



United States Department of Agriculture

Improving Agricultural Data: Modernizing the U.S. Agricultural Productivity Data Series

Eric Njuki

**Research Agricultural Economist
Economic Research Service, USDA**

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Overview

- Productivity serves as a benchmark for sectoral performance (Shumway et al. 2016; O'Donnell 2016).
 - Structural adjustments
 - Technological progress—research & development, infrastructure
 - Impacts' resource allocation decisions
 - Policy makers' decisions on incentives
- Conveys the potential for enhanced well-being of households
 - Higher standards of living
 - Lower prices



AAEA-USDA Task Force review of ERS Productivity Accounts recommendations

- Gardner et al. 1980 recommendations
 - Move away from Laspeyres index to Divisia index, specifically for pesticides, fertilizers, and aggregate inputs.
 - Incorporate input quality-adjustments to ensure that inputs are measured in constant-quality units.
 - Jorgensen and Griliches (1967) refer to ‘quality changes’ as a type of aggregation error.
 - Occurs when items of different qualities, productive efficiencies, and growth rates are aggregated rather than treated as different items in calculation—resulting in bias.
 - Move away from the value-added approach to the gross-output approach.



Shumway, Fraumeni, Fulginiti, Samuels and Stefanou (2014) external review committee

- Following Office of Management and Budget (OMB 2011) mandate for ensuring data quality and valid procedures.
- Shumway et al. (2014) recommendations.
 - Fully document and keep current all procedures—from data sources through measurement of productivity change—to enable replication.
 - Improve data documentation and communication with data users.
 - Continuously explore new data sources to improve input-quality measurements, capitalize on research and expertise.
 - Cultivated assets (biological) should be tracked as capital.
 - Reinstate the state-level productivity measures.



Current modernization project

- Undertake a complete rewrite of the codebase used to update national accounts
 - Current system relies on a deprecated software no longer supported by its original developers.
 - Eliminate vulnerabilities created by relying on deprecated platforms.
 - Enhance reproducibility by using a more rigorous testing and debugging process.
 - Document the logic and workflow processes.
 - Enhance continuity of operations so they can be rewritten or recreated should the need arise.
 - Capitalize on current research, innovation and expertise.





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How does ERS Measure productivity?

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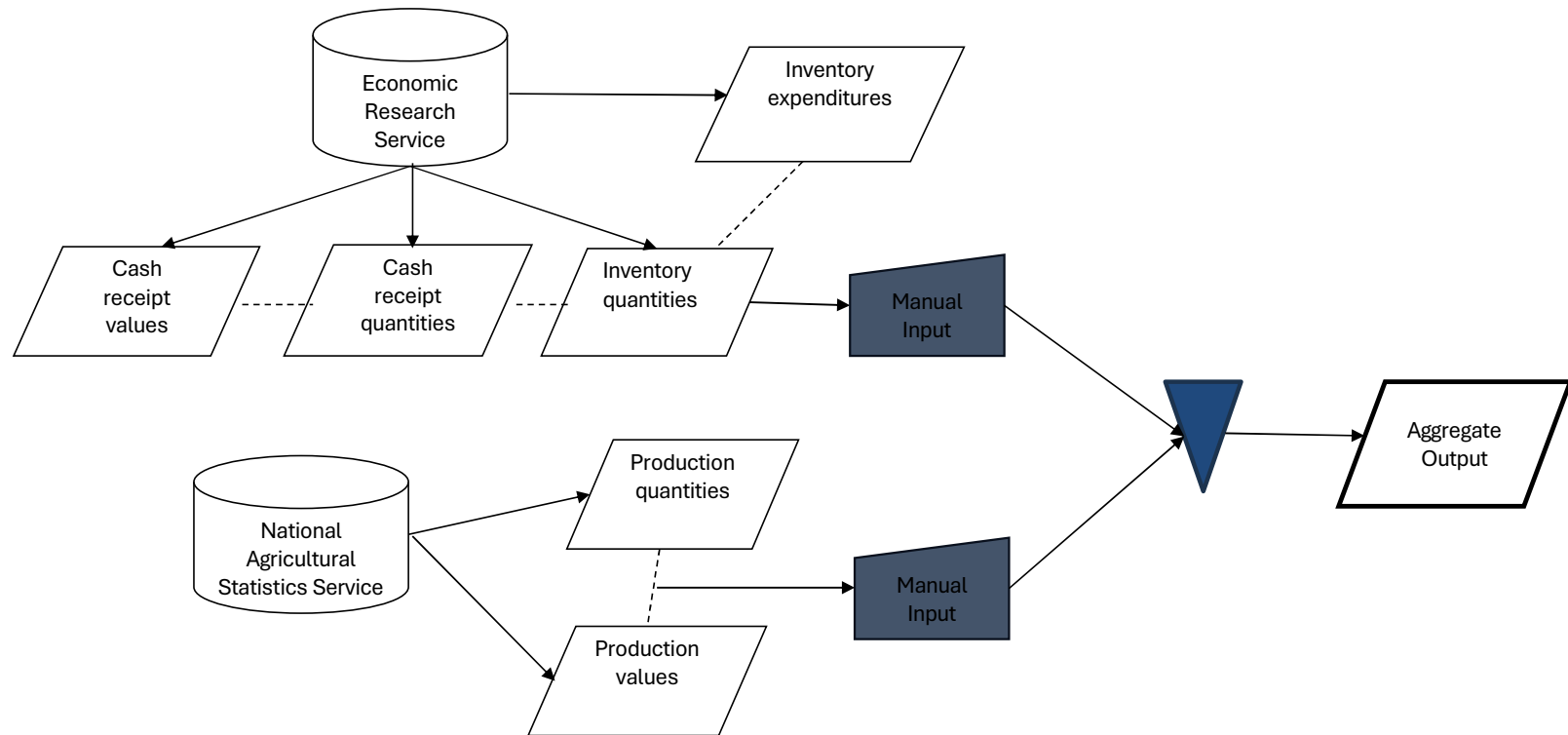


Draw data from numerous sources

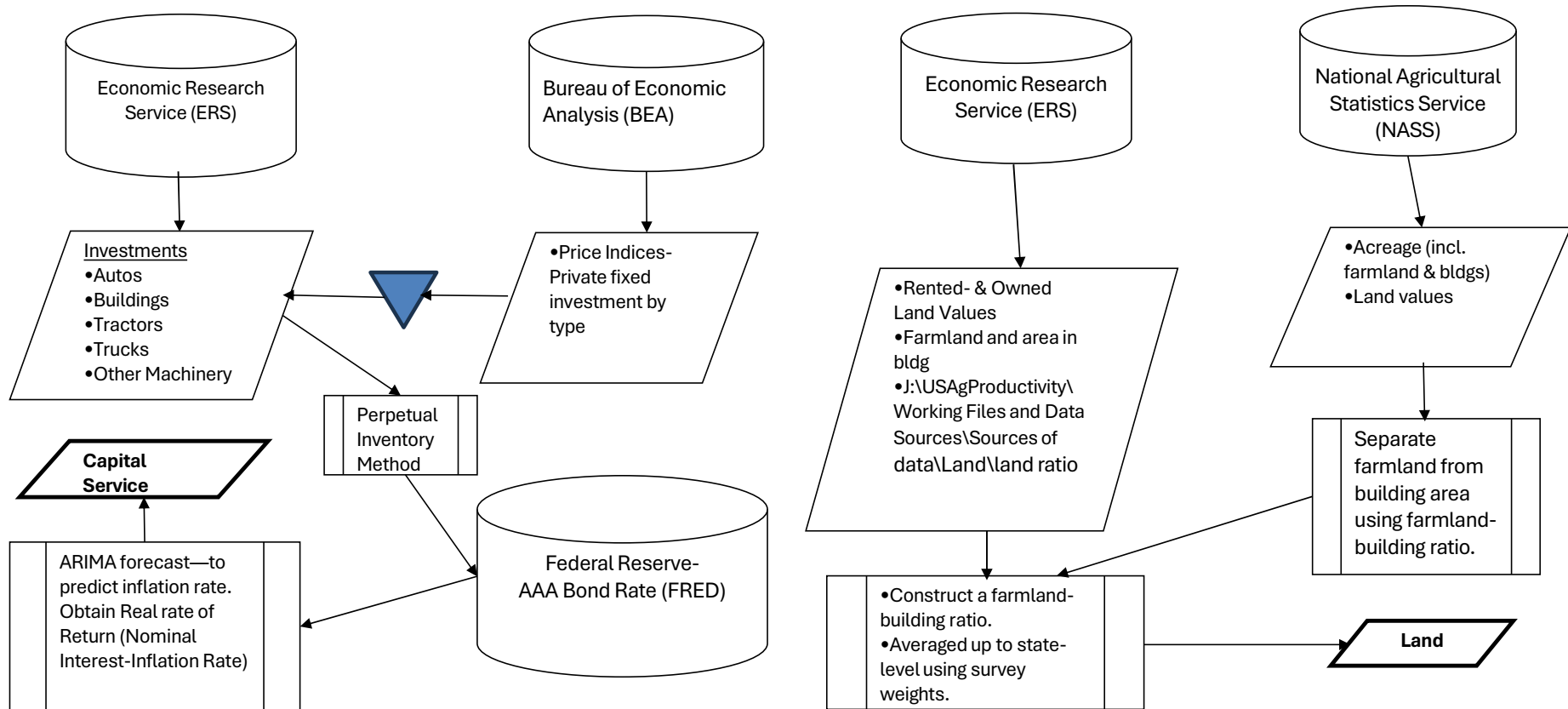
- Agricultural Resource Management Survey (ARMS)
- Bureau of Economic Analysis (BEA)
- Bureau of Labor Statistics (BLS)
- Energy Information Administration (EIA)
- U.S. Census Bureau—Population census
- National Agricultural Statistics Service (NASS)—Census of Agriculture
- Federal Reserve Economic Data (FRED)
- Private Sector—Kynetec, ChemInfo, Association of American Plant Food Control



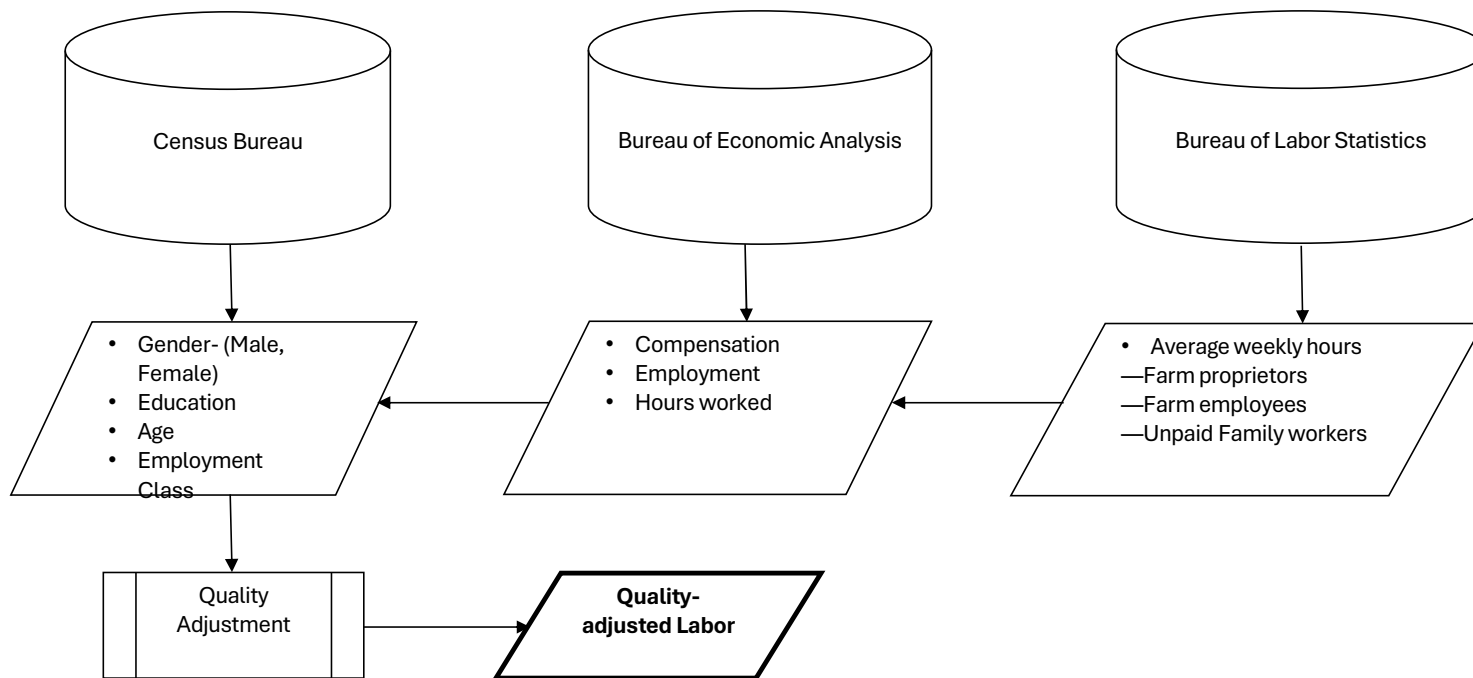
Outputs



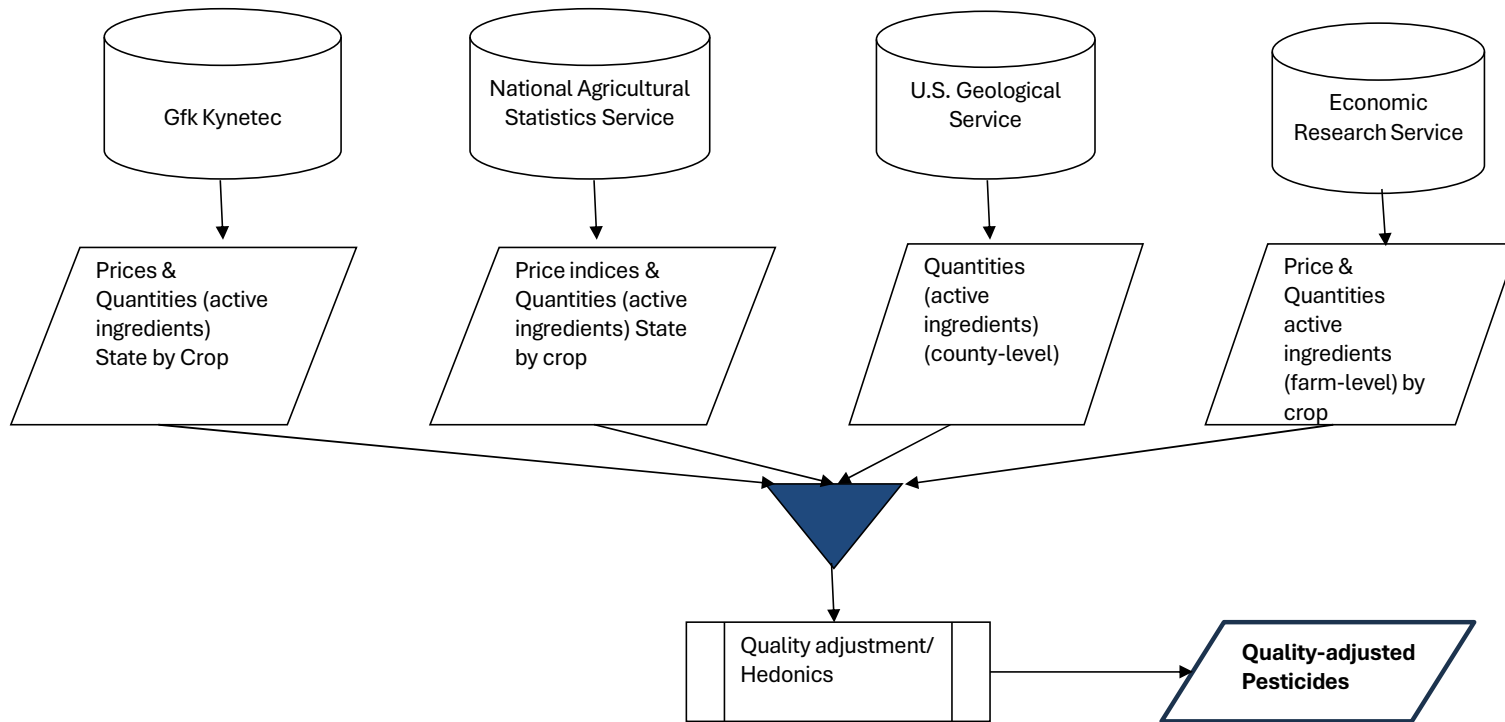
Durable Capital and Land



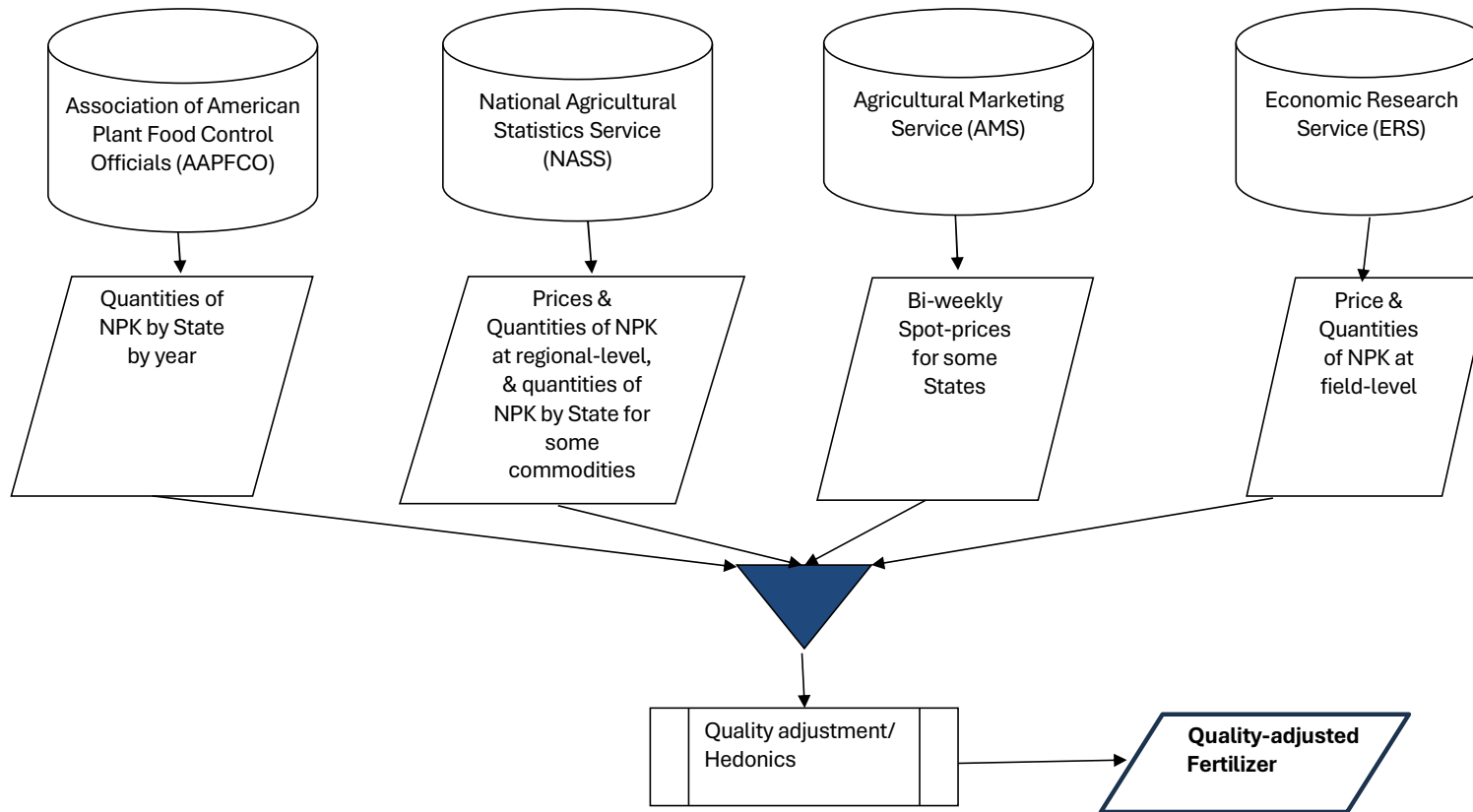
Labor



Pesticides



Fertilizer

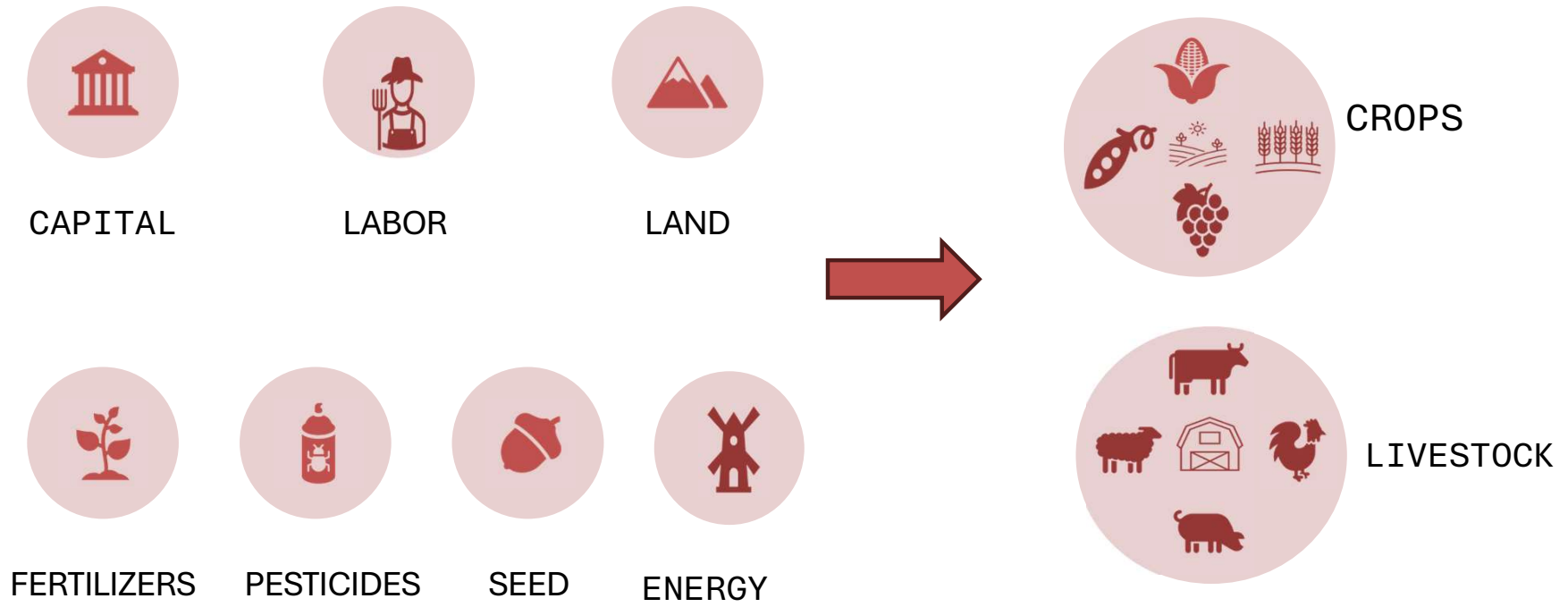


Factors considered in quality adjustments

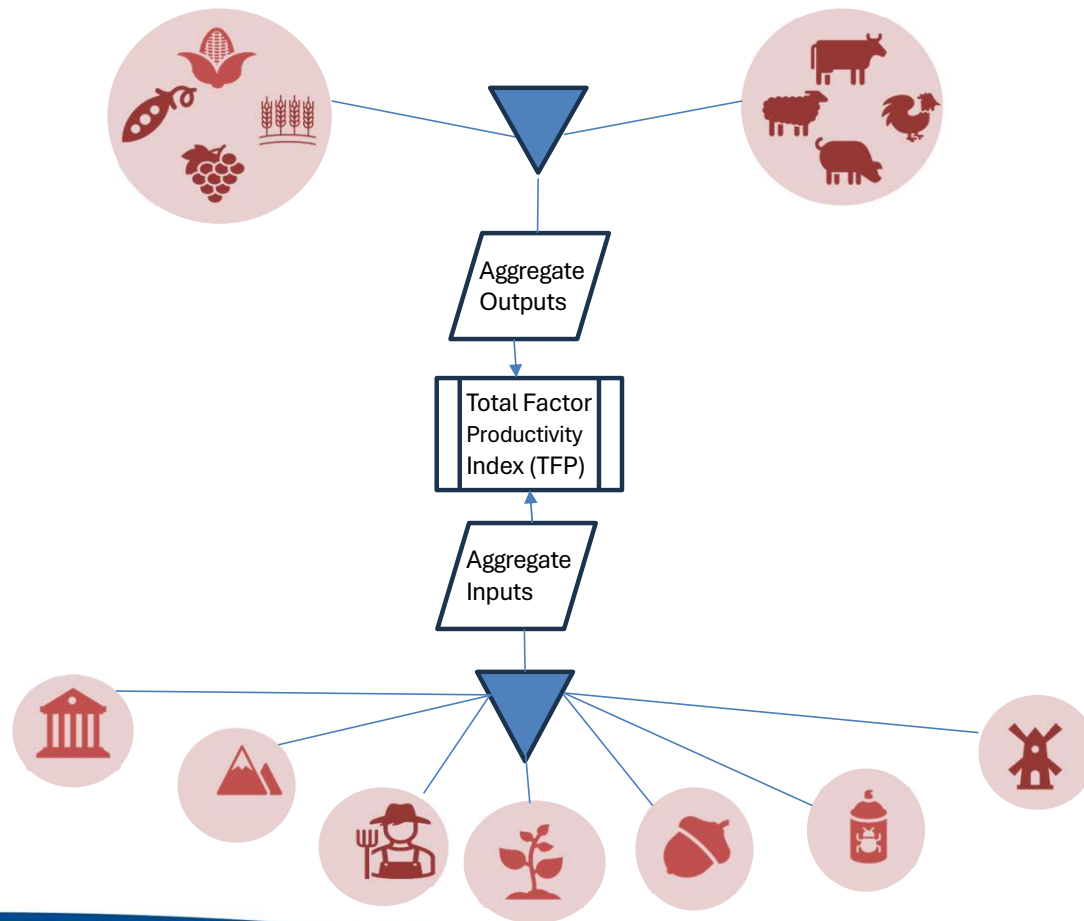
- Fertilizer & pesticides
 - potency level
 - chronic toxicity score
 - persistence
 - absorption rate
 - water solubility
- Labor
 - education attainment
 - experience
 - gender
 - age
 - Compensation
 - Employment class
- Land—agro-ecological characteristics e.g.,
 - soil type
 - slope
 - region
 - separate farmland from buildings
- Durable Capital
 - depreciable assets are constructed using the perpetual inventory method
 - ARIMA forecasting to predict inflation rate, and therefore real rate of return



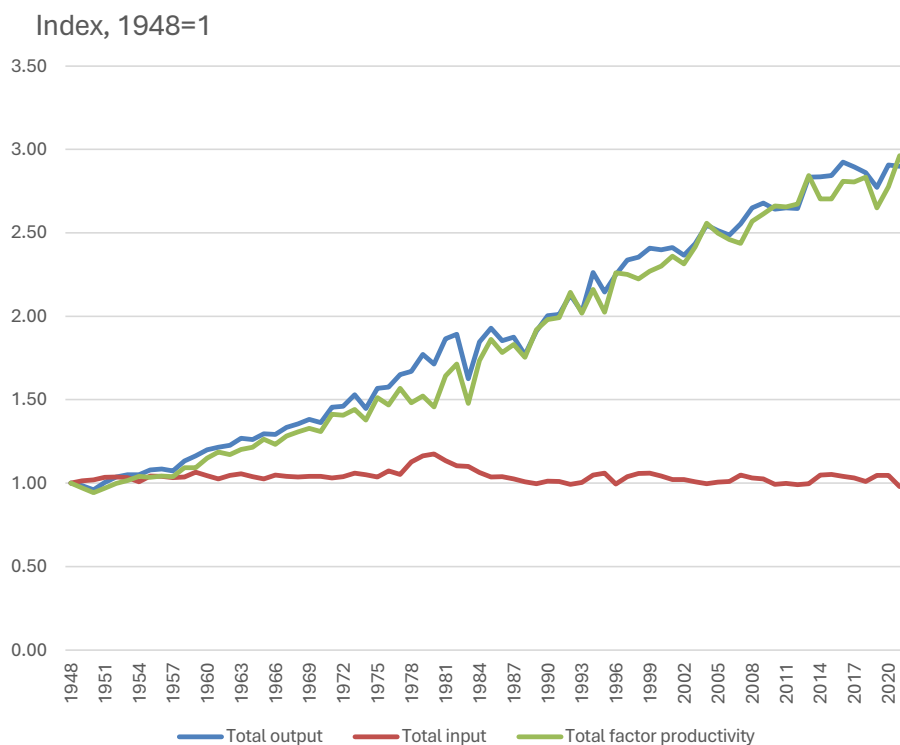
Production Technology



Input-Output Aggregation and TFP



U.S. Agricultural output, inputs and total factor productivity, 1948-2021



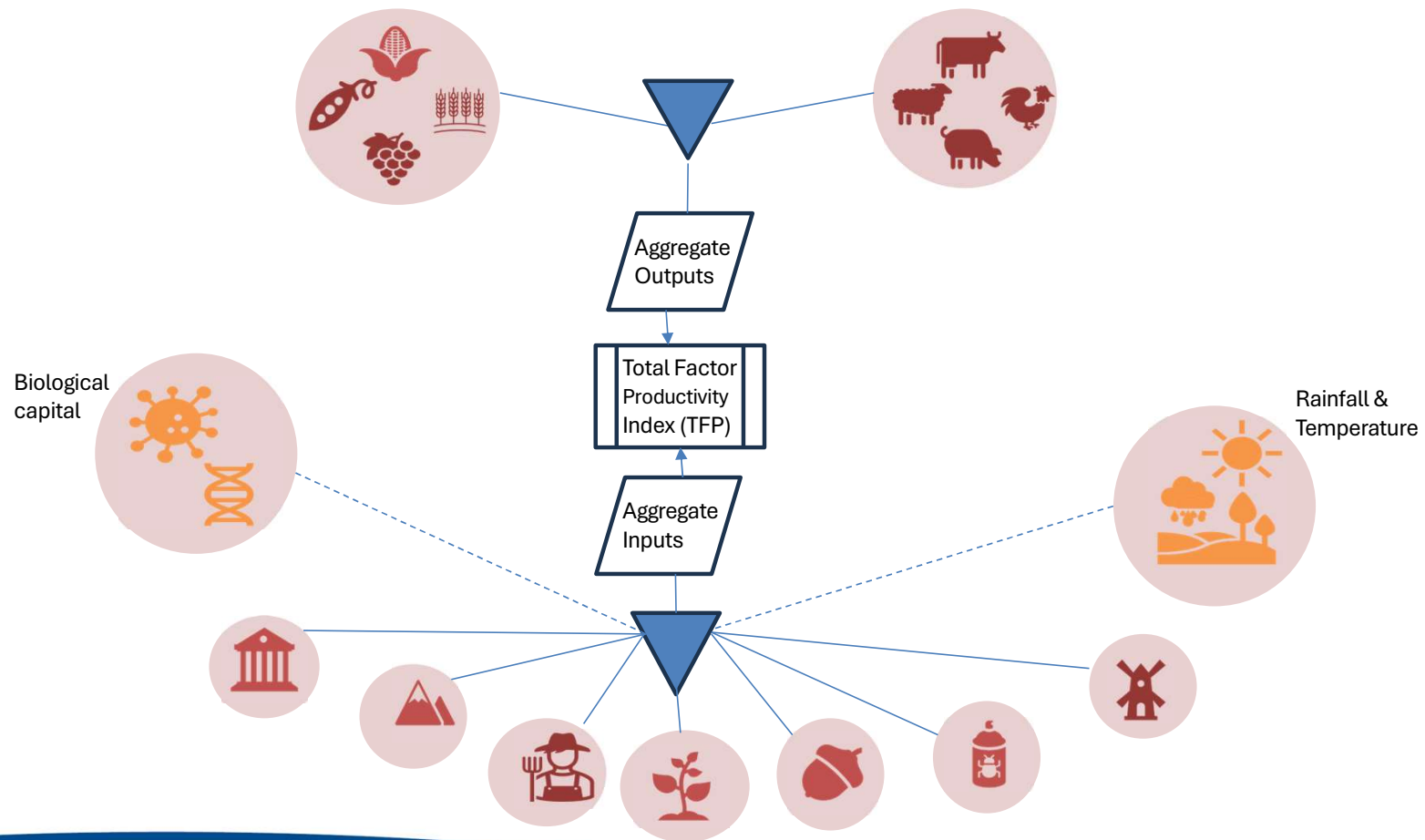
• Highlights

- Agricultural TFP increased at an annual rate of 1.49 percent.
- Total output increased at an annual rate of 1.46 percent.
- Total inputs declined at a rate of -0.03 percent.
- Land and labor declined by -0.45 percent and -1.93 percent per year, respectively.
- Durable capital, and intermediate materials increased by 0.95 percent and 1.01 percent per year, respectively.

Source: *Agricultural Productivity in the U.S., 2024*, Wang, S.L., E. Njuki, R. Nehring, and R. Mosheim.



Input-Output Aggregation and TFP



Biological Capital

- System of National Accounts (UN 2009) and Shumway et al. (2014) recommend that cultivated assets should be tracked as capital.
- Challenges exist (Rocha Jr. et al. 2023):
 - Perpetual inventory methods and geometric decay are not appropriate for measuring biological capital
 - The level of investment is not evident—assets are not purchased but produced on own account.



ERS proposed approach (Adauto Jr. et al. 2023)

○ Livestock

- Estimate age-efficiency profiles from animal science literature.
- Estimate 1st year rent value by solving present value (PV) equation.
 - $\text{Cost of replacement} = \text{PV of services (expected price} \times \text{age-efficiency profile)} + \text{expected PV of cull animals.}$
- Use resulting age-rental paths, combined with animal counts to estimate for each year
 - Total annual value of capital service flows
 - The value of wealth capital as the sum of PV of all ages of assets

○ Crops

- Estimate life-cycle budgets, with process for each vintage year.
- Use resulting age-rental paths and acreage to estimate.
 - Total annual value of capital service flows
 - The value of wealth capital as the sum of PV of all ages of assets



References

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<https://ers.usda.gov/data-products/agricultural-productivity-in-the-u-s/>



Q&A

Thank you

eric.njuki@usda.gov



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