's cost			
Cost of production for 1mt of cherry coffee	MT	177,000	
Cost of production for 1mt of green coffee (*6.7)	MT	**1,185,900**	
II. Wet-Mill Charges			
Wet processing	MT	250,000	
Transport		31,250	
Sub-total		281,250	
Bank interest (18% of sub-total)	MT	50,625	
Total (sub-total + bank interest)	MT	**331,875**	
III. Dry-Mill, and Export Charges			
Fertilizer fund 97 Rwf	MT	97,000	
Insecticide fund 11 Rwf	MT	11,000	
Dry milling, handpicking, bagging, loading	MT	92,871	
Export bag and marking (1700+(2300 Rwf per bag*30%))	MT	39,833	
Bank transfer (1% of total revenue)		27,542	
Sub-total		268,246	
Overheads (2% of sub-total)		5,365	
Total (sub-total + overhead)		**273,611**	COP Green Rda
TOTAL COST OF PRODUCTION (I+II+III)	MT	**1,791,386**	2.18
Sales and Market Inputs			
Exchange rate (USD)		820.29	
NY"C" Contract (cents/lb)		149.75	
Differential FOT Kigali (cents/lb)		20	**C-price +Dif**
Price FOT Kigali (cents / lb)		169.75	**3.74**
Price FOT Kigali Rwf/Ton/FW(A+B)	0.80 T	2,455,823	
Price FOT Kigali Rwf/Ton/FW C ($0.90 per pound)	0.15 T	244,136	
Price FOT Kigali Rwf/TRIAGE ($.60 per Pound)	0.05 T	54,252	
Price Local Sales (1.11%)			**Rwanda Price**
TOTAL REVENUE (Rwf/Tonne)	MT	**2,754,211**	3.36
Overall Interest/ gain/net profit of Rwandan coffee		1.17	962.83
Contribution % for the production cost/interest share	66.20	637.39	**272.13**
CWS	18.53	178.37	510.25
EXPORTER	15.27	147.06	420.67

Source: NAEB (2016c).

3. Experiences from other coffee producing countries

Global production in coffee year 2018/19 reached 168.05 million bags (165.54 million bags in 2017/18). The largest growth occurred in South America, where output increased by 4.4% to 80.42 million bags. Brazil's 2018/19 crop year production is estimated at 62.5 million bags and its exports in the first five months of the coffee year are 29.7% higher than the previous year, reaching 18.32 million bags. Colombia's production is estimated to rise by 2.7% to 14.2 million bags in coffee year 2018/19. In February 2019, it exported 1.26 million bags of coffee, and its shipments in October 2018 to February 2019, grew by 6.1% to 6.01 million bags production. At the regional level, Africa is estimated to harvest 17.74 million bags in 2018/19, an increase of 1.4% over 2017/18. The top three producing countries in Africa are all estimated to increase their output in 2018/19. Notably, Côte d'Ivoire's production is estimated to rise by 9% to 1.6 million bags. This is reflected in the growth of their shipments in the first five months of coffee year 2018/19, which more than doubled to 617,241 bags compared to last year when they reached 243,155 bags (International Coffee Organization, 2019) (see Figure 4 in Appendix).

Therefore, with about 270000 bags in 2018/19, Rwanda is still a small producer and a price taker in the world market. In order to be competitive, well-functioning markets at all stages of the chain are required: from input provisions and pre-harvest farming technology, to post-harvesting contract enforcement with foreign buyers. Borrowing from Miquel-Florensa (2015), this section presents some lessons on the price setting mechanism in two countries with success stories in the coffee sector, namely Colombia and Costa Rica. Both countries have established strong reputations for quality and an equitable distribution of rents along the chain.

Costa Rica

Costa Rica is a small country with a market dominated by small farmers, where all coffee is fully washed. Traditionally the aim of the authorities has been to protect the coffee growers. This is clearly reflected in the composition of the ICAFE (Instituto del Café de Costa Rica) board: out of seven members, four are representatives of the producers, one of the washing stations, one of the exporters, one of the roasters and one representative of the national executive powers.

The law regulating the relationship among the producers-washing stations- exporters implements a profit-sharing rule between washing stations and farmers, and a mechanism to enforce this rule ensuring farmers on their sale of cherries deposited on credit to the CWS.

The process is structured as follows:

1. Advance payments and reception of cherries: at the moment the farmer deposits the cherries, the CWS issues a receipt for the coffee and an advance payment. The deposit is on volume.

2. Coffee washing station: the CWS has to update every two weeks the amount of coffee received from the producers to ICAFE. The washing station, every three months, gives a payment to the farmer proportional to the executed sales of the washing station. The amount is reported to ICAFE.

3. Export sales and National consumption: the sales from the CWS to exporters or national roasters have to be approved by the ICAFE in accordance with international prices and current price differentials. The board sets the reference prices in relation to the NYC future prices at the time of the coffee delivery, not allowing contracts below the price[4]. The sales are backed by contracts registered at ICAFE.

4. Payment of the final liquidation: at the end of the season the CWS should pay the producers the final liquidation price that is the result of sales minus production costs minus the fixed profit for the CWS (9% of sales – costs) and contribution to FONECAFE (Coffee Stabilisation Fund).[5] The final liquidation prices should be published in

[4] Crucially, the differential applied (week-by-week) on to the NYC price is not disclosed to market participants.

[5] Following the Law 2762 of June the 21st 1961, profits obtained by exporters are also legally regulated: they cannot be higher than 2.5% of the value of the transaction when purchasing and selling is done assuming market risks. When exporters only act as intermediaries and do not assume the risk of the purchase and fluctuating prices, only 1.5% of the value of the transaction can be charged by exporters.

the newspapers of national circulation, and once they have been published the CWS has 8 working days to proceed with the payment to producers. In case a farmer does not receive the payment in the expected time, he can use his sales receipt along with the published prices to the Liquidation Commission to claim his payment. The Commission will follow legal procedure of the washing station to ensure the payment.

The main advantages of this system are; i) the well identified and fixed profit for CWS and exporters, which is meant to provide farmers with (at least) 80% of the reference price and it allows for a more transparent distribution of rents along the chain; ii) the strong monitoring by ICAFE, which guarantees contract enforcement in the coffee sector.

Colombia

In Colombia the average annual coffee production is 11.5 million bags, which represents the third total highest in the world, after Brazil and Vietnam (see Figure 4 in Appendix). Like Rwanda, Colombia has a large population of subsistence coffee farmers working on small plots of land, primarily washing coffee at the farm level. Of the 563,000 families growing coffee in Colombia, 96% are families with less than 5 hectares of land, and many farmers are in vulnerable situations both due to reliance on subsistence production and due to the incidence of armed conflict within coffee growing regions. Mainly due to the geographic characteristics of the coffee growing areas, differently from both Costa Rica and Rwanda where coffee is washed at mill level, Colombian coffee is washed on the farms.

The Colombian Coffee Growers Federation (FNC), in addition to the so-called Purchase Guarantee, the public service which guarantees farmers the best base price in the market, computes the domestic price that producers receive for their coffee. FNC has always been seen as a model of transparency not only in Colombia, but in many coffee-producing countries (http://www.cafedecolombia.com).

Daily reference prices are computed according to:

1. The price of the C contract in the New York Stock Exchange, which is the global reference price of washed Arabica coffees.
2. The quality premium, which recognizes the quality, reputation and relative availability of Colombian coffee against other origins.
3. From the addition of these two variables is deducted the so-called “coffee contribution,” of 6 cents per pound, which serves to finance public goods and services that have given Colombian coffee growing its competitive advantage in the global industry. These include, among others: scientific research and technological development by the National Coffee Research Center (Cenicafé); technical assistance provided by the Extension Service; the Purchase Guarantee; activities of commercial promotion and search for new markets; and promotion and defense of the Colombian origin.
4. To the addition of the international price and the quality premium, minus the coffee contribution, the peso-dollar daily closing exchange rate in the local currency market is applied.
5. Finally, logistical and financial costs, which are those necessary for coffee receipt, threshing, storage and export costs, are subtracted.

There are two main advantages of this model. First, the floor price is enforced through the purchase guarantee service which assures Colombian coffee producers that at the moment to sale the coffee, he/she will always find a buyer that is willing to pay a market price without taking advantage of the small coffee grower's condition. Second, reference prices are set daily and consequently are not affected by within-seasonal variation (of both international prices and exchange rates) and do allow for a more fair negotiation between producers and mills.

In addition, in the case of added value or specialty coffees (including sustainable ones), higher quality premiums are recognized and paid by buyers themselves, who are willing to recognize producers’ commitment and additional effort towards quality. Examples include quality premiums recognized to the so-called “microlots”, which are exceptional high-quality and limited-edition coffees, or coffees that win important competitions, such as Cup of Excellence, and then are

auctioned at very competitive prices for the producers. Between January and October 2015, thanks to its commercial work of high added value, the FNC paid to producers' quality premiums worth $6.38 million (1$ = 2,667 peso Colombian), of which about $1.88 million corresponded to specialty coffee premiums (including microlots) and social premiums paid to coffee growers with farms certified under fair trade initiatives. The average value of the additional premium paid for each load of specialty coffee was 4% of standard price.

Table 2 summarizes the main points of the coffee regulation schemes in these two countries. Main takeaway messages are: i) continuously monitoring activities of production costs and revenues along all stages of the value chain (Costa Rica); ii) Reference prices updated daily (Colombia); iii) Fixed mark-ups for mills and exporters (Costa Rica) and iv) Quality premium (significant premiums for specialty coffees) as second payments (Colombia).

Table 2. Experiences from Costa Rica and Colombia

	COSTA RICA	COLOMBIA
Processing	Coffee is sold as cherries to washing stations.	Coffee is (mostly) processed by farmers.
Price formula	Price is determined at the end of the season as sales minus production costs minus the (regulated) profit for the CWS and exporters (9% and 2.5%/1.5%, respectively) and contribution to the stabilization fund.	Daily reference price is based on: the NYC price; the quality premium; minus the coffee contribution (6 cents per pound) and logistical and financial costs.
Insurance scheme	The board sets reference prices in relation to the NY future prices at the time of the coffee delivery, not allowing contracts below these prices.	The purchase guarantee service assures Colombian coffee producers that at the moment to sale the coffee, he/she will always find a buyer that is willing to pay a market price.
Monitoring	Revenues & costs and international prices.	International prices.
Quality premium		The average value of the additional premium paid by buyers was 4% of standard price.

4. Updating cost figures used in the formula

Given the significant influence of cost data on the computed minimum price in the mechanism currently used by NAEB, the statistical accuracy of wet milling, dry milling and exporting costs is of crucial interest, especially because some of these figures have remained unchanged since 2013.

In order to update cost figures used in the table, this report makes use of both a "Rwanda Coffee Washing Survey, 2017" developed by Macchiavello and Morjaria (2019), and a survey carried out by MAFAP, in collaboration with NAEB, in September 2017. While the former focuses on wet milling, surveying more than 250 CWS, the latter analyzes dry milling and exporting costs for 8 companies.

Macchiavello and Morjaria (2019) survey covered all aspects of mills operations. The mill's manager, the main coffee collector, five randomly selected farmers and four randomly selected workers were interviewed at each mill. Table 3 reports summary statistics for mills in Rwanda. For instance, the average mill labor cost is around 130,483 Rwf per tonne of green coffee, while the average cost of procuring is 302,415 Rwf. There is however a high degree of dispersion, as the median mill labor cost is only 103,786 Rwf while the median cost of procuring is 99,405 Rwf. For this reason, it is strongly

recommended to look at the latter values. Therefore, total median cost of wet milling is 326,419 Rwf per tonne of green coffee.

Table 3. Cost of wet milling, per tonne of green coffee

Types of costs	25th-percentile	50th-percentile	75th-percentile	Mean	N
Total labor cost	79,047	103,786	136,685	130,483	256
Total cost of procuring	40,329	99,405	178,310	302,415	252
Total cost of transport	13,709	23,012	30,150	26,491	235
Total cost of marketing	0	0	0	10,050	187
Total Other cost	61,434	100,217	201,387	195,408	241
Total	**194,519**	**326,419**	**546,531**	**664,847**	

Source: Macchiavello & Morjaria (2019) "Rwanda Coffee Washing Survey, 2017". Note: The cost of wet milling has been converted from parchment coffee to green coffee by multiplying by a ratio of (6.7/5.2) (tonnes of cherry necessary to produce one tonne of green/tonnes of cherry necessary to produce one tonne of parchment).

As above mentioned, cost figures for dry milling and exporting are sourced from a MAFAP survey. This collected data on 19 cooperatives or companies, of which 5 companies operating at all three points of the value chain (wet milling, dry milling and export), 2 cooperatives operating at wet milling and exporting stages, 11 cooperatives operating at coffee washing station stage only and 1 company involved in exporting only. All 19 organisations received a questionnaire that comprised questions on costs of wet milling, dry milling, exporting, selling prices, margins and production support activities. For the purpose of our analysis we will exclude the 11 companies operating at the CWS only. Consequently, estimates of the average milling cost were based on cost data provided by 3 companies operating at all stages of the value chain, 2 companies working at both the CWS and exporting stages and 1 company working at both the milling and exporting stages. The resulting figures are shown in Table 4. The total cost of milling per tonne of green coffee amounts to Rwf 60,396 for 2017. This cost includes electricity charges, the costs of bags, transport, and maintenance.

Table 4. Average cost of dry milling, per tonne of green coffee

Types of costs	2016	2017
Electricity	2,931	2,730
Bags	30,275	28,192
Transport	27,523	25,629
Maintenance	3,303	3,844
Total costs	**64,031**	**60,396**

Source: MAFAP (2017)

Lastly, estimates of the costs of exporting per tonne of green coffee were based on 5 companies operating at all stages of the value chain, 1 company working at both the CWS and exporting stages and 2 companies working at both the milling and exporting stages. The results are given in Table 5. Costs of transport and insurance are not included in the table since the coffee is sold Free-on-Truck (FOT), which means the buyer pays for transport and insurance. The total cost of exporting amounts to Rwf 216,094 for 2017.

Table 5. Average cost of exporting, per tonne of green coffee

Types of costs	2016	2017
Warehouse cost	1,875	1,500
Grading and sorting costs	44,425	43,094
Bagging and marking	61,500	61,500
Laboratory analysis costs	2,000	2,000
Taxes	108,000	108,000
Total	**217,800**	**216,094**

Note: Taxes also include costs of certification, admin export papers and contribution to the procurement of inputs (fertilizers)
Source: MAFAP (2017)

The cost estimates computed from the collected data are given in Table 6, which compares the estimates with the figures used in the January 2017 NAEB price-setting table. As can be seen from the table, costs of wet milling and exporting were about 16% higher in the survey dataset with respect to the figures used in the January 2017 NAEB table, while those for dry milling and exports slightly differ in the two columns (difference is only 1%). Overall, the total cost of processing amounts to Rwf 661,663, a 9 percent increase with respect to NAEB's January 2017 table.

Table 6. Costs of wet, dry milling and exports, per tonne of green coffee

Item	NAEB 2017 table	2017 Revised	Difference
Wet milling	281,250	326,419	
Bank interest (18 %)	50,625	58,755	
Wet milling sub-total	**331,875**	**385,174***	**16.06%**
Electricity		2,730	
Bags		28,192	
Transport		25,629	
Maintenance		3,844	
Warehouse cost		1,500	
Grading and sorting costs		43,094	
Bagging and marking		61,500	
Laboratory analysis costs		2,000	
Taxes		108,000	
Dry milling and exporting sub-total	**273,611**	**276,489****	**1.05%**
Total wet milling, dry milling and exporting	**605,486**	**661,663**	**9.28%**

**Source: Macchiavello & Morjaria (2019). Note: median values.*

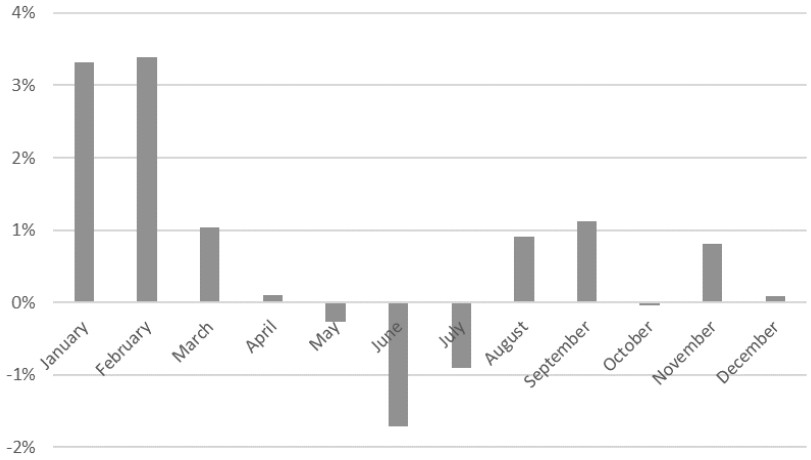
***Source: MAFAP (2017)*

5. Adjustment factors

First, international coffee prices may vary quite a lot across the year (see Figure 1). The effects of this volatility are currently born by all stakeholders along the coffee value chain, according to their sales/payments schedule. Specifically, the vast majority (almost 85%) of payments to farmers occur during the harvest season (i.e., by month four after the beginning of harvest); this reflects the fact that mills rarely source coffee from farmers on credit or make payments to farmers after the end of the season. Mills' sales and deliveries are executed later, as shipments are in bulk and, in some cases, mills might wait to have the right types and volumes of coffee to mix. Exporters instead sell throughout the year (Blouin and Macchiavello, 2019). Since a single cherry floor price is determined in January or early February for the whole season using the NYC first-nearby price, volatility risks are then non-negligible. In addition, Rwf to USD exchange rates are quite fluctuant as well.

There are however a number of ways to deal with this issue. An interesting option would be to use average future contract prices for the whole duration of the upcoming season, instead of spot prices. This would allow to better capture the expectations of the market regarding the upcoming season. Figure 2 suggests that even if the March contract prices do not necessarily differ significantly from other maturities—for example, the maximum spread between futures contracts from March through December 2017 as quoted during January the 31st 2017 was only 10 cents (see Figure 2)—it is still prudent to include all available information. For instance, by only considering first-nearby future prices as currently it is in the pricing formula (149 USD cents/pound), instead of the average of all maturities (154 USD cents/pound), a slight downward bias may be introduced in the minimum price earned by farmers. We therefore propose inclusion of all seasonal maturities, possibly with a weighting system to adjust for typical volumes traded on the various maturities. Figure 5 in appendix shows data for 2020 and confirms that it still prudent to include all maturities.

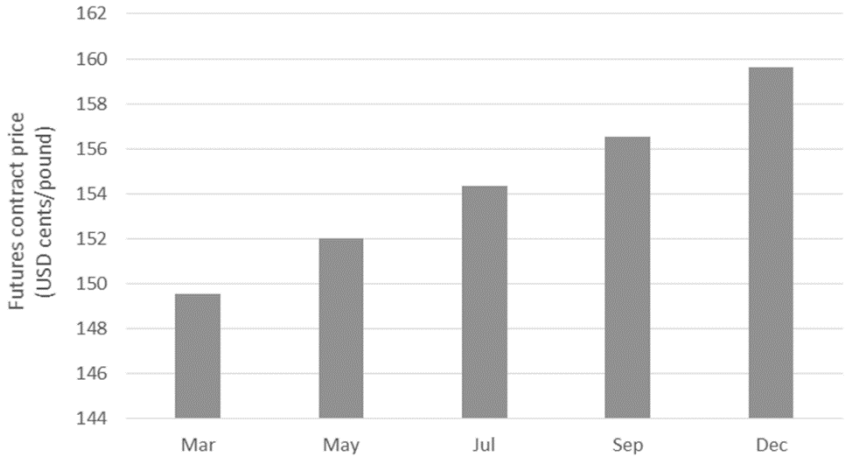
Figure 1. Variations in monthly world Arabica coffee prices, average 2000-16.



Note: monthly prices are averages for the New York and Bremen/Hamburg markets.
Source: World Bank (2016) and authors' computations.

Using such average future prices allows to make sure farmers use as much information as possible when making decisions about the upcoming harvest.

Figure 2. Futures coffee C settle prices March – December 2017 as quoted January 2017



Source: ICE Coffee C Futures (available at https://www.theice.com/)

Second, since it is very costly to run extensive surveys every year to update farmers' production cost, it would be useful to take into account a simple inflation adjustment. The latter, measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services. Figure 6 in Appendix shows the inflation rate over the last ten years and its average value, i.e. 4.2%. Since farmer's production cost is estimated to be 177,000 Rwf per tonne of cherry coffee in 2016 (Clay et al, 2016), its updated 2020 figure would be on average 12% higher, i.e. 198,240 RwF. However, as next section shows, this adjustment will not be introduced into the proposed price formula. Rather it will only be useful in measuring farmers' mark-up.

6. A proposed alternative price-setting mechanism for coffee cherries

The structure and content of the price setting table used by NAEB should be given a coherent justification, which takes the perspectives of all stakeholders into account and is in the interest of the whole value chain. As mentioned above, three straightforward issues emerge with the current table: cost data, price volatility and rents. The effect of changing the mechanism can be looked into in an ex-post fashion, by observing how producer prices would have been if an alternative mechanism had been used. In addition, the expected effect of the changes should be analyzed in view of expected trends in international coffee markets. It is quite evident that introducing and accepting changes will be easier if export prices follow an upward trend. However, providing proper incentives to all actors and increasing cherry output should yield benefits to all stakeholders in the medium and long run, and exit the stagnant state in which the sector seems to be locked in.

Against this background, following the lessons from other coffee producing countries, the updated cost figures and the adjustment factors, the suggested price setting formula is as follows:

$$p_{fg} = [\pi - EC\ (1 + \mu_E) - MC\ (1 + \mu_m)] * \frac{1}{6.7}$$

where p_{fg} is the minimum farm gate price in Rwf/kg of cherries; π is the computed Total revenue in Rwf/kg of green coffee (which includes the average future prices); *EC* and *MC* are the exporters (including dry mill charges) and wet mills (updated) production costs in Rwf/kg of cherries, respectively; μ_E and μ_m are the exporters and wet mills percentage mark-ups; and 6.7 is the cherry-to-green transformation factor.

The main advantages of this proposed formula are that, by better identifying rents of each stakeholder and thanks to the introduction of the average future prices, it allows to a more equitable distribution of the coffee sales along the chain and to better expectations of the agents regarding the upcoming season.[6]

It is then useful to look at what producer prices would have been if the proposed mechanism had been used. Table 7 shows the minimum price for coffee cherries in 2017 used by NAEB compared to the proposed alternative mechanism, introducing each new component at a time. While column 1 reports the price for coffee cherries in 2017 under the current NAEB price setting mechanism, column 2 computes the price when fixed mark-ups at 50% level are introduced. This offers an insight on the actual rents for wet, dry millers and exporters, as the two prices show a very slight difference (3.26 Rwf). Column 3 introduces the updated cost figures and the average NYC future prices; it turns out that the minimum price is even closer to that computed by NAEB (-0.14 Rwf). Finally, Column 4 estimates the price when mark-ups are set at 9% and 2.5% levels, as in Costa Rica where such rents are regulated by law. In this case the minimum price would have been around 15% higher (from 272.13 Rwf to 315.16 Rwf). [7]

Table 7. 2017 alternative price setting table

	1	2	3	4
	NAEB 2017	NAEB 2017 & mark-ups	Updated costs/price & mark-ups	Updated costs/price & mark-ups
Exchange rate (RWF/USD)	820	820	820	820
NYC price (USD cents/pound)	149.75	149.75	**154**	**154**
Differential Kigali (USD cents/pound)	20	20	20	20
Grade A+B (0.8)	2,454,954	2,454,954	2,516,419	2,516,419
Grade C (0.15)	244,136	244,136	244,136	244,136

[6] It also avoids the inclusion of farmers' production costs from the main formula, which are always difficult to compute.
[7] The minimum price set by NAEB is Rwf267/kg in 2018 and Rwf190/kg in 2019.

TRIAGE (0.05)	54,252	54,252	54,252	54,252
Total revenues	2,753,342	2,753,342	2,814,807	2,814,807
Wet milling costs	331,875	331,875	**385,174**	**385,174**
Wet milling mark-up		**50%**	**50%**	**9%**
Dry milling and export costs	273,611	273,611	**276,489**	**276,489**
Dry milling and export mark-up		**50%**	**50%**	**2,5%**
Wet, Dry mills and Export costs and mark-ups	605,486	908,229	992,495	703.241
Farm gate price per kg of cherry coffee	**272.13**	**275.39**	**271.99**	**315,16**

Note: amended items are in bold.

Table 8 shows the 2020 NAEB minimum price for coffee cherries compared to the proposed alternative mechanism. The only differences with the 2017 table are: i) the relative proportion of coffee types in total production changed with the 2020 table update, going from 0.8 (grade A and B)/0.15 (grade C)/0.05 (TRIAGE) in 2017 to 0.75 (grade A and B)/0.18 (grade C)/0.07 (TRIAGE) in 2020; ii) the transport cost for wet-mills, going from 31,250 to 209,375 per tonne of green coffee. This, computed as 6.7*31,2250, however represents a mistake, as the cost of wet milling has been already converted from parchment coffee to green coffee by multiplying by a ratio of (6.7/5.2) (tonnes of cherry necessary to produce one tonne of green/tonnes of cherry necessary to produce one tonne of parchment). Therefore, we will only report the latter on the first two columns, for ease of comparability, while in the rest of columns we will make use of the cost figures introduced in section 4.

While column 1 reports the price for coffee cherries in 2020 under the current NAEB price setting mechanism, i.e. 216 Rwf, column 2 computes the price when fixed mark-ups are introduced. As in the previous table, this exercise offers an insight on the actual rents for wet, dry millers, exporters and ultimately producers. The 22% equal shares hide however the fact that transport costs for wet millers have been mistakenly computed. Accordingly, when we make use of the cost figures documented in section 4 (column 3), it turns out that the actual (potential) rents for millers and exporters are around 50%, confirming the 2017 results. Column 4 shows that, when introducing the NYC average future prices (as quoted January the 17th 2020) in place of the spot price, i.e. 116.74 USD cents/pound, and the mark-ups used in Costa Rica, the computed minimum price is 269,47 Rwf, i.e. about 25% higher than the 2020 NAEB minimum price. Considering this price and the 177 Rwf as farmers' production costs as computed by Clay et al. (2016), the farmers' mark-up would have been around 50%. However, as described in section 5, production costs should take into account the inflation adjustment, resulting in 198 Rwf, up 12% from 2016. Consequently, farmers' mark-up is estimated to be 14% in the third column case and 36% in the fourth (see last row).

Table 8. 2020 alternative price setting table

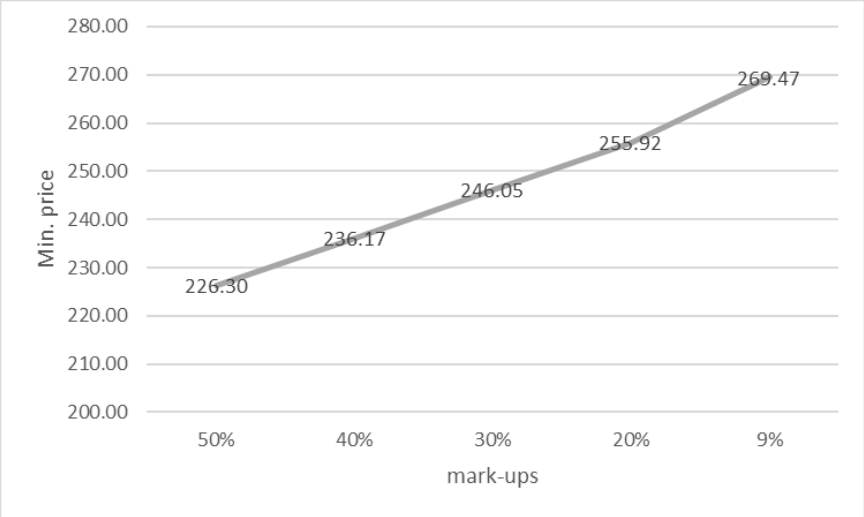
	1	2	3	4
	NAEB 2020	NAEB 2020 & mark-ups	Updated costs & mark-ups	Updated costs & NYC & mark-ups
Exchange rate (RWF/USD)	924,61	924,61	924,61	924,61
NYC price (USD cents/pound)	111,95	111,95	111,95	**116,74**
Differential Kigali (USD cents/pound)	20	20	20	20
Grade A+B (0.75)	2.017.247	2.017.247	2.017.247	2.090.476

Grade C (0.18)	332.596	332.596	332.596	332.596
TRIAGE (0.07)	85.613	85.613	85.613	85.613
Total revenues	2.435.455	2.435.455	2.435.455	2.508.684
Wet milling costs	528.281	528.281	**385.174**	**385.174**
Wet milling mark-up		**22%**	**50%**	**9%**
Dry milling and export costs	278.311	278.311	**276.489**	**276.489**
Dry milling and export mark-up		**22%**	**50%**	**2,5%**
Wet, Dry mills and Export costs and mark-ups	806.593	984.043	992.495	703.241
Farm gate price per kg of cherry coffee	**216,35**	**216,63**	**215,37**	**269,47**
Farmers mark-up		22%	22%	52%
Farmers mark-up w/ inflation adjustment			**14%**	**36%**

Note: amended items are in bold.

Finally, Figure 3 makes use of the cost figures and adjustments introduced in column 4 (Table 8) to show minimum prices according to different level of mark-ups. Starting from 50% mark-up level, for which the proposed min. price would have been 226,3 Rwf, down to 9% level which reports the same price as that compute in the Table, i.e. 269,5 Rwf.[8]

Figure 3. Minimum prices by different level of mark-up



Source: authors' computations.

7. Conclusions and recommendations

Coffee is a key export commodity in Rwanda and an important source of rural farm income and foreign exchange earnings. However, despite its importance and contrary to neighboring countries, coffee production stagnated over the last decade. Because coffee farmers are often price-takers, the government implements a minimum coffee cherry price. The objective is to incentivize farmers to sell to CWSs instead of drying cherries at home, which results in a lower average green coffee quality. Indeed, even if production stagnates, Rwanda's reputation as a supplier of specialty coffee is growing

[8] Table 11 shows the results for the 2022 season.

among roasters. Accurately setting a minimum cherry price is therefore of tremendous importance to allow all value chain agents expand their activities.

This chapter commented on the 2017 reform of the coffee cherry pricing mechanism, presented the results of two data collection exercises on costs and margins along the coffee value chain, and proposed further refinements by drawing on lessons from other coffee producing countries. It focused on cost allocation among stakeholders, volatility management and rents along the chain. Several remarks and propositions were made, which are summarized below:

- Cost figures: given that the cost data used in the price setting table has a strong influence on the computed minimum prices, it is essential to regularly measure and revise the costs of wet milling, dry milling and exporting that are used as inputs in the mechanism. The survey conducted in September 2017 by MAFAP and that developed by Macchiavello and Morjaria (2019) have shown that these costs were, overall, slightly higher than the values used in NAEB's January 2017 table.
- Volatility management: volatility can be accounted for in different ways. In the present analysis, a comparison was made between NAEB's table and a proposed revised table incorporating an adjustment factor which takes the variation of international prices into account. The comparison showed that although both the 2017 and 2020 NYC prices would not have been very different using either tables, the two systems behave differently depending on market conditions. Thus, the use of average future prices in place of the spot price would allow to better capture the expectations of the market regarding the upcoming season.
- Rents along the value chain: regulating mark-ups for each stakeholder allows to a more equitable distribution of rents along the chain. The proposed mechanism showed that, even in the case of unfavorable conditions in the international market, producers would have been able to gain some profit in the presence of fixed mark-ups for both mills and exporters.

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Appendix

Table 9 Price setting table for cherry coffee used by NAEB in January 2020

FARM GATE PRICE - ARABICA CHERRIES 2020			
Item	**Unit**	**C.T**	
I. Farmer's cost			
Cost of production for 1mt of cherry coffee	MT	177,000	
Cost of production for 1mt of green coffee (*6.7)	MT	**1,185,900**	
II. Wet-Mill Charges			
Wet processing	MT	250,000	
Transport		209,375	
Sub-total		459,375	
Bank interest (15% of sub-total)	MT	68,906	
Total (sub-total + bank interest)	MT	**528,281**	
III. Dry-Mill, and Export Charges			
Fertilizer fund 97 Rwf	MT	97,000	
Insecticide fund 11 Rwf	MT	11,000	
Dry milling, handpicking, bagging, loading	MT	92,871	
Export bag and marking (1700+(2300 Rwf per bag*30%))	MT	39,833	
Bank transfer (1% of total revenue)		24,355	
Sub-total		265,058	
Overheads (5% of sub-total)		13,253	
Total (sub-total + overhead)		**278,311**	COP Green Rda
TOTAL COST OF PRODUCTION (I+II+III)	MT	**1,992,493**	2.15
Sales and Market Inputs			
Exchange rate (USD)		924.61	
NY"C" Contract (cents/lb)		111.95	
Differential FOT Kigali (cents/lb)		20	**C-price +Dif**
Price FOT Kigali (cents / lb)		131.95	**2.91**
Price FOT Kigali Rwf/Ton/FW(A+B)	0.75 T	2,017,247	
Price FOT Kigali Rwf/Ton/FW C ($0.90 per pound)	0.18 T	332,596	
Price FOT Kigali Rwf/TRIAGE ($.60 per Pound)	0.07 T	85,613	
Price Local Sales (1.11%)			**Rwanda Price**
TOTAL REVENUE (Rwf/Tonne)	MT	**2,435,455**	**2.63**
Overall Interest/ gain/net profit of Rwandan coffee		0.48	**442.96**
Contribution % for the production cost/interest share	59.52	263.64	**216**
CWS	26.51	117.45	645.73
EXPORTER	13.97	61.87	340.18

Source: NAEB (2019)

Table 10. Data and method differences between the price-setting tables used by NAEB in 2013-16, 2017 and 2020.

	2013-16	2017	2020
Wet mill Charges			
Wet processing	250,000	250,000	250,000
Transport	31,250	31,250	209,375
Bank interest (% of wet mill charges)	18%	18%	15%
Dry-Mill, and Export Charges			
Fertilizer fund	97,000	97,000	97,000
Insecticide fund	11,000	11,000	11,000
Dry milling, handpicking, bagging, loading	55,000	92,871	92,871
Export bag and marking	25,833	39,833	39,833
Bank transfer (% of total revenue)	2%	1%	1%
Overhead (% of dry mill and export charges)	0%	2%	5%
Average shares of coffee grades in total production			
A+B	75%	80%	75%
C	18%	15%	18%
TRIAGE	7%	5%	7%
Average price of inferior coffee grades (USD/pound)			
C	0.7	0.9	0.9
TRIAGE	0.6	0.6	0.6

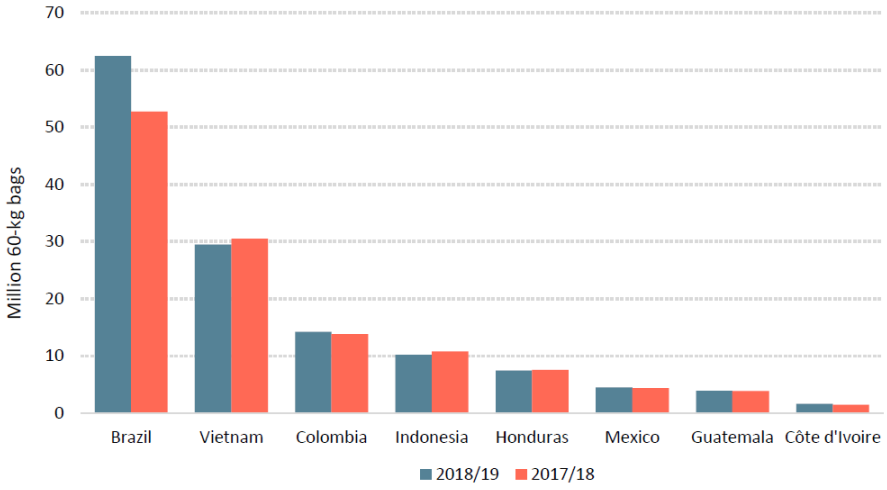
Note: cost values are in Rwf/tonne of green coffee, unless specified.
Source: NAEB (2016c) and authors' computations.

Table 11. 2022 alternative price setting table.

	NAEB 2022	NAEB 2022 & mark-ups	Updated costs & mark-ups	Updated costs & NYC & mark-ups
Exchange rate (RWF/USD)	1013,83	1013,83	1013,83	1013,83
NYC price (USD cents/pound)	255	255	255	**250,48**
Differential Kigali (USD cents/pound)	20	20	20	20
Grade A+B (0.75)	4.609.872	4.609.872	4.609.872	4.534.103
Grade C (0.15)	364.689	364.689	364.689	364.689
TRIAGE (0.07)	93.874	93.874	93.874	93.874
Total revenues	5.068.435	5.068.435	5.068.435	4.992.666
Wet milling costs	542.063	542.063	**385.174**	**385.174**
Wet milling mark-up		**149%**	**50%**	**9%**
Dry milling and export costs	305.958	305.958	**276.489**	**276.489**
Dry milling and export mark-up		**149%**	**50%**	**2,5%**
Wet, Dry mills and Export costs and mark-ups	848.021	2.111.572	992.495	703.241

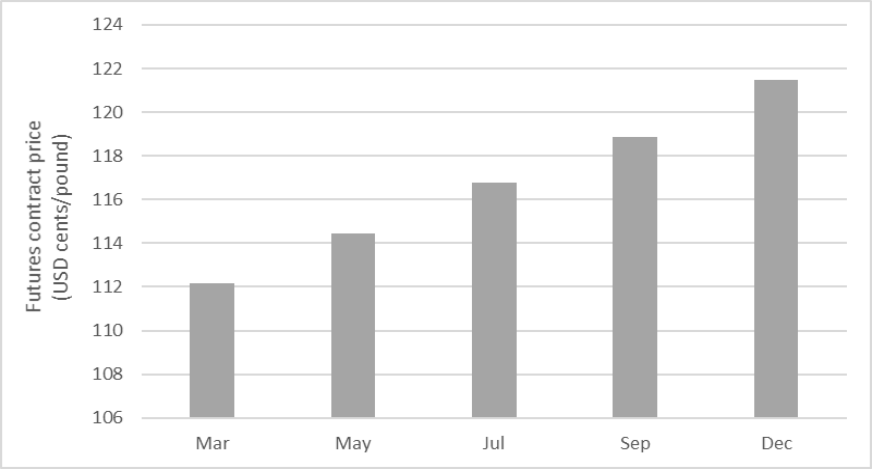
Farm gate price per kg of cherry coffee	441,08	441,32	608,35	640,21
Farmers mark-up		149%	244%	262%
Farmers mark-up w\ inf. adjustment				**216%**

Figure 4. Crop year production



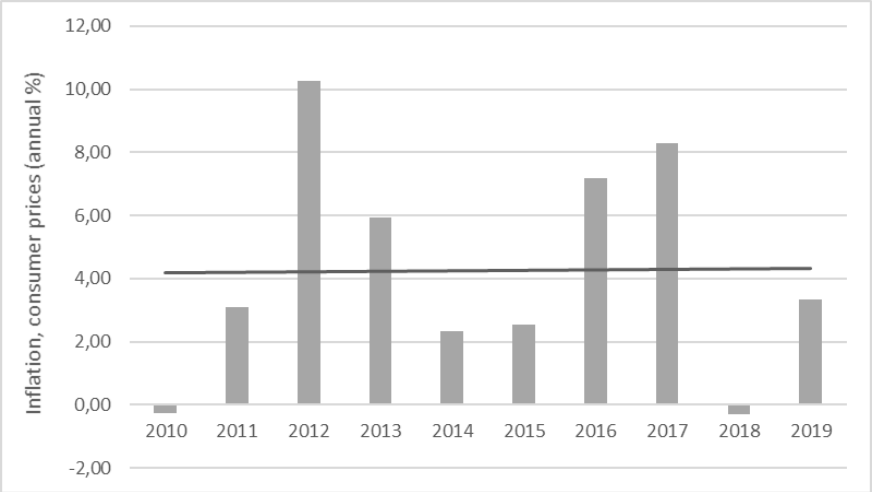
Source: International Coffee Organization 2019.

Figure 5. Futures coffee C settle prices March – December 2020 as quoted January 2020



Source: ICE Coffee C Futures (available at https://www.theice.com/)

Figure 6. Inflation, consumer prices (annual %)



Source: World Development Indicators

Chapter 2

Rwanda's potato price setting mechanism

1. Overview

Agriculture is among the top three sectors in terms of contribution to the Rwandan economy and, despite being dominated by smallholder farmers, it has always played a major role in the Rwandan economy, employing approximately 67% of the population and contributing about 27% of the country's Gross Domestic Product (GDP) (NISR, Q4 2022).

Rwanda is one of the top ten African producers of Irish potatoes, with an estimated production of 908,007 metric tons in 2022. Since 2015 up to 2019 potato production was increasing at an impressive rate of 23,7%, but in the 2020 the production decreased significantly by -13.3%; while the following year, 2021, the production increased by 8.5%. The potato value chain, which encompasses all the activities from seed production to processing and marketing of potatoes, contributes to the country's food security and economic development, as it provides a source of livelihood for many smallholder farmers (around 300,000) and plays a vital role in meeting the nutritional needs of Rwandans.

The Government of Rwanda has implemented various policies and initiatives to support the Irish potato value chain. These include the Irish Potato Strategy (IPS), which was launched in 2015 with the aim of increasing productivity, improving quality, and enhancing market access for Irish potatoes. The strategy includes interventions such as the distribution of high-quality seeds, training of farmers on best practices, and the establishment of market linkages. In addition, the government has also implemented the Crop Intensification Program (CIP) to improve the productivity of smallholder farmers, including those involved in the Irish potatoes value chain. The CIP provides farmers with improved inputs such as fertilizers and seeds, as well as training on modern agricultural practices. In 2018, The government of Rwanda also has been promoting the establishment of Irish potato collection centers (68) as part of its efforts to promote smallholder agriculture and increase farmers' income. These collection centers are located in BURERA, MUSANZE, NYABIHU and RUBAVU districts, managed by potatoes farmer's cooperatives. The government has also been working to improve the infrastructure connecting the collection centers to markets and processing facilities, as well as providing training and capacity-building support to the managers and staff of these centers.

Despite these efforts, the sector is still facing various challenges, including low yields, post-harvest losses, and limited access to markets and finance. Despite the increase in production in 2021, the market prices continued to rise so much that they doubled (from 262 in 2021 to 561 in 2023 per kg), mainly due to the increase of consumer demand and the increased inflation rate which affect the cost of production.

Against this background, since 2018 the government has been setting farm-gate prices in an attempt to guarantee a minimal level of income for farmers. A meeting held in Musanze in December, 2017, brought together farmer representatives, traders, managers of Irish collection centers, Ministry of Trade and Industry (MINICOM), Ministry of Agriculture and Animal Resources (MINAGRI) and Ministry of Local Government (MINALOC), among other stakeholders, to set potato farm gate prices at between Rwf135 and Frw170/kg depending on the variety of the potatoes, thus to ensure that farmers get at least a 25% return on their investment, while the market price in Kigali was set at between Frw185 and Frw220/kg. The set prices should apply for the entire season countrywide.

Given the role prices have in driving potato supply and the whole activity of the value chain, it is crucial to take a close look at the way in which these prices are set. This chapter aims to provide a detailed analysis of the mechanism used by MINICOM to determine farm-gate prices. It starts by providing a description of the current price setting mechanism, in order to point out potential areas of improvements. An alternative price setting mechanism, which includes several adaptations and improvements with respect to the current system, is proposed in section 3. Recommendations and suggestions for next steps are summarized in section 4 which concludes the chapter.

2. Current Irish Potato's price setting table

Since 2018, in collaboration with sector stakeholders, MINICOM uses a specific price-setting table to compute the Irish potato farm-gate price. The price computed with the table is submitted to the stakeholders in a meeting, for negotiation before the official price is endorsed. Currently, the price is only indicative and has been revised only once. In 2022, MINICOM has been determining farm-gate prices using a table where a fixed gross margin per kg is applied to farmers' total costs (including production, transportation, loans, etc.) to compute a farm gate price, which is differentiated according to potatoes' varieties and production sites.

The following paragraphs describe the 2022 price setting table for the Kinigi variety in Musanze for season B (Feb-Jul) in detail, as measured on May 2022. For the other varieties and districts, the structure of the price table is relatively similar (see Table 1) and, hence, reported in the Appendix. The only differences from Table 1 are the production costs and the resulting proposed farm-gate prices.[9]

The farmer's production cost is estimated to be 160 Rwf per kg of potatoes. This estimate was produced using the survey results of MINAGRI, MINICOM, RAB, and RICA which collected data on production costs using a sample of farmers and cooperatives in 3 districts, namely Musanze, Rubavu, and Gicumbi for 5 different varieties, namely Kinigi, Kirundo, Peko, and Nyirakarayi.

The farm-gate price is then computed according to the following formula:

$$p_{fg} = FC\,(1+\pi)$$

Where p_{fg} is the farm gate price in Rwf/kg, *FC* is the farmer's production cost in Rwf per kg, and π is the gross-margin. Therefore, in the price setting table, the farmers' total cost is divided by the production in kg to obtain the average production cost per kg, to which a fixed gross margin of 25% is applied. As a result, the farm-gate price for the kinigi variety in Musanze is equal to: (3,524,164/22,000)*(1+0,25)=200.

The introduction of this price-setting mechanism aims to ensure a reasonable profit for farmers. However, taking into account retail prices would be a necessary condition for each actor to benefit from potato sales and to provide incentives for farmers for increased productivity. Furthermore, since a single price is determined for the whole season and the potato prices are highly volatile within the year and even the season, addressing price volatility is of crucial importance to drive investment in the sector. Secondly, the use of an identical fixed gross margin for different potato varieties does not provide quality-upgrading incentives. Finally, such a scheme is very demanding in data, both in terms of quantity, as production costs for a representative sample of farmers for each variety and district should be known, and reliability as farmers may be tempted to artificially increase their costs to capture a higher share of the value-added.

Table 1. Price setting table for Kinigi variety in Musanze in 2022.

#	Item		Type	Qty	Unit Cost	Total Cost
1	Rent a farm		Ha	1	500,000	500,000
2	Buy seeds		kg	2,500	500	1,250,000
3	Fertilizer	NPK	kg	300	882	264,600
		Inorganic/travertine	kg	2,500	100	250,000
		Organic (FUSO/T)	FUSO	6	70,000	420,000
4	Farming		Labor	55	1,500	82,500
5	Fertilizer transformation		Labor	20	2,000	40,000
6	Hole digging		Labor	20	1,500	30,000
7	Planting (Seeds and Fertilizer)		Labor	30	1,500	45,000
8	Tubes cultuvation		Labor	20	1,500	30,000
8	Weeding		Labor	20	1,500	30,000

[9] Table 4 in Appendix reports farm-gate prices for other potato varieties and districts.

9	Irrigation		Labor	20	1,500	30,000
10	Pesticides	Detane	kg	26	5,000	130,000
		A summer anti-aging	liter	1	10,000	10,000
		Redomil	kg	1	26,000	26,000
11	Rent for pesticides pompes			14	500	7,000
12	Water mix pesticides		Jerrican (30/ha*7 times)	20	210	4,200
	Labor/Water transportation		Labor (3/ha*7 times)	21	1,500	31,500
13	Labor/Pesticides		Labor (2/ha*7times)	14	1,750	24,500
14	Guardian		Labor	2	25,000	50,000
15	Harvesting transport		kg	3	20,000	60,000
	Sub total					3,315,300
	Interest on loans					208,864
	Total					**3,524,164**
	Production		kg	22,000		22,000
	Farmer Production cost per kg					160
	Gross Margin per kg		25%			40.05
	Proposed farm gate price (Frw/kg)					**200**

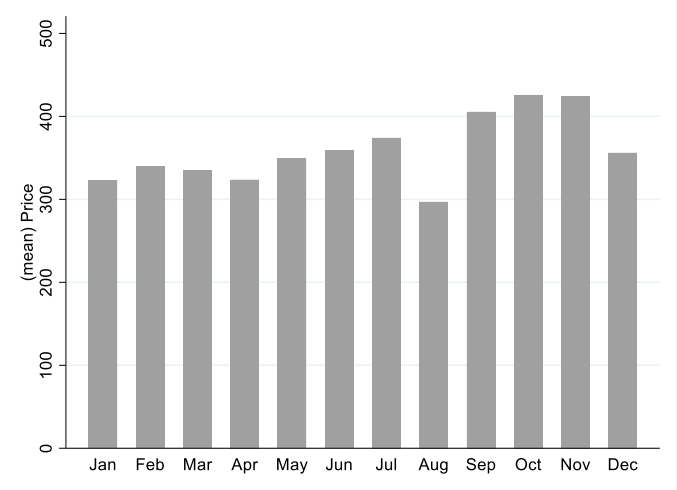
Source: MINICOM (2022).

3. Potential Adjustment factors

Including wholesale and retail prices. The current price-setting mechanism does not allow to share profits fairly across the value chain. The reason is that, without considering potato wholesale and retail costs and prices, it is impossible to compute total revenues and, therefore, identify profits. In particular, for instance, wholesalers pay 5 RwF to potato collection centers and bear the transportation costs of around 30 Rwf/Kg from these to the final market (usually Kigali). Accordingly, it is suggested to consider wholesale and retail costs and prices in the price setting formula, thus allowing to better capture the profits along the potato value chain.

Accounting for seasonality. Furthermore, since there are two main potato seasons in Rwanda – season A between September and Jan, and season B between February and July - these prices may vary quite a lot across the year, even within potato variety (see Figure 1). For instance, the average monthly retail prices for Kinigi potatoes in Kigali varied between 300 Rwf to more than 400 Rwf between 2020 and 2022. This is also because, normally at the end of harvest seasons, prices are likely to decrease in August and December/January as the supply is higher than demand. At the harvest period, farmers are pushed to quickly sell their produce to avoid possible deteriorations. Since a single price is determined for the whole season, volatility risks are then non-negligible. The effects of this volatility are currently borne by all stakeholders along the potato value chain, according to their sales/payments schedule. Therefore, it is suggested to establish regular price updates at the beginning of each season, i.e., September and February.

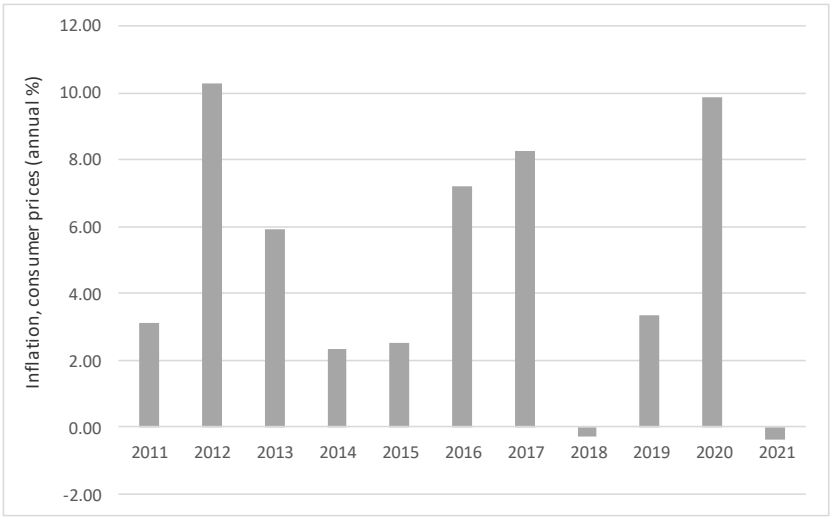
Figure 1. Average monthly prices for Kinigi potato in Kigali, 2020-22.



Source: E-soko dataset

Adjusting farmers' production costs. Third, since it is very costly to run extensive surveys every year to update farmers' production costs, it would be useful to take into account a simple inflation adjustment. The latter, measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services. Figure 2 shows the inflation rate over the last ten years. Since the farmer's production cost is estimated to be 160 Rwf per kg in 2022 for the Kinigi variety in Musanze (Table 1), its updated 2023 figure would be on average 20.8% higher, i.e. 192 RwF.[10]

Figure 2. Inflation, consumer prices (annual %)



Source: World Development Indicators

Creating quality-improving incentives. Finally, the use of the same gross margin for different potato varieties does not provide quality-upgrading incentives. Thus, currently a 25% mark-up is applied to farmers' production costs, irrespective of the potato variety produced, i.e., either Kinigi, Kirundo, Peko, or Nyirakarayi. However, there are currently more than 25 potato varieties available in Rwanda, with a very high heterogeneous level of productivity, ranging from 10 MT/ha to

[10] Rwanda's Consumer Price Index (CPI) increased by 20.8 percent year on year in February 2023 (NISR, 2023).

50 MT/ha (Table). For instance, Kinigi, among the most preferred potato variety, shows a productivity of 20-30 MT/ha, while Kirundo of 30 MT/ha.

Table 2. List of the available potato varieties in Rwanda and productivity.

Potato variety	Productivity capacity Yield (MT/ha)
Victoria	25
Gikungu	35
Kigega	40
Mizero	40
Mugogo	25-30
Nderera	35
Ngunda	50
Mabondo	30-35
Kirundo	30
Cruza	20-30
Gasore	10-18
Kinigi	20-30
Marirahinda	30-40
Nseko	20-30
Sangema	20-25
Gahinga	25-40
Nkunganire	30-35
Ndeze	20-25
Twihaze	30-50
Kazeneza	30-40
Izihirwe	30-50
Twigire	30
Gisubizo	35
Ndamira	30-40
Kerekezo	30
Jyambere	25
Seka	30

Source: CIP (2021) and MINAGRI (2021)

4. A proposed alternative price-setting mechanism

The structure and content of the price setting table used by MINAGRI and MINICOM should be given a coherent justification, which takes the perspectives of all stakeholders into account and is in the interest of the whole value chain. As mentioned above, three straightforward issues emerge with the current table: cost data, price volatility and rents.

Against this background, the suggested price setting formula computes the farm gate price as the farmer's production cost in Rwf per kg, adjusted for the inflation rate, plus the gross margin. It also includes wholesale and retailers' costs, margins, and the corresponding prices. The effect of changing the mechanism can be looked into in an ex-post fashion, by observing how producer prices would have been if an alternative mechanism had been used. Table 7 shows the farm-gate price for the Kinigi potato variety in Musanze in 2022 used by MINAGRI and MINICOM compared to the proposed alternative mechanism.

While column 1 reports the price for Kinigi Irish potatoes in 2022 under the current price setting mechanism, column 2 computes the price when the new formula is introduced. Specifically, it shows the wholesale and retail prices. Finally, Column 3 estimates the potential 2023 price when inflation adjustment is taken into account, resulting in 192 Rwf, up

20.8% from May 2022, and fixing the farmers' gross margin to 25%. In this case the minimum farm-gate price would have been around 242 Rwf. Finally, between December 2022 and January 2023, MINAGRI conducted a rapid assessment of the farmers' production costs, which resulted in an increase of the latter to 345 Rwf per kg. Considering also an inflation adjustment of 8% (CPI growth rate between December 2022 and March 2023) and a gross margin of 7%, Farm-gate price would be 399 Rwf (Tab 3, col 4).

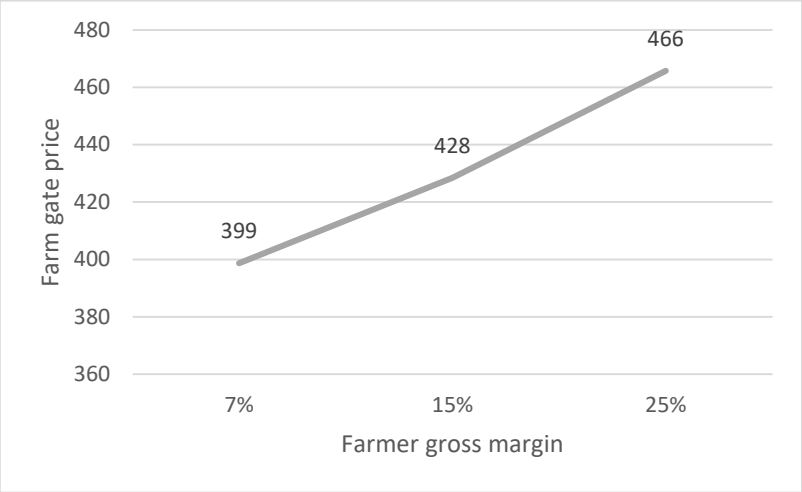
Table 3. Alternative price setting table for Kinigi variety in Musanze

		1	2	3	4
		Current PSM 2022	New Formula 2022	New formula 2023	New formula 2023
Farmer	Production cost per kg	160	160	160	**345**
	Inflation adjustment			**20.8%**	**8%**
	Gross Margin per kg	25%	25%	25%	**7%**
Farm gate price (Frw/kg)		200	200	**242**	**399**
Wholesale	Production cost per kg		**40**	**40**	**40**
	Gross Margin per kg		**2%**	**2%**	**2%**
Wholesale price (Frw/kg)			**245**	**287**	**447**
Retail	Gross Margin per kg		**2%**	**2%**	**2%**
Retail price (Frw/kg)			**250**	**293**	**456**

Note: amended items are in bold. Inflation adjustment in col 3 is computed as the CPI growth rate between May 2022 and March 2023, while in col 4 between December 2022 and March 2023 (NISR)..

Finally, Figure 3 uses the new formula and adjustments introduced in column 4 (Table 3) to show farm-gate prices according to the different levels of farmer margins. Starting from a 7% farmer share level, which reports a price of 399Rwf, up to a 25% level, for which the proposed farm-gate price would have been 466Rwf. Actually, in order to introduce productivity-enhancing incentives, we can further propose to differentiate the farmer share level according to the potato variety productivity. For instance, for all varieties between a productivity of 10-20 a farmer share of 7%; for those between 25-35 a farmer share of 15%; finally, for those varieties with productivity between 40-50 a farmer share of 25%.

Figure 3. Farm-gate prices by different levels of farmer margin in 2023



Source: author's computations.

5. Conclusions and recommendations

Irish potato is a key commodity in Rwanda and an important source of rural farm income. Because potato farmers are often price-takers, the government implements a farm-gate price setting mechanism. The objective is to guarantee a minimal level of income for farmers and incentivize production. Accurately setting a farm-gate price is therefore of tremendous importance to allow all value chain agents expand their activities.

This chapter commented on the 2022 potato pricing mechanism, focusing on cost figures, retail prices, and productivity issues. Several remarks and propositions were made, which are summarized below:

- Wholesale and retail prices: taking into account wholesale and retail prices would be a necessary condition for each actor to benefit from potato sales and to provide incentives for farmers for increased productivity. In the present analysis, a comparison was made between MINAGRI and MINICOM's table and a proposed revised table incorporating wholesale and retail costs and prices.
- Meeting schedule: Furthermore, since a single price is determined for the whole year and the potato prices are highly volatile within the year and even the season, addressing price volatility is of crucial importance to drive investment in the sector. At present, there is one meeting per year. MINAGRI and MINICOM could also explore the possibility to establish regular price updates, e.g. at the beginning of each season (September and February).
- Cost figures: given that the cost data used in the price setting table has a strong influence on the computed farm-gate prices, it is essential to regularly measure and revise the production costs used as inputs in the mechanism. It would be useful to take into account a simple inflation adjustment.

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Appendix

Table 4. Farm-gate prices for other varieties and districts

Disrict	Variety	Farm-gate prices
Rubavu	KINIGI, GIKUNGU	192
Musanze	KIRUNDO, RWANGUME, RWASHAKI, GIKUNGU	176
Rubavu	KIRUNDO, KURUSEKE	162
Rubavu	Peko, Kazeneza	140
Gicumbi	NYIRAKARAYI	160

Source: MINICOM (2022).

Chapter 3

Cotton pricing mechanism in Mozambique

1. Overview

Cotton is one of the most important cash crops in Sub-Saharan Africa (SSA). This is also true in Mozambique, where cotton is the third largest agricultural export crop after tobacco and sugar (FAOSTAT) and serves as a main source of income for about 250 000 farming households. Cotton exports are destined mostly for Asian countries such as Indonesia, China and Bangladesh (UN-COMTRADE). Despite its domestic importance, the Mozambican cotton sector is a small player in the global cotton market and therefore a price-taker. International price instability is therefore a major risk factor for domestic cotton value chain actors. Additionally, since cotton is generally priced in United States Dollars (USD) in the global market, but the local cotton value chain operates on the basis of Mozambican Meticals (MZN), exchange rate movements present another important risk factor.

This chapter comments on proposed changes to Mozambique's cotton pricing system as well as the establishment of a cotton price smoothing fund, as proposed and detailed in a recent report by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for the Instituto do Algodão de Moçambique (IAM) (hereinafter referred to as the "GIZ Report").[11]

2. Current cotton pricing mechanism

Mozambique's national cotton pricing system was first adopted in 1996 and is used as a tool to equitably share cotton revenues and risks between producers and ginneries (GIZ Report, p. 31). At present, the system is based on the setting of a minimum price negotiated between producers and ginneries prior to the start of the marketing season in April/May, derived from the following formula:[12]

$$PM = [\,(PIR - FS - DQ - TT) * FC * TC * TD + VS] * PP$$

PM represents the calculated minimum price of raw cotton to be paid to farmers. *PIR* is the international reference price. Under an initial formulation the *PIR* was based only on the so-called Cotlook A Index, an historical index for international cotton prices (see www.cotlook.com). More specifically, the *PIR* was simply taken as the average Cotlook A Index over the 30 days preceding the price negotiation. In a subsequent revision the *PIR* was calculated as the average of three equally-weighted reference prices: the average price under forward sales contracts entered into by ginneries; the 30-day average of the Cotlook A Index (as above); and a weighted average of October, December and March futures contract prices (see GIZ Report, p. 32). This modification was introduced to reduce risks associated with fluctuations of lint and seed prices as well as the foreign exchange market.

To ultimately arrive at a minimum price *PM*, *PIR* is adjusted in several ways: first, freight and insurance costs (*FS*) for shipping cotton from Mozambique to the final port of destination are deducted; next a quality differential adjustment (*DQ*) is made to account for the historical three-year average grade difference between Mozambican cotton and the average grade in the international market (i.e., underlying the *PIR*); and finally an IAM transaction levy (*TT*) is subtracted. Several conversion factors are then applied to the adjusted *PIR*, including: a pound-to-kilogram adjustment (*FC*); an exchange rate adjustment (*TC*), where the reference exchange rate is the 30-day average official exchange rate (MZN/USD) prior to the price setting negotiations; and a three-year average ginning outturn rate (*TD*), defined as the

[11] Reference: Estur, G. 2015. "Feasibility Study of a Smoothing Mechanism for the Price of Seed Cotton", Final Report prepared by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for the Instituto do Algodão de Moçambique (IAM), November 2015.

[12] The price setting mechanism has evolved somewhat over time. Between 2008 and 2010 an initial target price was set in October/November, before planting commenced, using the same pricing formula. However, due to the extreme volatility of cotton prices during the 2010-2011 season, target price setting was abandoned. The pricing formula itself has also undergone minor changes since 1996. Details can be found in the GIZ Report.

quantity of cotton lint produced per unit of raw cotton processed, based on data from Mozambican processing plants. Finally, the market price of cotton oilseeds (*VS*) is added.

The final adjustment factor is the agreed share that producers will earn from the total income from cotton trade (*PP*). This essentially determines how sector revenues will be shared between producers and ginneries, and is typically set between 50 and 55 percent.

3. Proposed cotton pricing amendments and establishment of a price smoothing fund

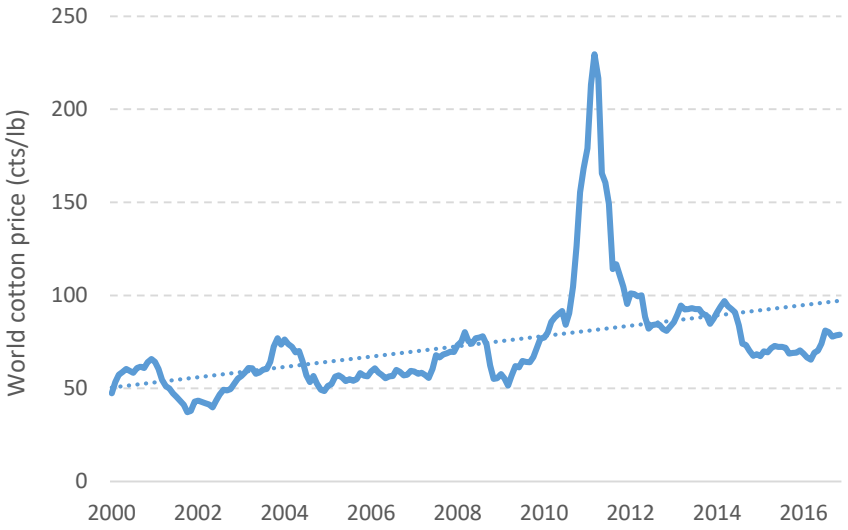
Since the minimum price is set prior to the start of the marketing season, both producers and ginneries face risks. Farmers assume the risk of investing in cotton production several months before the price is set. Moreover, since the price is fixed, farmers will not benefit when the international spot price rises above the reference market price underlying the pricing formula, or if the exchange rate depreciates. Ginneries, on the other hand, assume the risk of declining international cotton prices or exchange rate appreciation. It is evident that the international reference price (*PIR*) and the exchange rate (*TC*) are two of the key risk elements in the pricing formula. As price-takers in the global cotton market, local value chain actors or policymakers have virtually no control over international price movements; likewise, under the *de facto* free-floating exchange rate regime the exchange rate is determined by global market forces in the long run. National and sectoral policies (e.g., the cotton price setting mechanism) are at best mitigating measures and cannot influence these exogenous world market variables in the long run.

Most of the remaining variables in the formula are either fixed, are determined by domestic policy, or tend to remain relatively stable over time. For example, the quantity conversion (*FC*) factor is fixed at 2.2, while the transaction levy (*TT*) is also relatively stable, although it recently increased from 2.5–3.5 percent. The producer share (*PP*), in turn, only fluctuates within a tight range (50–55 percent), while a factor such as the outturn rate (*TD*) or the quality differential (*DQ*) will only change gradually in line with technological changes. Freight and insurance costs (*FS*), which are partly foreign currency-denominated, may be more volatile. In general, however, given the importance of the international reference price (*PIR*) and the exchange rate (*TC*) in the formula, the GIZ Report deals mostly with issues related to international market price risk management and exchange rate instability.

With respect to global cotton market, prices in USD have increased gradually over the past 15 years, with the exception of a substantial price spike in 2010–2011 (see Figure). As a result of this price episode, one of the recommendations in the GIZ Report is to derive the reference price (*PIR*) from the ICE Cotton Futures Price of the New York Stock Exchange (NYSE) rather than the Cotlook A Index, which is a historical price index. Given the timing of Mozambican cotton sales, the GIZ Report further proposes to use the average daily settle prices for futures contracts maturing in December as quoted during the 30 days prior to the price negotiation meeting (see GIZ Report, pp. 33–34, for details). They note, however, that although futures prices are more appropriate to use in this context, there is still some degree of "basis" risk since primarily US cotton is traded on the NYSE, and ultimately these futures prices are not perfectly correlated with international cotton prices for physical cotton (see GIZ Report, p.79).

Another key recommendation in the GIZ Report is the establishment of a smoothing fund or *Fundo de Suavização* (FdS) to deal mainly with currency risk. Currently in Mozambique cotton lint is sold in USD on the world market while producers are paid in local currency (MZN), typically in cash on or after delivery. The exchange rate adjustment in the pricing formula uses the 30-day average exchange rate during the period prior to the price negotiations, i.e., before the marketing season starts. An exchange rate appreciation will therefore benefit the farmer while a depreciation will benefit the ginneries.

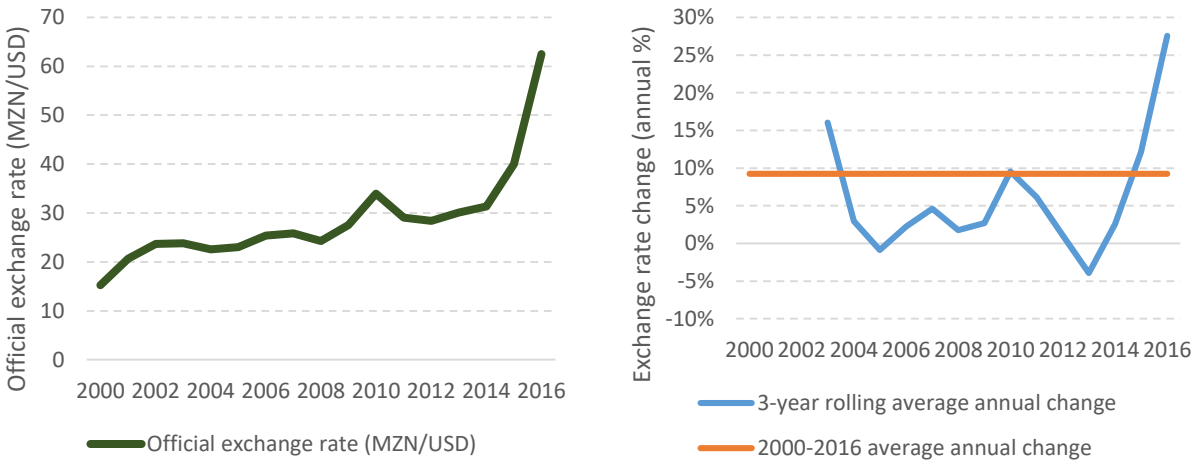
Figure 1. World cotton price trends, 2000–2016



Source: Prices based on Cotlook A Index' quoted in USD cents per pound (from http://www.indexmundi.com/)

The MZN has been depreciating steadily over the last decade. In 2000 it was traded at around 15 MZN/USD, but then depreciated sharply in 2001, after which it remained fairly stable at around 24 MZN/USD during 2002–2008 (see Figure 2). Since then the currency depreciated further, with particularly large successive depreciations of 27.5 percent in 2015 and 56.3 percent in 2016. The average annual depreciation rate for the currency during 2000–2016 was 9.2 percent.

Figure 2. Exchange rate movements in Mozambique, 2000–2016



Source: World Development Indicators (2017), World Bank (available at databank.worldbank.org/wdi)

Such exchange rate movements have significant implications for the real price cotton farmers receive. Consider, for example, the 2015/16 marketing season: in that season the minimum price was set at 10.25 MZN/kg (April 2015). At the time this was equivalent to 0.29 USD/kg. However, at the height of the selling season (December 2015) the minimum price had dropped to an equivalent of around 0.20 USD/kg, i.e., a 30 percent decline in USD-terms. This price decline works to the benefit of ginneries that are able to sell cotton in the global market and earn foreign currency, but only have to pay farmers the fixed price in local currency. This will likely negatively affect farmers' ability to procure imported inputs in the following planting season. Of course in the case of an appreciation of the currency, ginneries would lose out,

although, based on the discussion above, such a scenario seems less likely in the current economic climate in Mozambique.

The proposed price smoothing mechanism is structured around a floor price, calculated using the minimum price formula, which is guaranteed to producers for three consecutive marketing seasons. A price ceiling is also set at around 15 percent above the floor price. The argument is that by setting a price band over a three-year period, cotton stakeholders are able to make better-informed medium-term investment decisions. In addition to the three-year price band, each season an initial price is also calculated before the start of the marketing season in April in the same way the minimum price is currently set. As in the current system, this price serves as the guaranteed price producers will be paid in that particular season, subject to cotton grade. However, if the initial price, quoted in MZN/kg for first grade cotton, is below the prevailing floor price, the actual price paid to producer will be equal to the floor price. Similarly, if the initial price is above the price ceiling, the actual price paid to producer will be equal to the price ceiling. Such a scenario is only likely in the second or third year since in the first year the season-specific initial price and the three-year floor price are calculated in the same way.

At the end of the marketing season, i.e., in April of the following year, a final price is calculated based on the actual price of contracts executed by cotton ginneries. If the final price is above the price ceiling, each cotton company will make a deposit into its FdS savings account equal to the difference between the final price and the price ceiling multiplied by the volume of seed cotton purchased in that season. Similarly, if the final price is below the floor price, the cotton company will receive as compensation from its FdS savings account an amount equal to the difference between the floor price and the final price multiplied by the volume of seed cotton purchased. If the final price calculated is within the smoothing range, i.e., between the floor price and the price ceiling, no savings account transactions will take place. The GIZ Report estimates that in order to play its smoothing function, the FdS must be able to cover a price gap of 2 MZN/kg between the floor price and the final price, which equates to a minimum required fund balance of around USD 5 million, given the average cotton crop of around 100,000 metric tons.

The GIZ Report proposes that the FdS will be jointly managed by cotton companies and producers, with IAM involved as an independent third party. An initial deposit from cotton companies of around 1 MZN/kg seed cotton traded will be required as start-up funding. The fund will be set up in a commercial bank account operated by the signatories of a senior representative of IAM, a representative of the cotton ginning association (AAM), and a representative of the smallholder farmers (FONPA). A price monitoring committee comprising representatives from the three stakeholders will review price information, undertake analysis and agree on the use of the funds. Eventually, the bank, selected through a competitive tender, would be responsible for: (i) receiving deposits into the smoothing fund; (ii) paying the cotton companies, in case a compensation is due at the end of the season; and (iii) providing the fund management committee with regular statements of accounts (GIZ Report, p. 63).

4. Comments and discussion

The GIZ Report provides a useful and relevant overview of the Mozambican cotton sector's performance, the challenges it faces, and the functioning and objectives of the pricing mechanism. It rightly highlights international cotton price instability and exchange rate fluctuations as major risk factors that should be addressed in the pricing mechanism and also serve as justification for the proposed price smoothing fund. Our comments are structured around three thematic areas: (1) dealing with exchange rate risk; (2) management of a price smoothing fund; and (3) issues related to futures markets and pricing.

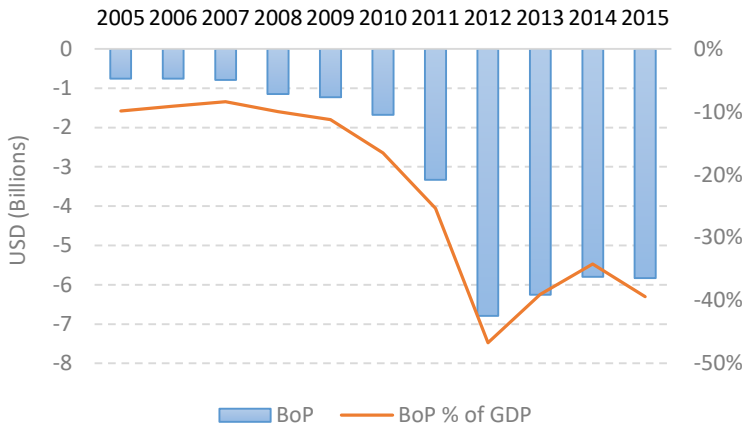
1.1 Exchange rate risk

The proposed cotton floor price formula, together with the smoothing mechanism based on a medium-term price band and season-specific initial and final prices, while potentially an important step forward, is still unlikely to fully overcome exchange rate risk. Even when the price levels are based on futures market prices—considered to be a reasonable benchmark of international prices—the conversion to local currency at the time they are set means that exchange rate movements can still have a substantial impact on earnings of value chain actors. This is not a problem *per se* if the

exchange rate movements are relatively small (i.e., so that the season-specific final price does not breach the upper or lower bounds of the price band), or are considered short-term spikes with the expectation of a return to a long term trend (i.e., a season-specific anomaly). However, when exchange rate movements are substantial and associated with a fundamental shift in economic variables with long-lasting consequences, the imposition of a fixed floor or ceiling prices for an extended period of time may disadvantage either millers or farmers.

A good example is the Mozambican experience during 2010–2016, when the currency first appreciated (2010-2012) and then rapidly depreciated (2013-2015) (Figure). During the latter period, Mozambique's balance of payments (BoP) has begun a modest recovery, after having recorded one of the largest current account deficits in SSA over recent years, reaching 47 percent of GDP in 2012. High demand for capital goods imports, particularly to develop the coal-related sector, was exacerbated by the impact of low commodity prices, leaving an enormous deficit in the country's external position, financed through a mixture of debt and foreign investment. A cotton price ceiling under such a scenario would have disadvantaged farmers.

Figure 3. Current account balance in Mozambique, 2005–2015



Source: World Development Indicators (2017) (available at databank.worldbank.org/wdi)

Several possible solutions can be envisioned. In the case of significant market fluctuations, either in international cotton markets or in the foreign exchange market, cotton sector stakeholders could reserve the right to request an interim review of the three-year price band. For example, this could be triggered when the season-specific initial price determined in the second or third season falls outside of the initial three-year price band. The price band itself could also be wider. If the long-term outlook for the exchange rate is a 9.2 percent depreciation every year, as has been the case historically (Figure 2), then the ceiling price should probably be set at least 30 percent above the floor price rather than at 15 percent.[13] Alternatively, both the lower and upper bounds can simply be adjusted every year with either a pre-determined rate of inflation (e.g., based on the expected depreciation rate or forecasted inflation rate), which effectively means the price band is defined in real rather than nominal prices.

The pricing mechanism itself could also be improved with the use of forecasted or futures exchange rates rather than historical averages when setting the floor/ceiling price or the initial price (i.e., similar to the use of futures cotton prices). In Burkina Faso, for instance, the minimum price is fixed in March/April prior to the start of the planting season, but indexed to international cotton prices and adjusted by exchange rate projections rather than the historical or current

[13] Mathematically 9.2 percent per annum is equivalent to 1.092^3 = 30.3 percent over three years (compounded interest). If the sharp depreciations in 2000–2001 (36.0 percent) and 2015–2016 (56.3 percent) were considered anomalies and excluded from the analysis, the average annual depreciation rate for the currency would be only 4.8 percent, which equates to 15.1 percent over three years. From that perspective the proposed 15 percent width of band may be appropriate.

exchange rate. In Burkina Faso's case, however, the currency (West African Franc or CFA) is effectively pegged to the Euro (EUR), thus allowing them to use the highly liquid EUR-USD foreign exchange futures market as a reasonably good proxy for their own currency forecasts. The MZN-USD is significantly less traded and therefore futures prices may be less reliable, if available at all.

Considering that cotton is exclusively an export crop that is priced internationally, the cotton sector could simply decide to transform its entire pricing model into a USD-based system. Some production costs for farmers or cotton companies are priced in local currency (e.g., labour inputs), which implies some "reverse" currency risk under a USD-based system. However, this is unlikely to be problematic considering that the general currency trend in Mozambique is a gradual depreciation over time. Also, many other production costs, such as fertilizer inputs for farmers, or machinery, trade and transport margins for cotton companies, are priced internationally. The risk exposure is therefore likely to be minimal, and presumably significantly less than under the current MZN-based system. Although further analysis is required, a USD-based system may even reduce price and exchange rate risks to the extent that the adoption of a complex price smoothing fund is no longer necessary.

1.2 Price smoothing fund management

Although price smoothing funds make economic sense, especially in volatile market environments, the type of amendments to the price setting mechanism proposed above, i.e., the use of forecasted or futures exchange rates or a USD-based pricing mechanism, may negate the need for a fund in the first place. However, if after a few years of piloting any such changes to the pricing mechanism a smoothing fund is still deemed necessary, the management implications of such a fund should first be carefully assessed. The first step would be a detailed assessment of capacities within farmers' organizations and ginneries to participate in the management of such a fund. The assessment should also consider the precise management modalities to be adopted, drawing on experience elsewhere as applicable to the domestic circumstances. If, for example, a system of joint management between farmers' organizations and ginneries is adopted—as is indeed proposed in the GIZ Report—the assessment should also consider the existing institutional relationships and power relationships in the value chain.

While not many examples of smoothing funds exist in Sub-Saharan Africa, at least two examples are pertinent:

- Mali: The smoothing fund in Mali is the exclusive property of *cotton farmers*. The management principles of the fund are: (i) custody of the resources is given to a bank, which pays interest on surplus funds; (ii) an agreement between the bank manager and the president of the farmers' union defines the conditions for bank fees and interest earned; (iii) the bank manager should be informed by the Minister of Finance whenever payments are to be made out of the fund, and all withdrawals are jointly signed by the president of the farmers' union and the authorized representative of the Bank; and (iv) the bank manager should prepare an annual report on the management of the fund for the president of farmers' union.

- Burkina Faso: The smoothing fund belongs to an *inter-professional cotton association*, a grouping of the producers' association and the cotton companies' association, and is operated by a commercial bank, selected through a competitive tender. A management contract defines the roles and responsibilities of the bank and the association. The bank receives a management fee and pays interest on surplus funds. The *Agence Française de Développement*, as initial financier of the fund, keeps a non-objection right on all decisions affecting the operation of the fund as long as the start-up loan is not yet repaid. The smoothing fund has proved to be sustainable thanks to its complex rules of replenishment. The system allows to cope with significant price movements. However, despite several training sessions, it is still not fully understood by producers, because of its complexity.

The management of price smoothing funds in Burkina Faso and Mali, although very different in terms of the models adopted, have both proven to be reasonably successful. Thus, assuming a fund is to be established in Mozambique, and following a careful assessment of the different stakeholders' management capacities, they cotton sector could either: (i) assign the ownership exclusively to the smallholder farmers association (FONPA), which will operate on the basis of agreements and conventions signed by the relevant professional bodies; or (ii) if joint management is deemed most

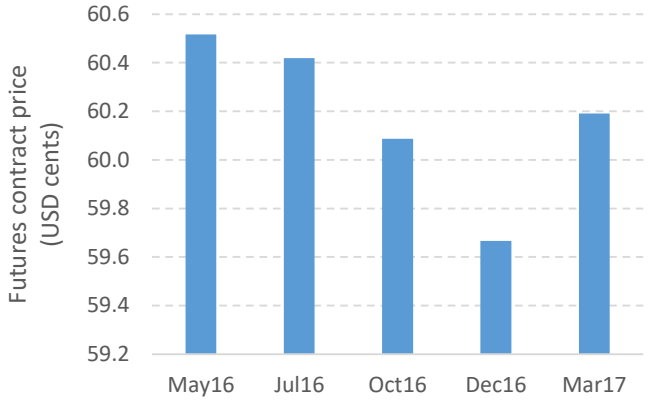
appropriate, the proposal as outlined in the GIZ Report could be followed. Most likely, this would entail a formal arrangement starting with the establishment of an inter-professional cotton association, which will serve as the fund managing agency with some degree of autonomy.

Further analysis is also required to assess the exact functioning of the fund. The model proposed in the GIZ Report only makes provision for deposits and withdrawals to be made by cotton companies (including providing the initial start-up capital), thus effectively serving as a revenue smoothing mechanism for cotton companies. Consideration should therefore also be given to the possibility for top-up payment to producers should the season-specific final price be well above the initial price.

1.3 Futures markets and pricing

In a departure from the current system, the GIZ Report proposes to use the average daily settle prices for December futures contracts during the 30 days prior to the price negotiations rather than the average of settle prices of May, July, October, December and March contracts. The author argues that the December futures contract is the most relevant for price discovery as it is more actively traded than the other contracts. Furthermore, it is claimed that the predictive power does not necessarily increase by taking into account all futures contracts rather than December only, since the futures market tends to be fairly flat over the different maturities (GIZ Report, p. 36). Our main response to this is that even if the December contract prices do not necessarily differ significantly from other maturities—for example, the maximum spread between futures contracts from May 2016 through March 2017 as quoted during April 2016 was only 1 USD cent (see Figure 4)—it is still prudent to include all available information.

Figure 4. Futures cotton settle prices May 2016 – March 2017 as quoted April 2016



Source: ICE Cotton No.2 Futures (available at https://www.theice.com/)

Figure 4 further suggests—and longer-tem analyses of seasonal trends in cotton markets confirm this—that by only considering December futures prices in the pricing formula, a slight downward bias may be introduced in the minimum price earned by farmers. We therefore propose inclusion of all maturities, possibly with a weighting system to adjust for typical volumes traded on the various maturities.

5. Summary

Cotton is a key export commodity in Mozambique and an important source of rural farm income and foreign exchange earnings. Preservation of the sector is important, particularly in the context of the current weak BoP position, which has been linked to rising imports associated megaprojects and weakening energy prices. This has led to a renewed reliance in recent years on agricultural exports as a source of foreign exchange, with cotton being one of the key export crops.

However, as a price taker on world cotton markets, the Mozambican cotton sector is particularly vulnerable to global market instability. The world cotton price and the exchange rate are both important sources of this instability; hence, it is important to design effective interventions or support tools that mitigate the effects of such instability. One such tool is the pricing mechanism which sets minimum cotton producer prices, first adopted in 1996. The pricing formula has been refined and improved several times over the years, which is commended. Another tool now being proposed is a price smoothing mechanism, which deserves serious consideration although such funds are complex to manage.

This chapter commented on proposed changes to Mozambique's cotton pricing system as well as the establishment of a cotton price smoothing fund, focusing especially on issues related to dealing with exchange rate risk, the management of the price smoothing fund, and futures pricing. Several remarks and recommendations were made. These are briefly summarized below:

- With respect to dealing with **exchange rate risk**, several recommendations are offered:
    - If for any particular reason the pricing model has to be MZN-based, *improved exchange rate forecasting* methods should be used (e.g., futures exchange rates) in the estimation of minimum prices.
    - If an MZN-based pricing model is not mandated, then the cotton sector should investigate the option of adopting a *USD-based pricing model* in order to reduce the exchange rate risk. A USD-price system may also remove the need for a price smoothing fund.
    - If a smoothing fund is eventually established, a more *flexible price band* should be adopted. This could entail the *option to review the three-year price band* periodically, e.g., when the initial seasonal price falls outside of the price band and this is thought to represent a fundamental shift in market dynamics rather than a short-term anomaly. Alternatively, the *price band itself can be widened*, e.g., by setting the ceiling price at 30 percent above the floor price rather than only 15 percent. The price band could also be adjusted annually based on exchange rate or inflation forecasts.
- Related to the management of the **smoothing fund**, and given concerns about the capacities within farmers' organizations and cotton companies to manage such a fund, a first step should be a detailed assessment of their capacities and competencies. Depending on the outcome of such an assessment, the fund's ownership could be entrusted to smallholder farmers' association(s) or to a joint association of producers and ginneries. The functioning of the fund should also be carefully considered; for example, rather than only serving as a revenue smoothing tool for ginneries, provisioning could also be made for top-up payments for producers in instances where international prices are significantly above the minimum price.
- The use of **futures prices** as opposed to historical prices in calculating indicative prices for the sector is generally commended. However, rather than relying only December futures prices alone, which tend to be marginally lower than those of other futures contract, all available maturity dates should be included in the price setting formula. A weighting system that accounts for differences in traded volumes across futures with different maturity dates can be introduced to increase precision. While it is unlikely that this change will have a significant impact on the minimum price calculation, it is still more prudent and fair to use all available data.

In conclusions, while issues related to cotton pricing and smoothing are important for the stability of the sector, they represent just one component of the cotton sector's revenues. Raising the productivity of producers and ginneries should ultimately remain a top priority for improving the competitiveness and profitability of the cotton sector in Mozambique in the long run.

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