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EGU General Assembly

How seasonal flooding affects diets in Bangladesh during a nutrition-sensitive agriculture intervention.

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Background

Existing gap in quantifying flood impacts on diets

Background

Climate change is expected to **increase** the frequency and severity of **flooding events** (IPCC, 2021)

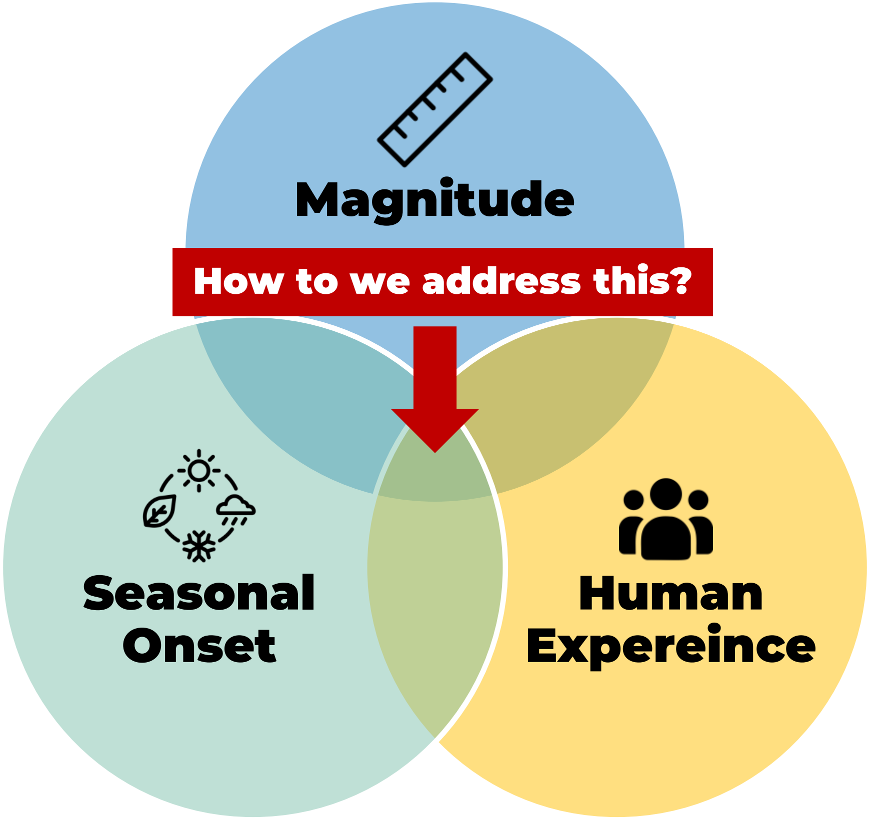
Monsoon flooding is necessary for agriculture but can be detrimental to diets if it **diverges** from expected **seasonal patterns** (Zhong, 2018)

Homestead Food Production (**HFP**) can improve diets (Bird, 2019), but there is **limited research** on it's role in mitigating flood impacts

Data Deficit & Methodological Gap

Satellite data

- No human experience
+ Open source
+ Global coverage
+ High frequency & spatial resolution



Survey data

+ Detailed human experience
- Expensive & time consuming
- Limited coverage
- Low frequency & spatial resolutions

* Standard flood differencing techniques only apply to single events

Aims

1) Innovate a **method for extracting water extents as a time** series, to better link with health outcomes

2) Establish the relationship between **flood patterns and women's diets, across seasons**

3) Further assess the impacts of a **Homestead Food production (HFP)** intervention on this relationship

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Methodology

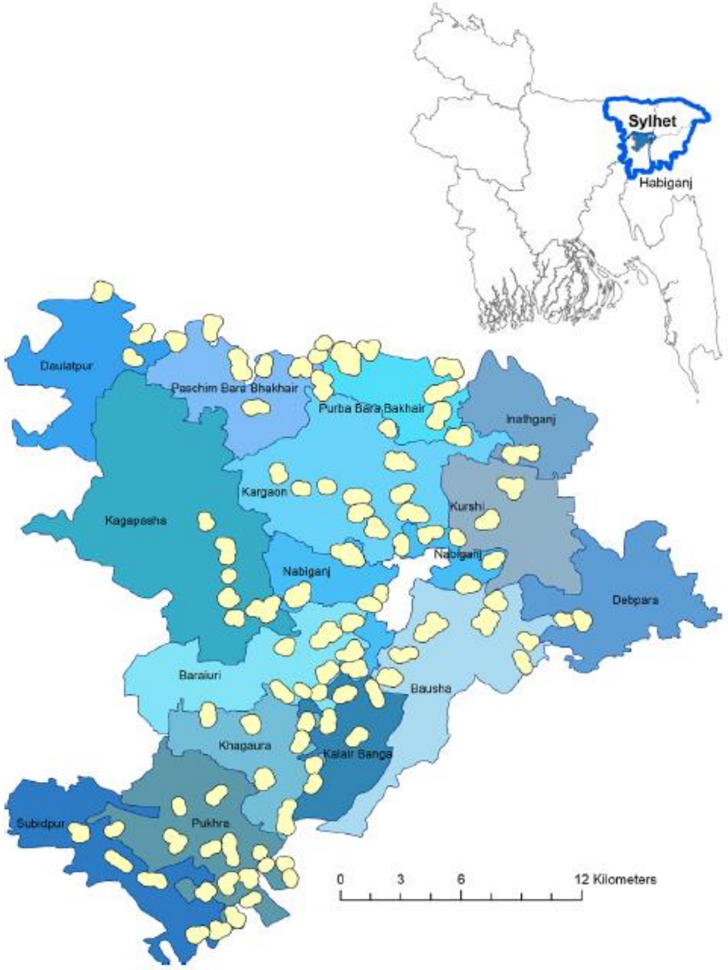
Study area, flood time series method & statistical analysis used

Study Area

- Food and Agricultural Approaches to Reducing Malnutrition (FAARM) Trial
- 2015-2019 Homestead food production (HFP) intervention on **horticulture, poultry, nutrition** including ~2700 women across 96 clusters
- Baseline, endline, surveillance in both arms, program monitoring in intervention

- Why FAARM Trial Data?
    - **Dietary Diversity Surveillance (full panels every 6 months)***
        - model as time series
    - **Experience survey for 2017 Flood**
        - cross-validate metric using human experience data

Note: pregnant women were collected every 2 months



Source: Wendt et al, 2019

Method: Flood Extraction

1) Composite ‘dry’ reference image

- Selected images with least amount of variation (Stdev < 2) from dry season in 2018

2) UN SPIDER Flood Mapping

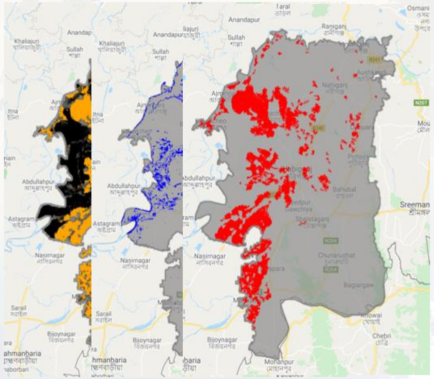
- Difference all subsequent images with the ‘dry' composite to extract flooded surface area (km)

3) Validation

- Parameter tuning and cross-validation by calculating accuracy scores against existing flood maps (Global Flooding database, 2021)

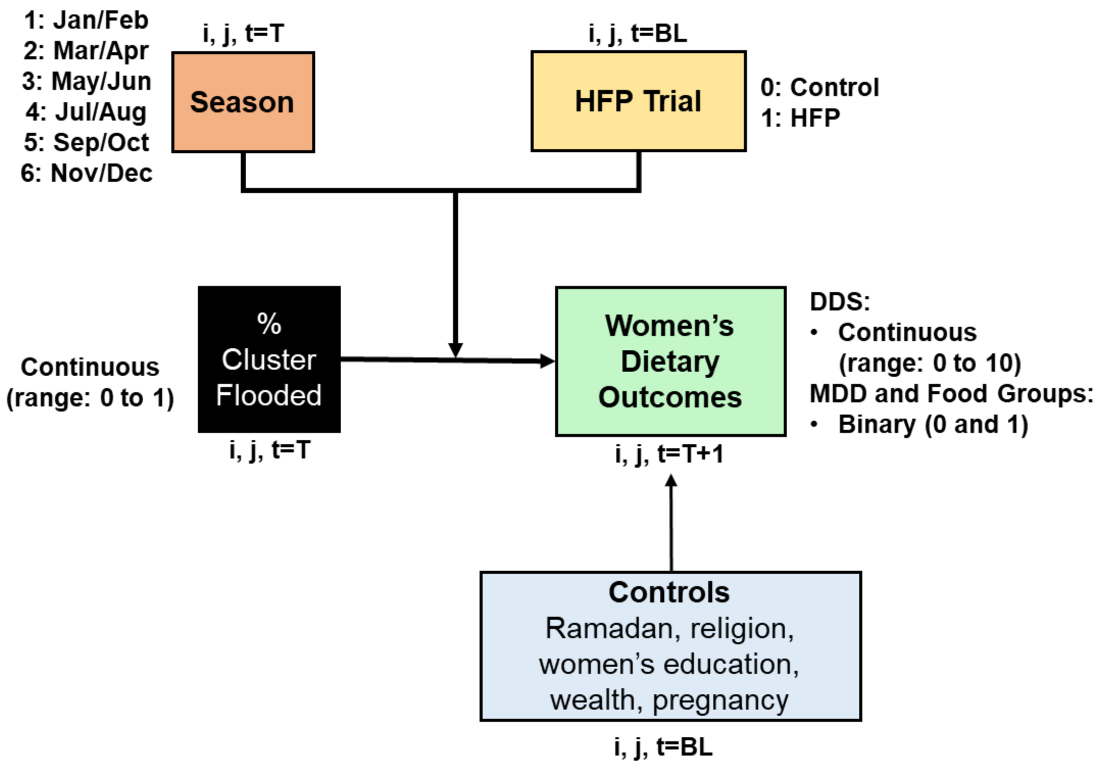
= Flooding in km per cluster over time (195 images; 4 years)

id	date	max	min	mean	stdev
0	2015-01-19	0.82	-27.92	-17.59	1.87
1	2015-02-12	0.07	-24.94	-16.44	1.54
2	2015-03-03	2.69	-31.09	-16.76	1.56
3	2015-03-08	-2.61	-26.30	-15.66	1.25
4	2015-03-27	4.98	-32.05	-16.20	1.82
5	2015-04-01	-0.86	-23.93	-14.60	1.28
6	2015-04-20	6.63	-28.46	-14.65	1.69



August 2017, Habiganj District

Analysis: Causal Pathways



Where i is the individual women, j is the cluster location, t is the sample time; BL: Baseline; HFP: Homestead food production; DDS: Dietary Diversity Score; MDD: Minimum Dietary Diversity.

Analysis: Mixed Effects Model Formulas

F1: Examines the <u>overall</u> effect of flooding on subsequent WDDS.

$$DD_{ijt} = \alpha_i + \beta^1_{ijt}(Flooding) + \beta^2_{ijt}(Treatment) + \beta^3_{ijt}(Season) + \ldots$$
$$+p_i + w_{jt} + \varepsilon_{ijt}$$

F2: Examines the <u>overall</u> effect of flooding on subsequent WDDS *by treatment*.

$$DD_{ijt} = \alpha_i + \beta^1_{ijt}(Flooding\colon Treatment) + \beta^2_{ijt}(Treatment) + \beta^3_{ijt}(Season) + \ldots$$
$$+ p_i + w_{jt} + \varepsilon_{ijt}$$

p_i = fixed effect of each woman; w_{it} = autoregressive term

Analysis: Mixed Effects Model Formulas

F3: Examines the <u>seasonal</u> effect of flooding on subsequent WDDS.

$$DD_{ijt} = \alpha_i + \beta^1_{ijt}(Season{:}Flooding) + \beta^2_{ijt}(Treatment) + \beta^3_{ijt}(Season) + \dots$$
$$+p_i + w_{jt} + \varepsilon_{ijt}$$

F4: Examines the <u>seasonal</u> effect of flooding on subsequent WDDS *by treatment*.

$$DD_{ijt} = \alpha_i + \beta^1_{ijt}(Season{:}Flooding{:}Treatment) + \beta^2_{ijt}(Treatment) + \beta^3_{ijt}(Season) + \dots$$
$$+ p_i + w_{jt} + \varepsilon_{ijt}$$

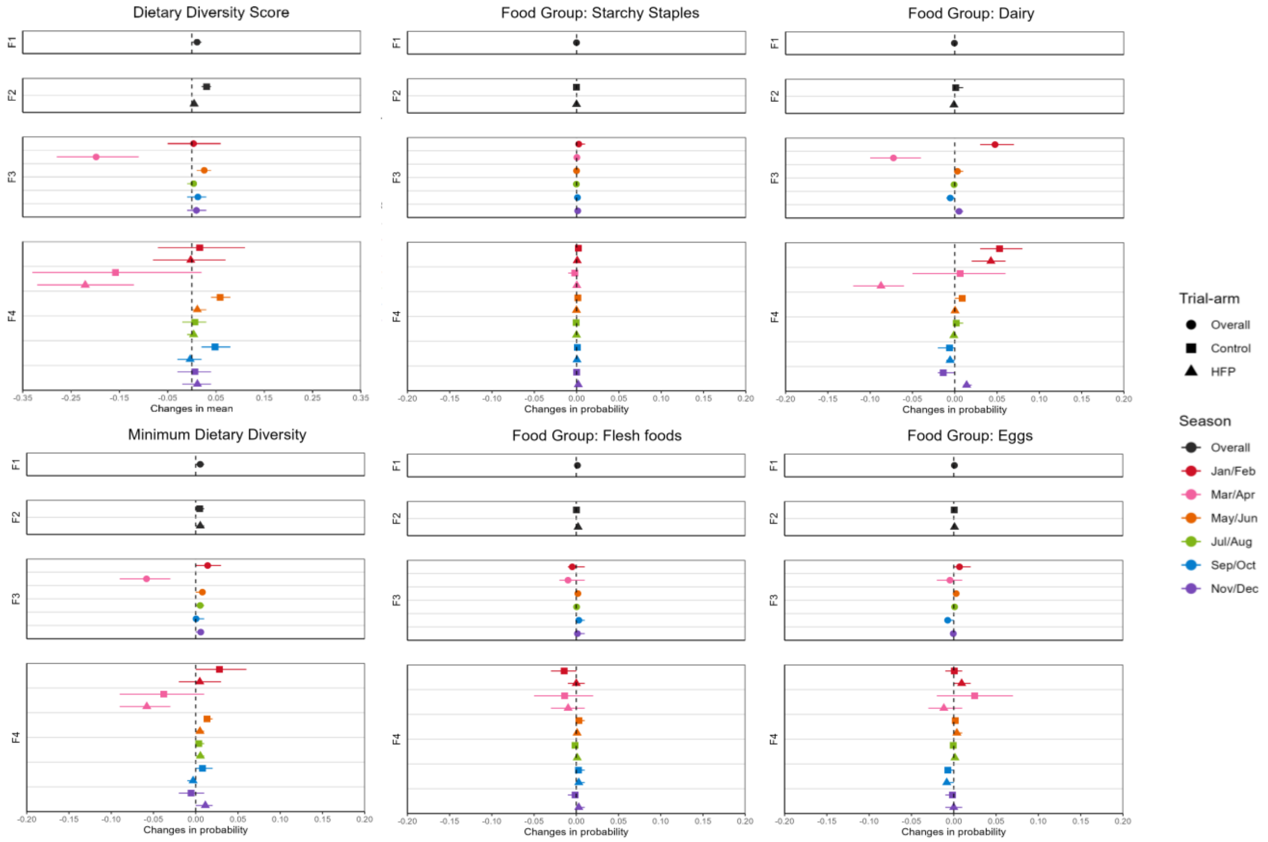
p_i = *fixed effect of each woman;* w_{it} = *autoregressive term*

03

Findings

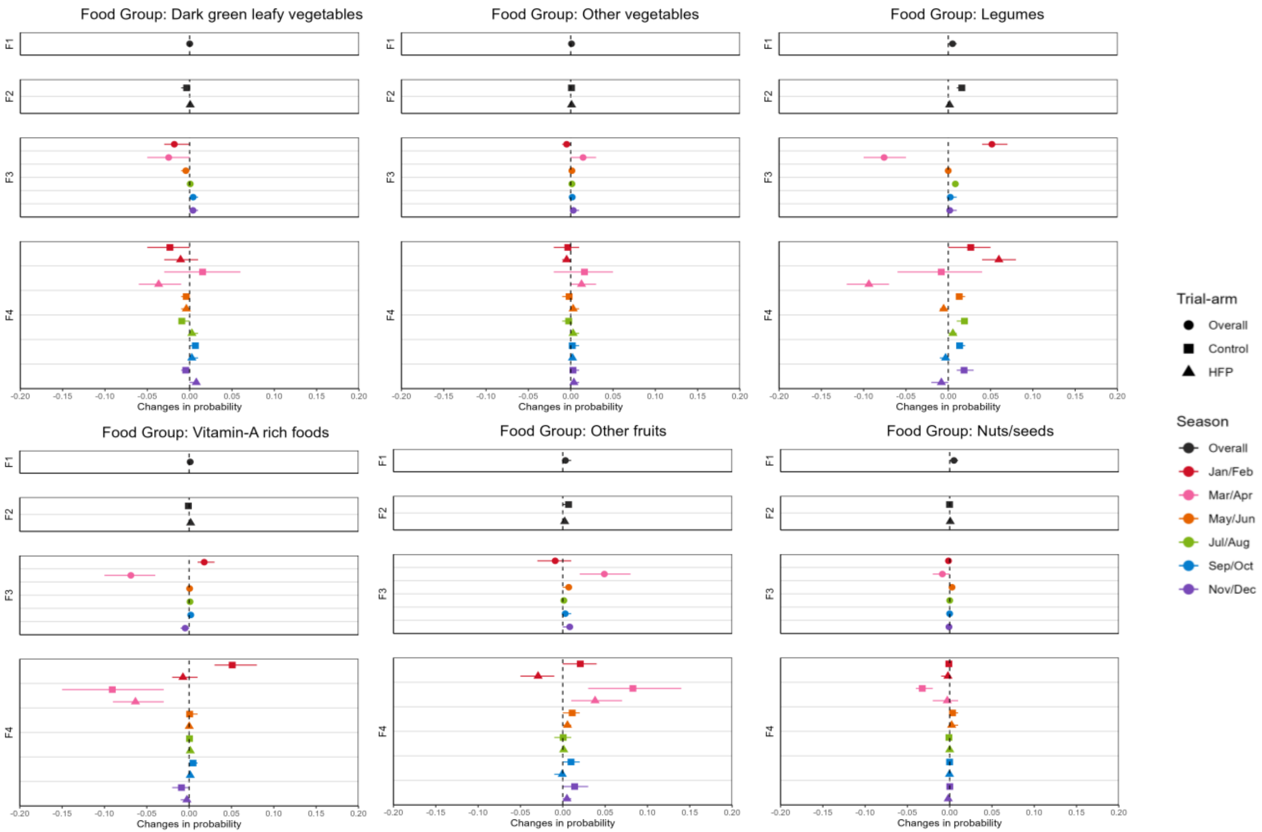
The impacts of flooding on diets by season and across HFP groups.

Marginal effects of flooding on all dietary outcomes by trial-arm and across seasons for models F1-F4.



Marginal effects are presented as coefficients for continuous outcomes and probabilities for binary outcomes; Prior to modelling, flooding was centered and scaled to represent a 1% increase in cluster flooded; Evidence was evaluated using a 95% confidence interval; HFP: Homestead Food Production intervention; F1: no interaction; F2: with flood×HFP interaction; F3: with flood×season interaction; F4: with flood×season×HFP interaction

Marginal effects of flooding on all dietary outcomes by trial-arm and across seasons for models F1-F4.



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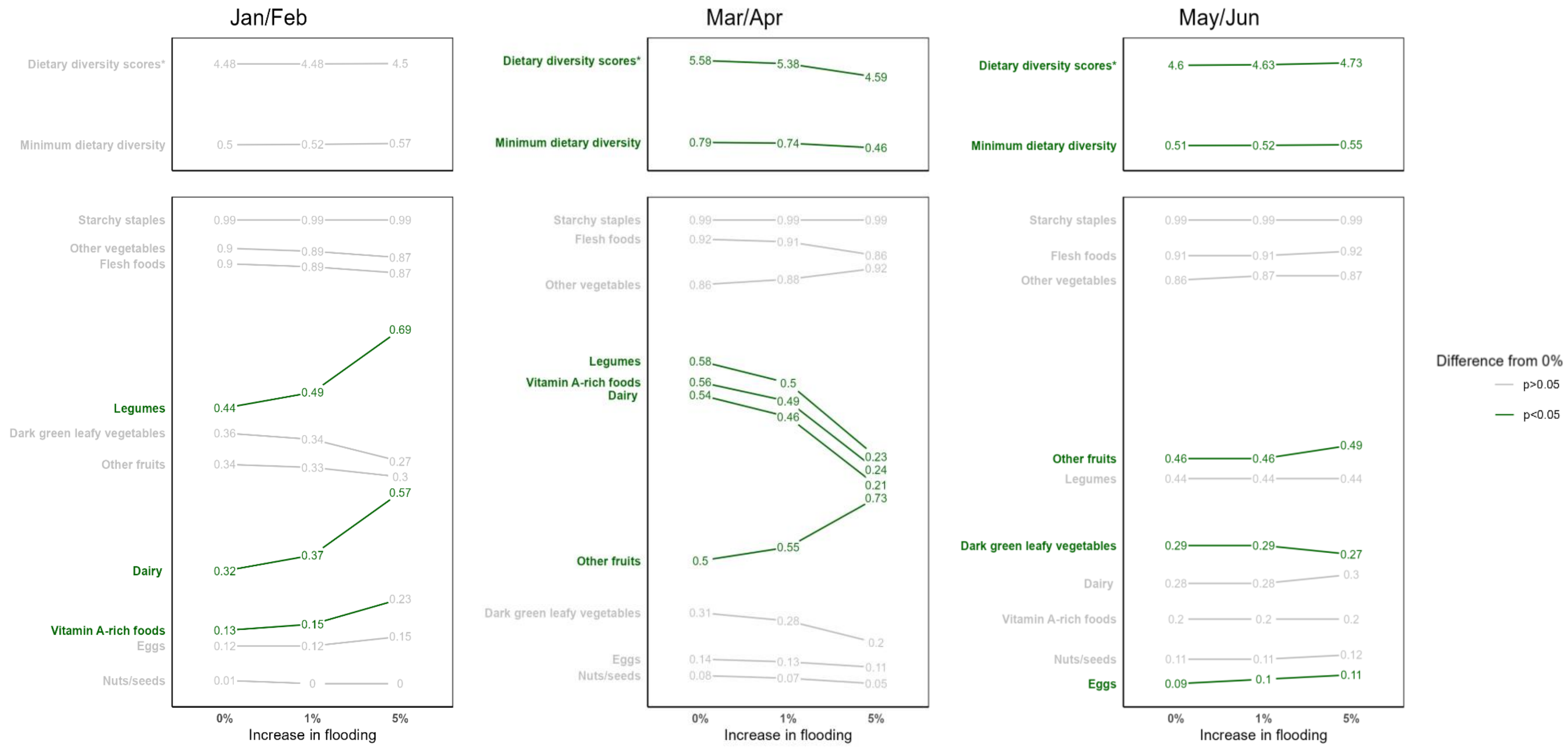
Absolute value measures of different levels of flooding on dietary outcomes across seasons, over all trial-arms, with difference tests for each flood level (relative to no change in flooding) and season.



Difference tests evaluate the significance between increasing flood levels, relative to no change in flooding (0%); Strong evidence is highlighted in green (p<0.05, confidence interval 95%); Continuous outcomes are presented as averages and binary outcomes as probabilities.

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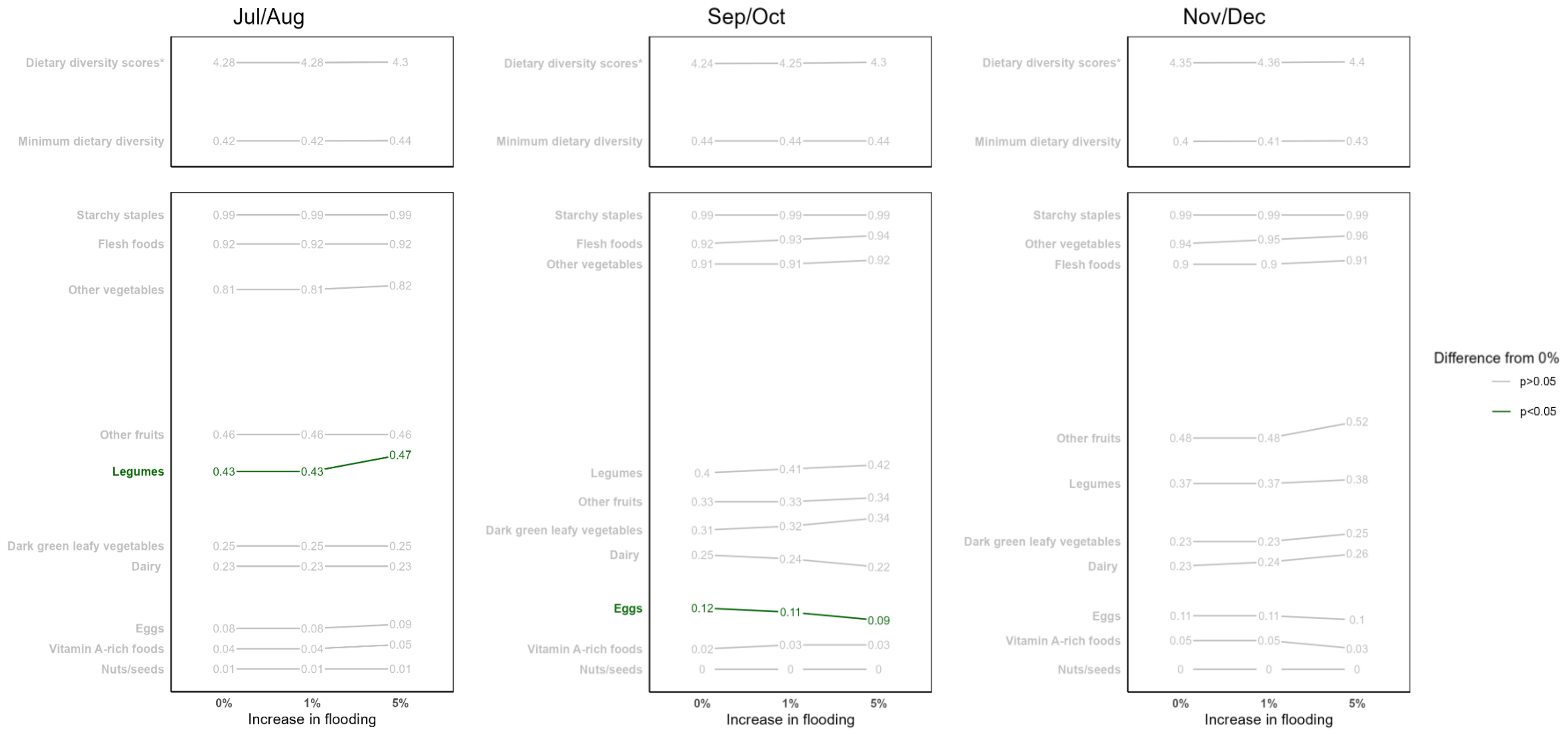

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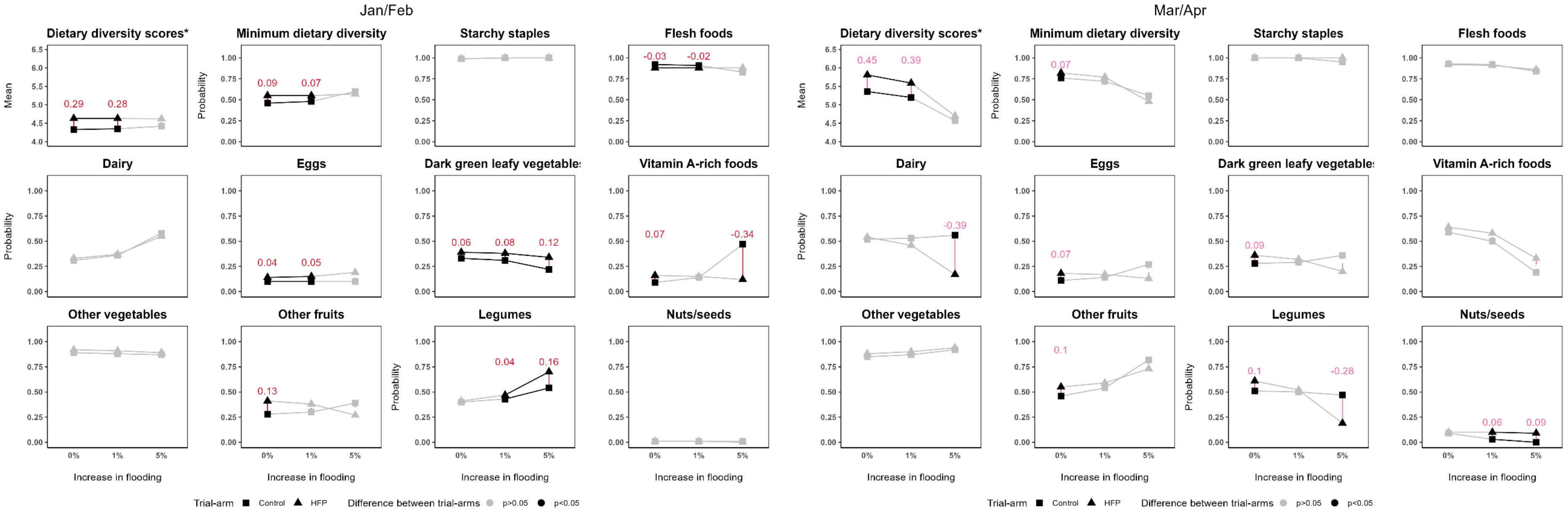
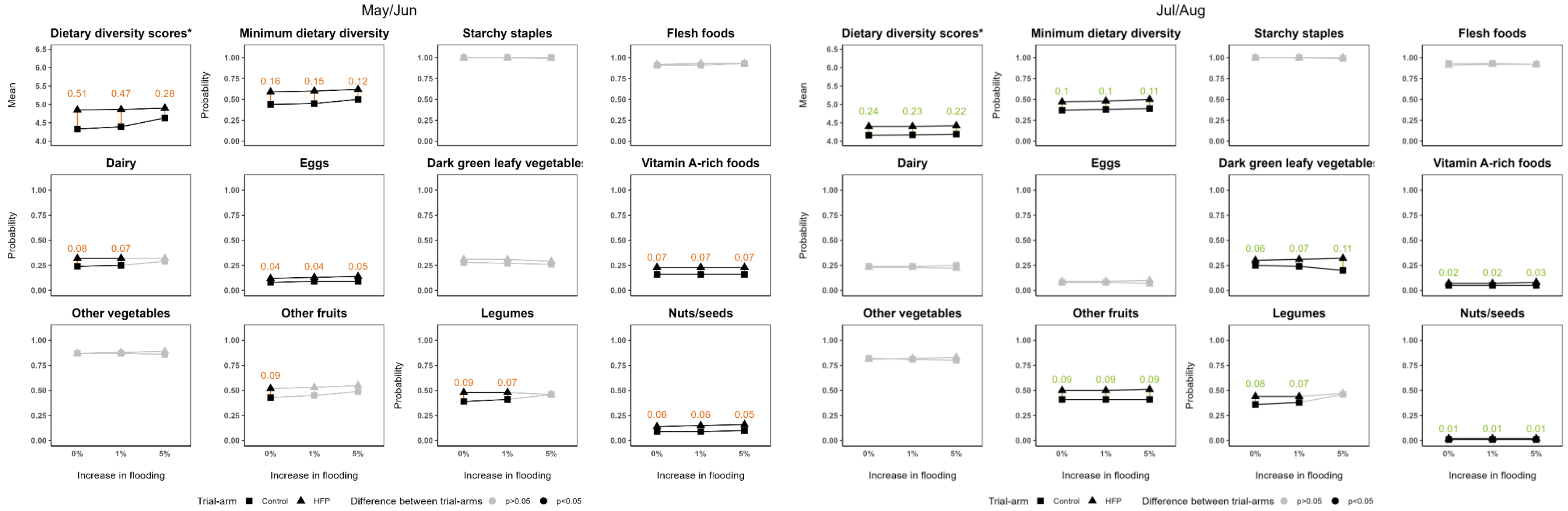
Absolute value measures of different levels of flooding on dietary outcomes across seasons, for each trial-arm, with difference tests between each trial-arm, relative to the control.



Difference tests evaluate the significance between trial arms, relative to the control group, at each increase of flood level and season; Strong evidence is highlighted in green (p<0.05, confidence interval 95%); Continuous outcomes are presented as averages and binary outcomes as probabilities.

Absolute value measures of different levels of flooding on dietary outcomes across seasons, for each trial-arm, with difference tests between each trial-arm, relative to the control.



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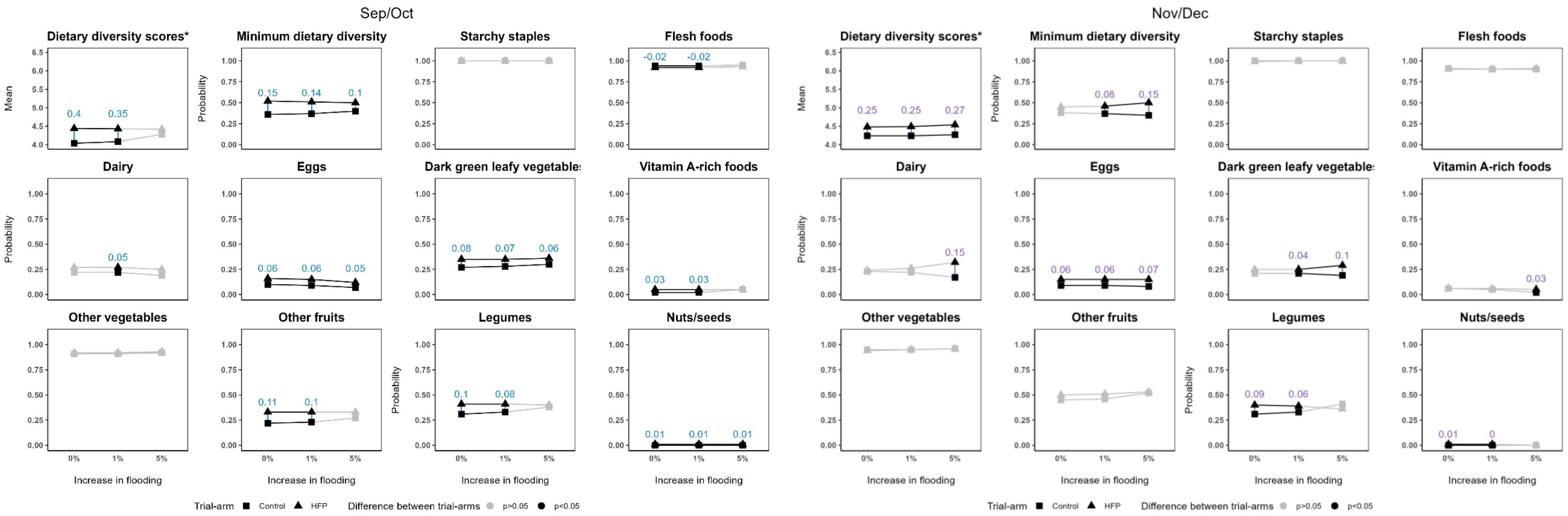

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Summary

- The effects of flooding on dietary diversity in rural Bangladesh are **detrimental** in the months of March and April and **beneficial** in the months of May and June.

- **Dairy, vitamin A-rich food and legume** consumption were the food groups most impacted by changing flood patterns, particularly in March and April.

- Homestead food production interventions have a **positive impact on dietary outcomes**, but this effect decreases and disappears as flood levels increases

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Take aways

Interpretation and future research

Future research

- Need to design interventions that encourage **flood resilient** food production practices and reduce negative coping strategies
  - *Other <u>pathways from flooding to diets</u> (i.e. agriculture production, infrastructure, income) are still not understood and may play key roles in coping strategies.*

- **Seasonality is crucial** in understanding the long-term effects of flooding on population-level health outcomes
  - *<u>High frequency health data</u> collection will be needed to further develop nutrition-sensitive coping strategies to flooding*

- **Advances in technology** offer many opportunities, but we need more intra-disciplinary **collaboration** to harness its full potential in global health research.

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Thanks!

Do you have any questions?

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