Estimating value added from the world's agrifood systems[1]

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Abstract

Agrifood systems transformation is required to reach national and global food security, development, and sustainability goals but depends on substantial public and private investment. Yet most official statistics are delimited by economic sectors, so existing data do not readily quantify the contribution of multisectoral agrifood systems to national economies or the world. Such incomplete accounting is most likely to undervalue agrifood systems' economic contributions and hamper decision makers' ability to justify action. We fill this gap using official statistics and harmonized input-output table data to estimate the value added accruing from agrifood systems output from 1995-2019. Our results show that the agrifood systems of 170 countries contributed nearly $13 trillion (current US$) to global GDP in 2019, 15.4% of global GDP. Of that, primary production (agriculture, forestry, fishing) contributed only 26.1% ($3.3 trillion) while wholesale and retail trade comprised the largest share (53.4%; $6.8 trillion), followed far behind by manufacturing of agrifood products (food, beverages, wood, paper, etc.). Further, we show that agrifood systems are increasingly diversified at higher national incomes. The share of value added from agrifood systems per capita excluding primary production grows with country income but also follows the same well-known pattern as agriculture, declining as a share of GDP per capita as income rises. Our study helps to close an important data gap in understanding the economics of agrifood systems inclusive of the middle of value chains that enables future research on the economic contribution of food systems as they undergo the necessary transformations to meet ambitious economic, social, and environmental goals.

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Introduction

Agrifood systems transformation is increasingly at the center of national and global objectives, from meeting the Sustainable Development Goals (SDGs) and the Paris Agreement carbon emissions targets to ensuring supply chains are resilient to the next major war, pandemic, or other shock [1–7]. Such ambitious transformation requires public and private investment that may be hard for many decision makers to justify without knowing the economic value agrifood systems generate. Providing these crucial statistics is challenging because agrifood systems are not an economic sector [7–10]. Existing literature primarily focuses on individual sectors or economic contributions at the farm level. Taking a systems perspective instead recognizes that agrifood systems encompass all the actors and activities related to the production, processing, trade, consumption, and disposal of food and related non-food products and services, and therefore all the value addition created throughout the system and in sectors that combine both agrifood and non-agrifood activity [11]. This includes and extends beyond the primary production of agriculture, forestry, livestock rearing, and fishing, presumably contributing much more to national and global GDP than primary production alone [12]. Incomplete accounting is most likely to undervalue agrifood systems' economic contributions, which by consequence would diminish perceived potential return on investment that agrifood systems transformation could generate, thereby reducing the evidence to justify policy and investment action.

Incomplete accounting also leaves important questions about the relationship between economic development and agrifood systems transformation unanswered. The empirical regularity of an inverse relationship between the share of a country's GDP from agriculture and its level of development is a pattern long-recognized by agricultural economists [13,14]. Yet, how the rest of agrifood systems – the parts beyond primary production, including all the actors and processes in the middle of value chains and final distribution – changes with economic growth has never been as well understood [8,13,15]. Similarly, the sizable share of consumer food expenditures accruing to post-harvest value chain actors and rising with per capita incomes, demonstrated in recent research [10], may not reflect agrifood systems more broadly.

We address this fundamental data gap to estimate the value added generated by agrifood systems. Using a combination of official statistics (national accounts) and national accounts, namely derived, harmonized multi-region input-output table data [16–18], this study estimates the value added accruing from the output of agrifood systems to most countries around the world from 1995 to 2019. Data availability varies by country and year. Here we present results for 170 countries in 2019 and summarize patterns over time for 101 countries with data for all years from 1995 to 2019. The present work is novel in taking a supply chain perspective to economic accounting of agrifood systems, in line with the global agenda implicating agrifood systems and their transformation in achieving wide ranging goals from economic development, employment, and climate to food security, food safety, and nutrition [14,19–21]. Our results provide new insights into the role of agrifood systems output in national economies around the world.

Data and Methods

The primary datasets utilized in this study include the United Nations Statistical Division

(UNSD) System of National Accounts (SNA) Main Aggregates Value Added tables [18] and the Eora-26 multi-regional input-output tables [17]. This analysis starts with the ISIC to identify all economic activities that are part of agrifood systems [22]. ISIC is hierarchical, with the highest-level sectors given letter codes and sub-components given a two-to-four-digit code. The ISIC classification is periodically revised, Revision 4 is the latest [22]. However, many countries have not updated their systems and are still reporting official statistics using prior revisions or have not back-cast historical records according to newer revisions. To create a time series of value added data for as many country-years as possible, we combine ISIC Revision 3 [23] and ISIC Revision 4 [22] data. We then classify ISIC codes to identify agrifood system (AFS) and non-AFS activities. We classify ISIC codes to the 4-digit level as "wholly AFS," "partly AFS," and "not AFS" (supplementary materials). Partly AFS refers to sectors that contain activities both related to AFS and not related to AFS. This classification takes the hierarchical structure such that any aggregate category is coded reflecting the lower-level codes it contains. Higher level codes with some wholly and/or partly AFS subordinates are assigned as partly AFS. The SI dataset contains this classification for ISIC Revisions 3, 3.1, and 4.

We apply this classification to official statistics of value added. We start with United Nations Statistical Division (UNSD) System of National Accounts (SNA) data [18]. To maximize country and time coverage, we combined statistics created under different frameworks, including across SNA systems (2008, 1993); however, we are unable to do similarly across SNA systems as the differences are not traceable from the data categories. The differences between the 1993 and 2008 SNAs mostly relate to the valuation of goods and services that are not counted in agrifood systems and therefore are minimally consequential for our results, with the exception of research and international trade [24]. We may be underestimating value added from research and international trade in countries reporting data according to SNA 1993.

These UNSD data are only available for economic main aggregates, the highest-level ISIC code, which contain agrifood primary commodity production (e.g., agriculture, forestry, fisheries) as unique sectors, but all other parts of agrifood systems are aggregated into sectors that also contain non-AFS activities. More detailed official value added statistics are available for the manufacturing sector from the UNIDO [25]. For ISIC Revision 3, these are only available at the 2-digit level, and for ISIC Revision 4 they are only available at the 3-digit or 4-digit level, which we aggregate to the 2-digit level. Our objective is to substitute the detailed UNIDO data for the manufacturing main aggregate in the UNSD data. We start by identifying the ISIC revision available for each country-year in the UNSD data. If UNIDO data are available for that country-year in the same ISIC revision, we substitute the UNSD manufacturing main aggregate with UNIDO value added data. If the UNSD and UNIDO data are only available from different ISIC Revisions, we use the UNSD data and estimate the disaggregation of the manufacturing sector as if UNIDO data were not available, using the fraction method detailed further below. Our dataset does not include any data using ISIC Revision 3.1 because there are no data from UNIDO for the manufacturing sector according to this classification [26].

We also harmonize ISIC Revision 3 and Revision 4 in order to maximize country and time coverage. Supplementary materials show the harmonization across ISIC Revisions as well as the classification of the data into the AFS categories defined earlier. It includes all the categories that are wholly or partially attributable to agrifood systems for which we have value added data, the harmonization across revisions, and the justification for the inclusion of the partly AFS codes and the lower-level codes they contain that lead to the classification choice.

Similarly, in our effort to create a valid time series per country, we imposed decision rules that eliminated some existing data. For example, some country-years have UNIDO manufacturing sector data but no UNSD main aggregate sector data, so the UNIDO data are excluded from our final dataset (e.g., Russia 1995-2010 and 2014-2019). Additionally, where countries have multiple series due to methodological revisions, we select the series with the most recent data and the longest time coverage. Where the most recent data are not the longest time coverage, we select the shorter, more recent series, which again eliminates some years of data for a country that are technically available but not in a way that can be combined with other years into a time series. These countries and the affected years have a flag in the dataset.

Then, to disaggregate value added in the partly AFS categories into their AFS and non-AFS components, we turn to the inter-industry transaction matrix from input-output (IO) tables [17]. IO tables record where the output from each sector is consumed by other sectors in the economy, allowing us to track how goods emanating from agrifood production are used in the economy and all the goods and services consumed by agrifood systems from other sectors [27,28]. To incorporate the role of international trade (imports and exports), we utilize multi-region input-output (MRIO) tables from Eora, and specifically the Eora-26 product which harmonizes IO data across countries into 26 consistent sectors [17]. We use balanced tables produced by Yi et al (2025) [29] to extract matrices and aggregate all imports and exports into a single matrix per country-year at the sector level [29]. We use these matrices to define a unique relationship for each partly AFS category expressed in terms of a fraction summarizing inputs from one sector into another sector relative to sectoral gross output of either the input or output sector, depending on the direction of the relationship along the value chain (Tables S6 and S7).

The value added in year y is estimated by summing the value added (VA) of the wholly agrifood sectors (j_w) and each share of the partly AFS sectors (j_p) attributable to AFS (Eq.1). The j indexed sectors refer to the ISIC category sectors which delineate the UNSD value added data. For simplicity, the country is omitted from the subscript in all equations, as all calculations are conducted at the country level.

$$VA_{AFS,y} = \sum_{i=1}^{j_w} VA_{j_w y} + \sum_{i=1}^{j_p} \omega_{j_p y} * VA_{j_p y} \tag{1}$$

Where $VA_{AFS,y}$ indicates the total value-added value of the agrifood system, $VA_{j_w y}$ and $VA_{j_p y}$ are the value-added value of the industries (j) that are classified as wholly AFS or partly AFS in the year y, respectively, and $\omega_{j_p y}$ is the share to allocate of j_p – the partly AFS industry's value added – to AFS. To develop the share ($\omega_{j_p y}$), we use the inter-industry transactions in the IO matrix IO_y (Eq. 2) reflecting the inputs of sector i into sector o (a_{io}) and the gross output of the input (GO_i) and output sectors (GO_o) (Eq. 2). The i and o indexed sectors refer to the EORA-26 harmonized sectors. This approach is conceptually similar to the matrix of technical coefficients from the inter-industry transaction matrices employed by Savin et al. (2022) [30] to decompose labor productivity by value chains incorporating the role of trade, a similar application of IO data to understand the structure of the economy through value chains that span countries and sectors when the data are structured by country-sector.

$$IO_y = \begin{bmatrix} a_{1,1} & \cdots & a_{1,0} \\ \vdots & \ddots & \vdots \\ a_{i,1} & \cdots & a_{i,o} \end{bmatrix} \tag{2}$$

Where the weight $\omega_{j_p y}$ for sector j_p is calculated as the value of a_{io} relative to the gross output of the input sector (GO_i) when j_p is an input to sector o and relative to the gross output of the output sector (GO_o) in all other cases (Eq. 3). In addition, we estimated the value added by margin industries, including transportation, wholesale, and retail trade sectors, which facilitate the movement and distribution of goods to final consumers. Specifically, where j_p is wholesale and retail trade or transportation, a_{io} includes the margins reflecting the additional value added from these sectors into final consumption; a_{io} is calculated at basic prices in all other cases, described in further detail below.

$$\omega_{j_p y} = \begin{cases} \frac{a_{io}}{GO_i} & j = \text{input to } o \\ \\ \frac{a_{io}}{GO_o} & \text{otherwise} \end{cases} \tag{3}$$

The share ($\omega_{j_p y}$) is then applied (as a multiplier) to disaggregate the partly AFS industry j_p in equation (Eq. 1). For example, consider j_p to be the manufacture of textiles (ISIC Rev. 3 code D17). The share attributable to AFS reflects the share that uses natural fibers and is estimated as the value of inputs from primary production (EORA-26 sectors A01 and A02) into the textiles and wearing apparel sector (EORA-26 sector A05) relative to the gross output of textiles and wearing apparel. In this example, j is not an input to the output sector (textiles and wearing apparel), so we estimate the share of manufacture of textiles ($\omega_{j_p y}$) that is made from natural fibers is estimated as the share of agriculture inputs (domestic and imported) into the textiles sector (a_{io}) relative to the gross output of the textiles and wearing apparel sector (domestic and exported) (GO_o). Supplementary materials define and provide the rationale for each inter-industry transaction fraction based on the ISIC Revision 3 categories. The procedure and results are quite similar for ISIC Revision 4.

We define each relationship with respect to the ISIC category the fraction will be used to disaggregate. As noted briefly above, for most sectors we compute the shares using the transactions at basic prices, which are prices received by producers for their goods and services. Additional services are provided by trade and transportation industries to deliver goods from producers to consumers. We estimate these margins, focusing by necessity on food and beverage (which can be isolated as AFS in the Eora-26 framework) as additional value to the bilateral transactions matrix represented in Eq. 2. The margins are defined as the trade (transportation) services paid by food service industries divided by the total commodities or services purchased by food service industries from the upstream agrifood sectors (agriculture, forestry, fisheries, and manufacturing of food and beverages). This limitation suggests our estimates are a lower bound on the wholesale and retail trade and transportation sectors. The wholesale and retail trade margin tables provided by Eora do not disaggregate between wholesale and retail, so we use the share of wholesale and retail trade in final consumption to disaggregate the trade margin into wholesale and retail. For wholesale and retail trade margins accruing from international trade, we attribute the margin value added for the wholesale transaction to the exporter and the margin value added for the retail transaction to the importer.

An immediate concern is whether these fractions ($\omega_{j_p y}$) are stable over time. To test this, we regress the share ($\omega_{j_p y}$) on year (y), with country fixed effects, for the 101 countries with data for the full period 1995-2019 (Eq. 4).

$$\omega_{j_p y} = \alpha + \beta_1 y + \beta_2 country + \varepsilon \tag{4}$$

The resulting coefficients are plotted in supplementary materials as the point estimate of the coefficient on time (β_1) with error bars for the 95% confidence interval; asterisks indicate estimates statistically significantly different from zero. Most of the fractions are quite stable over time (time trends close to and statistically insignificantly different from zero). Several are statistically significantly different from zero, but still very small in magnitude, indicating variation over time of less than 0.001% difference in the share of the gross output in question attributable to AFS from year-to-year. Even the transportation fraction, which appears to show greater variation over time has a coefficient smaller than 0.001%, a very small difference over time in practical terms. This stability suggests that the fractions could potentially be calculated periodically and applied over multiple years, especially under constrained resources to access and process the IO data. However, sectors in the "hidden middle" of agrifood systems – like accommodation and food service, transportation, and wholesale and retail trade.

Finally, we merge the fractions with the UNSD and UNIDO data, separately by ISIC Revision. Of note, for the few cases of ISIC Revision 3 where the country only reports combined main aggregates (or where we determine that the subordinate aggregates do not sum correctly to the combined category), we use the combined categories and drop the individual categories where they were deemed inconsistent. Then we apply the most logical fraction; manufacturing, mining, and other industrial activity (ISIC Revision 4: B+C+D+E) uses the manufacturing aggregate and wholesale and retail trade, accommodation, and transport (ISIC Revision 4: G+H+I) uses the wholesale and retail trade fraction. This will undoubtedly result in an underestimate in the role of food service and transport for these countries, which include some large nations including the United States and Australia, but where ISIC Revision 3 data are not available to use instead. After calculating the AFS share of the partly AFS codes, we harmonize the categories to append the ISIC Revision 3 and 4 datasets to each other, ensuring no duplicate observations. Wherever both revisions are available, we use the ISIC Revision 4 data unless UNIDO data are only available for Revision 3 in that country-year, in which case we use the ISIC Revision 3 data (for both the main aggregates and manufacturing disaggregated data). The ISIC Revision used per country-year is shown in supplementary materials.

We use the UNSD and UNIDO data series in nominal local currency. The Eora-26 database is in US dollar values, but the fraction we create is unitless and can be merged with the UNSD data without unit conversions. To express value added results in comparable currency, we convert to nominal US dollars using the International Monetary Fund (IMF) average annual exchange rate unless the data series contains an adjusted Analysis of Main Aggregates (AMA) rate that is not equal to the IMF rate. These rates are sourced directly from the UNSD SNA database and the AMA rate makes adjustments in specific countries and years where rapid economic change was deemed not accurately captured by the IMF rate [31]. Value added as a share of GDP is calculated from the nominal local currency data. Value added per capita is calculated using the population statistic also contained in the UNSD database, replicated from the official source of population statistics, UN Population.

We limit our final dataset to UN member states but preserve non-member state territories (e.g., Puerto Rico) until the final stage of our data management workflow so that other researchers could make a different choice with our replication files. We exclude data for historical states no longer existing (e.g., Sudan prior to 2011 separation of South Sudan). We triangulate our results against value added as a share of GDP and gross value added for agriculture in FAOSTAT [32]. We exclude Venezuela (1995-2019) and certain years for Ghana (1995-1999), Sao Tome and Principe (2001-2019), Belarus (1995-2013), and Turkmenistan (1995-2003) due to extreme estimates of value added from agrifood systems multiple times total GDP. FAOSTAT similarly does not have data for Venezuela for value added from agriculture as a share of GDP. We have preserved these data points in a quality flag variable for replicability, but they are replaced as missing for the purposes of our analysis presented here.

Finally, to merge different data sources, we used a combination of Area Codes for Statistical Use (M-49) codes, ISO-alpha3 codes, and country names, due to different identifying information. We use the R package 'countrycode' (version 1.5) with manual review to harmonize country names across the datasets to official UN country names [33]. All data management and analysis were done in R version 4.2.2.

Results

We find that from 1995 – 2019, wholesale and retail trade has become the largest single contributor at the global level to value added from agrifood system output. It accounts for just above half (53.7%) of all agrifood system value added by 2019, and exhibits the greatest growth in the period. **Figure 1** shows the global distribution of agrifood system value added in 2019 by category and region, comprising data for 170 countries (listed with exact values and values as shares in supplementary materials). In total, agrifood systems contributed nearly $13.1 trillion (nominal) to global GDP in 2019, 14.7% of the $87.7 trillion global GDP [34], or 15.4% of the total GDP ($84.1 trillion) of the 170 where the value added in agrifood systems can be calculated (shown in supplementary materials).

Primary production contributes only 25.8% to value added, consistent with results from related studies [10]. However, most value added in Africa remains from primary production (agriculture, forestry, fishing) accounting for 73.3% of the continent's agrifood value added, which is a small share ($485.3 million; 3.7%) of the global agrifood total. On all other continents wholesale and retail trade is the dominant contributing sector to total agrifood system value added. Just about half of all global value added comes from Asia (49%, nearly $6.4 trillion), with just under half of that ($2.9 trillion) from wholesale and retail trade and one third ($2.2 trillion) from primary production. Post-farmgate activities generate even larger shares of the value added – over 80% – in the Americas, Europe, and Oceania. Wholesale and retail trade dominates on these continents as well.

Figure 1. Total value added from agrifood systems by region, 2019.

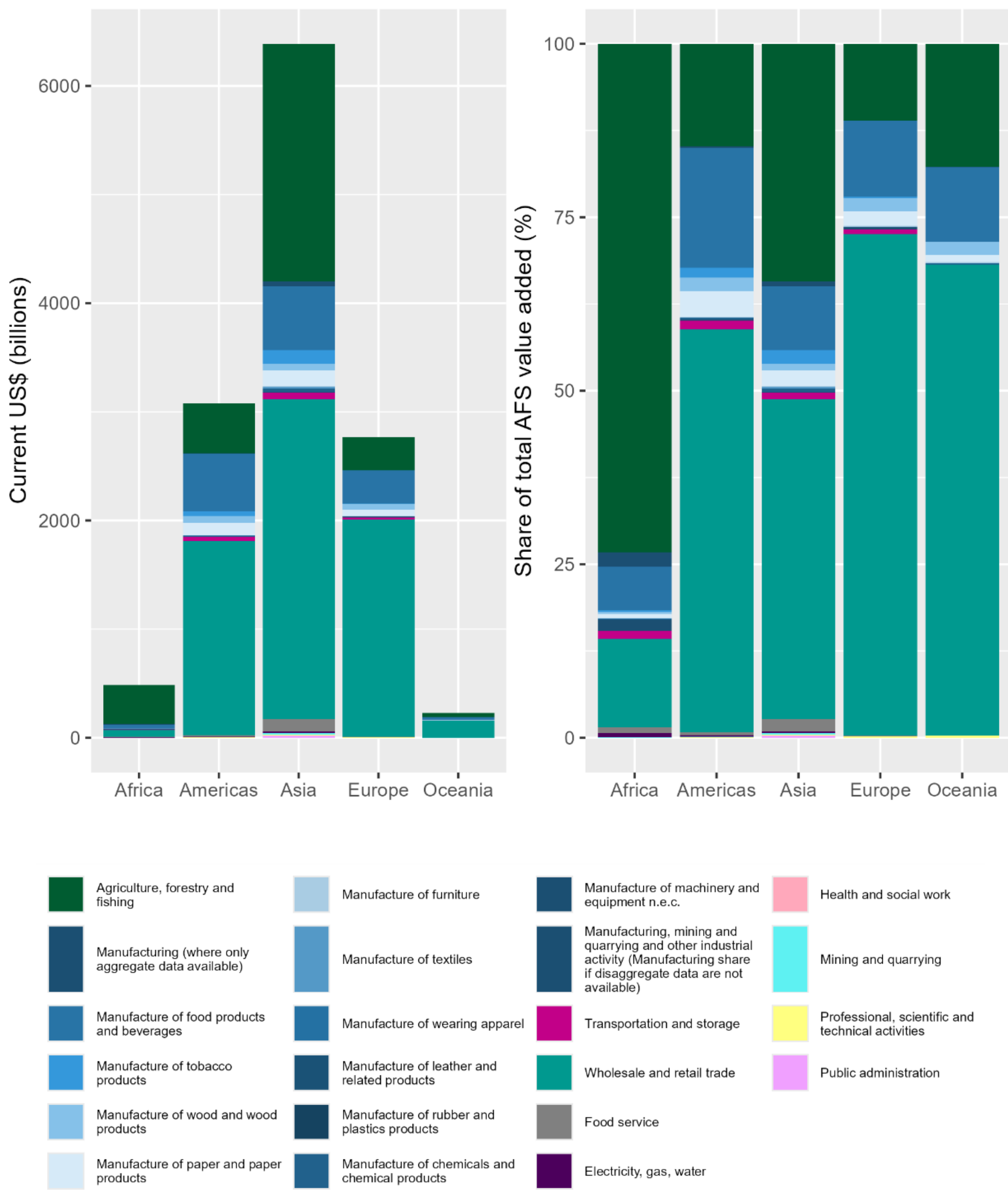
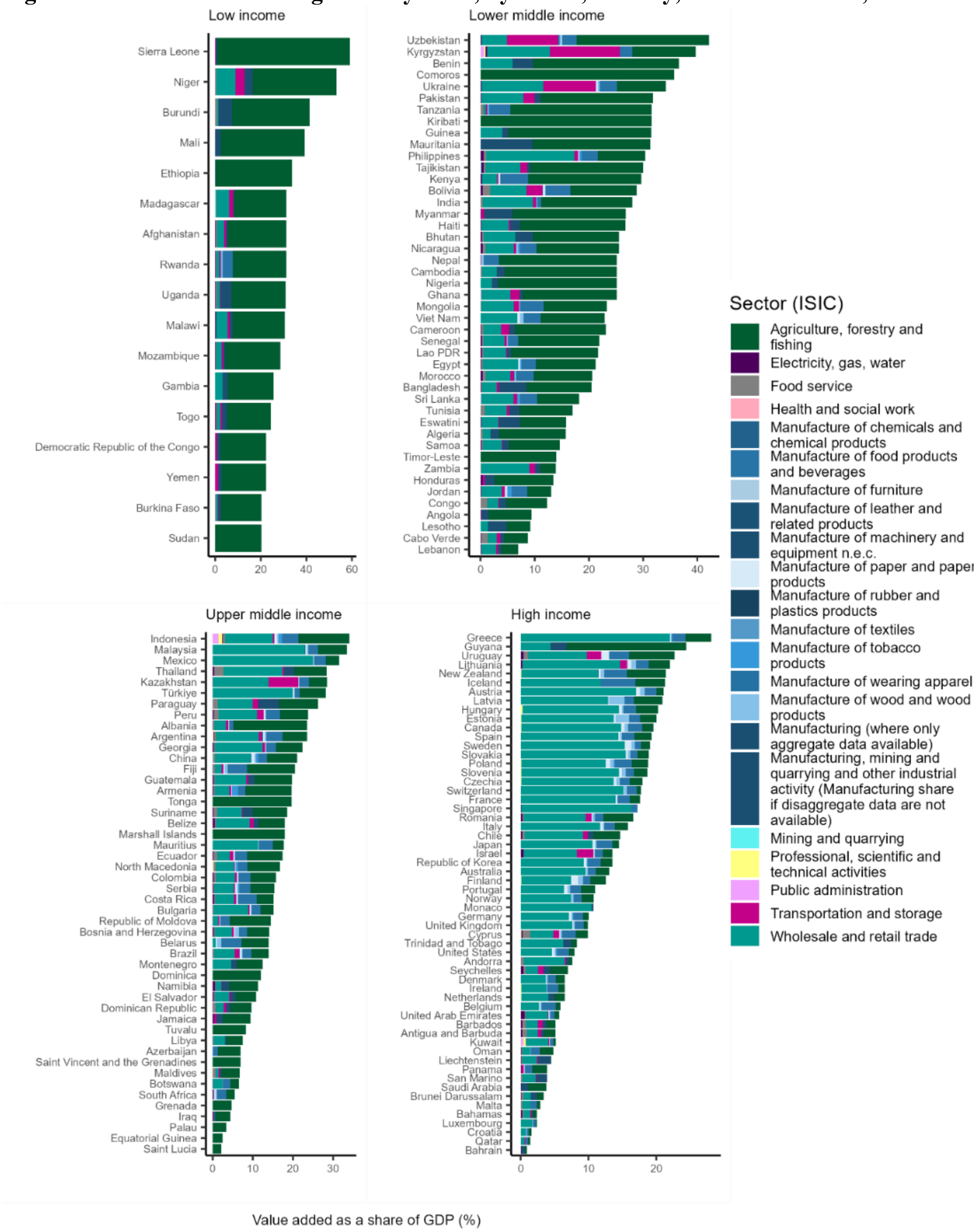


Figure 2 shows the sectoral contribution of agrifood systems value added at the country level, grouped by country income for 2019 (again, N=170 countries). Although the total share of GDP from agrifood systems is smaller for high income countries (note the different ranges in the x-axis), they are much more diversified in terms of the sector and sub-sector contribution to GDP. In a few upper middle-income and high-income countries primary production remains the vast majority of agrifood system activity but these are mostly isolated (island) nations (e.g., Tuvalu, Kiribati, Guyana) or countries with resource wealth and limited economic diversification (e.g., Equatorial Guinea, Saudi Arabia). Discussed further below, an important caveat that pertains mostly to lower income countries is that informal sector activities (e.g., unregistered trading and vending) are much more prevalent (and in some places dominant) in wholesale and retail trade

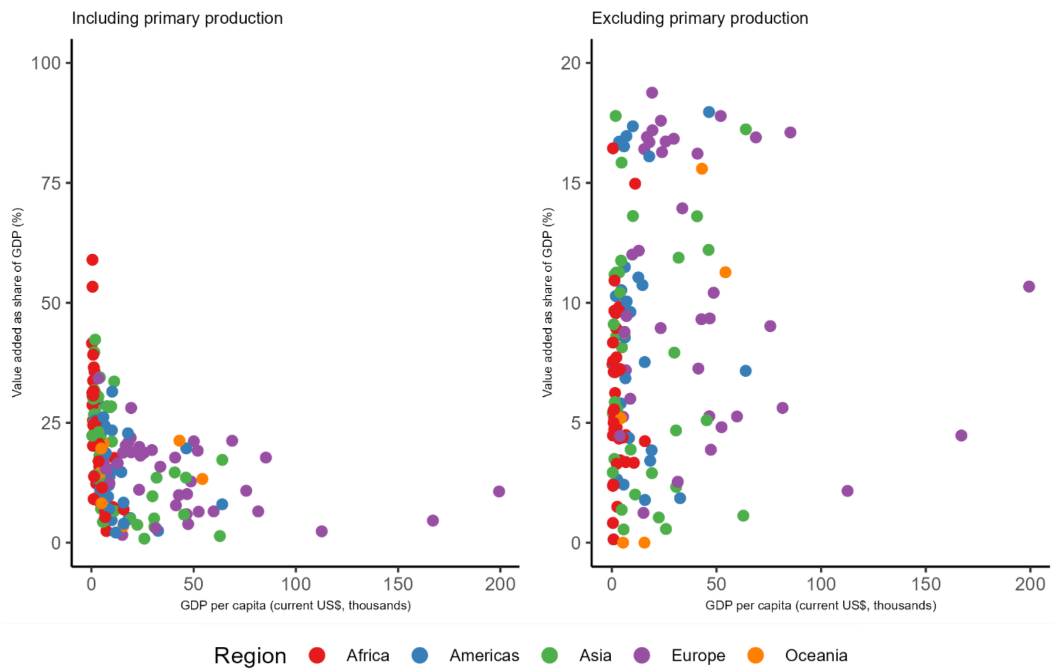
and food services, and the value addition created by those activities is not included in the official statistics reflected here [35].

Figure 2. Value added from agrifood systems, by sector, country, and income level, 2019.



The share of GDP from all parts of agrifood systems declines as country income increases. We find that the long-observed pattern that value added in agriculture as a share of GDP declines with GDP per capita also holds for the rest of agrifood systems (beyond primary production) (**Figure 3**). This follows naturally from the widespread empirical finding that consumer demand for fuels, food, and fibers, the main products of agricultural primary production, increases with income but at less than a one-for-one rate (i.e., demand is income inelastic) and similarly from the fact that productivity growth has tended to be higher in agriculture than in other parts of the economy leading to its smaller share of the total as the economy grows [36,37]. We find that value added per capita from the manufacturing and wholesale and retail subsectors of agrifood systems increase relatively linearly with rising per capita incomes, though the pattern is least consistent at the lowest end of the income range suggesting there may be an income threshold below which these sectors struggle to grow and may be more dependent on country context (supplementary materials).

Figure 3. Comparison of value added in agriculture and non-agriculture parts of agrifood systems relative to GDP per capita, 2019.

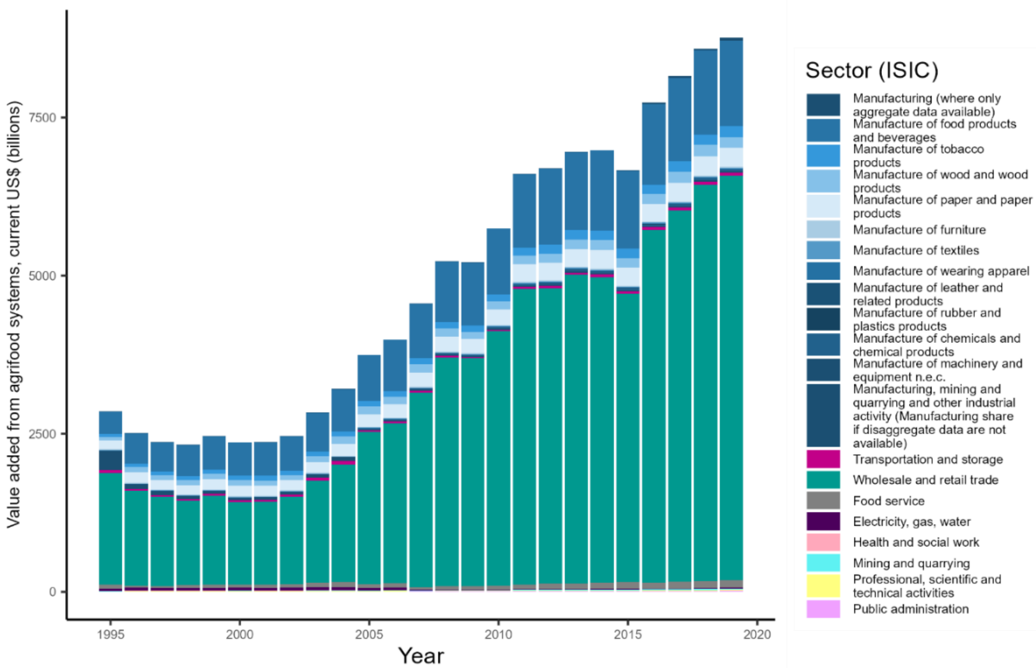


Interesting insights also emerge looking at which countries have the greatest contribution from the non-primary production parts of agrifood systems even at low levels of GDP per capita. The top 10% (above the 90th percentile) of countries in terms of the share of GDP from the value added of agrifood systems excluding primary production include a heterogenous list of nations from across continents. Shown in supplementary materials, these countries are Mexico, Kyrgyzstan, Malaysia, Ukraine, Greece, Kazakhstan, Türkiye, Indonesia, Philippines, Thailand, Austria, Lithuania, Canada, Uzbekistan, Sweden, and Estonia.

Agrifood systems also become more diversified with rising income. Looking closely at the composition of agrifood systems value added in these outlier countries (supplementary materials) shows that, consistent with the global results, wholesale and retail trade is the dominant contributor in most countries. Manufacturing food and beverages is the second largest category in most countries, however, in several countries this is dwarfed by transportation. Specifically, transportation dominates in Kyrgyzstan, Ukraine, Kazakhstan, and Uzbekistan , notably large countries with difficult terrain requiring greater use of transportation services. Manufacturing of wood and paper products features prominently in Estonia, highlighting the role of forestry there. Food service comprises a relatively large share in only a few countries, including Indonesia, the Philippines, and is greatest in Thailand. These outliers provide insight into the heterogeneous structure of agrifood systems across countries and suggest that, while wholesale and retail trade clearly makes a large economic contribution within agrifood systems, specialization patterns and the scale of services industries within agrifood systems vary. This heterogeneity likely reflects a combination of factors (resource endowments, integration with global markets, topography, country income level, urbanization) which can be further investigated in future research.

A similar pattern emerges in the sectoral/sub-sectoral distribution of value added globally over time. As **Figure 4** shows, the dominant contributor to value added within agrifood systems beyond primary production is wholesale and retail trade, followed by the production of foods and beverages, paper/paper products, wood and wood products, and tobacco. Wholesale and retail trade generates more value added than all agrifood manufacturing combined. Much of the growth over the 1995 – 2019 period happened in Asia (supplementary materials), which aligns with the earlier finding that Asia dominates in terms of global contribution to agrifood systems output value added by 2019.

Figure 4. Changes in global agrifood systems value added over time, by sector excluding primary production (complete cases only, N=101), 1995-2019.



Discussion

We show that value added from wholesale and retail trade contributes the largest share – just over half (53.7%) – of the economic contribution of agrifood systems across countries in 2019, while primary production accounts for only 25.8%. Of the remainder, we show that manufacturing of foods, beverages, and other products made from agricultural raw materials (including forestry and fishing) contributes much more value added and larger shares of GDP than the agrifood system activities in transport, food service, or any other agrifood system output. Further, we develop a practical methodology using fractions of relationships in input-output transaction data to represent a share of each partially agrifood economic sector that can be attributed to agrifood systems, drawing estimations from the foundational work by Yi et al (2025) [29], while addressing both food and non-food agricultural sectors. In estimating the disaggregation of economic statistics that combine agrifood and non-agrifood activities our approach could be useful for similar exercises focused on agrifood systems and relying on data using official sectoral classification. Our analysis helps to further understanding of the role of agrifood systems in the global economy and at the country level and can be used to set priorities towards agrifood system transformation goals and monitor outcomes [7].

In this paper, we provide comprehensive, transparent, and replicable global estimates of value added in agrifood systems. We estimate total value added in 2019 to be $12.9 trillion, for 170 countries reflecting 94.1% of the global population and 95.5% of global GDP. Agrifood systems contribute 14.7% to total global GDP (of $87.9 trillion), or 15.4% of the total GDP ($84.1 trillion) of the 170 where the value added in agrifood systems can be calculated. Wholesale and retail trade contribute more value added than any other parts of agrifood systems (53.7%), with primary production accounting for only 25.8% of total agrifood system value added. We find that high income countries have much more diversified agrifood systems compared to lower income countries, though nearly all countries have some output value added from the non-primary production parts of agrifood systems. Relatedly, value added from agrifood systems as a share of GDP decreases with income (GDP per capita) even when looking only at the parts of agrifood systems beyond primary production. This shows that the post-farmgate segments of agrifood value chains follow the well-recognized pattern of structural transformation where the GDP share from agriculture declines with income [8,13,14].

After wholesale and retail trade, the manufacture of food and beverage products is the largest sub-sector contributor to total global value added outside of primary production. However, the manufacturing sector remains nascent in many places and even in places showing fast growth, it is occurring is from a very modest starting point [8,21,38]. That being true for manufacturing overall, we find the share of agrifood manufacturing in GDP is 11.3% in Africa, not far behind the 14-16% found in Asia, Europe, and Oceania (supplementary materials). While the importance of the food and beverage manufacturing sector may appear to reflect a growth opportunity, further food manufacturing must contend with the health and nutritional consequences of the energy-dense, nutrient-poor products that have been a major driver of the industry's past growth. These products and the dietary transition to which they contribute are associated with increasing prevalence of obesity and non-communicable diseases (NCDs) throughout the world [39]. The consumption of ultra-processed foods and sugar-sweetened beverages has been growing rapidly across low-income countries, even in rural areas, alongside increasing prevalence of obesity and NCDs [40,41]. Similarly, manufacturing includes slaughter, meatpacking, and dairy processing therefore also reflecting global growth in animal source food consumption over this period, which are similarly associated with the rise in NCDs [42]. That this sub-sector is the second-largest within agrifood systems after primary production highlights an important potential tradeoff and a need to transition away from unhealthy and unsustainable food and beverage products in a way that does not undermine growth and employment goals [38,43]. Achieving those multiple goals requires good governance of food systems transformation, especially attention to political economy factors and institutional mechanisms for coordination within and across countries and sectors [44–46]. Recent evidence shows one promising approach is through policies to incent product reformulation to improve health, though it requires complementary policies to fully address the nutritional challenges posed by current food environments [47]. Taking a systems approach that can anticipate and guide decisions around tradeoffs and synergies is essential and requires, among other things, new data that is disaggregated in ways that are meaningful for agrifood systems policy, planning, and governance [7].

Our estimate of value added from primary production in 2019 ($3.4 trillion) compares favorably with the estimate in FAOSTAT ($3.5 trillion) and the World Bank's estimate of gross output value of agriculture in 2019 ($3.5 trillion), with the small differences likely accounted for by different data sources (United Nations Statistical Division (UNSD) in the case of our estimates and FAOSTAT vs. World Bank input-output tables) and the 24 countries for which there are no data in our analysis for 2019 [32,34]. Our finding that primary production accounts for only 25.8% of total value added is also consistent with recent estimates that >70% of consumer food expenditures accrue to post-farmgate segments of agrifood value chains [10]. This shows that the patterns of value addition accrual specific to consumer food expenditure recently revealed by Yi et al (2021) [10] and expanded for inclusion in the FAOSTAT database [48], are mirrored in the rest of agrifood systems.

A number of methodological differences exist between the Yi et al (2021) [10] and present study that merit delineation to underscore the importance of such consistent results. First, we estimate value added from all agrifood system primary production not just that associated with consumer food expenditures [10], i.e., we work from upstream to downstream, not vice versa and we include non-food products. Looking at the destination of primary production using the IO data (supplementary materials), we can see that only half of primary production (52.6%) goes into food and beverage manufacturing and just 4.6% on top of that goes directly into hotels and restaurants, wholesale, or retail trade. The remainder (42.8% in 2019) generates value added that does not go into value chains that produce consumer food products and services and therefore would not be part of decomposition analysis of consumer food expenditure. Second, our analysis includes a greater number of countries and more low-income countries than in Yi et al (2021) [10], and primary production still dominates in the economies of low-income countries. Third, in order to incorporate more countries and a longer time series, we use Eora data rather than OECD input-output data. Fourth, we include international trade, while (10) focuses solely on domestic value chains, which necessarily omits all primary production that is exported for processing or consumer purchase in other countries. We thus consider these new estimates to be more comprehensive than prior published global estimates, yet they remain wholly consistent with the prior insights. These results are also consistent with Yi et al (2025) [29], which develops a parallel method working instead from consumer food expenditures upstream to primary production, similarly disaggregating value addition by sector, including international trade, and tapping the longer, more comprehensive Eora time series data.

Our findings open several avenues for future research. First, systematic comparisons with other related research, similar to model intercomparison exercises, would help to triangulate conclusions and understand the drivers of differences. Specific comparisons are warranted with global economywide models (e.g., [49]), final consumer demand disaggregation methods at the country and global levels [10,50], and other methods for reconciling international system of national accounts data [51]. Second, additional methods could be applied to triangulate our findings. Comparing retail to import costs for commonly traded foods would better explain the role of trade in ingredients to total value addition [52]. And applying the approach of Yi et al (2021) [10] to final products for an expanded list of products beyond consumer food would illuminate how value addition accrues along these additional agrifood value chains.

Relying on official statistics means the quality of the input data in our analysis depends on countries' reporting choices and capacity and excludes any value addition in final goods and services in the informal economy. Some countries only report data that combines even main aggregate categories. We have disaggregated these categories with the fraction method (see Materials and Methods) as a second best measurement option. Supplementary materials shows the source of manufacturing sector data (United Nations Industrial Development Organization (UNIDO) or estimated) by country-year. Of specific note, the ISIC Revision 4 data for many large countries, including the United States, report only a combined value for the main aggregates of wholesale and retail trade, transportation, and accommodation and food service. In conservatively assigning the wholesale and retail trade fraction to disaggregate this category, we are undoubtedly underestimating value added in accommodation and food services, and which will affect the global totals given that several of the world's largest economies are included in those who report only this combined aggregate. Data on the informal economy might reveal more sector and sub-sector diversity in low-income countries than we observe.

Future research could integrate additional datasets, such as those available from national statistics offices of the affected large countries, so that the patterns over time and in relation to economic development could be further interrogated especially in the manufacturing, wholesale, retail, and food service sub-sectors. Lastly, we could not identify any adequate inter-industry transaction fraction to disaggregate the data for certain categories that are conceptually partially attributable to agrifood systems. Specifically, in International Standard Industrial Classification of all economic activities (ISIC) Revision 3 these are recycling (under manufacturing) and other services which contains washing of textiles. Taken together, these limitations suggest our estimates are likely to be a lower bound on the value added from agrifood systems' output. Future research can extend this analysis as more countries report ISIC Revision 4 data and disaggregated data for the manufacturing sector.

This study demonstrates how existing data can be used to close data gaps that emerge in the transition from policy objectives aligned to economic and industrial sectors to policy objectives focused on cross-cutting and multisectoral objectives such as food systems transformation. Taking official statistics as the starting point for this analysis ensures that our results maintain fidelity to the data governments endorse and are not in conflict with any official statistics. We aim, thereby, that these results are easy for governments to incorporate into their food system transformation planning and monitoring. The classification of all ISIC codes by relation to agrifood systems (SI "Metadata and Codebook") enables numerous researchers to better understand agrifood systems and build a consistent evidence base. In addition, these data fill an important gap in monitoring global agrifood systems [7].

Supplementary materials exceed page limits and are available from the authors on request.

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