FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

The continuous rise in the adoption of labor-saving agricultural technologies in Asia: Evidence from Myanmar

Bart Minten

November 18

APAP, Bangkok

Photo Credit: SOMRERK WITTHAYANANT/Shutterstock

USAID FROM THE AMERICAN PEOPLE

IFPRI MYANMAR

MICHIGAN STATE UNIVERSITY

INTRODUCTION

- Agri-food systems rapidly transforming, driven by population growth, urbanization, policy reform, and improved road and communication infrastructure

- Farm sector reforming accordingly:

1/ Increasing spread of improved and yield-increasing technologies

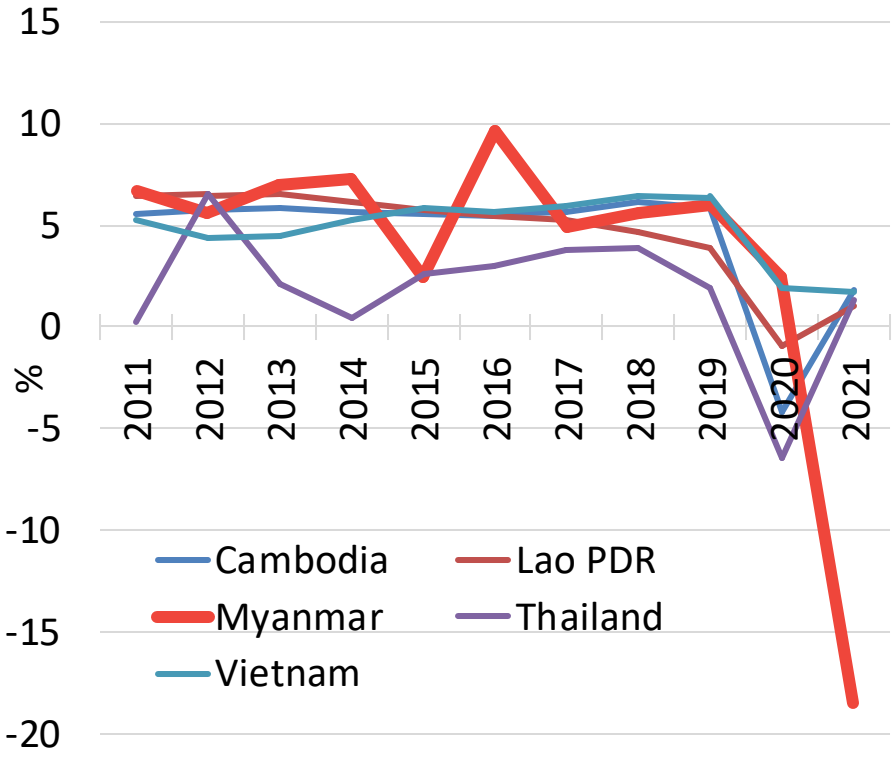
2/ The rise in adoption of labor-saving agricultural technologies

- Look at changes in the adoption of agricultural technologies in Myanmar over the last ten years

BACKGROUND

- **Economic boom:**

In the beginning of the 2010s, economic policy reform program (relaxation import restrictions, reform banking, migration, FDI, relaxation cropping controls) - Myanmar's economy 50% bigger in 2020 compared to 2011

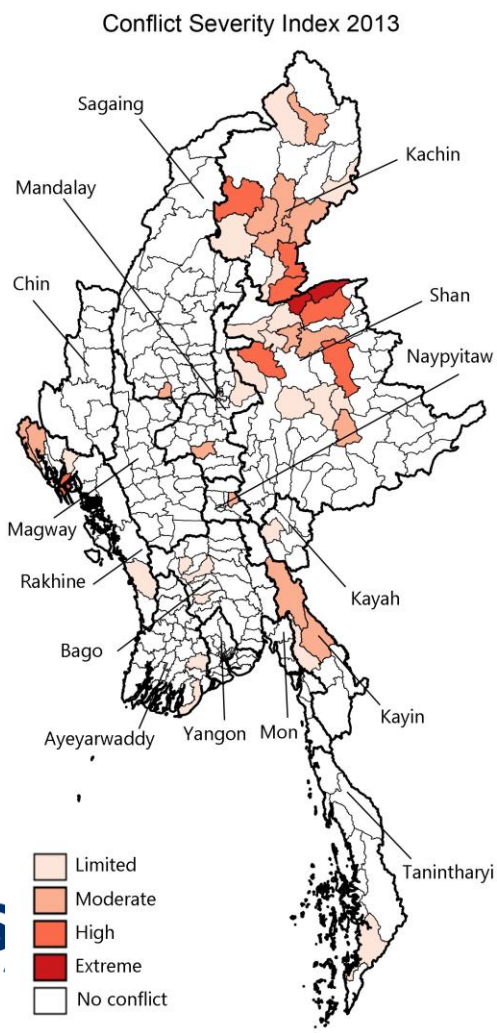


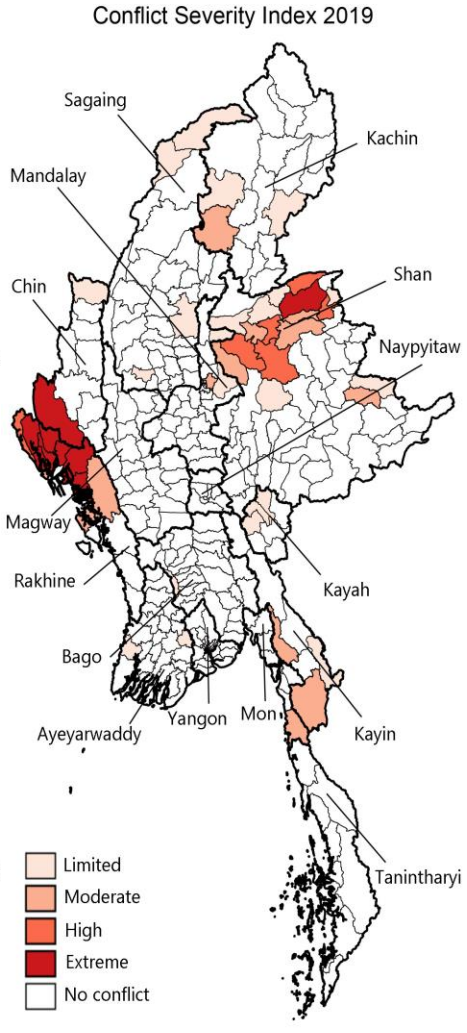
- **Economic bust and crisis**

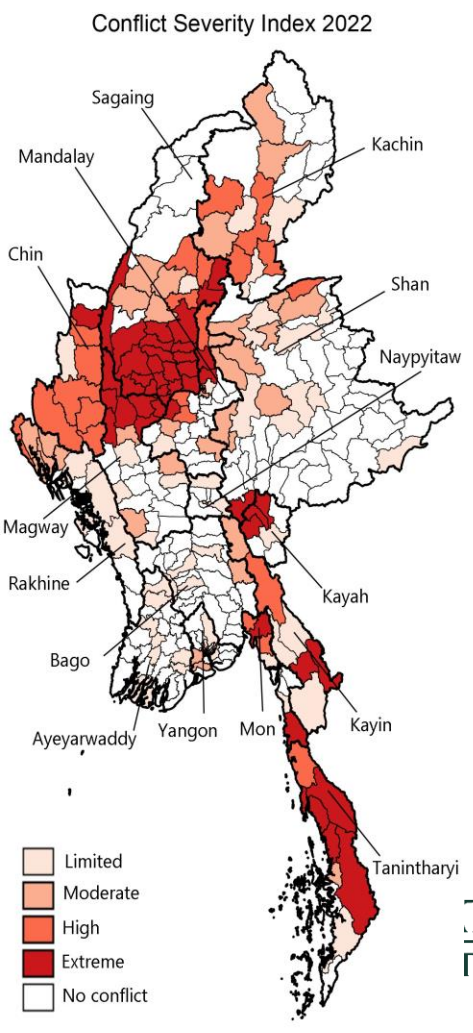
COVID-19, coup, upheaval and conflict: Myanmar's GDP in 2022 13% smaller than in 2019

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

"THE BURMESE CIVIL WAR IS THE LONGEST-RUNNING ARMED CONFLICT IN THE WORLD… IN A WAY BURMA IS A PLACE WHERE THE SECOND WORLD WAR NEVER REALLY STOPPED"
THANT MYINT U







FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

DATA

- Myanmar Agricultural Performance Survey:

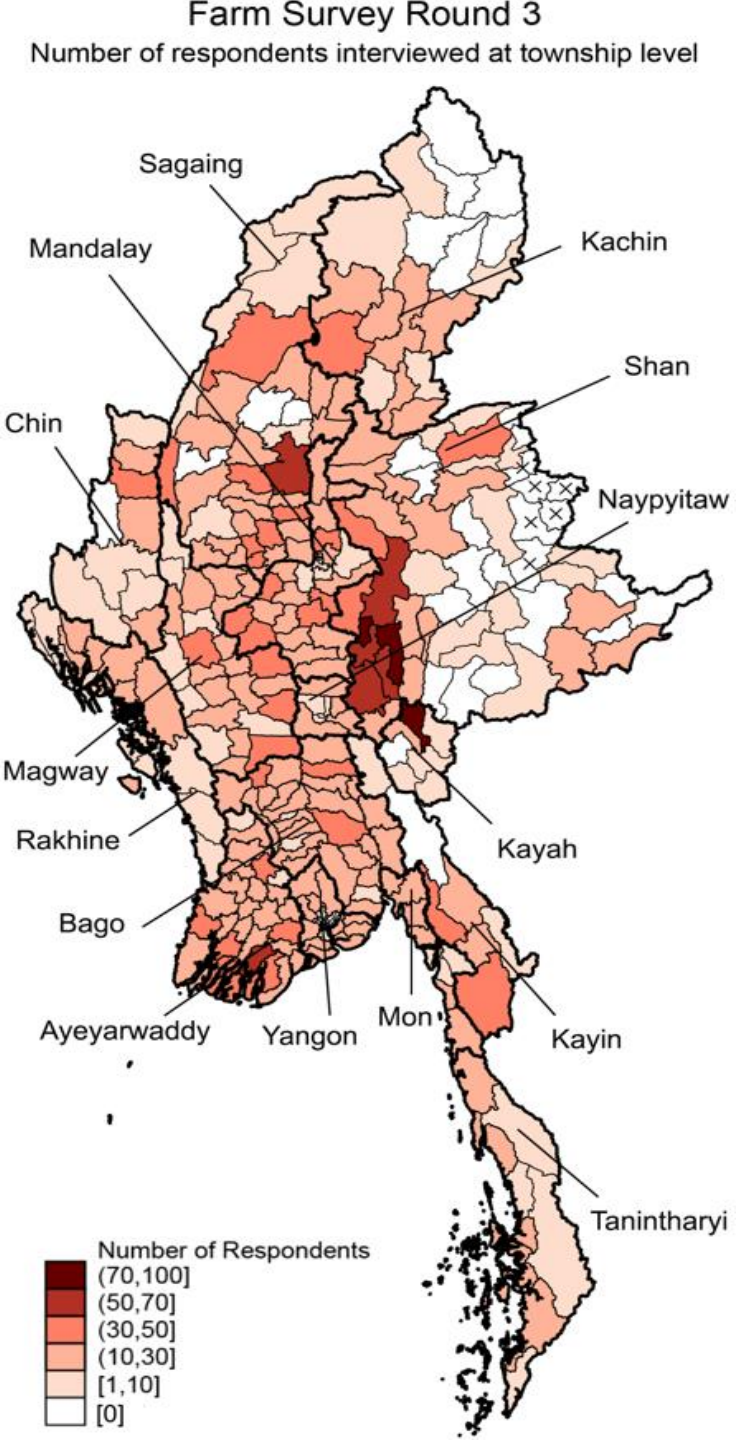
- 4,961 crop farmers
- January 23rd - February 22nd, 2023
- Monsoon season

- Average size farm: 5.6 acres
- Share of farmers cultivating

1/ rice: 60%
2/ pulses: 11%
3/ maize: 10%

- Focus on recall data:

1/ 2013: opening economy
2/ 2019: before crisis
3/ 2022: last monsoon



USAID FROM THE AMERICAN PEOPLE

IFPRI MYANMAR

LABOR-SAVING AGRICULTURAL TECHNOLOGIES

Transplanting of rice

- 30 people/day/ha
- use rice seedlings grown in nursery, replanted after 15 – 45 days
- ensuring higher rice yields through uniform plant stands and better weed control

Direct seeding
Row planting

LABOR-SAVING AGRICULTURAL TECHNOLOGIES

Herbicides

- Rapidly taking off globally
- patent expiration
- cheap generic products
- complementarity to changing agricultural management techniques
- increased labor costs
- *Glyphosate* (First registered in “Roundup”)
- applied before crop emergence
- non-selective
- *Selective herbicides*

USAID
FROM THE AMERICAN PEOPLE

LABOR-SAVING AGRICULTURAL TECHNOLOGIES

Mechanization

- Machines mostly imported from China

1. Plowing

- 2- or 3-wheel tractors
- 4-wheel tractors, typically done by service providers

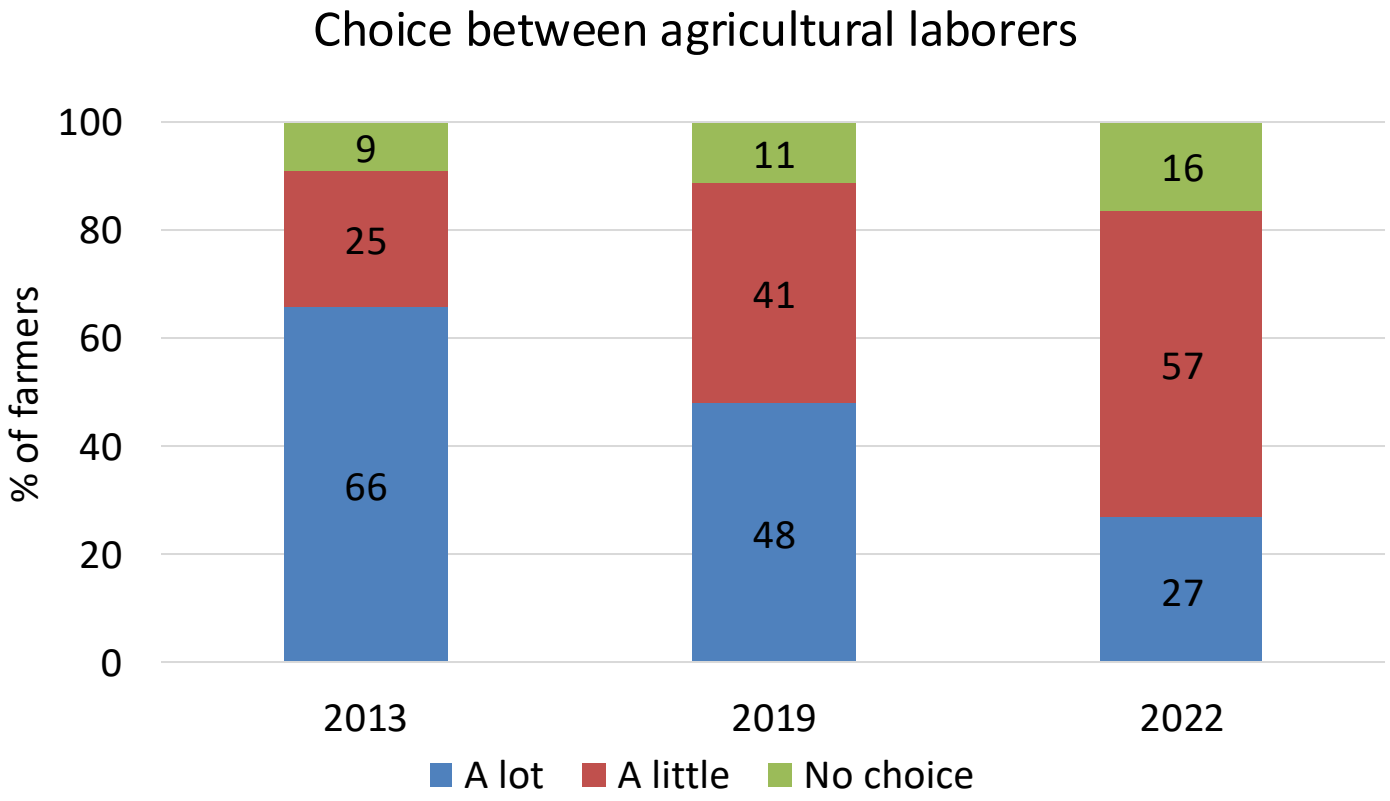
2. Combine-harvesters

- typically done by service providers

PROBLEMS IN INPUT MARKETS (MONSOON 2023)

	Unit	Agricultural labor	Pesticides/ herbicides	Mechanization
Financial difficulties to purchase inputs	%	3.9	4.7	6.5
Inputs have become more expensive	%	4.9	5.4	5.9
Cannot find enough of the inputs - inputs not available	%	14.2	1.8	3.2
Required to pay in cash, instead of on credit	%	0.6	0.2	0.4
Difficulty to travel to purchase inputs/high transportation costs	%	10.0	1.7	10.3
No difficulties	%	58.2	52.9	52.4

TIGHTENING OF AGRICULTURAL LABOR MARKETS



ADOPTION LABOR-SAVING TECHNOLOGIES

	2013	2019	2022	Significance of change	
				2019 vs 2013	2022 vs 2019
Seeding methods (%)					
Transplanting	63.5	46.1	40.1	***	***
Broadcasting	23.3	38.3	43.4	***	***
Row planting	7.5	9.0	9.9	*	n.s.
Combination	5.8	6.6	6.6	n.s.	n.s.
Herbicide use (%)					
Glyphosate	2.6	21.7	23.0	***	n.s.
Selective herbicides	6.5	41.0	45.3	***	***
Mechanization on most rice plots (%)					
Tractor used	39.2	77.7	83.1	***	***
Combine-harvester used	10.2	45.0	51.1	***	***
Asterisks show significant differences at p-values: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; n.s.: not significant					

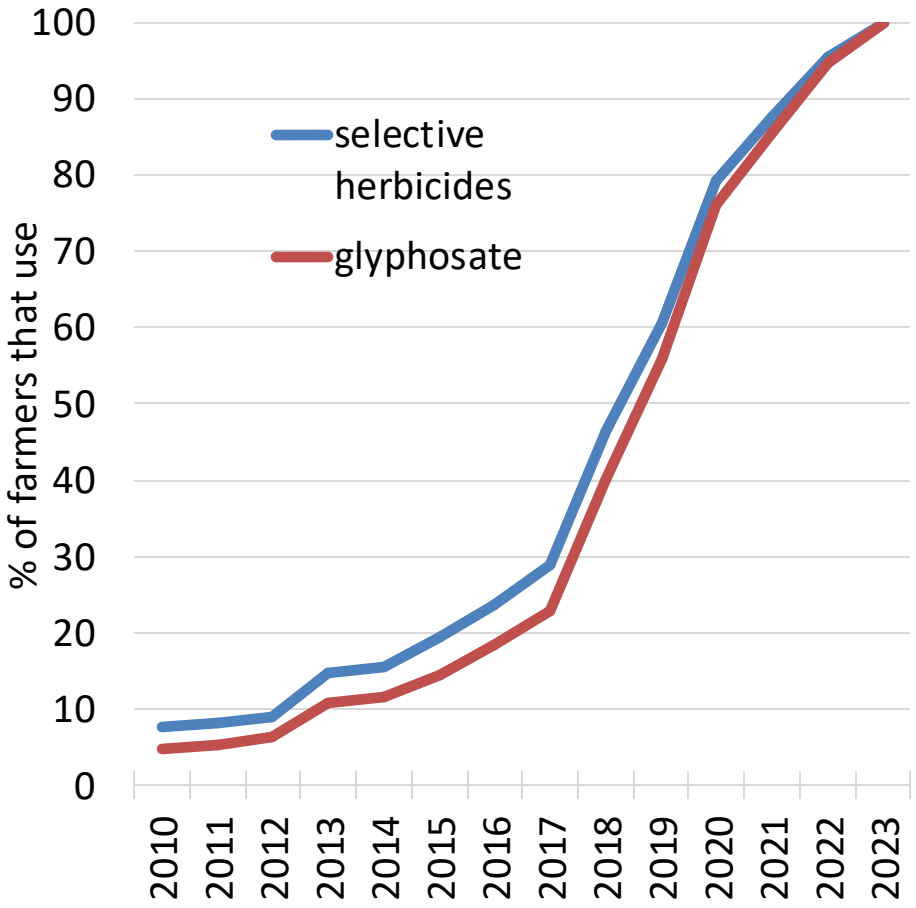
HERBICIDES

YEAR THAT FARMERS STARTED USING HERBICIDES (FOR USERS)

- 50% of farmers only started using herbicides in 2018/19; further uptake in crisis years

- Adoption possibly linked to direct seeding methods

- Direct seeding requires non-flooded conditions, allow more weeds to germinate, making weed management bottleneck



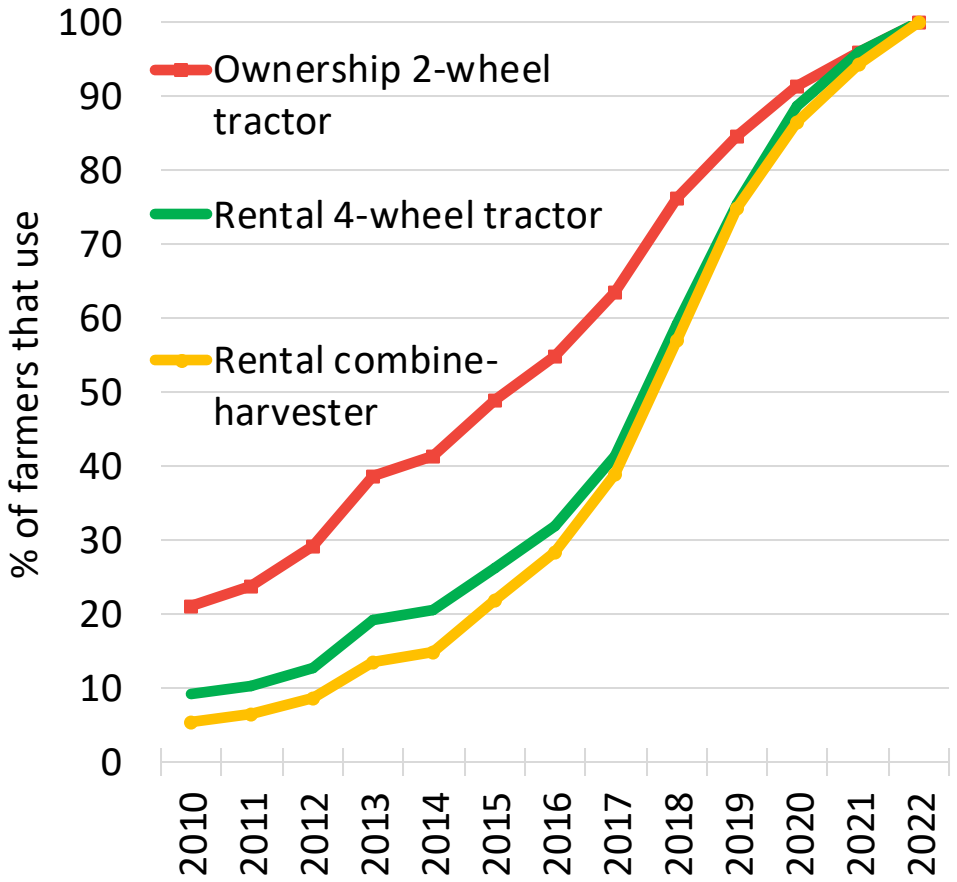
MECHANIZATION

YEAR THAT FARMERS STARTED USING MECHANIZATION (FOR USERS)

- Ownership and use low in 2010

- Ownership of 2-wheel tractors gradual

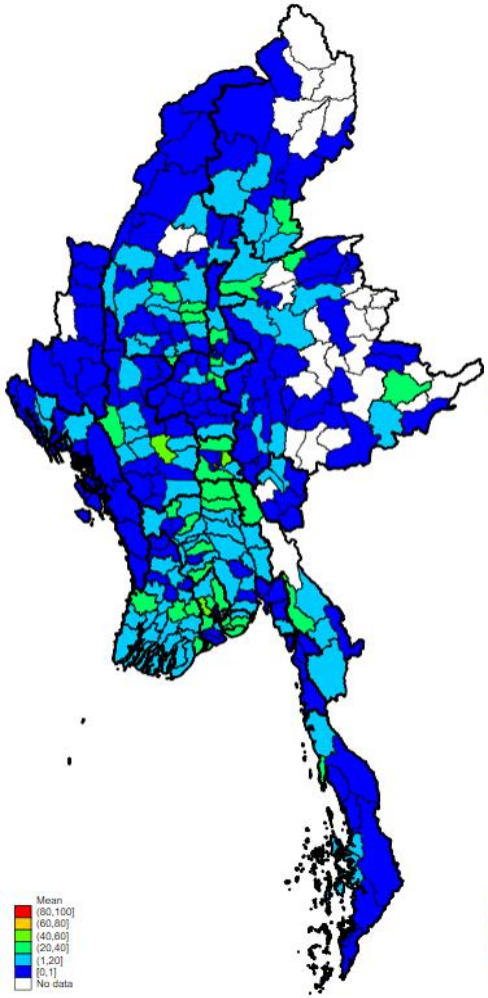
- Use of rental services more recent phenomenon:
  a. 43 % started doing only since 2018
  b. 13% started since the crisis started



MECHANIZATION – COMBINE-HARVESTERS

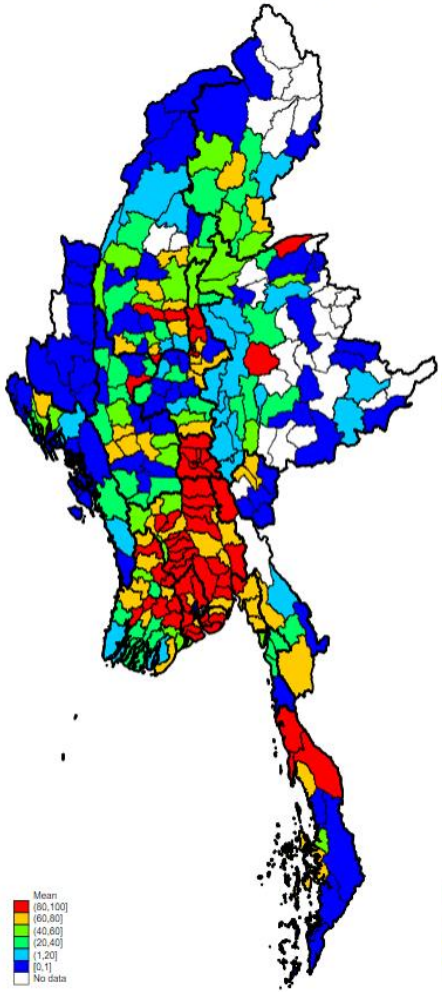
2013

Combine Harvester Usage 10 years ago



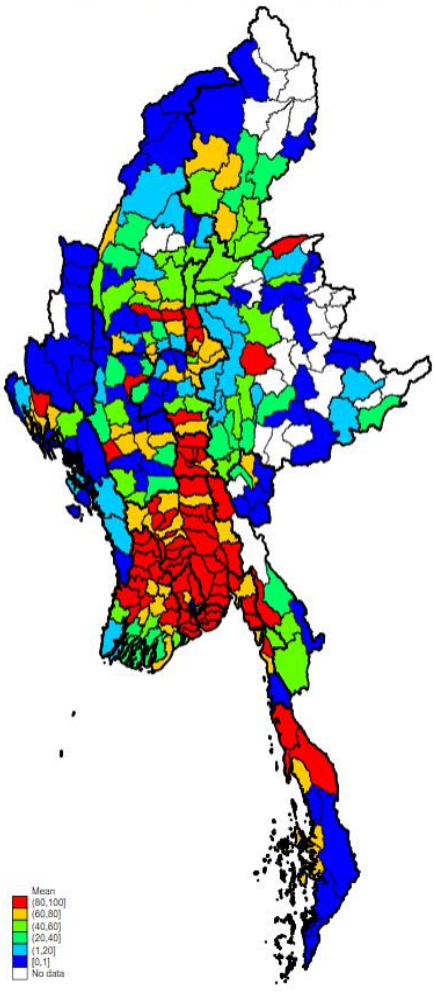
2019

Combine Harvester Usage 3 years ago



2022

Current Combine Harvester Usage



METHOD

$$A_{hrt} = \alpha_h + \sum_{t=1}^{n} \beta_t Y_t + \gamma\, CSI_{rt} + \sum_{t=1}^{n} \delta_t [\, Y_t * R_h] + \varepsilon_{hrt}$$

- variable A_{hrt} - adoption of an agricultural technology by household *h* at time *t* in area *r*
- α_h - household fixed effect
- Y_t - yearly dummies
- CSI_{rt} - conflict severity index
- R_h - vector measuring remoteness of the farmer and the size of the farm
- ε_{hrt} - error term

HETEROGENOUS EFFECTS

- Linear probability model

- Very insecure areas less likely to adopt

- 4-wheel tractors and combine-harvesters (mostly hired):
1. Small farms less likely to adopt
2. Remote farmers less likely to adopt

		Any tractor for plowing		4-wheel tractor		Combine-harvester	
	Unit	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Year 2019	yes=1	**0.410**	**23.09**	**0.364**	**21.23**	**0.528**	**29.91**
Year 2022	yes=1	**0.467**	**24.56**	**0.439**	**23.09**	**0.623**	**33.20**
CSI group 1 (Moderately insecure)	yes=1	-0.025	-1.85	**-0.034**	**-2.66**	-0.023	-1.74
CSI group 2 (Very insecure)	yes=1	**-0.042**	**-2.77**	**-0.034**	**-2.31**	**-0.043**	**-2.84**
Interactions size of farm							
Year 2019*small farm	yes=1	-0.022	-1.13	**-0.068**	**-3.92**	**-0.101**	**-5.45**
Year 2022*small farm	yes=1	-0.010	-0.50	**-0.042**	**-2.21**	**-0.117**	**-5.96**
Interactions remoteness township to city							
Year 2019*remoteness city	yes=1	0.003	0.16	**-0.054**	**-3.12**	**-0.102**	**-5.53**
Year 2022*remoteness city	yes=1	0.029	1.48	**-0.050**	**-2.61**	**-0.094**	**-4.88**
Interactions remoteness within township							
Year 2019*remoteness in township	yes=1	-0.025	-1.29	**-0.099**	**-5.76**	**-0.094**	**-5.09**
Year 2022*remoteness in township	yes=1	-0.029	-1.46	**-0.108**	**-5.76**	**-0.110**	**-5.70**
Intercept		0.405	64.11	0.119	20.30	0.105	16.96
Household fixed effects		yes		yes		yes	

USAID FROM THE AMERICAN PEOPLE

CONCLUSIONS

1. Availability of technologies and increased labor scarcity leading to rapid changes in adoption of labor-saving agricultural technologies in Myanmar

2. Increase in adopting farmers over 10 years: tractors for plowing +43%, combine-harvesters: +41%, herbicides: +39%, direct seeding: +20%

3. Trends continued over crisis years

4. Remote and conflict-affected smallholders lower adoption - lowest agricultural labor productivity increases, with important implications for their welfare

5. Importance of labor markets as driver of change in agriculture

IMPLICATIONS

1. Role of private sector in ensuring resilience in ag. input sector

2. Increasing demand for mechanization – need for training of skilled people, repair of machinery, as well as better machinery

3. Increased use of agro-chemicals, possibly having environmental and health effects – good regulatory framework and enforcement needed

4. Direct seeding leading to lower yields – need for integrated crop management techniques and improved weed management

5. Need to collect data in household surveys beyond land-increasing technologies