AGRODEP
African Growth & Development Policy modeling consortium
FACILITATED BY IFPRI

AGRODEP Technical Note 0016

November 2018

Distortions to Agricultural Incentives along Value Chains

Simla Tokgoz

About the Author

Simla Tokgoz is a Research Fellow in the Markets, Trade and Institutions Division at the International Food Policy Research Institute in Washington, DC, USA.

Acknowledgements

The author would like to thank Fahd Majeed for help in developing the Incentives along Value Chains (IVC) Toolbox in Excel and Fousseini Traore for providing comments on this Technical Note.

Table of Contents

Abstract

Development of agricultural value chains is necessary to help smallholder farmers in Africa. Domestic agricultural policies and trade policies impact all economic agents along the value chain, from farmers to traders to consumers. Thus, it is critical to understand the impact of policy distortions to agricultural incentives along the complete value chain. This AGRODEP Technical Note provides a description of the Nominal Rate of Protection methodology that can be utilized to analyze agricultural policies in a value chain context. It also provides a description of the Incentives along Value Chains (IVC) Toolbox in Excel, developed to aid AGRODEP researchers in conducting this type of analysis with a focus on agriculture.

1. Introduction

For countries in Africa south of the Sahara, the agriculture, forestry, and fishing sectors generate value added of approximately 16 percent of Gross Domestic Product (GDP) (WDI 2018). Thus, development of these agricultural value chains plays a critical role in overall development in this region. To this end, policymakers have enacted various policy frameworks to aid agricultural value chain development and to support productivity growth along the value chain. At the same time, policymakers also use domestic agricultural policies (in the form of taxes, levies, and subsidies to consumers or producers) and trade policies (in the form of import tariffs, quotas, and export taxes) serve other policy goals as well.

Smallholder farms dominate the African agricultural sector. As a result, policies that impact smallholder farmers have important implications for overall food and nutrition security, rural employment, and income.

FAO (2010) notes that the rapid globalization of agricultural markets has created new consumption patterns and new production and distribution systems. This trend has also been observed in developing regions, including Africa south of the Sahara. Figure 1 (taken from McCullough, Pingali and Stramoulis 2008) presents an agricultural value chain that contains both traditional and modern food system characteristics. All economic agents (smallholder farmers, cooperatives, buying agents, wholesalers, retailers, processing agents, and exporters) along the value chain are linked to each other. Thus, since any trade or domestic policy that targets a part of the value chain would impact all participants along that chain, policy analysts and policymakers need to understand how proposed policies would affect price transmission and incentives for producers and consumers along the complete value chain.

This Technical Note attempts to aid AGRODEP researchers in conducting this type of analysis geared toward measuring distortions to incentives along value chains, with a focus on agricultural commodities. We provide a methodology for a "simple" value chain consisting of one agricultural commodity. The methodology does not include downstream products along the value chain: in other words, processed products or by-products (such as groundnut oil and groundnut meal) from an agricultural commodity (such as groundnut). In this Technical Note, we use "value chain of a commodity" to refer to different nodes in the market through which the commodity moves between farm gate to border. Although labeling of the agricultural commodity may change along the value chain (for example, from **milled** rice to **paddy** rice), the value chain under analysis refers to a "one-dimensional" value chain. For the nominal rate of protection methodology specifically developed for value chains, please refer to Tokgoz and Majeed (2018).

There is a wide literature, as well as multiple International Organization (IO) databases, that measures agricultural incentives. Both the literature and the IOs use two main approaches: indirect measurement of incidence and direct measurement of policies. Krueger, Schiff, and Valdes (1988) made the first major attempt at indirect measurement of incidence methodology using the nominal rate of protection (NRP)

methodology. This is a reliable and easily implemented method that relies on price gaps between the prices that producers see and the prices that prevail in international markets. Anderson et al. (2008) expanded this effort by measuring the Nominal Rate of Assistance (NRA). OECD has launched a major effort for the direct measurement of policies with its Producer Support Estimates (PSE) (OECD 2018). IDB-Agrimonitor uses the OECD methodology and focuses on Latin America and Caribbean countries (IDB-Agrimonitor 2018).

FAO-MAFAP also publishes NRPs, with a focus on the African agricultural sector (MAFAP 2018). The methodology utilized in the MAFAP database and described in MAFAP (2015) expands upon the NRP approach of Krueger, Schiff, and Valdes (1988); it includes observed versus adjusted exchange rates and identifies access costs along the value chain (such as farm gate, point of competition, or border) and their sub-components in more detail. This Technical Note borrows from the MAFAP methodology in identifying each node of the value chain.

We focus on the NRP methodology because it provides an estimate of the overall impact of domestic agricultural policies and includes an Excel toolbox, Incentives along Value Chains (IVC Toolbox). We provide a description of the equations used in the toolbox and instructions for using the toolbox based on an example for Nigeria palm oil market. We then list possible data sources to carry out the analysis for Africa in section 6. For a more detailed application to African agricultural value chains, see Kassie *et al.* (2018) for Ethiopia.

2. Methodology

In order to understand the implications of policy space on agricultural commodities, one methodology to use is nominal rate of protection (NRP) from Krueger, Schiff, and Valdes (1988). The NRP methodology measures the direct effect of policies using the proportional difference between the producer price and the border price, adjusted for distribution, storage, transport, and other marketing costs.

This methodology can be applied to African agricultural commodity value chains using national or regional price data at different points in the market in order to measure the impact of sector-specific and national policies on agricultural incentives. In this section, we describe the methodology and show its application to two nodes along the value chain: point of competition (POC) and farm gate (FG).

The NRP methodology employs the 'comparing like with like' principle, so it is crucial to ensure that prices along the nodes of the value chain correspond to the same product in terms of quality and quantity. The price gaps between border and POC and between POC and farm gate are reported as calculated, i.e. without any additional adjustments other than those necessary to compare like with like.

First, we need a representative international price (IP) and the exchange rate (EX). EX is Local Currency Unit per International Price Currency Unit, which is the undistorted market exchange rate. In countries

where official the exchange rate varies widely from the market exchange rate, necessary adjustments need to be made to the official exchange rate used in the analysis in order to reflect market conditions accurately.

Based on the characteristics of the commodity value chain under analysis, a Quantity Adjustment (QTY) and a Quality Adjustment (QUA) can be made to the international price. Quantity adjustment (QTY) is included if the prices being compared (between international and domestic markets) are for products that differ due to processing or other physical treatment. The quantity adjustment is critical when we are choosing the reference international price and comparing it to the domestic farm gate price. Examples for quantity adjustment include milled rice versus paddy rice, groundnuts shelled versus groundnuts in-shell, cotton lint versus cotton seed, or beef versus cattle. For example, if the international rice price chosen is the milled rice price and the available domestic farm gate price is the paddy rice price, the QTY needs to be used in order to 'compare like with like'. This QTY applied between nodes of the value chain is important when we consider the processing of an agricultural commodity; however, at the same time, it differs from processing costs.

Quality adjustment (QUA) is included if the prices being compared are for products of differing levels of quality. For example, Nigerian cacao beans do not receive as a high a price as Ghanaian cacao beans when exported to world markets, due to perceived quality differences. This difference needs to be accounted for if the international price chosen for an analysis of Nigerian cacao bean market is the Ghanaian cacao bean export price.

We compute the reference price at border (RP_{border}) as:

$$RP_{border} = \big((IP * EX) * QTY\big) - QUA \qquad (1)$$

If a country is a net exporter of the commodity, we use RP_{border} as above, with IP as FOB (free on board) price from world markets. If the country is a net importer of the commodity, we need to adjust RP_{border} to be CIF (cost, insurance, freight) price, using transportation costs from port of IP to port of country.

Next we define prices at the point of competition, RP_{POC}. If the country is a net exporter,

$$RP_{POC} = \big((RP_{border} * QTY) - QUA\big) - marketing\ costs \qquad (2)$$

Marketing costs are subtracted to take into account all of the costs incurred by exporters to bring the commodity from the point of competition to the border, resulting in the RP_{POC}.

If the country is a net importer,

$$RP_{POC} = \big((RP_{border} * QTY) - QUA\big) + marketing\ costs \qquad (3)$$

Marketing costs are added to take into account all the costs incurred by importers to bring the commodity to market, resulting in the RP_{POC}. These marketing costs include margins between the border and POC,

such as processing costs, transport costs, handling costs, taxes and fees, and other costs. The marketing costs from border to point of competition in equation (3) need to be in the same unit as the point of competition price of that commodity. If a QTY was employed to compute RP_{POC}, the unit of marketing costs needs to be consistent with this adjustment. Analysts should also be careful to differentiate between processing costs and the QTY in the case of commodities that have been transformed. For example, QTY may be used to move between **paddy** rice and **milled** rice, but this does not entail the processing costs accrued by the mills. Although analysts may choose to use both adjustment types, it is also crucial not to double-count processing.

The analyst can choose where point of competition is defined in the value chain under analysis; for example, it could be the main market point at which most domestic exchange takes place. The existing literature often uses the wholesale or retail point of the value chain for point of competition.

NRP at the POC is computed using the following formula, which uses wholesale price as an example:

$$NRP_{POC} = \frac{Wholesale\ Price - RP_{POC}}{RP_{POC}} \quad (4)$$

For producer NRP, we calculate underlying price gaps at the farm gate node of the value chain. Thus, RP_{POC} needs to be made comparable to the observed producer price at the farm gate. To do so, we add quality and quality adjustments if necessary. RP_{POC} is made comparable to the observed domestic price at farm gate by subtracting the marketing costs between the farm gate and the POC. This takes into account all of the costs incurred by farmers to bring the commodity from the farm to the POC, resulting in the reference price at the farm gate (RP_{FG}) as:

$$RP_{FG} = RP_{POC} - marketing\ costs \quad (5)$$

Producer price at the farm gate (PP_{FG}) is data, specifically the price received by the agricultural producer from the purchaser for a unit of a good produced as output.

NRP at the farm gate is computed as

$$NRP_{FG} = \frac{PP_{FG} - RP_{FG}}{RP_{FG}} \quad (6)$$

As discussed previously, this methodology is geared toward a 'simple' value chain in which the commodity moves along different points in the market (farm gate, border, and point of competition). We are not including value chains in which a commodity is transformed multiple times or in which processing generates multi-products in the downstream value chain.

3. Worksheet "Instructions"

This section of the Incentives along Value Chains (IVC) Toolbox provides a summary of the data categories needed for the value chain analysis, with descriptions and units for each data category. These input data lists, provided in Column B of the worksheet, includes Location, Time Period, Commodity Trade Status, International Price, Exchange Rate, Quantity Adjustment on International Price, Quality Adjustment on International Price, Quantity Adjustment Between the Reference Price and the Point of Competition, Quality Adjustment Between the Reference Price and the Point of Competition, Marketing Costs between the Reference Price and the Point of Competition, Wholesale Price, Quantity Adjustment Between the Point of Competition and the Farm Gate, Quality Adjustment Between the Point of Competition and the Farm Gate, Marketing Costs between Point of Competition and the Farm Gate, and the Farm Gate Price. These input data correspond to multiple nodes along the value chain: border, point of competition, and farm gate.

The worksheet also lists the output data computed from the input data in Column B: Reference Price at Border, Reference Price at the Point of Competition, NRP at the Point of Competition, Reference Price at the Farm Gate level, and NRP at the Farm Gate level.

Column C indicates whether the data category is input or output, and Column D notes whether data is needed for computation or whether it is computed from input data.

Column E describes each data category, giving information on how to fill in the data input.

Column F describes sources of data used in the analysis.

4. Worksheet "Calculation Tool for NRP"

The worksheet "Calculation Tool for NRP" provides the formulas needed to compute the NRP for a primary agricultural commodity. The formulas are organized for one year of analysis, but the analyst can add additional years. Only the colored cells in Column E need to be filled with data by the analyst. The rest of the cells in Column E are formulas.

Column A explains the location for each data point along the value chain: border, point of competition, and farm gate. There are also additional data points that need to be filled in between these three nodes of the value chain. Data between border and POC and between POC and farm gate are categorized into three types: quantity adjustment, quality adjustment, and marketing costs. Depending on the type of commodity under analysis, these data points can be filled in or left at their original values of 1 or 0 (Column E).

Column B describes the data category for each node of the value chain to guide the analyst to choose the relevant source data.

Column C indicates whether data category is an input data that analyst has to fill in or an output that is automatically computed by the formula in Column E.

Column D explains whether data input is required for computation of formulas.

In Column E, colored cells need to be filled in with data by the analyst; currently placeholder values highlight the data cells. For example, international price cell, wholesale price cell, and farm gate price cell are filled with 100 as placeholder values, along with quantity adjustment as 1 and quality adjustment as 0. Units are added as examples, such as MT (metric tonne). The analyst can choose different units as long as they are consistent throughout the value chain.

Row 8 shows the time period, which needs to be filled in. This time period can be a calendar year, such as 2008, or a crop year, such as 2008-2009.

Row 9 shows trade status options as a drop-down menu: 'Net Exporter', 'Net Importer', or 'Not Traded'. The formulas used depend on this choice, which needs to be based on export-import trade volume data input by the analyst.

International Price in Row 10 is the IP in formulas shown previously.

Exchange rate unit in Row 13 must be consistent with the currency of the international price.

Quantity adjustment refers to cases in which the international price and domestic prices refer to commodities that differ in terms of processing stage. For example, international price can be for beef and domestic price can be for cattle. In this case, it is necessary to use the Quantity adjustment. Quality adjustment refers to cases in which there is a measurable quality gap between the good from the international price and the domestic good, such as different types of rice quality that lead to consistent gaps in prices.

Reference Price at Border (row 18) is a formula using data in the previous row cells and corresponds to RP_{border} in equation (1).

When the commodity moves between the border and the POC, the analyst needs to fill in the quantity adjustment, quality adjustment, and marketing costs between these two nodes of value chain.

Reference Price at the Point of Competition is a formula in which the net trade status from Row 9 is used and corresponding to RP_{POC} in equation (2) and equation (3).

Wholesale price is price data selected for point of competition in this worksheet. Another market price can be selected as well, such as retail market. Then, we use Wholesale Price and Reference Price at the Point of Competition to compute NRP_{POC} in Row 32. This corresponds to equation (4) above.

When the commodity moves between the POC and the Farm Gate, the analyst needs to fill in the quantity adjustment, quality adjustment, and marketing costs between these two nodes of value chain.

Reference Price at the Farm Gate level is a formula using input data and corresponds to RP_{FG} in equation (5).

NRP at farm gate is computed using farm gate price, which is data and Reference Price at the Farm Gate (a formula corresponding to NRP_{FG} in equation (6)).

5. Worksheet "Example Nigeria"

Worksheet "Example Palm Oil in Nigeria" gives an example of palm oil NRPs in Nigeria for crop years through 2001-02 and 2016-17. The commodity net trade status is a net importer. This is reflected in column L, in which we have transportation cost between port of international price and Nigeria. In these years, FOB price from international markets is converted to CIF price for imports using transportation costs in Column M.

In this example, the quantity adjustment between the Reference Price and the Point of Competition Price is kept at 1 (i.e. no adjustment is made).

$NRP\ at\ POC$ and $NRP\ at\ Farm\ Gate$ are computed based on available data in column AA and column AM, respectively.

6. Data Sources

Please note that the data sources provided in this Technical Note can be changed or enhanced by using other data sources. Below is a non-exhaustive list.

6.1 Trade Data

Trade data is required to determine whether a country is a net exporter or a net importer for the commodity under analysis. This determines how the methodology will be applied for computation of NRP. Thus, it is important for this data component to be computed correctly. Below is a list of sources that can be of help.

The World Bank's World Integrated Trade Solution (WITS) (WITS 2018) provides an important data source and application. This software was developed by the World Bank, in close collaboration and consultation with various International Organizations including United Nations Conference on Trade and Development (UNCTAD), International Trade Center (ITC), United Nations Statistical Division (UNSD), and WTO. The WITS database provides access to major international trade, tariffs, and non-tariff data compilations, including:

- the UNComtrade database maintained by the UNSD: Exports and Imports by detailed commodity and partner country;
- the TRAINS database maintained by the UNCTAD: Imports, Tariffs, Para-Tariffs & Non-Tariff Measures at national tariff level; and
- the IDB and CTS databases maintained by the WTO: MFN Applied, Preferential & Bound Tariffs at national tariff level.

International organizations also publish trade data. For example, FAOSTAT (2018) and U.S. Department of Agriculture (USDA 2018) publish annual import and export data at the national level. FAOSTAT provides data for the calendar year definition (January - December), while USDA provides data for the crop year definition (starting at harvest month).

It should be noted that informal cross-border trade is also critical for agricultural commodity trade among African countries. No official statistics are currently published on cross-border trade, although some organizations (such as FEWSNET in East Africa and CILSS in West Africa) attempt to keep track of such commodity flows (FEWSNET 2018; CILSS 2018). This issue is important when deciding on net trade status.

There have also been attempts to analyze and harmonize the trade data published by UN COMTRADE, specifically the BACI data published by CEPII. The BACI database is constructed using a harmonization procedure to reconcile trade data declared by the exporter and the importer; this harmonization is done using mirror flows and the quality of declarations (BACI 2018). BACI provides bilateral values and quantities of exports at the HS 6-digit product disaggregation and is updated annually (Gaulier and Zignago, 2010). FEWS NET/FAO/WFP Joint Cross-Border Market and Trade Monitoring Initiative publications also provide available data on cross-border trade that can be used to construct harmonized trade data.

6.2 International price data

International prices should reflect the world market conditions. To this end, commodity prices from major global producers or exporters are generally used as the best representative price in global markets. As discussed previously, the international price is adjusted based on whether the country of analysis is a net exporter or a net importer of a commodity. Thus, if FOB or CIF international prices are used, necessary adjustments need to be made for transportation costs across countries. The World Bank GEM (2018 compiles prices in international markets. If the U.S. is the major exporter of a commodity (e.g. maize), analysts can use USDA publications for U.S. prices.

As discussed previously, the main principle of NRP methodology is to ‘compare like with like’. Thus, choosing a representative international price that can be compared to the domestically produced commodity is crucial. If a country is an importer or exporter of various qualities and types of an agricultural commodity, knowledge of the domestic market can assist in identifying the most representative international price. There are multiple international prices published for the same agricultural commodity category, however, so this can be a difficult task. For example, Thailand is a major exporter of rice and exports various types of rice for which price data is published. There is available data for 100-percent Grade B rice price, 5-percent parboiled rice price, 5-percent broken rice price, 15-percent broken rice price, and 35-percent

broken rice price from Thai sources. Thus, the rice price best suited for an analysis can be chosen from different rice varieties. If a close representative is not found, necessary quality adjustments need to be made. In the same vein, if the analyst is using **milled** rice price for international price and **paddy** rice price for the domestic farm gate price, quantity adjustment needs to be made in the columns indicated in the worksheet.

All international prices need to be converted to local currency using official exchange rates. However, in some countries, the adjusted exchange rates can be used to reflect market conditions that are not accounted for by the official exchange rate. Official exchange rates are published by the World Bank's WDI (WDI 2018)

6.3 Domestic price data

The most critical component of NRP analysis is finding and using domestic prices that are reliable indicators of domestic market dynamics at different nodes of the value chain.

For farm gate prices, which are prices received by the farmers at harvest time, one critical data source is Living Standards Measurement Study (LSMS) data, a household survey program published by World Bank (LSMS 2018). The LSMS collects data at the regional or state level for multiple years for specific countries. While it does not provide annual price data, farm gate prices can be computed using these household survey results.

National statistics agency publications or agricultural ministry sources provide longer term annual price data for selected commodities and can be a useful source.

The World Food Program (WFP) Vulnerability Analysis and Mapping database provides domestic prices at wholesale markets or at retail markets. Prices are spatially disaggregated at national, regional, or state levels (WFP 2018).

FEWS NET, provided by USAID, also publishes domestic prices at wholesale markets or at retail markets. Prices are spatially disaggregated at national, regional, or state levels (FEWSNET 2018).

International commodity organizations, such as ICCO, and national commodity research centers, such as CRIN and NIFOR, can provide reliable price data as well.

References

Anderson, K., Kurzweil, M., Martin, W., Sandri, D., and Valenzuela, E. 2008. "Measuring Distortions to Agricultural Incentives, Revisited." *World Trade Review 7(4):* 675– 704.

BACI. 2018. International Trade Database at the Product-Level. The 1994-2007 Version. Available at http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=1

Comité permanent inter-État de lutte contre la sécheresse au Sahel (CILSS). 2018. Available at http://www.cilss.int/

FAOSTAT. 2018. Rome: FAO. Available at http://www.fao.org/faostat/en/#home

FEWS NET. 2018. Famine Early Warning Systems Network. Available at http://fews.net/>

Gaulier, G. and S. Zignago. 2010. "BACI: International Trade Database at the Product-Level. The 1994-2007 Version". CEPII Working Paper 2010- 23. Paris: CEPII.

IDB-Agrimonitor. 2018. PSE Agricultural Policy Monitoring System (data). Available at https://mydata.iadb.org/idb/dataset/2dqw-u35p/about

Kassie, G. T., R.S. Wube, S. Tokgoz, F. Majeed, A. Aw Hassan, B. Rischkowsky, and M. Yitayih. 2018. "Policy-Induced Price Distortions along the Small Ruminant Value Chains in Ethiopia." *Journal of Agribusiness in Developing and Emerging Economies*, forthcoming.

Krueger A. O., M. Schiff, and A. Valdes. 1988. "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economywide Policies." *The World Bank Economic Review*, 2(3), 255–271.

Living Standards Measurement Study (LSMS). 2018. World Bank. Available at http://surveys.worldbank.org/lsms

McCullough, E.B., P.L. Pingali, and K.G. Stramoulis, eds. 2008. "Small Farms and the Transformation of Food Systems: An Overview." In *The transformation of Agri-Food Systems*, Chapter 1. London: FAO and Earthscan.

Monitoring and Analysing Food and Agricultural Policies (MAFAP). 2015. "MAFAP Methodological paper: Volume I. Analysis of price incentives." MAFAP Technical Notes Series. Rome: FAO.

Monitoring and Analysing Food and Agricultural Policies (MAFAP). 2018. Rome: FAO. Available at http://www.fao.org/in-action/mafap/home/en/

Organization for Economic Co-operation and Development (OECD). 2018. "Agricultural Policy Monitoring and Evaluation 2018." Paris, France: OECD Publishing. Available at https://doi.org/10.1787/agr_pol-2018-en

Tokgoz, S. and F. Majeed. “Measuring Distortions to Agricultural Incentives for Value Chain Analysis: Evidence from Indian Value Chains”. *Journal of Agricultural Economics*. Article in press. First published online on October 10, 2018. Available at https://doi.org/10.1111/1477-9552.12305

U.S. Department of Agriculture, PS&D. 2018. Production, Supply, and Distribution Database. Available at www.fas.usda.gov/psdonline/psdHome.aspx

WITS. 2018. World Bank World Integrated Trade Solution. UNCTAD TRAINS database. Available at https://wits.worldbank.org/

WFP. 2018. World Food Programme, Vulnerability Analysis and Mapping. Rome: WFP. Available at http://vam.wfp.org/

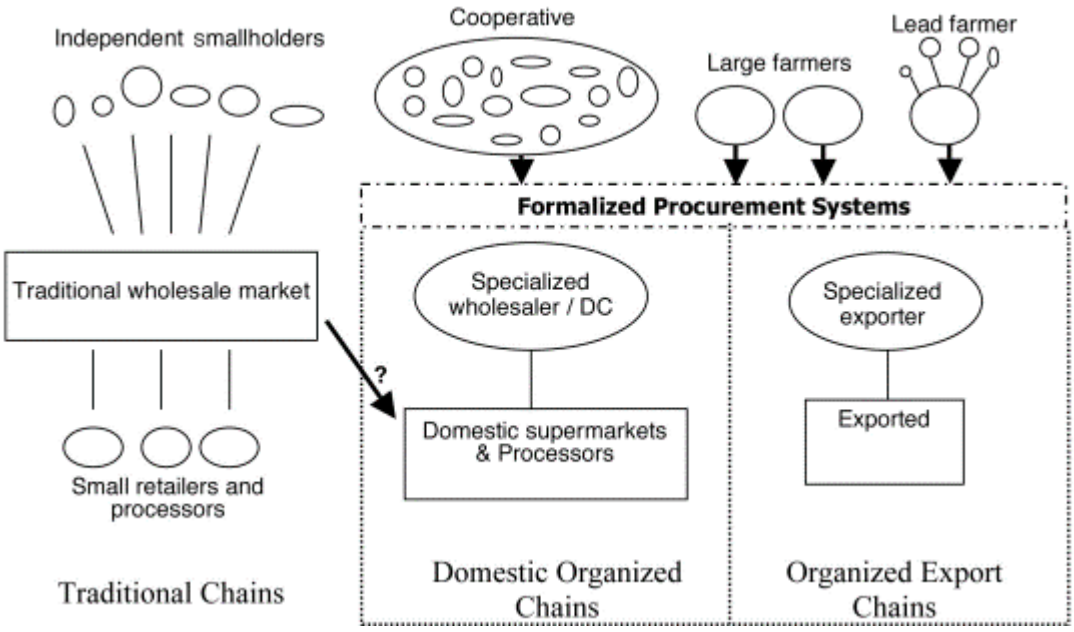
GEM Database. 2018. Global Economic Monitor. Washington, D.C.: World Bank. Available at https://data.worldbank.org/data-catalog/global-economic-monitor

WDI Database. 2018. World Development Indicators Database. Washington, D.C.: World Bank. Available at https://data.worldbank.org/products/wdi

Appendix I: Figure 1

Figure 1 shows both traditional and modern value chains in a food system, as characterized by McCullough, Pingali and Stramoulis (2008), linking producers with consumers and processors through various channels.

Figure 1: Interactions between traditional and organized chains in modernizing food systems



Source: E.B. McCullough, P.L. Pingali and K.G. Stramoulis, eds. 2008. "Small Farms and the Transformation of Food Systems: An Overview." In *The transformation of Agri-Food Systems*, 17. Chapter 1. London: FAO and Earthscan.