Policy Research on Agricultural Mechanization in Bangladesh

Dr. Akhter Ahmed, Bangladesh Country Representative
Dr. Mehrab Bakhtiar, Research Fellow
Dr. Ben Belton, Research Fellow
Dr. Ruhul Amin Talukder, Senior Policy Advisor
Aminul Karim, Research Analyst
Raisa Shamma, Research Analyst

International Food Policy Research Institute (IFPRI)

Dhaka, Bangladesh | March 5, 2024

Background

- **Responding to a High-Level Request for Policy Research and Process Evaluation**
  - Request from Ms. Wahida Akter, Secretary, Ministry of Agriculture and Dr. Mohammad Abdur Razzaque, MP and former Minister of Agriculture

- **Program in Focus**
  - Quantify the effect of mechanization in Bangladesh's agricultural sector
  - Assess the government's ongoing and previous mechanization support/incentive phases
  - Process evaluation of 'Farm Mechanization through Integrated Management'

- **IFPRI/CGIAR Role:**
  - Commitment to comprehensive research on agricultural mechanization
  - Research supported by the Bill & Melinda Gates Foundation

IFPRI

CGIAR

Goals and Objectives

- **Overall Goals**
  - Research on the state of agricultural mechanization in Bangladesh
  - Assess the mechanization support program's impact on the agricultural sector and its effectiveness

- **Specific Objectives**
  - Investigate mechanization trends across crops and geographic regions
  - Evaluate current methods of targeting beneficiaries of government support programs
  - Assess the impact of mechanization
  - Special focus on smallholder farmers, climate change and gender
  - Provide recommendations to policymakers based on the findings

IFPRI

CGIAR

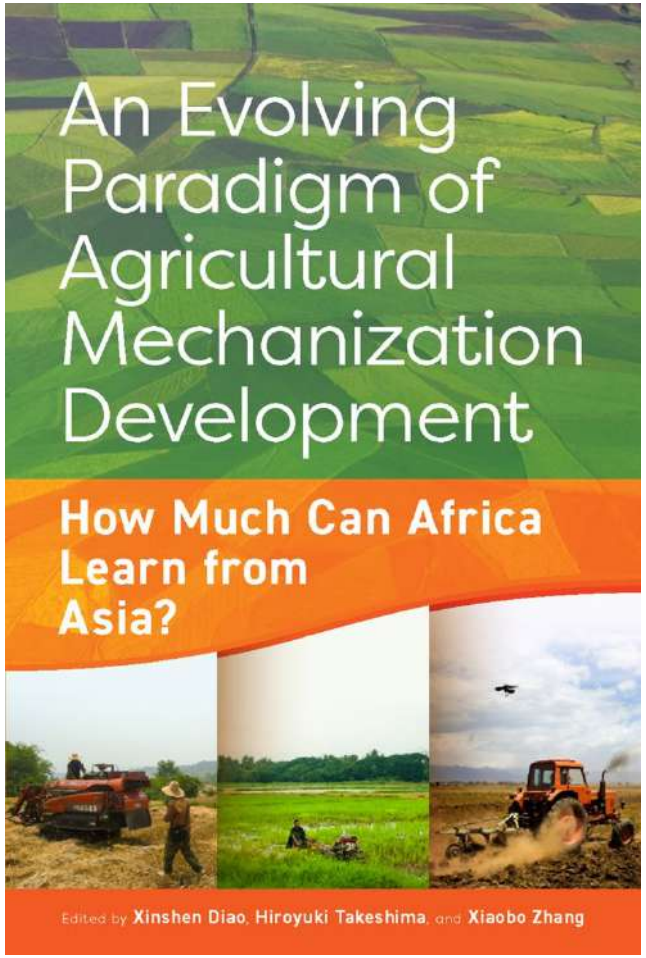
Collaboration

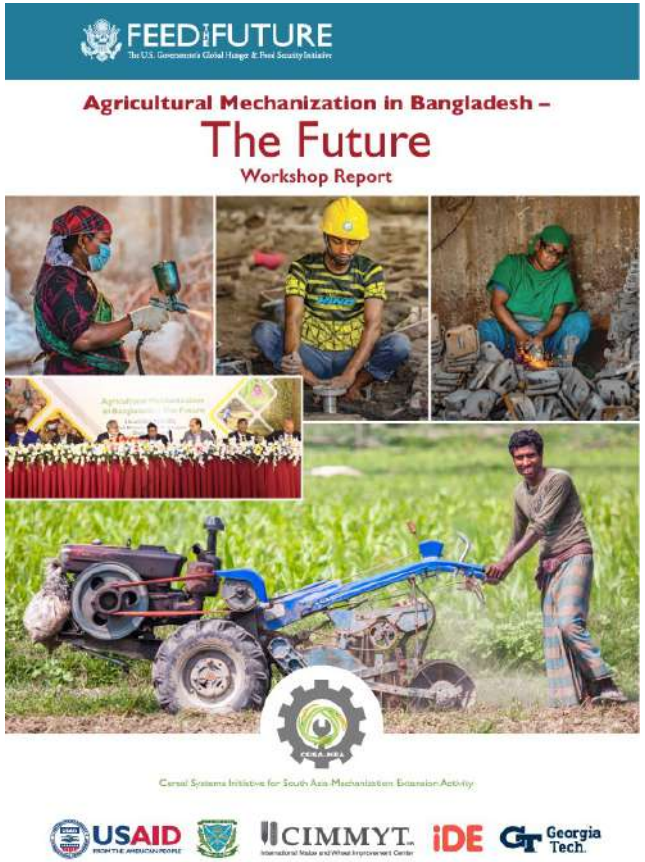
- Technical Advisory Committee (TAC) formed at the Ministry of Agriculture
- Inaugural meeting took place recently
  - Provided TAC with overview of proposed research objectives and methodology
  - Received detailed feedback from TAC on proposed research activities
- Coordinate policy research through TAC and the Agricultural Policy Support Unit (APSU) at MOA that IFPRI helped establish
- Collaborate with other CGIAR centers, such as CIMMYT

IFPRI

CGIAR

IFPRI and CGIAR have extensive experience with research on agricultural mechanization in different contexts



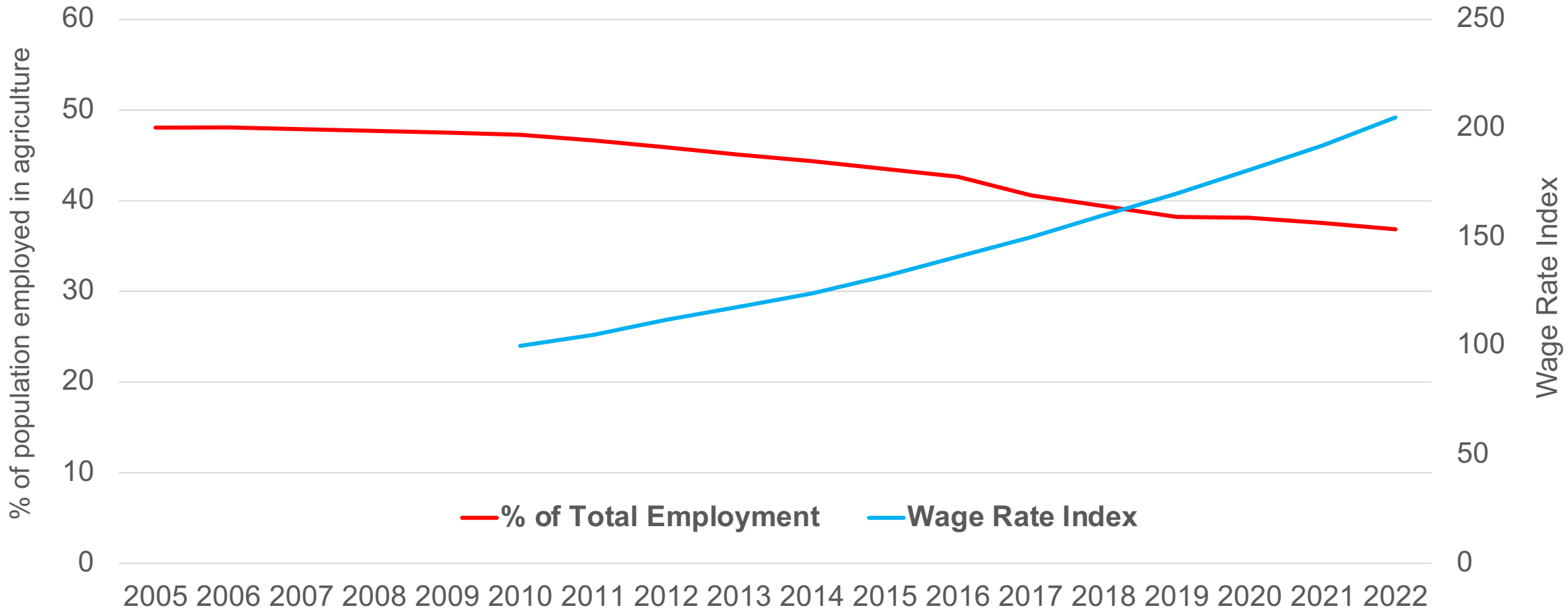


IFPRI

CGIAR

IFPRI's Current Work on Agricultural Mechanization in Bangladesh

Declining agricultural labor force participation and increasing real wages in agriculture



% of labor force employed in agriculture (2005-2022) and index of real agricultural wages (2010-2022), Bangladesh

Source: World Bank Indicators, various years & BBS Wage Rate Index (Base 2010-11)

Evolution of agricultural mechanization & policy

1970-1990

Adoption of mechanized irrigation

- Liberalization of input markets
- Elimination of import tariffs on machinery
- Multiple engine and pump brands and sizes & spare parts enter the market
- Repair workshops appear

1990-2005

Adoption of mechanized tillage

- Duty-free import for 2WT (1995)
- Flourishing of SME metal workshops
- Flourishing of machinery rental market local service providers

2005-present

Adoption of mechanized threshing

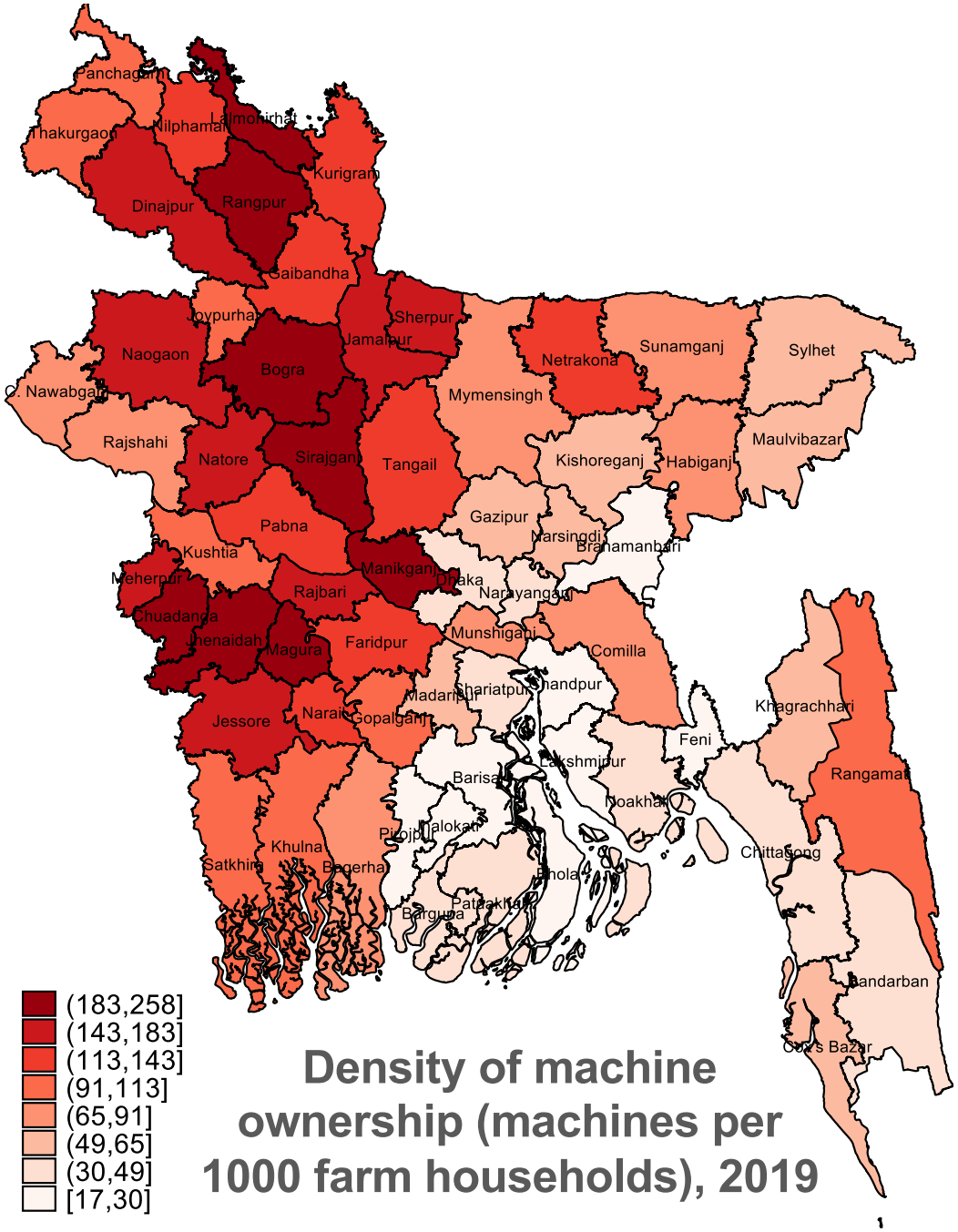
- Targeted government incentives for purchase of selected machinery (combines, transplanters etc.)
- Special consideration to areas where mechanization is lagging

IFPRI

CGIAR

Large regional variations in extent of machine use

- Machines considered: power pump, seeder, power tiller, tractor, thresher
- Lowest levels of ownership in coastal zone and Northeast (focus of government mechanization priorities)
- Highest levels of machine ownership in West and Northwest (districts with high cropping intensity)
- Hubs of small-scale machinery manufacturing have emerged in W and NW



Density of machine ownership (machines per 1000 farm households), 2019

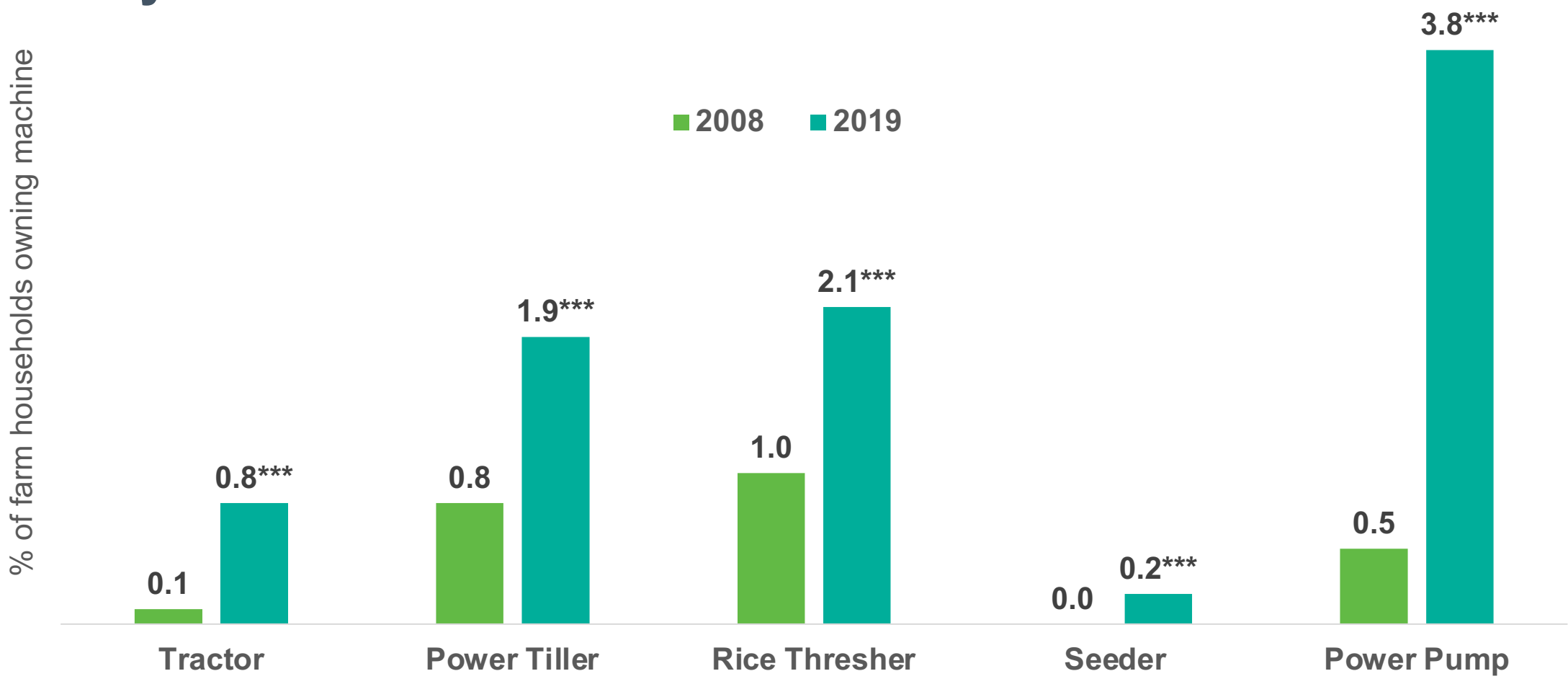
Source: Authors' calculation using Bangladesh Agriculture Census, 2019.

Evolution of government support for agricultural mechanization, 2005-present

Phase 1 (2005-2012)	Phase 2 (2012-2019)	Phase 3 (2019-Present)
30% incentive for purchasing: • Power Thresher • Reaper • Sprayer • Power Tiller • Seeder • Weeder • Dryer • Power winnower • Sprinkler irrigation set	**50-70% incentive for purchasing:** • Power Thresher • Reaper • Sprayer (foot pump) • Combine Harvester • Rice Transplanter	**50-70% incentive for purchasing:** • Power thresher • Reaper • Sprayer (power) • Combine harvester • Rice transplanter • Seeder/bed planter • Power weeder • Dryer • Maize sheller • Potato digger • Potato chip maker • Carrot washer

Source: Evaluation report by the Ministry of Planning (2014, 2018); Ministry of Agriculture.

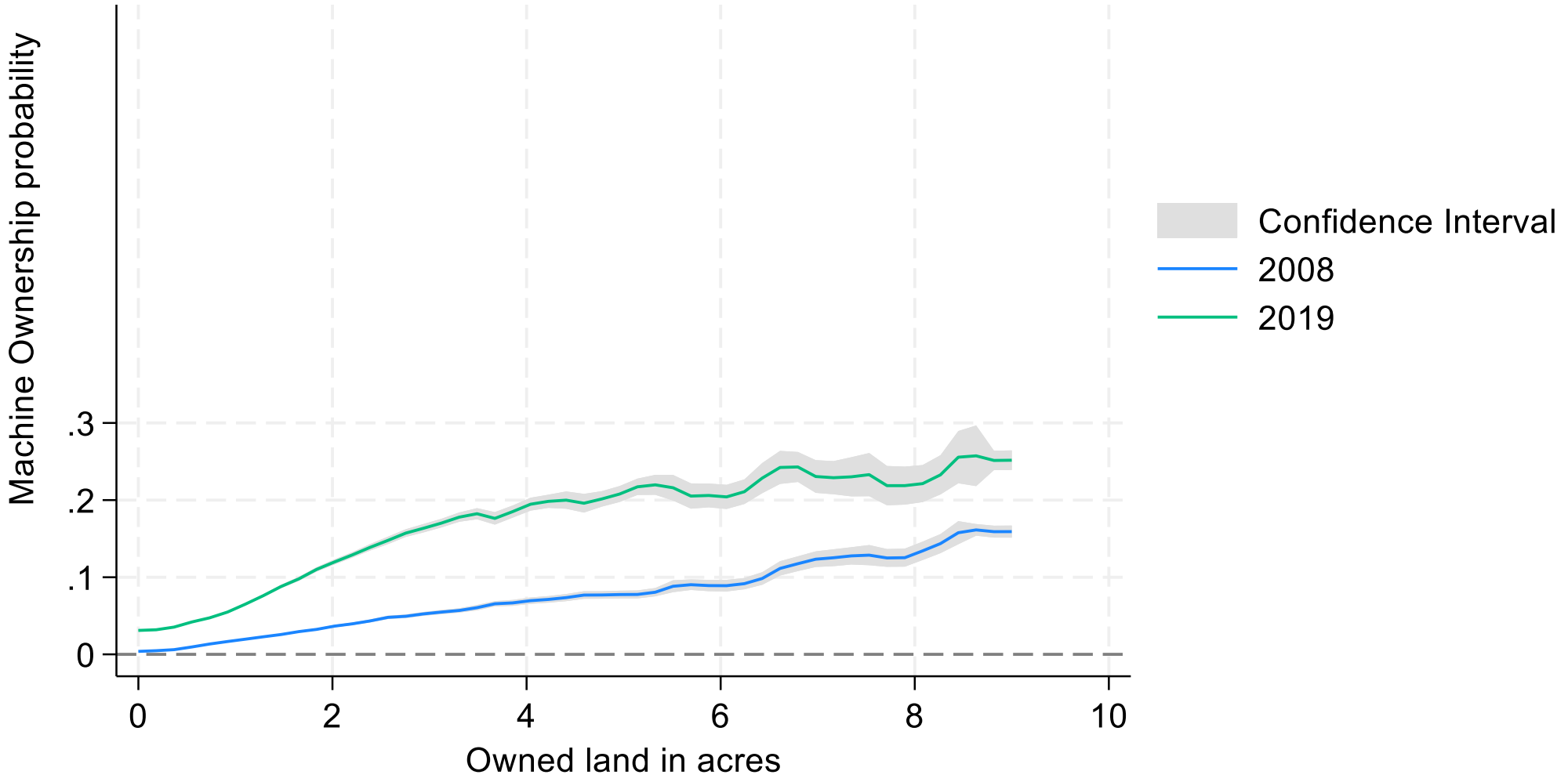
Machine ownership increased from 2008 and 2019, but from a very low base



Share of farmers owning machines by type of machine, 2008 and 2019 (%)

Source: Authors' calculation using Bangladesh Agriculture Census, 2008 and 2019.

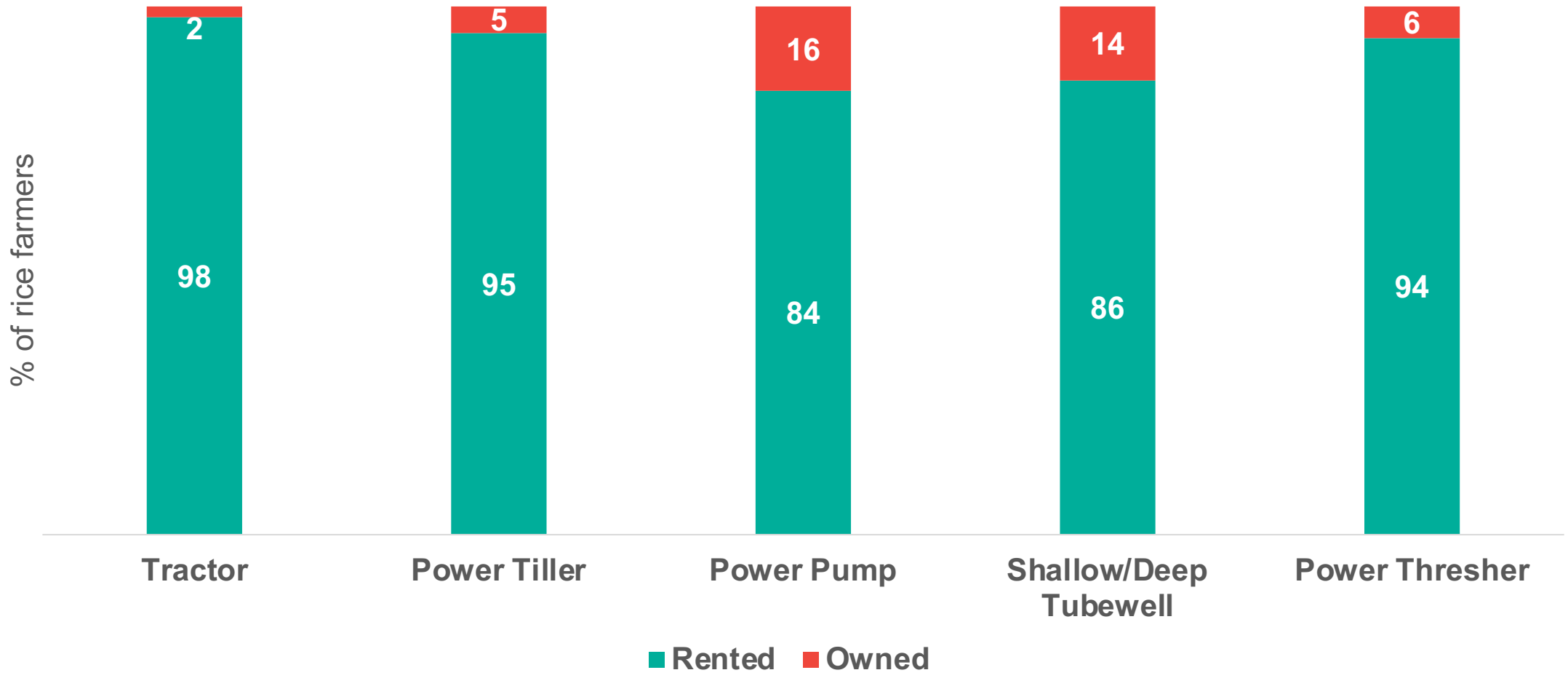
Ownership of agricultural machinery increased among smallholders, but remained concentrated among larger farms



Probability of machine ownership by size of landholding and year, 2008 and 2019

Source: Authors' calculation using Bangladesh Agriculture Census, 2008 and 2019.

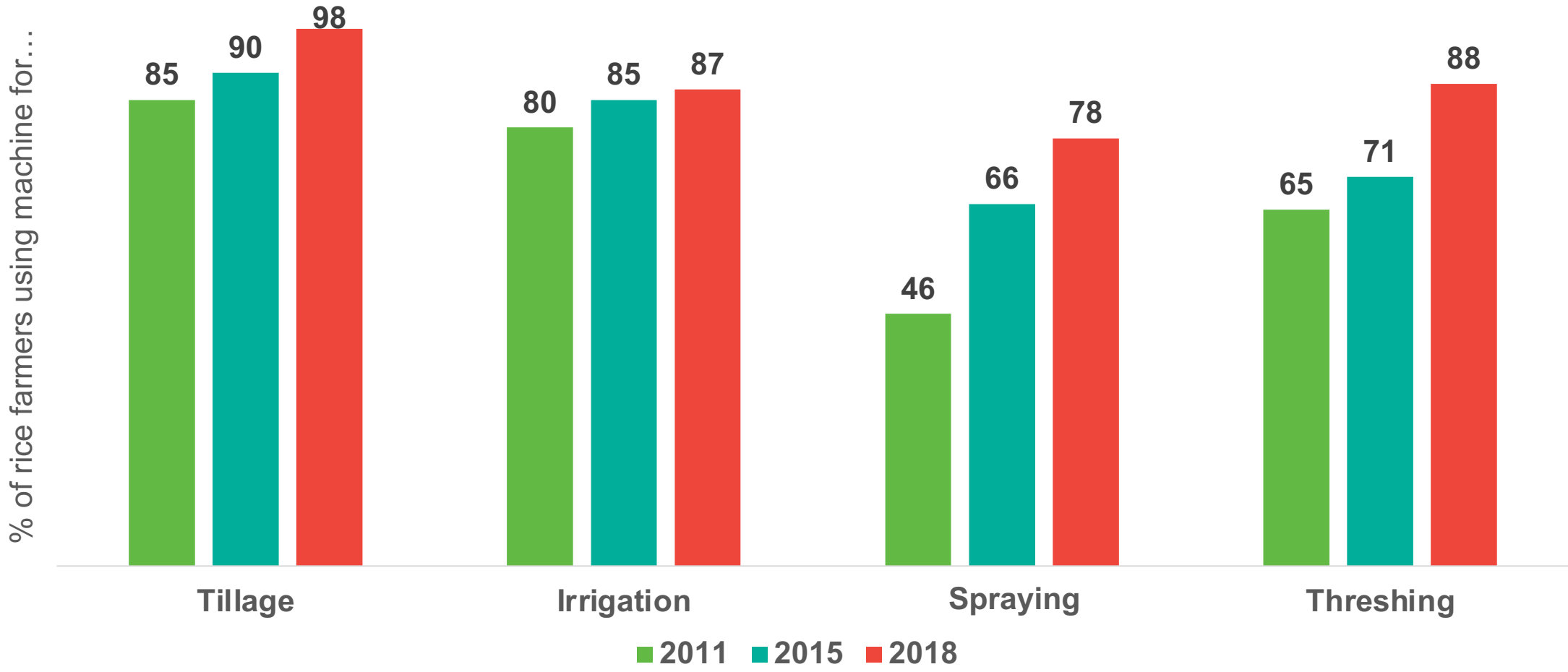
Most agricultural machines used by farmers are rented



% of rice farmers renting or owning machines by task, conditional on using

Source: IFPRI's Bangladesh Integrated Household Survey (BIHS), 2018/2019.

Land preparation, irrigation, spraying, threshing highly mechanized by 2018



% of rice farmers using agricultural machinery by task, 2011-2018

Source: IFPRI's Bangladesh Integrated Household Survey (BIHS), 2011/2012, 2015, 2018/2019.

Impacts of machine use, 2011-2018 (from regression analysis)

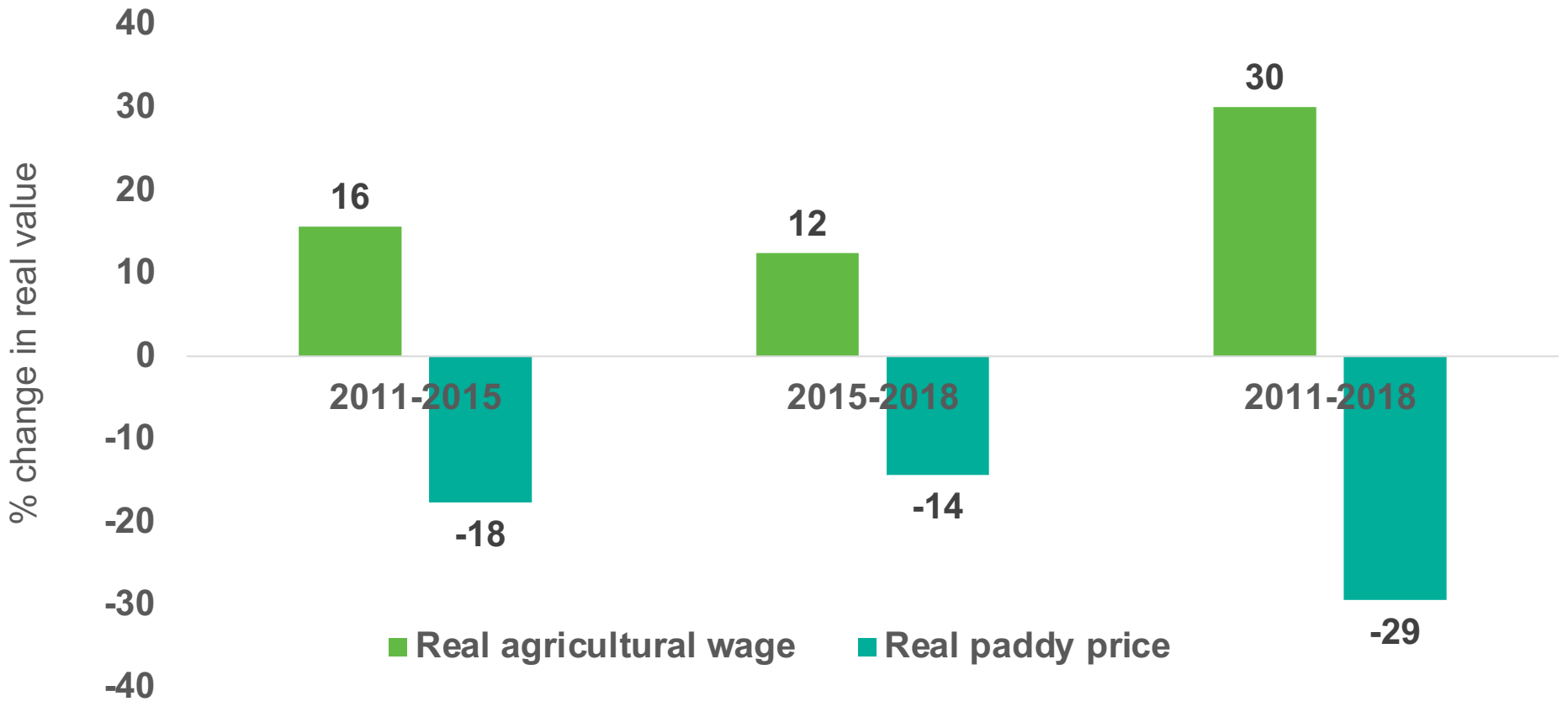
- **Threshing**
  - Small yield gain from threshing (reduced grain loss)
  - Labor saving from threshing
  - Small increase in labor productivity from threshing
  - No increase in profitability associated with threshing (rental costs may offset labor savings/yield increase)

- **Other machines**
  - No yield, labor, or profitability gains from mechanized land preparation over the survey period (as expected)
  - Major part of rationale using these machines appears to be convenience, speed, and avoiding drudgery

IFPRI

CGIAR

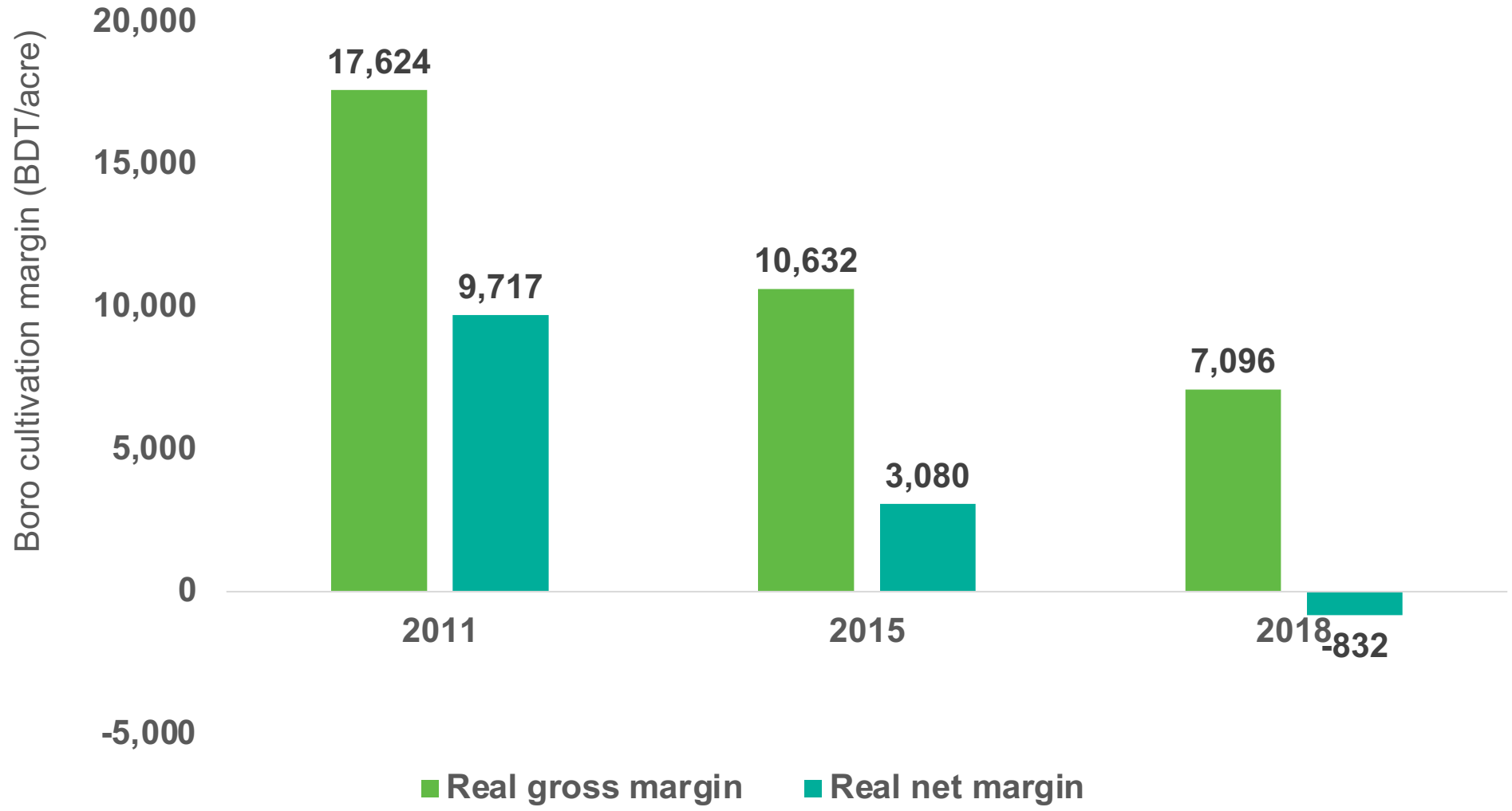
Wage rates and paddy prices moving in opposite directions



% change in real agricultural wage rates and paddy prices in boro season, (constant 2011 prices) 2011-2015, 2015-2018, 2011-2018

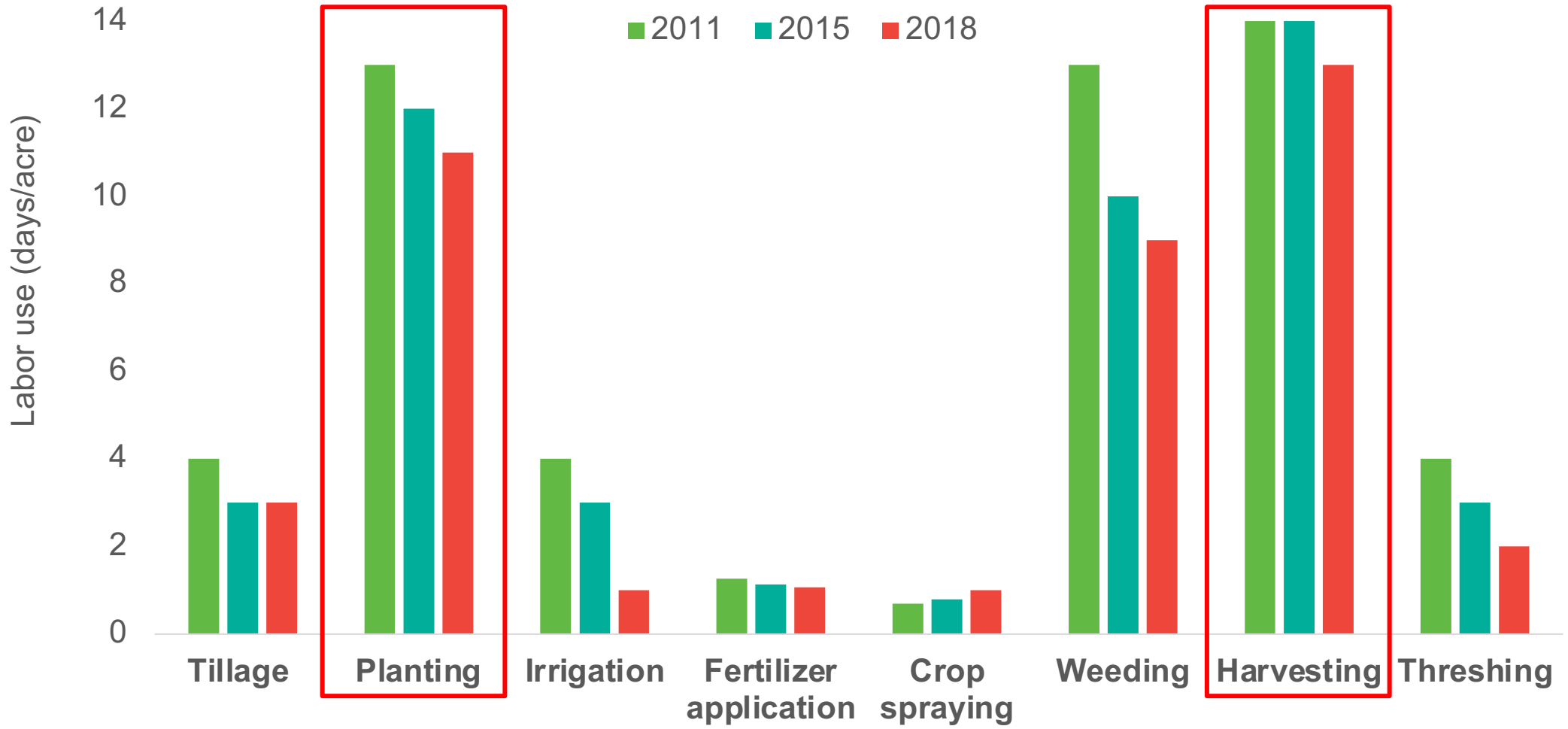
Source: IFPRI's Bangladesh Integrated Household Survey (BIHS), 2011/2012, 2015, 2018/2019.

Profitability of paddy cultivation is declining



Real gross margin and net margin for boro cultivation (constant 2011 prices), 2011-2018

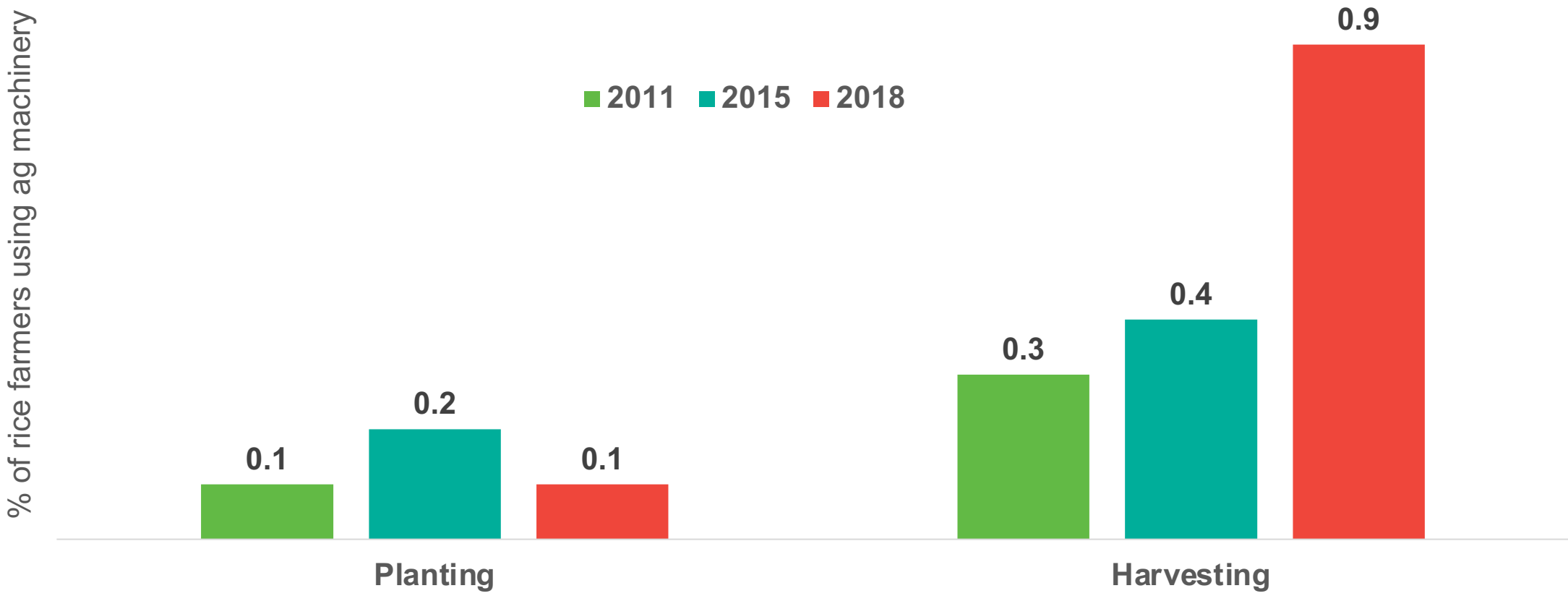
The most highly labor-intensive tasks are least mechanized



Total agricultural labor use by task, 2011-2018 (days/acre)

Source: IFPRI's Bangladesh Integrated Household Survey (BIHS), 2011/2012, 2015, 2018/2019.

Extremely low mechanization of planting and harvesting in 2018 *(before current phase of incentive program)*



% of rice farmers using agricultural machinery by task, 2011-2018

Source: IFPRI's Bangladesh Integrated Household Survey (BIHS), 2011/2012, 2015, 2018/2019.

Photo Credit: Cereal Systems Initiative for South Asia–Mechanization Extension Activity (CSISA–MEA)

Photo Credit: Md. Aminul Karim/IFPRI

Emerging Policy Considerations

- Rental market is key for smallholder access to agricultural machinery
- Large machines much more expensive than small machinery
- Banks hesitant to provide loans due to limited rural presence, lack of credit history, lack of understanding of rental service business viability.
- Importers and manufacturers have limited capacity to extend (or obtain) credit
- Current mechanization policy prohibits transfer of machine ownership
- No hire-purchase loans via banks (common in other countries)
- Challenges with spare parts, maintenance for sophisticated machines
- Few skilled operators, mechanics, little training

IFPRI

CGIAR

Knowledge gaps

- Extent of adoption of machines for planting and harvesting post-2018, following GoB push to mechanize
- Impacts of adoption of new machines (yields, profitability, labor allocation, **gender**, **climate**)
- Financial viability of rental service provision models for service providers, and barriers to effective operation.
- Efficacy of targeting incentives for machine purchases and scope for improvement
- Effective models for financing machine purchases and rentals

IFPRI

CGIAR

Conclusions

- Long run decline in profitability of farming due to tightening rural labor market and declining cereal prices (pre-2022)
- High levels of mechanization in irrigation, land preparation, and threshing; limited scope for productivity gains or cost savings
- Mechanizing harvesting and planting has potential to reduce labor constraints, improve productivity, free up labor, reduce costs
- Extent of adoption, impacts and constraints not yet well understood
- Focused research planned to inform policy choices that enable accelerated adoption

IFPRI

CGIAR

Thank You

IFPRI

CGIAR