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Monitoring incentives in low- and middle-income countries during the first wave of COVID-19

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Abstract

COVID-19 has resulted in a shock to agrifood systems around the world, with the potential for low- and middle-income countries to be particularly affected. Although policy responses were more muted than during the 2007–2008 world food crisis, efforts to insulate from supply shocks and ensure local availability during COVID-19 have generally included export restrictions and import tariff reductions, among other responses. In an effort to enable rapid market monitoring and realignment, we develop a new indicator defined as a monthly nominal rate of protection “express” which seeks to isolate as much as possible the effect of trade and market policies on domestic prices in real-time in order to understand how they responded. This analysis examines changes to this indicator during the first wave of the pandemic in 27 low- and middle-income countries for the most-consumed staple cereals of the poor and food insecure. We show that agricultural price incentives declined by 12.6 percentage points compared to the same months in previous years, suggesting that retail domestic price spikes may have largely been mitigated or avoided. However, impacts varied across countries and commodities, and this indicator can serve as a tool for examining primary drivers of changes and conducting causal analysis to facilitate adequate agrifood policy responses to support economic recovery in the post-COVID-19 era.

Keywords: COVID-19, agricultural incentives, food prices, agricultural trade policy, price insulation.

JEL codes: Q02, Q17, Q18.

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This paper supports FAO's strategic objective of enabling more inclusive and efficient agrifood systems, and falls under the ESA "agricultural and food policy monitoring" area of work.

The project under which this study was developed was undertaken to generate improved data and analysis on the effects of the COVID-19 pandemic on agricultural incentives, providing technical ground to help countries make decisions to support agrifood systems development as the pandemic and its economic consequences continue to evolve.

The paper outlines changes to agricultural price incentives in key staple food value chains during the first wave of COVID-19 in developing and emerging economies, primarily in Latin America, Asia and Africa, using a new monthly nominal rate of protection "express" indicator.

The project may also include the development of an interactive dashboard that will be updated on an ongoing basis to provide timely measurements of incentives, not only during the COVID-19 era, but also when future shocks in agrifood systems unfold.

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1 Introduction

The COVID-19 pandemic has resulted in a shock to agrifood systems around the world as containment measures have disrupted agricultural value chains and hampered economic activity, with the potential for low- and middle-income countries (LMICs) to be particularly affected (FAO, 2021a). However, the full mid- to long-term effects of the pandemic on agrifood markets are yet to be observed, and timely monitoring and analytical tools are important to provide a better understanding of markets, define national and regional strategies and policy responses, and determine where to direct international cooperation efforts.

When analysing the effects of COVID-19 on staple food markets, efforts have largely focused on global food security concerns (e.g., Laborde *et al.,* 2021; Swinnen and Vos, 2021) and changes to global market prices (e.g., Falkendal *et al.,* 2020; Sulser and Dunston, 2020), which can indeed trigger a number of economy-wide effects in developing countries depending on the extent to which they are transmitted through domestic prices. These effects, in the case of agricultural commodities and food items, may result in impacts to developing countries' food security levels, especially for low-income and net food importing developing countries. However, it is well known that changes to international prices are not always fully transmitted to domestic prices due to transport costs, market failures such as imperfect information, and changes in exchange rates and government policies[1] intended to protect producers or consumers, all from which market distortions arise (FAO, 2015). With respect to domestic prices, studies investigating changes during the pandemic have typically done so on an individual country level (e.g., Hirvonen *et al.,* 2021; Mahajan and Tomar, 2020; Santeramo and Dominguez, 2021; Varshney *et al.* 2020). While Elleby *et al.* (2020) simulates demand-side impacts to both world prices and producer prices in four countries, our analysis provides a larger cross-country examination of how domestic prices are changing relative to world prices during COVID-19, an emphasis not yet covered by current literature.

With the intent of isolating the effect of trade and market policies on domestic prices to undersand policy responses, and in an effort to generate the type of evidence that can support decision-making in price and market policies, this paper builds upon the so-called nominal rate of protection (NRP) indicator (Anderson, 2010) for further developing a novel, simplified, adapted monthly version (monthly NRP "express," or monthly NRPx) that may be more timely to inform decision making in the short term. This new monthly indicator can track in the closest to what we could call real-time how COVID-19 market responses, including the implementation of policies, are affecting agricultural price incentives across different countries and staple food value chains. In addition to contributing to the understanding of the pandemic's disruptions to key staple food markets, the monthly NRPx indicator, when examined in conjunction with policy responses to COVID-19 such as export restrictions,[2] can aid in determining how incentives need to be realigned to be more supportive of an economic recovery in the post-COVID-19 era, serving as a technical basis to help support the development of policy recommendations.

In this paper, we outline the data and methodology used to calculate and compare changes to monthly price incentives levels for some of the most-consumed staple cereals of the poor and

[1] These policies include, among others, price stabilization policies, market interventions and import tariffs.

[2] As in the world food price crisis of 2007–2008, in the first wave of the COVID-19 pandemic, some national governments moved to restrict food exports (Anderson and Nelgen, 2012; Hepburn *et al.,* 2020). This behavior, in aggregate, can have dire unintended consequences for vulnerable people in food-importing countries, increasing prices and exacerbating issues of food insecurity already inflamed by the COVID-19 pandemic.

food insecure in 27 LMICs, as a means of generating evidence on the intra-annual relationship between international and local markets. This paper seeks to contribute empirical evidence to the analysis of agricultural price incentives during the first wave of COVID-19 – primarily, our indicator (the monthly NRPx) shows a clear decline in incentives for staple food value chains through price and market policies of 12.6 percentage points, compared to levels observed prior to the first months of the pandemic. We discuss potential drivers of these changes to agricultural incentives during the first wave of COVID-19 and how the monthly NRPx can inform ongoing policy monitoring as the pandemic and its economic consequences continue to evolve.

This paper is organized as follows. Section 2 provides background information on the context of this analysis. This is followed in Section 3 with the conceptual framework and in Section 4 with a description of the methodology and data. Section 5 discusses the main findings and results. Section 6 provides concluding comments and explores the policy implications of the results.

2 Background

Even today, a large part of the income of the rural poor comes from agriculture (FAO *et al.,* 2020). Historically, earnings of farmers in developing countries often were depressed by their own country's policies, such as heavy taxation of agricultural exports, which had pro-urban, anti-agricultural and anti-trade biases (Anderson, 2010). This situation has changed dramatically over the last 40 years, giving way to different patterns of agricultural price incentives worldwide. Efforts to monitor the impact of these changes ultimately led to the creation of the International Organisations Consortium for Measuring the Policy Environment for Agriculture (Agricultural Incentives Consortium) (IFPRI, 2020).

The Consortium maintains a harmonized database of the agricultural price incentives indicators that its participating organizations calculate annually and use to guide policy discussions.[3] It was established to carry forward the World Bank's large-scale examination of price incentives in developing countries, which began in 2006 through the program Distortions to Agricultural Incentives (DAI), the first stage of which is synthesized in Anderson (ed., 2009) and the second in Anderson (ed., 2010) and Anderson *et al.* (eds., 2010). In addition to prompting the ongoing policy monitoring efforts of the Consortium, the DAI project provided technical ground for further examination of impacts to price incentives during the world food crisis of 2007–2008. Anderson and Nelgen (2012) found that incentives were lower during the 2008 international price spike relative to the preceding non-spike period, largely attributed to changes in import and export restrictions. In addition to reducing incentives for producers, risking declines in local agricultural production, changes to trade policies were found to have collectively contributed to the global price spikes during the 2007–2008 world food crisis (Anderson and Jensen, 2017).[4]

COVID-19 disruptions in agrifood supply chains seem to have prompted similar trade-altering policy responses to those enacted in 2007–2008, albeit to a much lesser extent: 22 countries implemented food export restrictions at the beginning of the COVID-19 crisis, none of which are currently active, compared with 33 countries in 2007–2008 (FAO, 2021a; Hepburn *et al.,* 2020). The main reasons given for the implementation of these measures were fears of acute shortage and price volatility of the products involved (Laborde *et al.,* 2020a). The immediate responses of some countries to enact trade-insulating policies, despite potentially adverse effects on domestic and international prices, motivated the need to develop a mechanism to rapidly monitor price incentives to better understand the pandemic's disruptions to agricultural markets.

Over 255 million cases of COVID-19 have been recorded globally as of November 2021, with cases rising during an initial wave from March 2020 to August 2020 and then again at a faster rate afterwards (WHO, 2021). While the prevalence of COVID-19 cases initially was higher in places such as the United States and the European Union, developing countries still had the potential to be largely be impacted by the global spread through trade disruptions (FAO, 2021a). Though there is no widely-used definition of waves as the timing and nature of the spread has varied across countries, for the purposes of this study, we define the first wave of COVID-19 as March 2020 to August 2020.

[3] The members of the Consortium are the Organisation for Economic Co-operation and Development (OECD), the Inter-American Development Bank (IADB), the World Bank, FAO's Monitoring and Analysing Food and Agricultural Policies (MAFAP) programme, and the International Food Policy Research Institute (IFPRI). The consortium is also supported by funding from CGIAR (IFPRI, 2020).

[4] For example, during the 2007–2008 world food crisis, around one-third of the increase in the international price of rice was attributed to changes in border restrictions (Anderson and Jensen, 2017).

3 Conceptual framework: agricultural price incentives

Some of the most seminal applications of nominal rates of protection (NRPs) and related concepts include Krueger *et al.* (1988), Monke and Pearson (1989), Tsakok (1990), and Anderson and Masters (2009). A detailed comparison of such applications can be found in Balié and Maetz (2011). The NRP indicator was designed to measure the percentage by which domestic producer prices diverge from "international-equivalent prices" that would have prevailed in a well-functioning market at free trade. Relevant international-equivalent prices are generally found at each country's border, and are considered to be undistorted by national policies and free of influence of domestic market failures.

Derived from the indicator in Krueger *et al.* (1988), the NRP indicator used today likewise compares domestic prices to international-equivalent prices in a manner that is comparable across countries, commodities and time. An important contribution of the price incentives literature has been quantifying the impacts of policy and market environments on levels of price incentives in developing countries and providing insight into policy options for price stabilisation (Pernechele *et al.,* 2018; Anderson and Nelgen, 2012). In this study we operationalize the concept of price incentives to facilitate rapid policy monitoring by creating a simplified, modified version of the NRP that allows for calculation of incentives on a monthly, rather than annual, basis. The Agricultural Incentives Consortium provides annual NRPs typically with a two-year delay, due to the complexities of gathering data on updated domestic prices, border prices and adjustment factors. The new monthly NRP "express" indicator (monthly NRPx) builds upon and simplifies the price incentives methodologies used by the Consortium,[5] allowing for a more timely evaluation of the effects of changing market and policy environments on staple cereals, particularly beneficial during shocks to agrifood systems such as COVID-19. Future developments of this monthly indicator will include the incorporation of seasonality and other aspects derived from intra-annual trade variation.

Considering data availability, our analysis covers the three most-consumed staple cereals – rice, wheat and maize – as well as sorghum, millet and potatoes, when available. We focus on low- and middle-income countries (LIMCs), where agricultural production constitutes a larger share of household income and changes in prices present more of a food security concern (FAO *et al.,* 2020). A recent analysis found that the poor spend more than a quarter of their income on staple foods such as rice, wheat and maize (Laborde *et al.,* 2020a), which together account for as much as half of the calorie supply in developing regions (FAO, 2016). Even though cereals are often missing many key micronutrients, cereal prices are of critical importance for nutrition, as higher cereal prices can crowd out expenditures on nutrient-rich non-staples such as fruits, vegetables, eggs and dairy, more so when coupled with income declines of poor households (Laborde *et al.,* 2021).

As many of the poor are both producers and consumers of food, the impact of high domestic prices with respect to food security can vary by country and commodity; however, research has shown that the poorest are often net food consumers and thus can benefit from lower prices of staples (e.g., Ivanic and Martin, 2014; Lederman and Porto, 2016). Thus, governments may respond to a shock to food systems with policies intended to insulate consumers from world

[5] Specifically, the new monthly NRPx indicator builds directly off of the decade-long experience of FAO's Monitoring and Analysing Food and Agricultural Policies (MAFAP) programme in calculating annual NRP indicators for countries in sub-Saharan Africa.

price fluctuations and ensure adequate supplies of staple foods, especially in light of falling income levels and contracting economic growth during a crisis such as COVID-19 (Laborde *et al.,* 2020a). However, food policies have trade-offs, the magnitudes of which can vary greatly across countries and value chains. Timmer (2017) discusses how this analysis is encompassed in the so-called food price dilemma:

> A single market-clearing food price cannot satisfy all consumers and producers simultaneously – in other words, a pure market solution does not work. Additional policy instruments are needed, *but they all need to operate compatibly with market prices* (Timmer, 2017, pp. 6–7).

Policy responses to food crises can include export bans (which would prevent domestic prices from increasing at the same rate as international prices), import tariff reductions (which would offset increases in international prices) and other policies such as prices stabilisation and food aid measures. Such changes can lead to a decline in price incentives, highlighting the trade-off between reducing consumer price levels and volatility and incentivising agricultural production, as demonstrated during the 2007–2008 world food crisis (Anderson and Jensen, 2017; Anderson and Nelgen, 2012). Against this conceptual background, due to the fact that trade restrictions were limited and temporary during the first wave of COVID-19, we hypothesize that price incentives for staple cereals will tend to have had a muted change, with an overall small median decline, though impacts will vary across countries and commodities.

As stated in Torero (2021), the recession caused by COVID-19 – "the worst recession in four decades" – is unique in that it was prompted by a health crisis rather than a financial crisis, with inevitably lasting consequences exacerbated by the fact that "the heavier the efforts to contain the virus become, the deeper the recession gets." Developing countries must consider how to promote food security for poor consumers without consequently generating disincentives to local agriculture production and risking tightening the local supply of staples, especially as the pandemic and its impacts on international prices evolve. Moreover, abrupt implementation of export restrictions can introduce instability, uncertainty and volatility in both domestic and world markets (Glauber and Martin, 2020), distorting prices and the economy and leading to a reduction of economic welfare. The monthly NRPx indicator can continue to help governments monitor active trade and market policies and consider potential impacts of changes implemented during subsequent waves of the pandemic and other future shocks.

4 Data and methodology

4.1 Data

Since our analysis focuses on understanding domestic price incentives of staple cereals in LMICs on a monthly basis, we follow the selection criteria used in Dawe and Morales Opazo (2009),[6] which examined monthly domestic staple food prices in developing countries during the world food crisis of 2007–2008. Our first step was to bound the period of analysis: monthly domestic and international-equivalent (reference) prices are compiled from January 2017 to August 2020 in order to be able to examine changes to monthly NRPx values, or price incentives levels, during the first wave of COVID-19.

We term each selected country and commodity combination (e.g. Ecuador maize) a "case study." As shown in Table 1, 43 case studies of rice, wheat, maize, sorghum, millet, and potatoes were ultimately used across 27 LMICs,[7] and price data were available through at least July 2020 for 70 percent of case studies. There were 14 case studies for rice, 13 for maize, 12 for wheat, and only 2 for potatoes[8] and 1 for both sorghum and millet. Case studies were primarily from Africa (15 case studies from 11 countries), Latin America and the Caribbean (14 case studies from 6 countries) and Asia and the Pacific (8 case studies from 5 countries), with four countries from Eastern Europe and one from the Near East (Egypt). As trade values and volumes are often not reported, accessible or available in real-time for developing countries, case study selection was carried out first based on domestic price availability, and then further refined depending on the availability of an international-equivalent price, which proved to be the primary constraint to the sample size.

[6] Dawe and Morales Opazo (2009) find a median domestic staple food price increase of 48 percent in developing countries during the world food crisis of 2007–2008.

[7] A map of included countries is included in Annex 1.

[8] There was initially a case study included for Kyrgyzstan potatoes that was deemed an outlier and eliminated from the sample due to extraordinarily high changes in monthly NRPx values, largely due to country-specific factors outside of the scope of this analysis, such as currency depreciation (IMF, 2021) and a spike in demand due of fear of supply shortages at the onset of COVID-19, which exacerbated seasonal demands (FAO, 2021b).

Table 1. Included case studies by region, commodity group and end date

	Case studies	Countries
Region		
Africa	15	11
Asia and the Pacific	8	5
Eastern Europe	4	4
Latin America and the Carribbean	14	6
Near East	2	1
Total	**43**	**27**
Commodity group		
Rice	14	
Maize	13	
Wheat	12	
Potatoes	2	
Millet	1	
Sorghum	1	
Case study end date		
April 2020	5	
May 2020	3	
June 2020	5	
July 2020	16	
August 2020	14	

Source: Authors' own elaboration.

Domestic prices

The FAO-GIEWS Food Price Monitoring and Analysis (FPMA) Tool (FAO, 2021d) was utilized to obtain monthly nominal domestic prices.[9] The ultimate data sources in most cases are official government sources; full details of specific sources for each country are available in FAO (2021d). Nominal prices are used due to the fact that the recent monthly consumer price index (CPI) values are not available for many included countries, and the nature of the indicator as a ratio yields similar results using either nominal or real prices. However, using nominal rather than real prices would limit examination of longer price series data to complement analysis of changes to monthly NRPx values directly. Adjusting for inflation can be essential when examining price behaviour over longer periods of time when inflation would likely have a more substantial impact, whereas the time window in this analysis is under four years, making the use of real prices less critical for supplementary analysis.

Additionally, wholesale or retail prices are used rather than producer prices due to the fact that prices at the farm gate are typically only available at the annual level and not accessible on a

[9] Only Senegal rice had a different source: the price for local broken rice from the Market Regulatory Agency (DPEE, 2021) was used rather than the FAO-GIEWS FPMA Tool's imported rice price.

monthly basis in a widespread, timely manner.[10] Measuring incentives at the wholesale and consumer (retail) level can provide important insights from a food security and affordability perspective. Moreover, the use of these prices may also provide insight into how policies provided overall incentives or disincentives to main staple food value chains. While this is a simplification of the NRP methodology detailed in FAO (2015) as we did not use farm gate prices due to lack of monthly data and would imply an assumption that levels of incentives are translated equally throughout the value chain, with no changes in terms of market power, we recognize that the monthly NRPx indicator as calculated here can still provide a sense of the general directions of incentives to the value chain. Collection of more frequent and systematic farm-level price data should be a major priority for understanding supply responses and the food security of producers who receive income from crop sales.

Once we determined which nominal domestic price data were available, our next step was to select the data to be used for each country and commodity combination. Within a given country for a given staple food, nominal price data are often available for multiple locations, multiple qualities, and multiple levels of the marketing chain (i.e. both wholesale and retail), or some combination thereof. In order to choose which data series to analyse for a given case study, a set of ordered criteria were applied. To avoid skewing the sample, only one case study from each commodity in any given country was considered, (e.g. either prices for whole wheat or wheat flour, or either rice at wholesale or retail level). The first criterion was to use, whenever possible, wholesale price data (obtained for 31 case studies), as the wholesale level is the point of competition between domestic and imported production. However, if no wholesale price data were available for a particular case study, retail prices were used (12 case studies). The second criterion was to use, whenever possible, data on the primary output. In the case of wheat, if price data for both whole wheat and wheat flour was available, data on whole wheat was preferred. In the case of maize, data on maize grain was used if available, with maize flour as a second choice.

The third criterion was to use the most similar quality of the commodity to the one available in international markets. In cases where data on more than one quality was available, the lower quality was preferred, taking into account that lower qualities are usually more widely consumed by poor households. For example, 25 percent broken rice in Thailand was selected over 5 percent broken rice, as 25 percent broken rice is of lower quality. Our last criterion was to use national average prices when available. When national average prices were unavailable, an unweighted average price was calculated from all markets in the given country for which data were available, or a single market price was utilized if needed.[11] National average domestic price data were available for 11 case studies, an unweighted average was calculated for 21 case studies, and data from only a single location was available for the remaining 11 case studies.

[10] Though farm gate prices are used by FAO's MAFAP programme to calculate NRPs as well as in other existing approaches of policy monitoring, they are not as widely available on a recent monthly basis. For the cereals included in this study, producer prices are available on the FAOSTAT database for a range of countries, but only on an annual level, with the latest year 2019 (FAO, 2021e).

[11] This criterion differs slightly from FAO-MAFAP's methodology, which for imported commodities, uses the domestic wholesale market where the largest volumes of the commodity are traded or a national average, and for exported commodities uses the border market or main wholesale market (FAO, 2015). Future expansion of monthly NRPx calculations could include identifying the relevant market pathway for each case study and only utilizing the corresponding prices for those markets.

International reference prices

The relevant international-equivalent price is dependent on whether a country is a net importer or exporter of the commodity (FAO, 2015). To determine the net trade position, annual data from the UN Comtrade Database (UN, 2021) was used to compare import and export volumes and determine which quantity was higher, with monthly UN Comtrade data supplemented when needed. The trade status was assessed each year, and in cases where the trade status alternated between years, the country was considered a net importer if had been a net importer in two of the previous three years, and vice versa for net exporters (OECD, 2016). The international benchmark price was selected either as the monthly nominal CIF (cost, insurance, and freight) price for net importers (27 case studies) or FOB (free on board) price for net exporters (16 case studies). CIF or FOB unit prices were calculated for each case study by dividing the total monthly import or export trade value (in USD) by the total tonnes imported or exported that month.

In order to calculate a reference price comparable with the domestic price at the point of competition (for wholesale) or at retail, typically adjustments are made to the benchmark price for the quantity (e.g. physical transformation of wheat into wheat flour) and quality (e.g. imported yellow maize compared to domestic white maize) (Krueger *et al.,* 1988; FAO, 2015). To minimize the need for these adjustments, UN Comtrade data were selected to match the commodities that domestic prices were obtained for as closely as possible by using the corresponding Harmonized System (HS) code (UN, 2017).[12] Benchmark prices are also adjusted to reflect access costs from the border, which can include transport, processing, marketing and storage costs as well factors such as bribes, roadblocks, and profit margins for marketing agents (Krueger *et al.*, 1988; FAO, 2015). Here, given time and resource constraints to obtain the necessary data on access costs, the monthly NRPx indicator assumes a standardized ten percent adjustment to the benchmark price. In the ideal case with sufficient data, actual access costs for each case study would be calculated according to the FAO-MAFAP methodology as outlined in FAO (2015), but here the assumption of a ten percent adjustment allows for rapid monthly calculations of reference prices for a broader range of countries. Therefore, for CIF prices, ten percent of the price was added to the benchmark, and for FOB prices, ten percent of the price was subtracted from the benchmark. We acknowledge that this assumption limits the accuracy of the monthly NRPx indicator and can underestimate the actual levels of access costs, but implement this standard measurement given the constraints faced.[13]

For countries without sufficient import or export data from UN Comtrade to determine the trade status or calculate a monthly benchmark price, we first sought to leverage the data sources

[12] While at this stage quality and quantity adjustments were not made as efforts were made to closely coordinate HS codes with domestic commodities, in updates to monthly NRPx calculations the need for these adjustments should be examined more closely, especially in the case of white maize relative to yellow maize.

[13] In future extension of this analysis, this standardized adjustment could be further refined to reflect changes in levels of access costs over time, such as by adjusting for transport fuel prices. When comparing Agricultural Incentives Consortium NRPs at the farm gate level for 2017 and 2018 (IFPRI, 2020) to annual indicators computed with the same prices and adjustment factors we used for monthly NRPx values, a little less than half were within 20 percentage points. However, it is important to keep in mind that these comparisons were made for indicators at different points in the value chain; if a comparison was made to the Consortium NPRs at the point of competition or retail, there would likely be less differences and the standard ten percent adjustment to the benchmark would appear to more accurately estimate access costs.

used for countries where FAO's MAFAP programme has previously calculated indicators.[14] This resulted in a combination of utilizing import and export data from national statistics websites (see Annex 2 for list of sources), or when not available, estimating benchmark prices using neighbouring country wholesale prices (especially for cases of informal trade) or FOB prices from exporting countries, which were then either used directly as a proxy or adjusted for transportation costs.[15] Rather than adjusting the benchmark by ten percent in all cases for FAO-MAFAP countries, the average ratio between the reference and benchmark price from the most recent five years of FAO-MAFAP's NRP calculations was used to determine the adjustment factor, which often was much greater than ten percent depending on the level of access costs and quantity and quality adjustments for the case study.[16] The countries where this approach was taken are noted in Annex 2, and this further highlights how the standard ten percent adjustment likely significantly underestimates access costs for many other case studies, though levels of access costs can certainly vary by country and commodity.

Furthermore, it is important to note that the countries and case studies included in this sample were contingent on data availability from the FAO-GIEWS FPMA Tool, UN Comtrade, and sources previously used by FAO-MAFAP. Thus, the results of this analysis are by nature shaped by the characteristics of the 27 LMICs that were ultimately able to be included in the sample. Countries were not intentionally selected in an effort to be as reflective as possible of the various changes to levels of price incentives in LMICs during the first wave of COVID-19.

4.2 Methodology

The new monthly NRPx indicator estimates the joint effect of trade and market policies on domestic prices by comparing them to the corresponding reference prices (Krueger *et al.*, 1988; FAO, 2015). For net importers, policies such as import tariffs or quotas can cause domestic prices to be higher than those at the border, resulting in incentives for producers (displayed in positive monthly NRPx levels), and for net exporters, policies such as export restrictions or taxes can cause domestic prices to be lower than world prices, resulting in disincentives for producers (displayed in negative monthly NRPx levels).

The level of incentives can provide insight into the extent to which trade and market policies and dynamics are leading to distortions in agricultural staple markets. Thus, building off of the methodologies detailed in FAO (2015) and originating in Krueger *et al.* (1988) used to calculate annual price incentives,[17] and the methodology used in Dawe and Morales Opazo (2009) to calculate the median maximum change in domestic prices of staple cereals during the 2007–2008 food crisis, this paper conducts a cross-country analysis of changes to monthly agricultural price incentives during the first wave of COVID-19, which again, is defined in this paper as March 2020 to August 2020 (WHO, 2021). By comparing monthly NRPx levels before the start of the pandemic with levels during the same month in 2020, general effects of COVID-19 on

[14] We were able to replicate the trade status determination and benchmark data sources for all countries where FAO-MAFAP has previously calculated indicators (FAO, 2021c) besides Benin, Burundi, Ethiopia and Ghana.

[15] For a full description of benchmark data sources previously used by FAO-MAFAP and replicated in this analysis, see Annex 2. Non-UN Comtrade benchmark sources were also used for three case studies where data were readily available on national statistics websites and the UN Comtrade data proved to be insufficient (Ecuador maize, El Salvador rice, and Thailand rice), the sources of which are also detailed in Annex 2.

[16] The adjustment factor for access costs across FAO-MAFAP case studies ranged from 11 to 52 percent, with a median of 27 percent.

[17] See Annex 3 for a comparison of the annual NRP indicator and the monthly NRPx indicator.

agricultural incentives can be examined and case studies where significant changes occurred can be identified and prioritized for policy realignment.

For a full description of how the monthly NRPx indicator is calculated and how year-on-year comparisons are generated for each month during the first wave of COVID-19, see Annex 4. Ultimately, for each case study, we determined the month in the first wave where the greatest change occurred compared to the same month in a previous year (maximum one-month change), as well as the three-month period where the greatest change occurred compared to the same three-month period in a previous year (e.g. the average of March 2020, April 2020, and May 2020 was compared to the average of the same three months in 2019, and so on, until the maximum change in the three-month period averages was determined for each case study). The maximum three-month average change signals the period in 2020 where the most change occurred over multiple months; if it does not largely differ in magnitude from the maximum one-month change, it can indicate that the changes in price incentives occurred across several months during the first wave of COVID-19, rather than just a single month. Annex 4 also details further how the maximum one-month and three-month average changes were calculated.

In order to be able to better summarize and examine different change effects, we attributed an “incentives change category” to each case study (Table 2). This categorization allowed for cross-country comparisons of changes to price incentives across like-effects and provided a mechanism to characterise the general effect at the country and case study level.[18]

Table 2. Incentives change categories

Incentives change category	Description
Pre-existing incentives	
Category 1	Incentives *increased*
Category 2	Incentives *decreased*
Pre-existing disincentives	
Category 3	Disincentives became *less negative*
Category 4	Disincentives became *further negative*

Source: Authors’ own elaboration.

There were 12 case studies where the category of change differ for comparisons made to 2019 values and for comparisons made to 2017 and/or 2018 values; in these cases, the recent effect from 2019 was selected.[19] Furthermore, there were 13 case studies where the incentives change category switched within the first wave of the pandemic (e.g. incentives increased compared to previous years from March 2020 to June 2020, but decreased compared to previous years in July and August 2020). In these cases, typically the effect that occurred for

[18] While in many cases the direction of the maximum changes to monthly NRPx values corresponded with the representative change category, in situations where it may not have due to outliers (as discussed in Annex 4), we ultimately selected maximum changes that aligned with a case study’s representative change category.

[19] One limitation is that analysis was not conducted to quantify year-on-year changes prior to 2020 (such as comparing 2019 values to 2018 values), nor were pre-existing trends systematically examined to assess if changes to monthly NRPx values during the first wave of COVID-19 were part of a wider long-term trend, or unique to 2020. Further examination of previous levels could be beneficial in characterising the true disruption that occurred during the pandemic.

the most months during the first wave was considered representative, and the maximum change values were selected accordingly. However, the alternative effect should be examined when conducting country-specific analysis, especially when impacts differed in the later months of the pandemic's first wave.

Median levels of change

Finally, once the maximum monthly NRPx change values were determined for each case study, they were compared across countries and commodities by calculating the median values for maximum one-month changes and maximum three-month average changes. The median was used, rather than the mean, in order to avoid large change values skewing the effect. When computing the overall median effect, the positive and negative changes can tend to cancel out, thus lowering the overall magnitude of the median. Therefore, we also compute the median change for each category; by comparing only increases with increases and vice versa, the median magnitude is more accurately calculated for each type of change. The overall median effect is helpful in determining the general direction of changes to incentives across all case studies, but the comparisons by incentives change category give a more reflective depiction of the typical magnitude of changes, as discussed further in the results section.

5 Results

The results show remarkable movements in agricultural price incentives during the first wave of COVID-19. The median value for the maximum one-month year-on-year change to price incentives across all 43 case studies was a decline of 12.6 percentage points (Table 3). The quartiles in Table 3 indicate a change that was widely varied across case studies, as also depicted in Figure 1, with a slight majority (24 case studies from 18 countries) that experienced a decrease in price incentives for staple food value chains. This demonstrates that the local markets in the 27 LMICs included in the sample were affected by a range of policy changes during the first wave of COVID-19 (Kennedy and Resnick, 2020; Vickers *et al.,* 2020). However, the negative median does show that out of fear of shortages or domestic price spikes, governments did implement policies to prevent domestic prices from potentially increasing at the same rate as world prices (Glauber and Martin, 2020; Laborde *et al.,* 2020a). In some cases for net importers, pre-existing policies such as import tariffs or quotas were lifted, or price stabilisation measures were enacted, leading to lower levels of incentives, and in some cases for net exporters, policies such as export restrictions resulted in further disincentives. We briefly examine these policy changes for select case studies in later sections, but do consider that an understanding of all the different variables that affect the price dynamics warrants further empirical analysis in order to develop country-specific policy recommendations.

78 percent of the decreases in monthly NRPx values were from case studies with pre-existing positive price incentives that declined, but remained positive at lower levels (42 percent of all case studies). 26 percent of case studies had pre-existing price incentives that increased, and 21 percent had pre-existing disincentives that became less negative or reversed to incentives.[20] As shown in Table 3, the median three-month average change in price incentives was a small increase of 4.6 percentage points. Though a positive change, the fact that the increase was of very low magnitude and therefore is of similar nature to the negative median one-month change indicates that impacts were not restricted to a one-month period, though at times was slightly more pronounced in the month of maximum change.

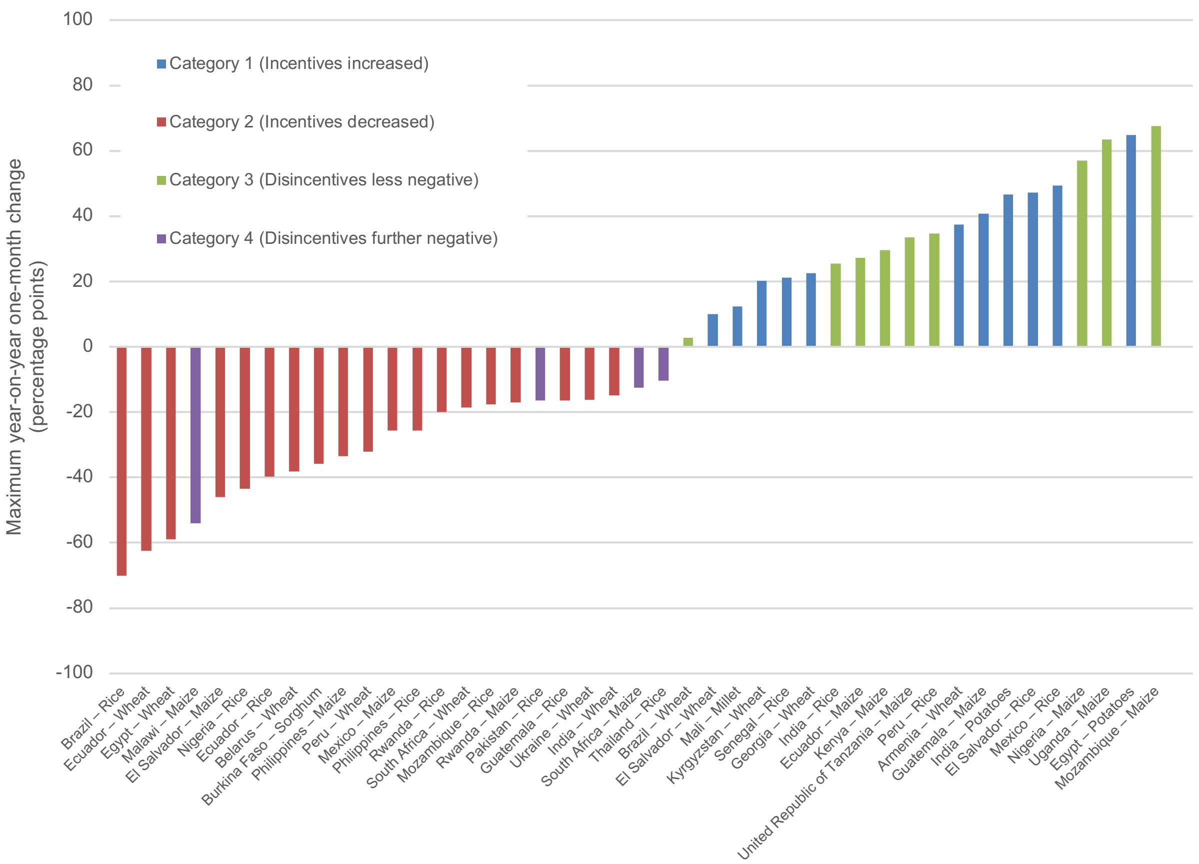
Table 3. Quartiles of maximum year-on-year percentage point changes in price incentives during the first wave of COVID-19

	One-month change	Three-month average change
Minimum	-70.2	-55.2
Quartile 1	-28.9	-13.4
Median	-12.6	4.6
Quartile 3	31.6	20.8
Maximum	67.6	68.3

Source: Authors' own elaboration.

[20] Figure 1 (along with Tables A3 and A4 in Annex 5) details the direction of change for each case study.

Figure 1. Maximum year-on-year percentage point changes in price incentives during the first wave of COVID-19 for included case studies, by incentives change category



Source: Authors' own elaboration.

Impacts of the pandemic specifically on domestic prices have been examined in the literature for select countries and commodities: for India, Varshney *et al.* (2020) find that spikes in wheat prices occurred only during the first month of COVID-19 and declined afterwards, anchored by the minimum support price, and Mahajan and Tomar (2020) find that pandemic lockdowns resulted in only minimal changes to online prices for various foods. Santeramo and Dominguez (2021) find price surges for low-perishable fruits and vegetables in the United States and European Union (largely as a result of panic-buying and hoarding), and to a greater extent in Mexico, which experienced large currency depreciation at the onset of the pandemic (IMF, 2021). Supply chain disruptions may not have had as drastic of an impact on non-perishable goods relative to perishables (Vickers *et al.,* 2020; Santeramo and Dominguez, 2021) – an impact that could warrant future investigation by later building upon this analysis to include fruits and vegetables.

Initial impacts to international prices of staple cereals

Although containment measures implemented in response to the pandemic limited access to labour supply, agricultural inputs, and agricultural extension and advisory services and interrupted logistics, processing, and market access (FAO, 2020a), these measures were quite limited and ad-hoc, especially for cereals. This is likely a reason why there was not a large international price spike for staple cereals during the first wave of COVID-19 (International Grains Council, 2021). As highlighted in Figure 2, between March 2020 and August 2020 (the first wave timeframe covered by this analysis), wheat and rice experienced only slight increases in international prices, and the international price for maize actually declined through May 2020, after which it increased to pre-pandemic levels by September 2020.

The muted impact to international prices during the first wave of COVID-19 can also be attributed in part to good production prospects and higher stocks of staples (Hepburn *et al.,* 2020; Mogues, 2020; FAO, 2021a) and contracted demand for transport fuel leading to lower oil, biofuel and maize prices (Elleby *et al.,* 2020). While we would have expected international prices to increase more significantly during the first wave of COVID-19, and therefore monthly NRPx values to decline more considerably (with other domestic market and policy conditions remaining constant), since international prices did not spike, the median monthly NRPx change was low. With relatively stable international prices, countries are less keen to resort to trade interventions that could alter domestic prices and thus affect monthly NRPx levels. However, in light of the more recent price increases for wheat and maize that are evident in Figure 2, it will be critical to investigate price incentives trends during subsequent COVID-19 waves, as updated data becomes available.

Figure 2. World price changes for wheat, maize and rice – Internationals Grains Council sub-indices, January 2020 to March 2021

Source: Authors' own elaboration based on data from IGC (International Grains Council). 2021. IGC Grains and Oilseeds Index (GOI). In: Market Information: Grains & Oilseeds Index (GOI) [online]. London. [Cited 12 March 2021]. https://www.igc.int/en/markets/marketinfo-goi.aspx

As noted, food export restrictions were in fact more limited during the first wave of COVID-19 than during the 2007–2008 world food crisis, and had less of a collective impact on international prices, only affecting five percent of globally traded calories – a quarter of the level affected in 2007–2008 (Hepburn *et al.,* 2020). Just two out of the four main rice exporting countries, Cambodia and Viet Nam, ultimately enacted export bans, and only for a short time in April and

May 2020 (Sulser and Dunston, 2020). For wheat, while export restrictions were of longer duration than rice export bans, generally implemented from March or April 2020 to June 2020 (through September 2020 for Kyrgyzstan), their impact was mitigated by the fact that they were implemented primarily only by Eurasian Economic Union countries (Laborde *et al.,* 2020b).

Variation in changes to price incentives across case studies

To further characterise the changes for different types of case studies, Table 4 gives the median change by category (as described in Table 2 in the methodology section), as well as by commodity type. As depicted in Figure 3, rice and wheat both had median declines to price incentives similar in magnitude to the overall decline. Maize had a median increase of 27.2 percentage points. Sorghum, with only one case study, had a median decline of 35.7 percentage points. Millet and potatoes, with one and two case studies respectively, had median increases of 12.3 and 55.8 percentage points. All of these commodities are staple foods, and thus following that classification, we include sorghum, millet, and potatoes in the analysis, even with few case studies. The median declines in rice and wheat likely drive the overall median decrease as they have the greatest number of case studies (collectively comprising 60 percent of all case studies). The median increase in maize and the large median increase in potatoes will be addressed in the "Country case studies: increasing price incentives" section.

As shown in Table 4, the effects by incentives change category show median changes that are as much as three times that of the magnitude of the overall median change, with the exception of the category where disincentives became further negative, which had a median decline of 14.6 percentage points. For all other categories, the median change ranged from an absolute value of approximately 32 to 37 percentage points. This deviation from the overall median change indicates further the dispersion of changes to the ratios between international and local prices: the low overall median across all case studies is driven by both positive and negative changes of much greater magnitude.

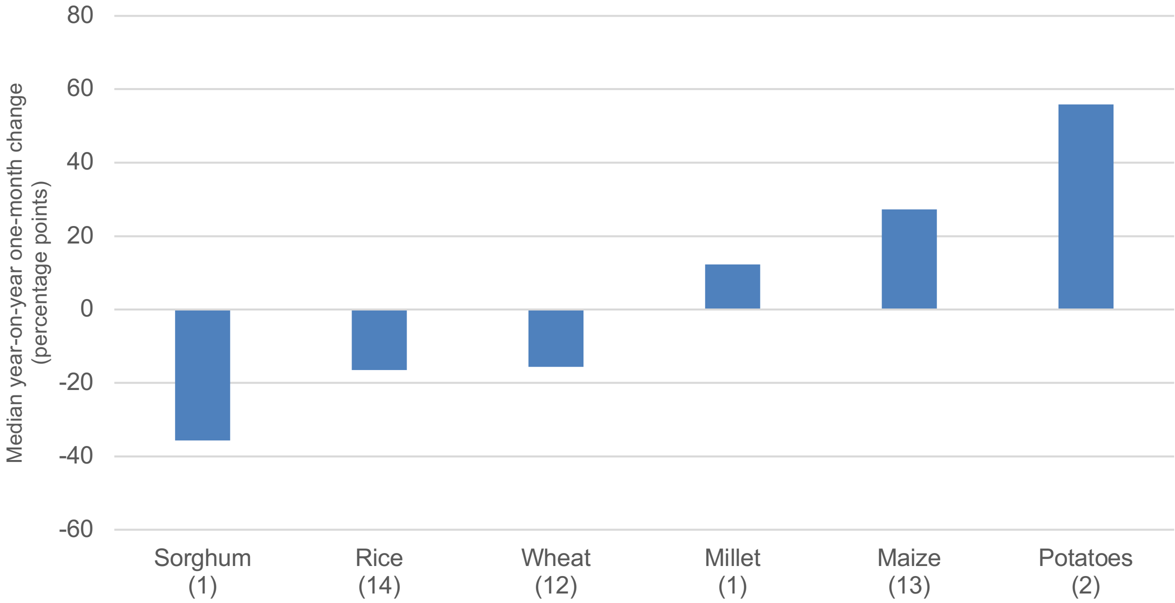
Table 4. Median percentage point changes in price incentives, by commodity and change category during the first wave of COVID-19

Commodity		Incentives		Disincentives		Overall median
		Category 1 *Increased*	**Category 2** *Decreased*	**Category 3** *Less negative*	**Category 4** *Further negative*	
	Count	*11*	*19*	*8*	*5*	
Maize	*13*	40.7	-29.5	45.3	-33.3	**27.2**
Millet	*1*	12.3				**12.3**
Potatoes	*2*	55.8				**55.8**
Rice	*14*	47.2	-25.7	30.1	-13.5	**-16.5**
Sorghum	*1*		-35.7			**-35.7**
Wheat	*12*	21.3	-32.1	2.8		**-15.6**
Overall median		**37.4**	**-32.1**	**33.6**	**-14.6**	**-12.6**

Notes: Blank cells indicate the commodity did not have a case study in that specific incentives change category.

Source: Authors' own elaboration.

Figure 3. Median maximum percentage point changes in price incentives, by commodity during the first wave of COVID-19



Note: Case study numbers in parentheses

Source: Authors' own elaboration.

Next, we note the median changes by region and by trade status. As seen in Table 5, the prevalence of decreases in price incentives (lower monthly NRPx values) across all categories suggests that the decline was not concentrated in a specific region, or confined to solely net exporters or net importers. Africa, Asia and the Pacific, and Latin America and the Caribbean, collectively making up 86 percent of the case studies, all had median decreases similar to the overall median decrease (-12.6, -12.7, and -6.8 percentage points, respectively). Eastern Europe and the Near East, with four and two case studies respectively, both had low median increases (3.2 and 3.0 percentage points). With respect to trade status, net importers and net exporters both had median decreases also similar to the overall median (-16.4 and -11.4 percentage points). While again these median changes are low in magnitude, the median declines across both trade statuses aligns with the hypothesis that governments in many LMICs prioritized implementing policies that could ensure sufficient domestic food supply and avoid domestic price increases, such as export restrictions, import tariff reductions and price stabilization measures (Vickers *et al.,* 2020), in order to protect poor consumers during the first wave of COVID-19. Further explanation of how these policy responses often led to a decrease in price incentives for producers will be given in the "Country case studies: decreasing price incentives" section.

Table 5. Median maximum monthly NRPx changes by region and by trade status

	Case study count	Median one-month change
Region		
Africa	*14*	-12.6
Asia and the Pacific	*8*	-12.7
Eastern Europe	*4*	3.2
Latin America and the Carribbean	*14*	-6.8
Near East	*2*	3.0
Trade status		
Net importer	*27*	-16.4
Net exporter	*16*	-11.4

Source: Authors' own elaboration.

Lastly, we examine the timing of the maximum changes to price incentives during the first wave of COVID-19, which can indicate when the largest levels of alterations to price interventions occurred in response to the pandemic for each case study. The maximum change occurred most frequently in May 2020 (11 case studies, or 26 percent of case studies each). However, this was followed closely by April 2020 and July 2020 (9 case studies each, or 21 percent of case studies each), March 2020 (8 case studies, or 19 percent of case studies) and lastly June 2020 (6 case studies, or 14 percent of case studies). While maximum change effects were largely spread across the first wave, the majority of case studies had the largest change to levels of incentives in the middle of the pandemic's first wave.

5.1 Country case studies: declining price incentives

Examining specific drivers behind changes to price incentives for every case study is beyond the scope of this paper, and is intended to follow in the form of country-specific narratives made publicly available through an online FAO dashboard. These narratives will be developed utilizing information on policies and market dynamics from the following sources, among others:

- International Food Policy Research Institute (IFPRI) COVID-19 Food Trade Policy Tracker (Laborde *et al.*, 2020b);
- Food and Agricultural Policy Decision Analysis (FAPDA) Tool (FAO, 2021g);
- International Monetary Fund (IMF) COVID-19 Policy Tracker (IMF, 2021);
- World Trade Organization (WTO)'s list of measures affecting trade in goods during COVID-19 (WTO, 2021); and
- Global Information and Early Warning System (GIEWS) country briefs (FAO, 2021f).

Examples of common policy changes documented through the above databases and their potential role in driving changes to price incentives for select case studies are discussed in the sections to follow.

Implementing export restrictions

In the countries included in our analysis, export restrictions were not widely implemented during the first wave of the pandemic because the majority are not net exporters of cereals. Moreover, Armenia, Belarus and Kyrgyzstan, countries in our analysis that are part of the Eurasian Economic Union where the longest export bans were enacted, are all net importers of wheat flour, resulting in mixed impacts to price incentives. Included in our analysis is Pakistan, a net exporter of rice that enacted an export ban for a short period from 29 April 2020 to 20 May 2020 (Laborde *et al.,* 2020b). Rice in Pakistan was characterized by price disincentives in 2019 that enlarged in April and May 2020. Once the short-lived export ban was lifted, such disincentives narrowed.

Lifting of import tariffs

Import tariff reductions, intended to avoid sharp increases in prices during times of crisis, were not as common in our case studies, but were more widespread in general for cereals (FAO, 2021a). However, some net food importing countries in our analysis such as South Africa (for wheat) and El Salvador (for white maize and rice) did experience declining incentives after reducing or eliminating their value-added tax (VAT) for staples (ITC, 2020; FAO, 2021a). For wheat in South Africa, subject to an import VAT exemption as a result of the pandemic, domestic prices remained stable through June 2020 despite the fact that the wheat reference price increased slightly. Monthly price incentives were typically lower for wheat in South Africa compared to previous years, with the largest decrease in monthly NRPx values occurring in May 2020.[21]

Price controls

Governments also implemented price control measures to fix the maximum price of basic staples, in some cases, leading to lower domestic prices and declining price incentives, but perhaps not as much as if international prices had increased as feared. Examples in our case studies include El Salvador (again for white maize and rice) and Rwanda (for maize and rice) (FAO, 2021g). Rwanda fixed the price of rice to prevent traders from taking advantage of the COVID-19 outbreak. This was done to avoid a situation like the one during the 2007–2008 food crisis, where an oligopsony of wholesalers and an indicative minimum price policy likely kept prices (and incentives) high, even though import duties were reduced (FAO, 2018). With the price fixation, from March to August 2020, domestic prices remained relatively stable while reference price for rice slightly increased, leading to lower incentives relative to the same month in previous years. Price control measures are also widely documented for countries outside our analysis and are noted to be the main market-based domestic instrument used to support consumers in the first wave of COVID-19, followed by the expansion of food reserves and stock releases (FAO, 2021g; FAO, 2021a).

[21] Domestic prices for South Africa wheat do spike a bit in July and August 2020 as reference prices remain stable, resulting in increased incentives during those months, the cause of which should be examined further in a country-specific analysis.

5.2 Country case studies: increasing price incentives

As mentioned, while the median change in price incentives was negative for rice, wheat and sorghum, the median change was positive for maize, potatoes and millet. All case studies included for potatoes (Egypt and India) and millet (Mali) were net exporters with pre-existing price incentives that increased during the first wave of COVID-19. Empirically, we cannot draw any strong conclusions due to the limited number of case studies available for these commodities. However, one possible factor for the large median increase in price incentives for potatoes (approximately 56 percentage points) is that their nature as a semi-perishable crop resulted in a tightened supply as transportation restrictions hindered the ability to reach storage facilities, leading to the large increase in domestic prices, especially in India. In Egypt, though domestic prices did not increase at the onset of the pandemic, they sustained higher levels relative to the same months in previous years, and price incentives also resultingly were higher. It is possible that supply chain disruptions from COVID-19 lockdown measures may have impacted potatoes more drastically than non-perishable cereals; a phenomenon that could be further investigated by examining changes to monthly NRPx levels of perishable commodities.

There are a few reasons that could at least in part explain the increasing price incentives for maize: the contracted demand for transport fuel leading to lower oil, biofuel and maize prices at the onset of the pandemic (Elleby *et al.,* 2020), the fact that only two export restrictions were enacted (compared with nine for rice and ten for wheat) (Laborde *et al.,* 2020b) and other existing food security threats such as the locust infestations in the Greater Horn of Africa and Southwest Asia (FAO, 2021a). However, further analysis is needed to assess compounding factors that impacted price incentives for maize on a case-by-case basis. Examples in our case studies include Kenya, a net importer of maize, and Uganda, a net exporter of maize, both of which were directly impacted by the desert locust outbreak and had pre-existing disincentives prior to the pandemic. Kenya experienced less negative disincentives (an increase in monthly NRPx values) as domestic prices converged closer to reference prices, despite the fact that duties for maize imports from outside the East African Community were reduced (FAO, 2020b), with the maximum change occurring in April 2020 when disincentives temporarily reversed to incentives. From March 2020 through June 2020, Uganda experienced price incentives contrary to pre-existing disincentives. Thus, initially during the first wave of COVID-19, the supply shock resulting from the desert locust outbreak in both countries put upward pressure on domestic prices and was likely a driving factor of the increases in monthly NRPx values. However, government control operations supported by FAO were ultimately able to avert widespread damages from the locust outbreak in both Kenya and Uganda, and monthly NRPx values declined in both countries beginning in June due to increased supply from the first season harvest in Uganda and the release of stocks ahead of the upcoming harvest in Kenya (FAO, 2020b; FAO 2020c).

6 Conclusion

Using monthly price data primarily from the FAO-GIEWS FPMA Tool and UN Comtrade, we develop a novel, "adapted NRP" indicator that makes it possible to track how policies affect prices on a monthly basis and to analyse intra-annual price incentives trends not only during COVID-19, but also on an ongoing basis. This monthly NRPx indicator could be made available in a dashboard for the purposes of informing country-specific case studies, and causal analysis at the market, value chain, or country level as COVID-19 continues to evolve. Ideally, it will continue to enable rapid policy monitoring and tailored policy recommendations during future shocks to the global food system.

In our analysis, we find that price incentives of staple food value chains measured by the monthly NRPx had a median decline of 12.6 percentage points during the first wave of COVID-19. This is in line with other studies that observed a similar price incentives declining trend in other periods of price spikes in the past (e.g., Anderson and Nelgen, 2012), though the low magnitude reflects an impact that varied across countries and commodities, some of which exhibited increasing monthly NRPx values. Further analysis will be necessary to understand the evolution of interventions in agricultural markets throughout the pandemic, especially in light of increasing global prices and changing national responses during the pandemic's subsequent waves. The new monthly NRPx indicator can help identify instances where domestic prices increase substantially relative to international reference prices, and can serve as a tool when determining how policies may need to be realigned in a manner that balances the perspectives and interests of local producers and domestic consumers.

While abrupt changes to trade policies can be successful in mitigating domestic price increases in individual countries, alternatives should be strongly prioritized so as not to collectively contribute to international prices increases, as in the 2007–2008 world food crisis (Anderson and Jensen, 2017). COVID-19 can provide the opportunity for governments to reconsider how to strengthen food availability, accessibility and resilience of food systems and how to adapt policy environments to be better equipped to respond to market shocks and trends in a comprehensive way that takes into account the potentially adverse effects of trade-insulating responses. While export restrictions were implemented to a much lesser extent than 2007–2008, changes in dis(incentives) derived from alterations to trade and market policies suggest that ongoing monitoring will continue to be vital. By providing a mechanism to isolate the effect of policy interventions on a monthly basis, the new monthly NRPx indicator can help identify the primary drivers of price incentives changes and the need for policy realignment.

Despite its shortcomings as a simplified indicator which relies on data that may not always be readily available with the detailed needed at commodity level, the monthly NRPx can be beneficial as a quantitative tool when timely analysis is needed and access to data is limited. However, extended use of the monthly NRPx indicator is dependent on availability of trade data (values and volumes) in many countries. For future work, collection of farm price data is another key priority, as farm prices do not necessarily move in conjunction with the wholesale and retail prices that are analysed in this paper.

Although it is not done here, partially due to lack of data, it would be worthwhile to construct the monthly NRPx indicator for lightly traded staple foods: for example, beans and potatoes in Latin America and cassava, sorghum and millet in Africa. Perishable commodities such as fruits and vegetables that were more impacted by supply chain disruptions would also be beneficial to include. The ability to measure price incentives on a monthly basis can help provide technical support for the development policy recommendations that can work to facilitate an economic recovery in food and agriculture sectors and ensure food security and nutrition for the world's poorest consumers.

References

Anderson, K., ed. 2009. *Distortions to Agricultural Incentives: A Global Perspective, 1955-2007.* Washington, DC, World Bank and Palgrave Macmillan. https://openknowledge.worldbank.org/handle/10986/9436

Anderson, K. & Masters, W. 2009. *Distortions to Agricultural Incentives in Africa.* Washington, DC, World Bank. https://openknowledge.worldbank.org/handle/10986/2607

Anderson, K. 2010. Krueger/Schiff/Valdés Revisited: Agricultural Price and Trade Policy Reform in Developing Countries since 1960. *Policy Research Working Paper,* No. 5165. Washington, DC, World Bank. https://openknowledge.worldbank.org/handle/10986/19952

Anderson, K., ed. 2010. *The Political Economy of Agricultural Price Distortions.* Cambridge, UK and New York, USA, Cambridge University Press.

Anderson, K., Cockburn, J. & Martin, W., eds. 2010. *Agricultural Price Distortions, Inequality and Poverty.* Washington DC, World Bank. https://openknowledge.worldbank.org/handle/10986/2430

Anderson, K. & Nelgen, S. 2012. Agricultural trade distortions during the global financial crisis. *Oxford Review of Economic Policy*, 28(2): 235–260. https://doi.org/10.1093/oxrep/grs001

Anderson, K. & Jensen, H. 2017. Grain Price Spikes and Beggar-Thy-Neighbour Policy Responses: A Global Economywide Analysis. *The World Bank Economic Review,* 31(1): 158–175. https://doi.org/10.1093/wber/lhv047

Balié, J. & Maetz, M. 2011. *A review of relevant policy analysis work in Africa.* MAFAP project. Rome, FAO. www.fao.org/fileadmin/templates/mafap/documents/MAFAP_Synthesis-Maindoc-22-02-2011.pdf

Bolsa de Cereales. 2021. FOB Bolsa de Cereales. In: *Bolsa de Cereales* [online]. Buenos Aires. [Cited 8 January 2021]. www.bolsadecereales.com/fob

Dawe, D. & Morales Opazo, C. 2009. *How Much Did Developing Country Domestic Staple Food Prices Increase During the World Food Crisis? How Much Have They Declined?* ESA Working Paper No. 09-09. www.fao.org/3/ak421e/ak421e.pdf

DPEE (Directorate of Forecasting and Economic Studies). 2021. Dashboard October 2020. In: *Directorate of Forecasting and Economic Studies* [online]. Dakar. [Cited 17 December 2020]. www.dpee.sn

Elleby, C., Dominguez, I., Adenauer, M. & Genovese, G. 2020. Impacts of the COVID-19 Pandemic on the Global Agricultural Markets. *Environmental and Resource Economics,* 76: 1067–1079. https://doi.org/10.1007/s10640-020-00473-6

Falkendal, T., Otto, C., Schewe, J., Jägermeyr, J., Konar, M., Kummu, M., Watkins, B. & Puma, M. 2021. Grain export restrictions during COVID-19 risk food insecurity in many low- and middle-income countries. *Nature Food,* 2: 11–14. https://doi.org/10.1038/s43016-020-00211-7

FAO. 2015. *MAFAP Methodological paper: Volume I. Analysis of price incentives.* MAFAP Technical Notes Series. Rome. www.fao.org/fileadmin/templates/mafap/documents/Methodological_Guidelines/METHODOLOGY_WORKING_PAPER_Vol1_Prices_Incentives.pdf

FAO. 2016. *Save and Grow in Practice: Maize, Rice, Wheat. A Guide to Sustainable Cereal Production.* Rome. www.fao.org/3/a-i4009e.pdf

FAO. 2018. Rwanda, Monitoring price incentives: rice, paddy. In: *FAO Monitoring and Analysing Food and Agricultural Policies (MAFAP)* [online]. Rome. [Cited 10 December 2020]. www.fao.org/in-action/mafap/country-analysis/commodity-dashboard/en/?iso3= RWA&commodity=Rice,%20paddy

FAO. 2020a. *Impact of COVID-19 on agriculture, food systems and rural livelihoods in Eastern Africa: Policy and programmatic options*. Accra. https://doi.org/10.4060/cb0552en

FAO. 2020b. Country Briefs: Kenya. In: *FAO GIEWS - Global Information and Early Warning System* [online]. Rome. [Cited 18 March 2021]. www.fao.org/giews/country-analysis/country-briefs/country.jsp?code=KEN

FAO. 2020c. Country Briefs: Uganda. In: *FAO GIEWS - Global Information and Early Warning System* [online]. Rome. [Cited 18 March 2021]. www.fao.org/giews/country-analysis/country-briefs/country.jsp?code=UGA

FAO. 2021a. *Agricultural trade & policy responses during the first wave of the COVID-19 pandemic in 2020*. Rome. https://doi.org/10.4060/cb4553en

FAO. 2021b. Country Briefs: Kyrgyzstan – Archives. In: *FAO GIEWS - Global Information and Early Warning System* [online]. Rome. [Cited 7 September 2021]. www.fao.org/giews/countrybrief/country/KGZ/pdf_archive/KGZ_Archive.pdf

FAO. 2021c. Country Analysis. In: *FAO Monitoring and Analysing Food and Agricultural Policies (MAFAP)* [online]. Rome. [Cited 18 March 2021]. www.fao.org/in-action/mafap/country-analysis/en

FAO. 2021d. Food Price Monitoring and Analysis (FPMA) Tool. In: *FAO GIEWS – Global Information and Early Warning System* [online]. Rome. [Cited 15 October 2020] www.fao.org/giews/food-prices/tool/public/#/home

FAO. 2021e. Producer Prices. In: *FAOSTAT Food and Agriculture data* [online]. Rome. [Cited 20 April 2021]. www.fao.org/faostat/en/#data/PP

FAO. 2021f. Country Briefs. In: *FAO GIEWS - Global Information and Early Warning System* [online]. Rome. [Cited 14 May 2021]. www.fao.org/giews/countrybrief/index.jsp

FAO. 2021g. FAPDA - Food and Agriculture Policy Decision Analysis Tool. In: *FAO Food and Agriculture Policy Decision Analysis (FAPDA)* [online]. Rome. [Cited 18 March 2021]. http://fapda.apps.fao.org/#main.html

FAO, IFAD (International Fund for Agricultural Development), UNICEF (United Nations Children's Fund), WFP (World Food Programme) & WHO (World Health Organization). 2020. *The State of Food Insecurity and Nutrition in the World 2020. Transforming food systems for affordable healthy diets.* Rome, FAO. https://doi.org/10.4060/ca9692en

Glauber, J. & Martin, W. 2020. Trade Policy and Food Security. *In* Baldwin, R. & Evenett, S. *COVID-19 and Trade Policy: Why Turning Inward Won't Work,* pp. 89–101. Centre for Economic Policy Research. London, UK, CEPR Press. https://voxeu.org/content/covid-19-and-trade-policy-why-turning-inward-won-t-work

Hepburn, J., Laborde, D., Parent, M. & Smaller, C. 2020. *COVID-19 and Food Export Restrictions: comparing today's situation to the 2007/08 price spikes.* Winnipeg, Canada, International Institute for Sustainable Development (IISD). www.iisd.org/publications/covid-19-food-export-restrictions

Hirvonen, K., Minten, B., Mohammed, B. & Tamru, S. 2021. Food prices and marketing margins during the COVID-19 pandemic: Evidence from vegetable value chains in Ethiopia. *Agricultural Economics,* 52(3): 407–421. https://doi.org/10.1111/agec.12626

IFPRI (International Food Policy Research Institute). 2020. International Organisations Consortium for Measuring the Policy Environment for Agriculture. In: *Ag-Incentives* [online]. Washington, DC. [Cited 9 April 2021]. www.ag-incentives.org

IGC (International Grains Council). 2021. IGC Grains and Oilseeds Index (GOI). In: *Market Information: Grains & Oilseeds Index (GOI)* [online]. London. [Cited 12 March 2021]. https://www.igc.int/en/markets/marketinfo-goi.aspx

IMF (International Monetary Fund). 2021. Policy Responses to COVID-19. In: *International Monetary Fund* [online]. Washington, DC. [Cited 18 March 2021]. www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U

ITC (International Trade Centre). 2021. COVID-19 Temporary Trade Measures. In: *Market Access Map, COVID-19* [online]. Geneva. [Cited 14 May 2021]. www.macmap.org/covid19

Ivanic, M. & Martin, W. 2014. *Short- and Long-Run Impacts of Food Price Changes on Poverty*. Policy Research Working Paper, No. 7011. World Bank Group, Washington, DC. https://openknowledge.worldbank.org/handle/10986/20350

Kennedy, A. & Resnick, D. 2020. *From farm to table: How are governments keeping food systems functioning during COVID-19?* COVID-19 Policy Response Portal Project Note No. 1. Washington, DC, IFPRI. https://doi.org/10.2499/p15738coll2.133974

Krueger, A., Schiff, M. & Valdés, A. 1988. Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economywide Policies. *The World Bank Economic Review*, 2(3): 255–271. https://doi.org/10.1093/wber/2.3.255

Laborde, D., Martin, W., Swinnen, J. & Vos, R. 2020a. COVID-19 Risks to Food Security: Economic fallout and food supply chain disruptions require attention from policy makers. *Science*, 369(6503): 500–502. https://doi.org/10.1126/science.abc4765

Laborde, D., Mamun, A. & Parent, M. 2020b. COVID-19 Food Trade Policy Tracker. In: *International Food Policy Research Institute* [online]. Washington, DC. [Cited 28 January 2021]. www.ifpri.org/project/covid-19-food-trade-policy-tracker

Laborde, D., Martin, W. & Vos, R. 2021. Impacts of COVID-19 on global poverty, food security, and diets: Insights from global model scenario analysis. *Agricultural Economics*, 52(3): 375–390. https://doi.org/10.1111/agec.12624

Mahajan, K. & Tomar, S. 2020. COVID-19 and Supply Chain Disruption: Evidence from Food Markets in India. *American Journal of Agricultural Economics,* 103(1): 35–52. https://doi.org/10.1111/ajae.12158

MAG-SIPA (Ministry of Agriculture and Livestock, Agricultural Public Information System of Ecuador). 2021. International Prices. In: *Ministry of Agriculture and Livestock, Agricultural Public Information System of Ecuador* [online]. Quito. [Cited 3 March 2021]. http://sipa.agricultura.gob.ec/index.php/internacionales

Mogues, T. 2020. *Food Markets During COVID-19.* International Monetary Fund Fiscal Affairs: Special Series on COVID-19. Washington, DC, IMF. www.imf.org/en/Publications/SPROLLs/covid19-special-notes

Monke, E. and Pearson, S.R. 1989. *The Policy Analysis Matrix for Agricultural Development.* Ithaca, Cornell University Press.

ANSD (National Agency for Statistics and Demography). 2021. Monthly Bulletin of Foreign Trade Statistics. In: *ANSD* [online]. Dakar. [Cited 11 January 2021]. www.ansd.sn/index.php?option=com_ansd&view=titrepublication&id=11

OECD (Organisation for Economic Co-operation and Development). 2016. OECD's Producer Support Estimate and Related Indicators of Agricultural Support: Concepts, Calculations, Interpretation and Use (The PSE Manual). Trade and Agricultural Directorate. Paris, OECD. www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/documents/producer-support-estimates-manual.pdf

Pernechele, V., Balié, J. & Ghins, L. 2018. *Agricultural policy incentives in sub-Saharan Africa in the last decade (2005–2016) – Monitoring and Analysing Food and Agricultural Policies (MAFAP) synthesis study.* FAO Agricultural Development Economics Technical Study No. 3. Rome, FAO. www.fao.org/3/i8997en/I8997EN.pdf

Santeramo, F. & Dominguez, I. 2021. *On the Effects of the COVID Epidemic on Global and Local Food Access and Availability of Strategic Sectors: Role of Trade and Implications for Policymakers.* Commissioned Paper 25. St. Paul, International Agricultural Trade Research Consortium. https://doi.org/10.13140/RG.2.2.28772.91523

SAFEX (South African Futures Exchange). 2021. Downloadable Files – South African Volatility Index (SAVI) White Maize. In: *Johannesburg Stock Exchange Client Portal* [online]. Johannesburg. [Cited 21 December 2020]. https://clientportal.jse.co.za/downloadable-files?RequestNode=/Safex/PriceHistory/SAVI%20White%20Maize

Sulser, T. & Dunston, S. 2020. COVID-19-related trade restrictions on rice and wheat could drive up prices and increase hunger. In: *IFPRI Blog* [online]. Washington, DC. [Cited 15 May 2020]. www.ifpri.org/blog/covid-19-related-trade-restrictions-rice-and-wheat-could-drive-prices-and-increase-hunger

Swinnen, J. & Vos, R. 2021. COVID-19 and Impacts on Global Food Systems and Household Welfare: Introduction to a Special Issue. *Agricultural Economics,* 2021(52): 365–374. https://doi.org/10.1111/agec.12623

TREA (Thai Rice Exporters Association). 2021. Rice Export Quantity and Value: 2020. In: *Thai Rice Exporters Association* [online]. Bangkok. [Cited 2 February 2021]. www.thairiceexporters.or.th/statistic_2020.html

Timmer, C. P. 2017. Food Security, Structural Transformation, Markets and Government Policy. *Asia & the Pacific Policy Studies,* 4(1): 4–19. https://doi.org/10.1002/app5.161

Torero, M. 2021. COVID-19 Has Shown Us Inequality and How to Treat It. In: *Our Economist* [online]. [Cited 21 January 2021]. https://maximotorero.wordpress.com/2021/01/21/covid19-toll-inequality-recover

Tsakok, I. 1990. *Agricultural Price Policy: A Practitioner's Guide to Partial-Equilibrium Analysis.* Ithaca, Cornell University Press.

UBOS (Uganda Bureau of Statistics). 2021. Merchandise Trade. In: OpenData for Uganda Bureau of Statistics. [online]. Kampala. [Cited 22 December 2021]. https://nso.uganda.opendataforafrica.org/lpghle/merchandise-trade

UN (United Nations). 2017. *Harmonized Commodity Description and Coding System (HS)* [online]. [Cited 15 March 2021]. https://unstats.un.org/unsd/tradekb/Knowledgebase/Harmonized-Commodity-Description-and-Coding-Systems-HS

UN. 2020. *Map of the World* [online]. [Cited 1 January 2021]. https://un.org/geospatial/file/3420/download?token=bZe9T8I9

UN. 2021. *UN Comtrade.* [online]. [Cited 21 October 2020]. http://comtrade.un.org

United States Census Bureau. 2021. *USA Trade Online*. In: *United States Census Bureau.* [online]. Washington, DC. [Cited 9 June 2021]. https://usatrade.census.gov

USDA (United States Department of Agriculture). 2021. Crop Calendars Charts. In: *United States Department of Agriculture Foreign Agriculture Service* [online]. Washington, DC. [Cited 14 May 2021]. https://ipad.fas.usda.gov/ogamaps/cropcalendar.aspx

Varshney, D., Roy, D. & Meenakshi, J.V. 2020. Impact of COVID-19 on agricultural markets: assessing the roles of commodity characteristics, disease caseload, and market reforms. *Indian Economic Review,* 55: 1–24. https://doi.org/10.1007/s41775-020-00095-1

Vickers, B., Ali, S., Zhuawu, C., Zimmermann, A., Attaallah, H. & Dervisholli, E. 2020. *International Trade Working Paper* 2020/15. London and Rome, Commonwealth Secretariat and FAO. www.fao.org/3/cb2578en/CB2578EN.pdf

WHO. 2021. WHO Coronavirus (COVID-19) Dashboard. In: *World Health Organization* [online]. Geneva. [Cited 8 September 2021]. https://covid19.who.int

WFR (World Freight Rates). 2021. Freight Calculator. In: *World Freight Rates*. [online]. Miami, USA. [Cited 9 June 2021]. https://worldfreightrates.com/en/freight

WTO (World Trade Organization) 2021. COVID-19: Measures affecting trade in goods. In: *World Trade Organization.* [online]. Geneva. [Cited 18 March 2021]. www.wto.org/english/tratop_e/covid19_e/trade_related_goods_measure_e.htm

Annexes

Annex 1. Map of included countries

Figure A1. LMICs included in the analysis

Notes: Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined. Final status of the Abyei area is not yet determined. A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

Source: UN. 2020. *Map of the World* [online]. [Cited 1 January 2021].
https://un.org/geospatial/file/3420/download?token=bZe9T8I9 modified by the authors.

Annex 2. Non-UN Comtrade benchmark price data sources

Table A1. Alternate benchmark data sources used, primarily for case studies where FAO's MAFAP programme has previously calculated annual indicators

Country	Commodity	Benchmark price source
Burkina Faso*	Sorghum (local)	FOB price at the Burkina-Niger border (Kantchari, Burkina Faso) which is estimated to be 90% of Niamey, Niger wholesale price (FAO, 2021d)
Ecuador	Maize	Ministry of Agriculture and Livestock in Ecuador's CIF price for white maize from Colombia (MAG-SIPA, 2021)
El Salvador	Rice	Constructed CIF price from US FOB price from USA Trade Online (United States Census Bureau, 2021), plus freight and insurance (WFR, 2021) adjusted for inflation with oil price index
Kenya*	Maize	Mombasa, Kenya wholesale prices (FAO, 2021d) used as a proxy for benchmark prices
Malawi*	Maize	Milange, Mozambique wholesale price used as proxy for CIF because trade is informal (Milange is closest to the Malawi border where maize enters); estimated to be 85% of Nampula, Mozambique wholesale price (FAO, 2021d)
Mali*	Millet (local)	Sikasso, Mali wholesale price (FAO, 2021d) with added 2015 transport cost to estimate Zégoua, Mali border price
Mozambique*	Maize (white)	South African Futures Exchange (SAFEX) Johanesberg, South Africa wholesale prices (SAFEX, 2021), adding 2015 transport cost adjusted for inflation with oil price index
Mozambique*	Rice	Weighted average of India and Pakistan Comtrade exports to Mozambique (UN, 2021), with added freight and insurance (WFR, 2021) adjusted for inflation with oil price index
Nigeria*	Maize (white)	FOB prices from Argentina (Bolsa de Cereales, 2021) plus transport cost from Anderson, ed. (2009)
Nigeria*	Rice (milled, local)	Thai Rice Exporters Association FOB (TREA, 2021), adjusted to 86% to make equivalent to trade with Nigeria as a partner, plus transport cost from Anderson, ed. (2009)
Senegal*	Rice (local)	Calculated CIF prices from reported trade quantities and values in Senegal monthly newsletters (ANSD, 2021)
Thailand	Rice (25% broken)	FOB price calculated from 25–35% broken rice export volumes and values from Thai Rice Exporters Association (TREA, 2021)
Uganda*	Maize	FOB price calculated from Uganda Bureau of Statistics (UBOS, 2021) reported formal export volumes and values
United Republic of Tanzania*	Maize	Nairobi, Kenya wholesale price (FAO, 2021d) with constant added 2008 transport cost to Namanga, Tanzania border

Note: Countries that are starred used an adjustment factor other than the standard ten percent adjustment to estimate the reference price, based on the average of the ratios of the benchmark and reference prices used by FAO-MAFAP over the most recent five years that annual NRP indicators have been calculated for.

Source: Authors' own elaboration.

Annex 3. Comparison of monthly and annual price incentives indicators

Table A2. Primary differences between monthly NRPx and annual NRP

	Monthly NRPx	Annual NRP
Time span	• Monthly from January 2017 – August 2020	• Annual figures available on the Agricultural Incentives Consortium database from 2005 – 2018 (IFPRI, 2020) • Annual figures also available from 1955 – 2007, as detailed in Anderson, ed. (2009)
Domestic prices	• FAO-GIEWS FPMA Tool *Data constraints:* Domestic price data used at the wholesale and retail level (more widely available on a monthly basis than farm-level prices) • Incentives calculated at the point of competition and retail can provide a sense of the general direction of incentives to the value chain	• Primarily national data sources • FAO-GIEWS FPMA Tool In addition to wholesale and retail prices, annual farm-level prices are often available to calculate incentives faced by producers
Benchmark prices	• Primarily UN Comtrade • National statistics websites, neighboring country domestic prices or FOB prices with added transport cost (closely replicating sources used by FAO-MAFAP, as outlined in Table A1) *Data constraints:* Limited updated monthly trade data available; largely only used sources outside UN Comtrade for case studies FAO-MAFAP has calculated indiactors for, restricting case study size	• UN Comtrade • National statistics websites, neighboring country domestic prices or FOB prices with added transport cost
Reference price calculation	• Primarily, CIF prices are multiplied by 1.10 and FOB prices are multiplied by 0.90, for a simplified ten percent adjustment to account for access costs – Adjustments to benchmarks for case studies that FAO-MAFAP has calculated indicators for range from 11 to 52 percent (average ratio between FAO-MAFAP's reference and benchmark prices, from most recent five years of annual NRP calculations) *Data constraints:* Simplified adjustments made to benchmarks, as updated access cost data (and data on quality and quantity differences) not widely or easily accessible.	• Adjustments made to benchmark prices based on actual levels of access costs each year, as well as quality and quantity differences (calculated specifically for each case study on an annual basis) – Typically ranges from a 10 to 50 percent adjustment

Source: Authors' own elaboration based on FAO. 2015. *MAFAP Methodological paper: Volume I. Analysis of price incentives.* MAFAP Technical Notes Series. Rome.

Annex 4. Monthly NRPx indicator and median change calculation

Monthly NRPx indicator

In order to calculate the monthly nominal rate of protection "express" indicator – the monthly $NRPx_{wh}$ at the point of competition (wholesale) or the monthly $NRPx_{rt}$ at the consumer level (retail) – we define the following in accordance with the terminology used in FAO (2015):[22]

- monthly domestic price at the point of competition, P_{wh}, or consumer level, P_{rt}, as defined in the data section;[23]
- monthly reference price "express" at the point of competition, RPx_{wh}, or at the consumer level, RPx_{rt}, as defined in the data section; and
- monthly price gap "express" at the point of competition, PGx_{wh}, or at the consumer level, PGx_{rt}.

The monthly price gap "express" is the difference between the monthly domestic price and the monthly reference price, as given in equations 1 and 2 below for the point of competition and consumer level, respectively:

$$PGx_{wh} = P_{wh} - RPx_{wh} \qquad (1)$$

$$PGx_{rt} = P_{rt} - RPx_{rt} \qquad (2)$$

The monthly nominal rate of protection "express" is then calculated by dividing the price gap by the reference price, in order to make the indicator comparable across different commodities, countries, and time periods, as given in equations 3 and 4 below for the point of competition and consumer level, respectively:

$$NRPx_{wh} = \frac{PGx_{wh}}{RPx_{wh}} \qquad (3)$$

$$NRPx_{rt} = \frac{PGx_{rt}}{RPx_{rt}} \qquad (4)$$

Year-on-year comparison

As stated in the data section, the monthly NRPx is calculated for each case study at the point of competition, if available, and at retail otherwise, for all months between January 2017 and August 2020, in order to be able to investigate the impacts of the first wave of COVID-19. The calculations include a three-year period prior to the pandemic in order to have a reliable period of comparison to levels in 2020. Due to the fact that the timing and effects of the COVID-19 outbreak varied across different countries and commodities, rather than selecting specific months of comparison across all case studies, a year-to-year comparison was made for each case study for all months from March 2020 to August 2020 and the corresponding months in

[22] While FAO (2015) defines both observed indicators and adjusted indicators, for the monthly NRPx we only examine observed indicators. The adjusted indicators used in FAO (2015) remove excessive access costs and imperfect functioning of markets to allow for a measurement of the effects of these inefficiencies. This is beyond the scope of the current analysis, but could be explored in future iterations especially for countries where FAO-MAFAP has previously calculated adjusted annual indicators.

[23] Note the monthly domestic price is not considered an "express" version as it is used directly as-is from the FAO-GIEWS FPMA Tool.

2017, 2018, and 2019. For example, the percentage point change from March 2019 to March 2020 was calculated, the percentage point change from April 2019 to April 2020 was calculated, and so on, for all months where corresponding data were available.[24] We performed the same calculation using successive three-month averages, e.g. the average monthly NRPx of February, March, and April 2019 compared to the same three months in 2020, followed by the March-April-May 2019 average compared to the same three months in 2020, and so on.

To quantify the extent of changes to incentives for each case study, we compute the following, which determine the case study's maximum change to monthly NRPx values during the pandemic's first wave. This allows us to systematically compare changes across case studies, even when the maximum impacts occur during different months:

- Maximum one-month change (∆NRPxMAX1), which is the maximum of the absolute value of the year-on-year percentage point changes for single month periods. This maximum value then signals the month in 2020 where the most change occurred.
- Maximum three-month average change (∆NRPxMAX3), which is the maximum of the absolute value of the year-on-year percentage point changes for the three-month averages. Likewise, this maximum three-month average value then signals the three-month period in 2020 where the most change occurred.

Note that while the analysis primarily focuses on the maximum one-month changes, the maximum three-month average changes are calculated as a robustness check in determining whether changes lasted more than a single month. If the two do not largely differ (meaning low change levels in the surrounding months do not significantly bring down the maximum three-month average change relative to the maximum one-month change), it can signal that changes occurred across several months during the first wave of the pandemic.[25]

By construction, identifying the maximum change can result in large values for ∆NRPxMAX1 and ∆NRPxMAX3. To identify when changes were of such a large magnitude that they were not representative of the change that occurred during the pandemic, a maximum change value was considered an outlier if it was 1.5 standard deviations or more from the mean change. This was especially relevant in cases where the largest change was in comparison to 2017, and the monthly NRPx had been steadily increasing or decreasing over the three-year period. In those cases, the maximum value was most often instead determined from the changes that were calculated in comparison to 2018 or 2019 values. In some cases, the maximum change was slightly more than 1.5 standard deviations from the mean change but was representative of the change that occurred during COVID-19, or had very large magnitude but was not determined to be an outlier. In these cases, the maximum change was generally left as-is.[26]

[24] While crop seasonality was not factored into this analysis, it was partially accounted for by the fact that comparisons were made with the same month of previous years. However, crop calendars for most commodities are made available online by FAO-GIEWS (FAO, 2021f) and the United States Department of Agriculture Foreign Agriculture Service (USDA, 2021). Seasonality should be factored in when generating country narratives and provides an opportunity for further refining this analysis.

[25] While we do not assess magnitudes of maximum three-month average changes besides the overall median, this could be helpful to incorporate into analysis of specific case studies.

[26] For cases where the maximum change was an outlier but the month seemed representative of the timing of the most noteworthy change, data interpolation was used with the values from the two surrounding months (or surrounding three-month averages) to calculate the ∆NRPxMAX1 or ∆NRPxMAX3 for that month. For cases where the maximum change was an outlier and the month of change did not seem representative (e.g. if the outlier change effect was due to an outlier in reference price data), the next maximum was generally used.

Annex 5. Included case studies by incentives change category

Table A3. Net importer case studies by incentives change category

	Disincentives		Incentives	
	Less negative	**Further negative**	**Increased**	**Declined**
Net importers				
Armenia			Wheat (flour, first grade)	
Belarus				Wheat (flour)
Brazil	Wheat			Rice
Ecuador	Maize			Wheat (flour)
El Salvador			Rice	Maize (white)
Georgia			Wheat (flour)	
Guatemala			Maize (white)	Rice (second quality)
Kenya	Maize			
Kyrgyzstan			Wheat (flour, first grade)	
Malawi		Maize		
Mexico			Rice (Sinaloa)	Maize (white, Sinaloa)
Mozambique	Maize (white)*			Rice
Nigeria	Maize (white)*			Rice (milled, local)
Peru	Rice (milled, corriente)*			
Philippines				Maize (white); rice (regular milled)
Rwanda				Maize*; rice
Senegal			Rice (local)	
South Africa				Wheat

Notes: For disincentives that became less negative, if starred, indicates that monthly NRPx sign reversed to positive (now incentives). For incentives that became less positive, if starred, indicates monthly NRPx sign reversed to negative (now disincentives).

Source: Authors' own elaboration.

Table A4. Net exporter case studies by incentives change category

	Disincentives		Incentives	
	Less negative	**Further negative**	**Increased**	**Declined**
Net exporters				
Burkina Faso				Sorghum
Ecuador				Rice (long grain)
Egypt			Potatoes	Wheat (flour)
El Salvador			Wheat (flour)	
India	Rice		Potatoes	Wheat
Mali			Millet (local)	
Pakistan		Rice (irri)		
Peru				Wheat (flour)
South Africa		Maize (white)		
Thailand		Rice (25% broken)		
Uganda	Maize			
Ukraine				Wheat (3^{rd} class, bid, EXW, processing)
United Republic of Tanzania	Maize*			

Notes: For disincentives that became less negative, if starred, indicates that monthly NRPx sign reversed to positive (now incentives). For incentives that became less positive, if starred, indicates monthly NRPx sign reversed to negative (now disincentives).

Source: Authors' own elaboration.

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