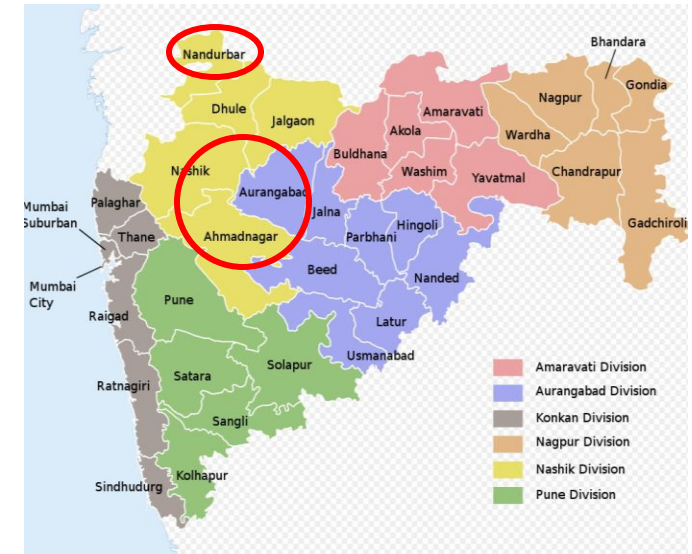# Contribution of Nature based Solutions (NbS) to Food Security
Evidence from India and Vietnam
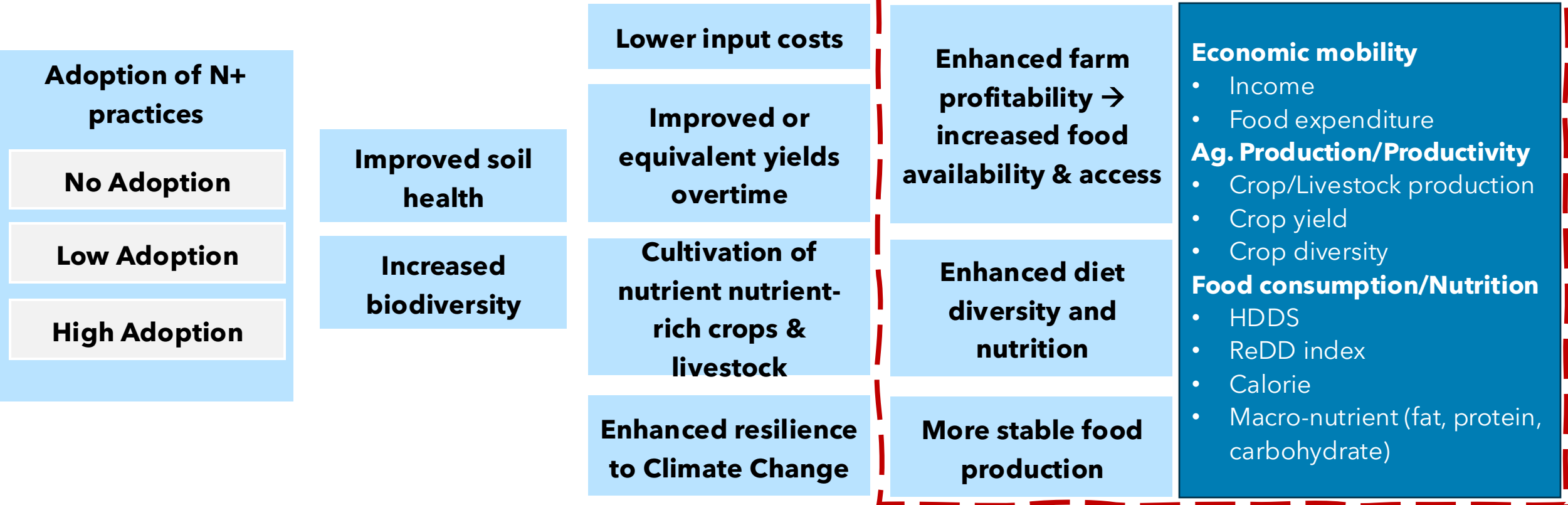
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IFPRI

Survey design & sample composition

- **CGIAR initiative on Nature-Positive Solutions** aims to re-imagine, collaboratively create and implement nature-positive solutions for agrifood systems that equitably support food and livelihoods and ensure that agriculture is a net positive contributor to biodiversity and nature

- **India**
  - Selection of the final sample was supported by our local counterpart, which provided list of beneficiaries and control HHs + KIIs
  - Data collection: March 2023
  - Sample size: 1,227 hhs in 27 communities (312 in 9 - Kalsubai-, 317 in 8 –Igatpuri-, and 596 in 8 -Shahada-)

- **Vietnam**
  - Coverage: Sapa and Mai Son districts
  - Treated: random sampling of households in the 8 identified treated villages
  - Control: random selection through two-stage sampling within communities similar to treated villages by agroecological zones
 - Sample size: 1,153 HH

Intensity of adoption of NbS and food security: conceptual framework

Food Security

Variables collected in the surveys

Adoption of N+ practices

No Adoption

Low Adoption

High Adoption

Improved soil health

Increased biodiversity

Lower input costs

Improved or equivalent yields overtime

Cultivation of nutrient nutrient-rich crops & livestock

Enhanced resilience to Climate Change

Enhanced farm profitability → increased food availability & access

Enhanced diet diversity and nutrition

More stable food production

Economic mobility
- Income
- Food expenditure

Ag. Production/Productivity
- Crop/Livestock production
- Crop yield
- Crop diversity

Food consumption/Nutrition
- HDDS
- ReDD index
- Calorie
- Macro-nutrient (fat, protein, carbohydrate)

In the areas surveyed in India, cultural norms favoring vegetarianism lead to under-reporting of meat&fish consumption, hence to ensure cross-country comparability, all food indices exclude meat&fish
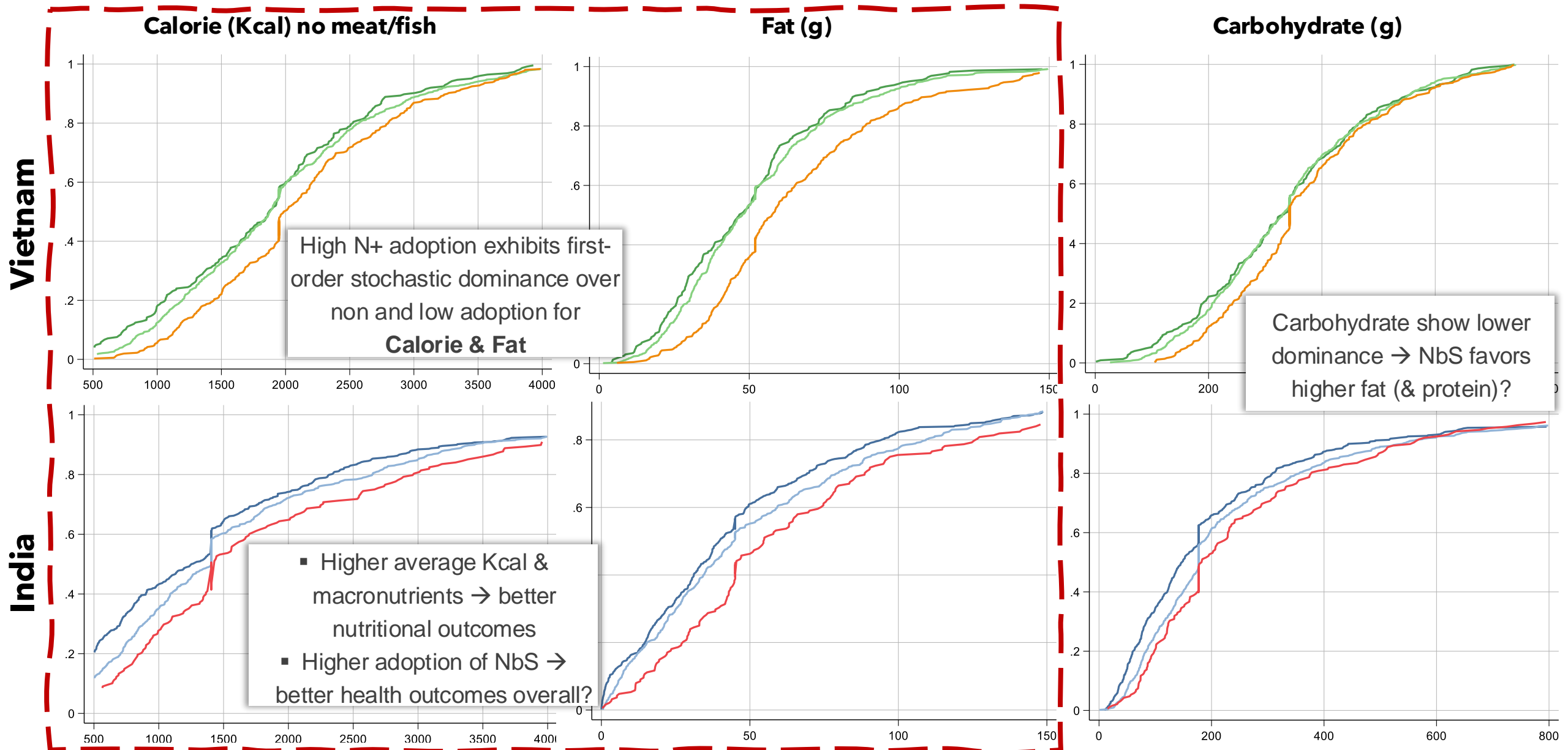
Adoption of NbS
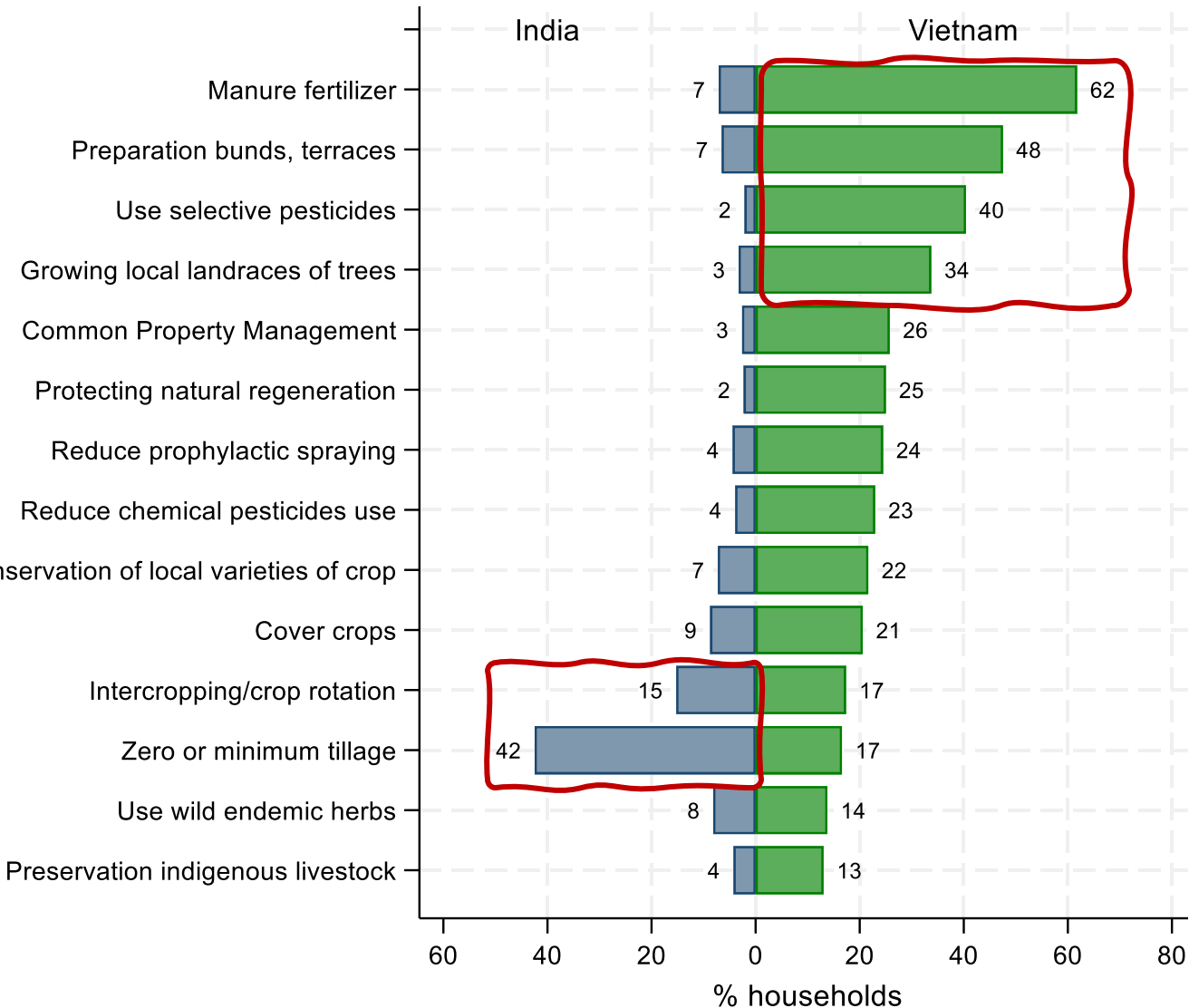
- The survey listed up to 48 Nature Based Solutions (NbS), depending on the country
- HH practice 4.9 NbS on average in Vietnam, vs 1.4 in India
- Adoption Intensity:
    - Non-Adopter: Reported practicing 0 NbS
    - Low: 1-5 practices in Vietnam, 1-2 in India
    - High: >=5 practices in Vietnam, >=3 in India
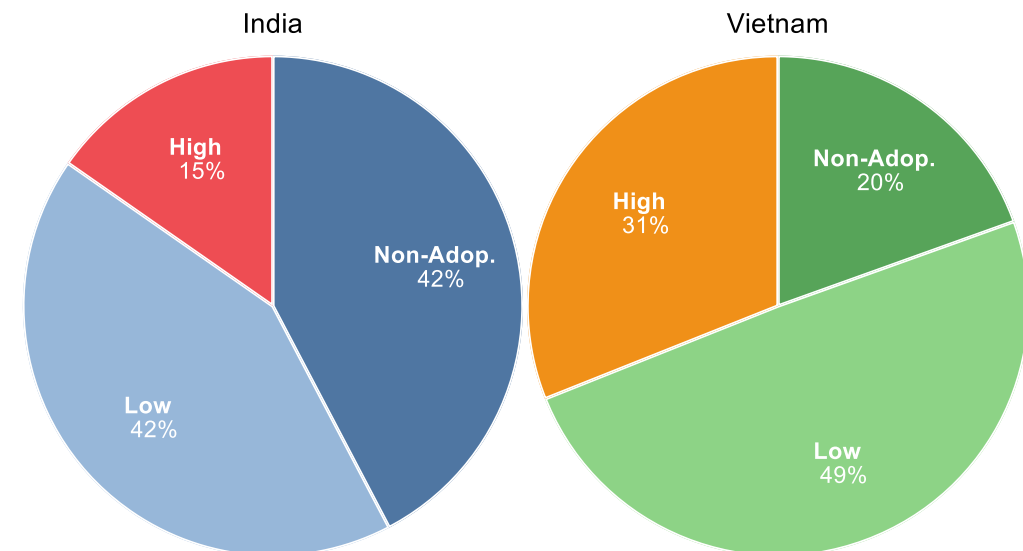
Descriptive statistics: Energy (per capita daily consumption)

Calorie (Kcal) no meat/fish   **Fat (g)**   **Carbohydrate (g)**

Vietnam

High N+ adoption exhibits first-order stochastic dominance over non and low adoption for **Calorie & Fat**

Carbohydrate show lower dominance → NbS favors higher fat (& protein)?

India

- Higher average Kcal & macronutrients → better nutritional outcomes
- Higher adoption of NbS → better health outcomes overall?

Descriptive statistics: Dietary Diversity (excluding meat/fish)

HDDS

ReDD index

Vietnam

India
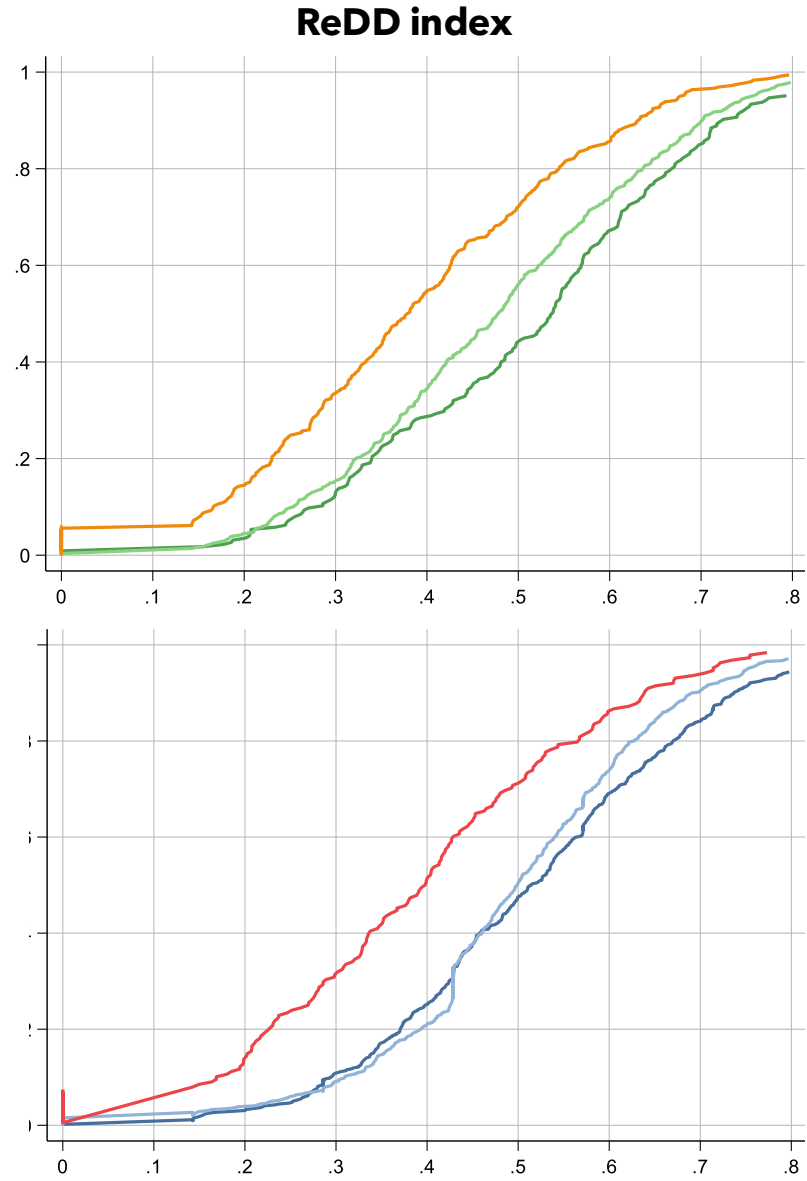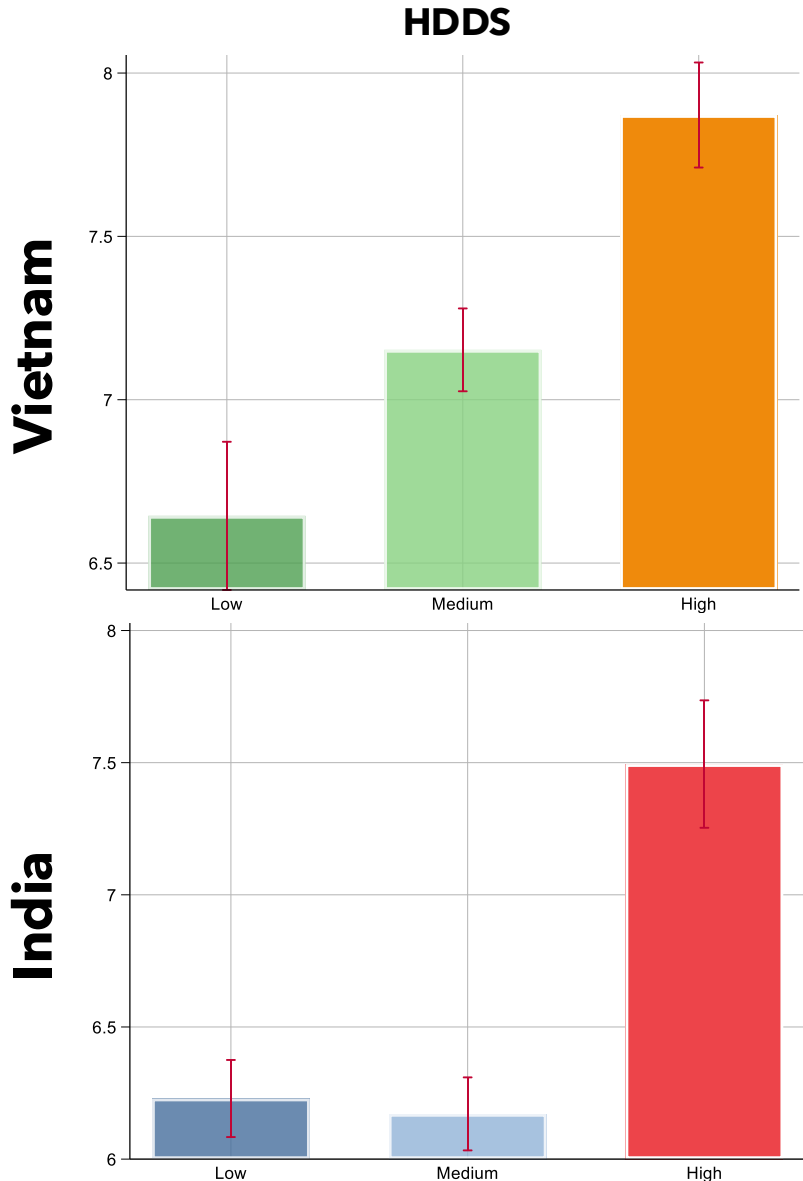
- Beyond energy (Kcal), NbS adoption intensity is positively associated with a diverse diet (HDDS) and negatively with diet deprivation (ReDD)

  - HDDS (Household Dietary Diversity Score): count of food groups that a household has consumed over the past 7 days

  - ReDD (Reference Diet Deprivation) index: incidence, breadth, and depth of diet deprivation across multiple food groups

Productivity trade-offs
Vietnam

Rice Yield (Ton/HA)

— Non-adopters   — Low adoption   — High adoption
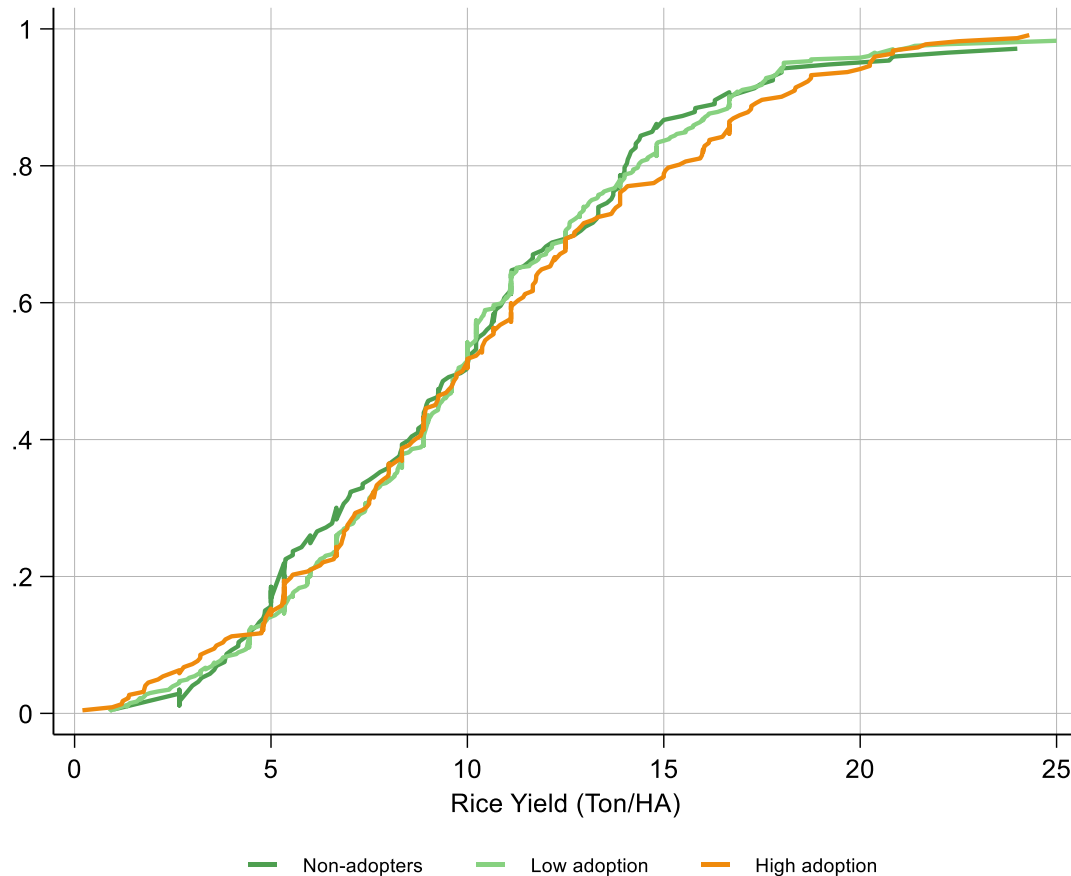
- Lack of difference in yield: NbS solutions can support productivity without necessarily relying on environmentally unsustainable inputs?

- 83% of the sample reported using NbS for more than 5 years

Results

- Model 1: multivariate regression $Y_{hc} = \alpha + \beta_1 Adoption\ Intensity_{hc} + \beta_2 \boldsymbol{X} + \boldsymbol{\delta} + \varepsilon_{hc}$

Where h and c are indices for household and country (Vietnam and India); Y represents the nutrition and food security outcomes of interest; and X is a vector of household-level covariates. δ is an indicator for each country

- Model 2: multivalued treatment effect (*ipw* regression adjustment estimator)
  - (1) Treatment model: $\Pr(T = i) = g(\boldsymbol{X}; \boldsymbol{\theta}) + \varphi;\ \ i = 0,1,2$
  - (2) Outcome model: $y = f(\boldsymbol{Z}; \boldsymbol{\beta}) + \varepsilon$

where $g(\cdot)$ and $f(\cdot)$ are assumed functional forms; $\boldsymbol{Z}$ is a vector of covariates affecting y (and whose elements may overlap with those of X); $\boldsymbol{\beta}$ and $\boldsymbol{\theta}$ are vectors of unknown parameters; φ is selection model error term assumed to have a normal distribution; ε is outcome model error assumed to be independent and identically distributed (i.i.d.)

	Vietnam				India				Pooled			
	Log Calorie	Log Fat	Log Carb	ReDD index	Log Calorie	Log Fat	Log Carb	ReDD index	Log Calorie	Log Fat	Log Carb	ReDD index
MODEL 1												
Adoption type (Base=Non adopters)												
Low Adoption	0.05	0.06	0.02	-0.03*	0.11*	0.09	0.17***	-0.02*	0.08**	0.08	0.10**	-0.02**
	(0.044)	(0.052)	(0.047)	(0.014)	(0.058)	(0.094)	(0.061)	(0.012)	(0.038)	(0.057)	(0.040)	(0.009)
High Adoption	0.10**	0.19***	0.07	-0.08***	0.28***	0.42***	0.27***	-0.10***	0.17***	0.28***	0.16***	-0.09***
	(0.041)	(0.048)	(0.043)	(0.014)	(0.075)	(0.108)	(0.080)	(0.017)	(0.037)	(0.052)	(0.039)	(0.010)
MODEL 2												
Adoption type (Base=Non adopters)												
Low Adoption	0.05	0.09*	0.01	-0.03*	0.10*	0.08	0.16***	-0.02*	0.05	0.06	0.06	-0.02*
	(0.043)	(0.048)	(0.046)	(0.014)	(0.058)	(0.093)	(0.061)	(0.012)	(0.035)	(0.050)	(0.037)	(0.010)
High Adoption	0.10***	0.22***	0.07	-0.08***	0.20**	0.32***	0.21**	-0.08***	0.14***	0.25***	0.11**	-0.08***
	(0.039)	(0.044)	(0.041)	(0.013)	(0.077)	(0.108)	(0.087)	(0.016)	(0.040)	(0.053)	(0.045)	(0.011)
Observations	1,073	1,073	1,073	1,073	816	816	816	817	1,889	1,889	1,889	1,890

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Covariates include place of residence, household composition variables, education of the head, number of tropical livestock units (TLU) owned, area of parcels cultivated in hectare, and wealth index

Conclusions

- **Adoption of NbS practices is positively associated with several outcomes related to food security:**

    - Adoption positively correlated with energy/Kcal and macronutrients

    - Multivariate regression & MVTE confirm significant positive correlation between adoption and calorie + macronutrients

    - More research is needed to disentangle attribution of NbS to food security and nutrition

- Data available on IFPRI Dataverse (open access)

    - Vietnam (India coming soon): https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/PZVGOH

Thank you!