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Aquaculture and Horticulture:

Pathways to improved income, diet diversity and nutrition

The Feed the Future Nutrition Innovation Lab team

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UC DAVIS UNIVERSITY OF CALIFORNIA
HELEN KELLER INTL
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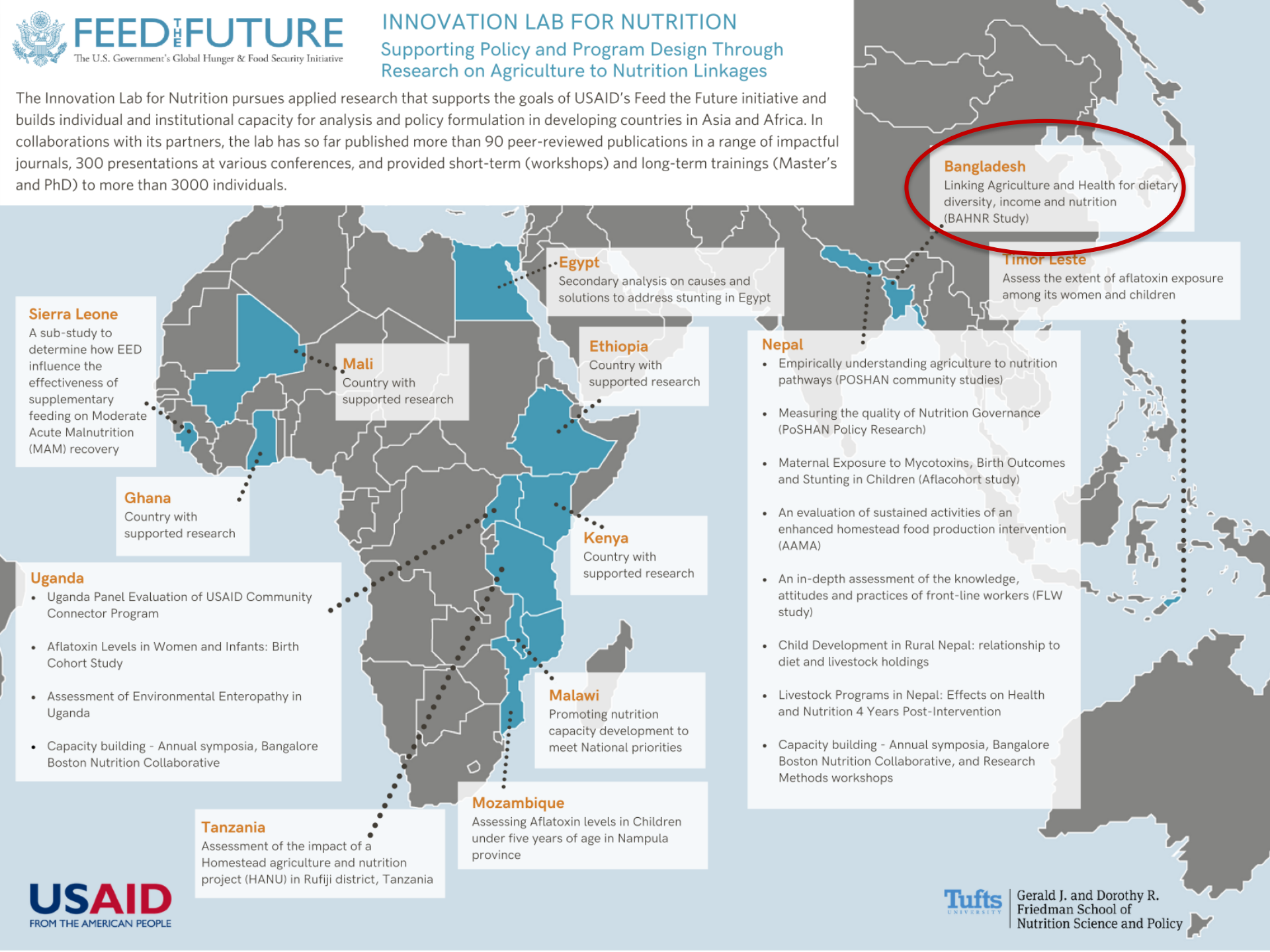
INNOVATION LAB FOR NUTRITION

Supporting Policy and Program Design Through Research on Agriculture to Nutrition Linkages

The Innovation Lab for Nutrition pursues applied research that supports the goals of USAID's Feed the Future initiative and builds individual and institutional capacity for analysis and policy formulation in developing countries in Asia and Africa. In collaborations with its partners, the lab has so far published more than 90 peer-reviewed publications in a range of impactful journals, 300 presentations at various conferences, and provided short-term (workshops) and long-term trainings (Master's and PhD) to more than 3000 individuals.



Bangladesh
Linking Agriculture and Health for dietary diversity, income and nutrition (BAHNR Study)

Timor Leste
Assess the extent of aflatoxin exposure among its women and children

Egypt
Secondary analysis on causes and solutions to address stunting in Egypt

Sierra Leone
A sub-study to determine how EED influence the effectiveness of supplementary feeding on Moderate Acute Malnutrition (MAM) recovery

Mali
Country with supported research

Ethiopia
Country with supported research

Ghana
Country with supported research

Kenya
Country with supported research

Nepal
- Empirically understanding agriculture to nutrition pathways (POSHAN community studies)
- Measuring the quality of Nutrition Governance (PoSHAN Policy Research)
- Maternal Exposure to Mycotoxins, Birth Outcomes and Stunting in Children (Aflacohort study)
- An evaluation of sustained activities of an enhanced homestead food production intervention (AAMA)
- An in-depth assessment of the knowledge, attitudes and practices of front-line workers (FLW study)
- Child Development in Rural Nepal: relationship to diet and livestock holdings
- Livestock Programs in Nepal: Effects on Health and Nutrition 4 Years Post-Intervention
- Capacity building - Annual symposia, Bangalore Boston Nutrition Collaborative, and Research Methods workshops

Uganda
- Uganda Panel Evaluation of USAID Community Connector Program
- Aflatoxin Levels in Women and Infants: Birth Cohort Study
- Assessment of Environmental Enteropathy in Uganda
- Capacity building - Annual symposia, Bangalore Boston Nutrition Collaborative

Malawi
Promoting nutrition capacity development to meet National priorities

Mozambique
Assessing Aflatoxin levels in Children under five years of age in Nampula province

Tanzania
Assessment of the impact of a Homestead agriculture and nutrition project (HANU) in Rufiji district, Tanzania

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GLOBAL AND LOCAL PARTNERS

ORDER OF BUSINESS

1. Introduction by moderator, Shibani Ghosh
2. Patrick Webb – findings from aqua/hort intervention research
3. Robin Shrestha – findings on cost-effectiveness of innovative value chain technologies
4. Patrick Webb – preliminary findings on food safety concerns and demand for processed packaged foods in rural markets
5. Q&A moderated by Hannah Koehn

KEY QUESTIONS

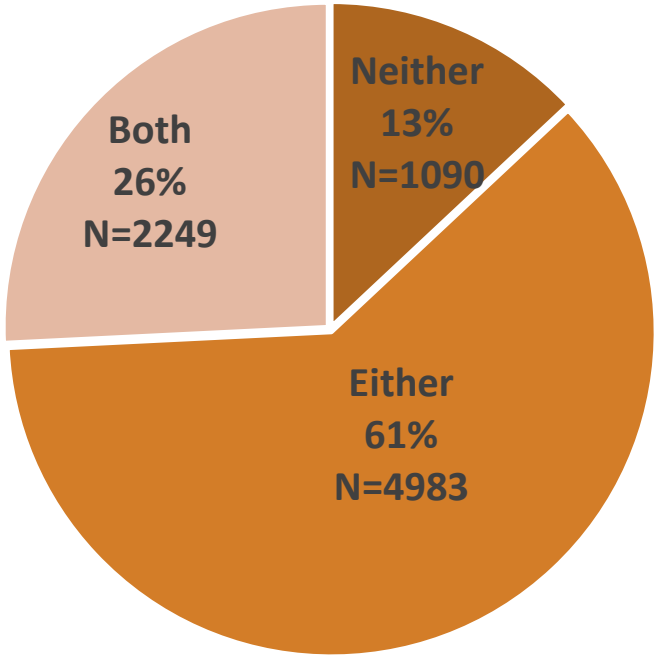
1. Are there additive benefits of promoting combined aquaculture and horticulture (on income, diets and nutrition)?

2. What are the cost constraints relating to uptake, scaling and profitability of innovative value chain technologies?

3. What frontier food security issues are of concern when considering rural markets? eg. food safety, spending on processed packaged foods, mycotoxins, etc.,

RESEARCH APPROACH

- Longitudinal panel survey in 3,060 households located across 102 unions of the FTF zone of influence.
- Respondents interviewed 3 times over 2 years on diets, livelihoods, aqua./hort., marketing, food safety.
- Embedded sub-studies on technology innovation adoption, perceptions of food safety.



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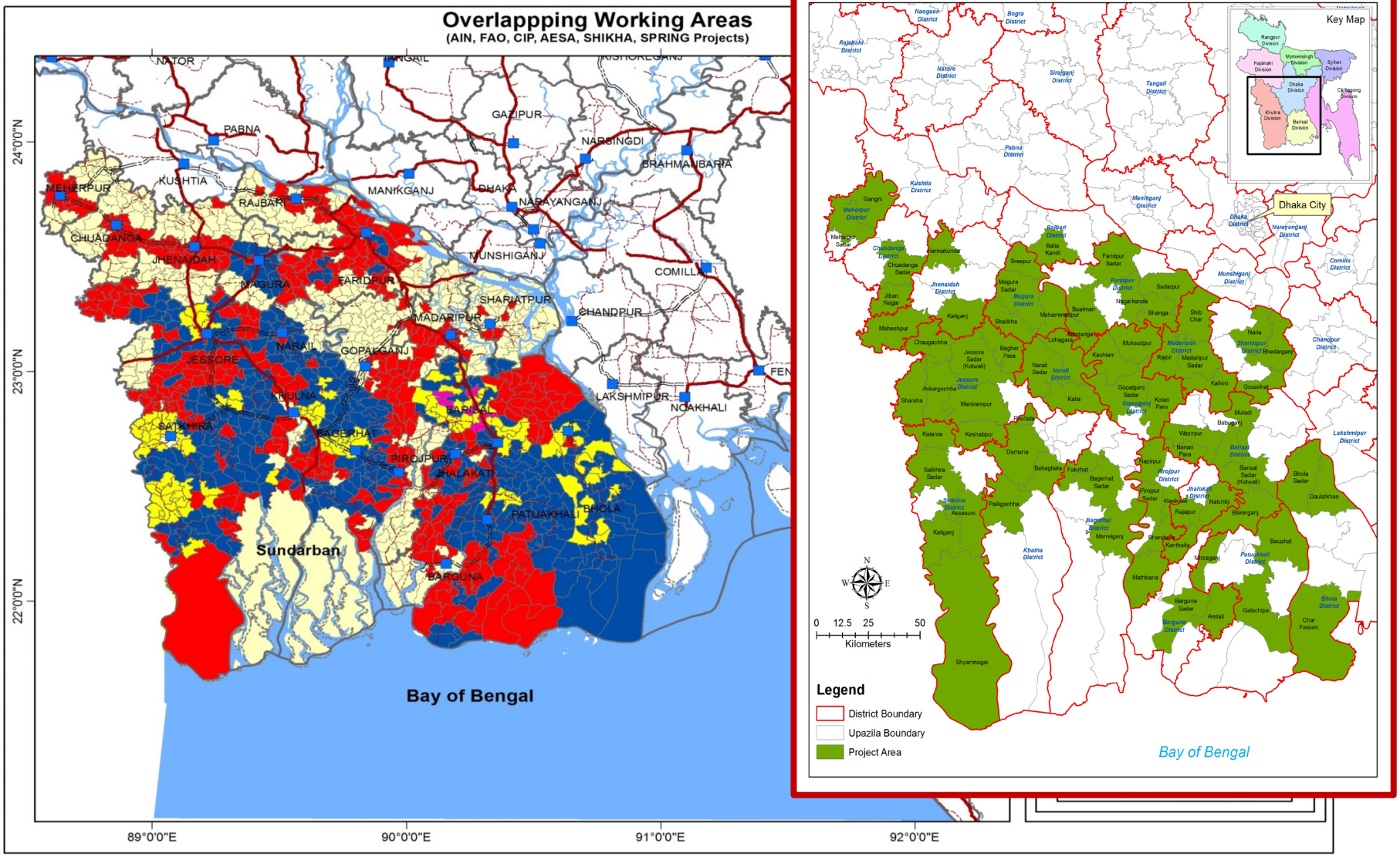

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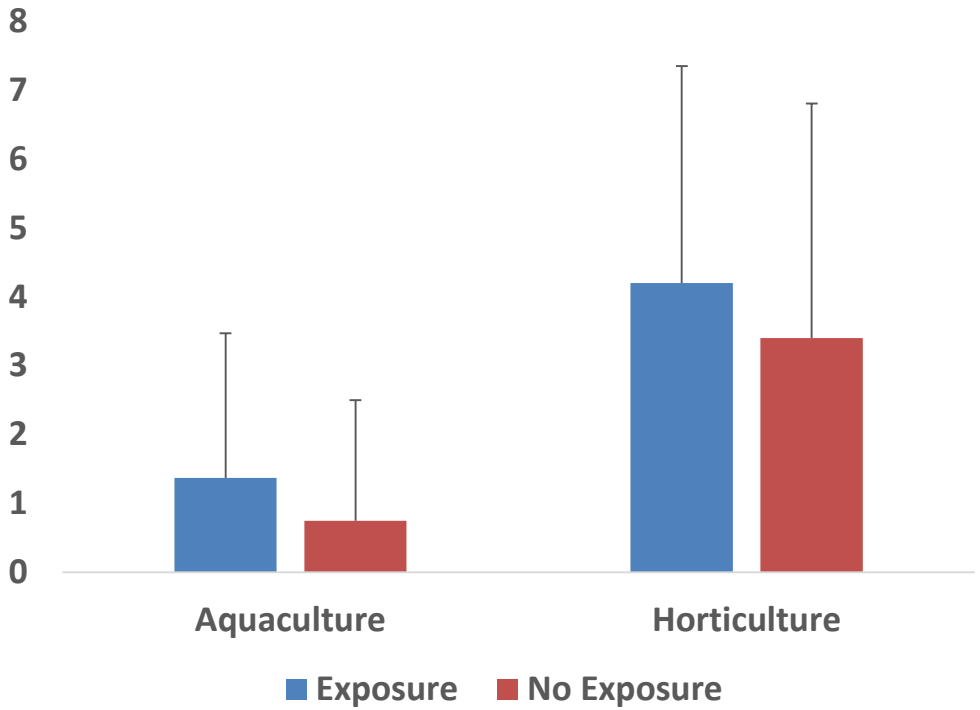
MORE EXPOSURE = MORE FARM DIVERSITY

Number of crops/fish species farmed



…AND HIGHER NET INCOME FROM AGRICULTURE

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CHANGE IN HOUSEHOLD SPENDING

US$/capita	Total household expenditure	Household food expenditure
No USAID program exposure	*Reference*	*Reference*
Exposed to one USAID program	0.040	0.024
Exposed to multiple USAID programs	**0.348****	**0.366***
N	2802	2802

β-coefficients are shown in the table above; * $p<0.05$

*Models adjust for engagement in aquaculture and horticulture, baseline dietary diversity/fish consumption, female caregiver's education level, household food insecurity access score (HFIAS)

CHANGE IN DIETARY DIVERSITY

	Household	Child	Female caregiver
Neither aquaculture NOR horticulture	*Reference*	*Reference*	*Reference*
Either aquaculture OR horticulture	0.139	0.081	0.039
Aquaculture AND horticulture	0.246*	0.156*	0.155*
N	2800	2791	2801

β-coefficients are shown in the table above; * $p<0.05$

*Units of diet diversity is food groups

*Models adjust for exposure to USAID programs, baseline diet diversity, education (household head for household model, female caregiver for child and female caregiver models), HFIAS

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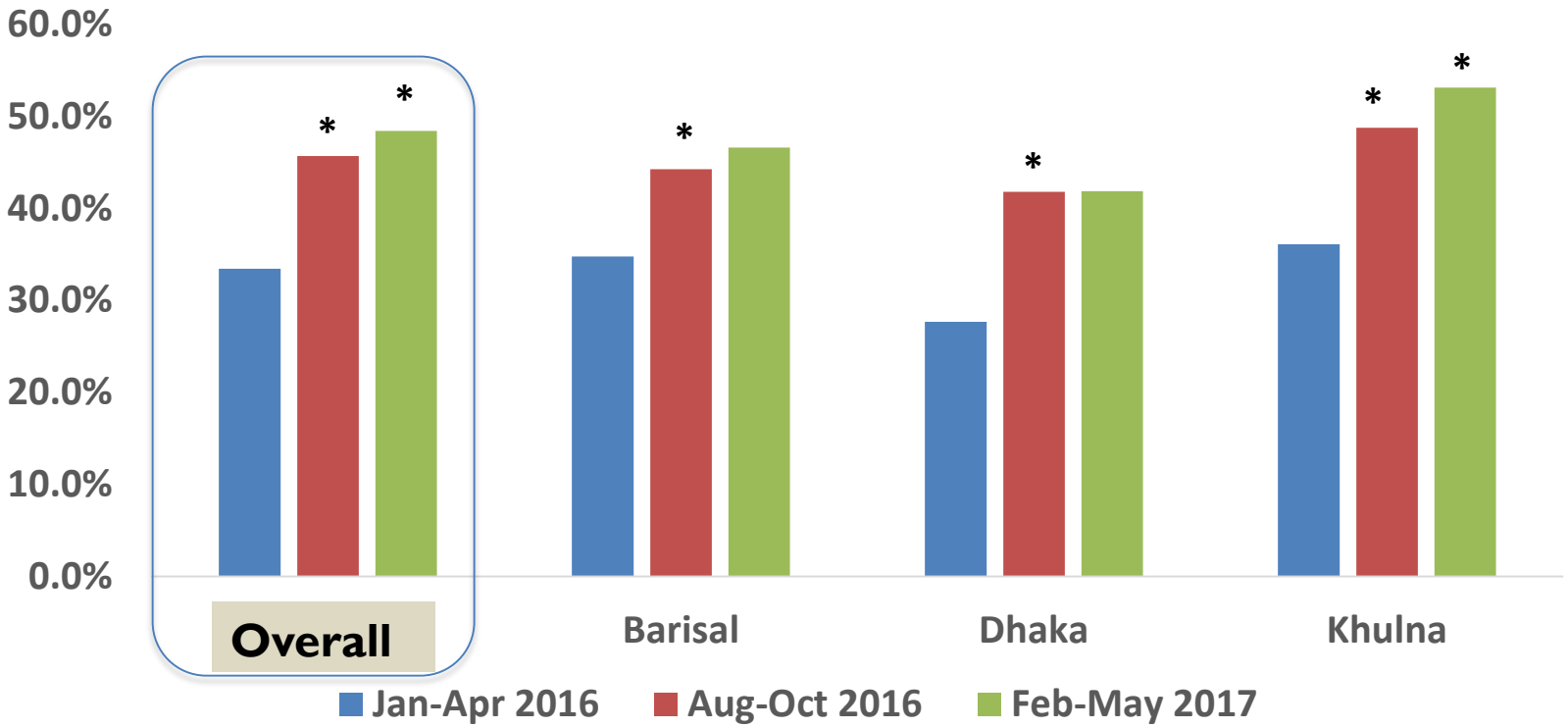
FISH INTAKE ROSE IN CHILDREN <24M

* Significantly higher compared to Round 1 p<0.05 (logistic regression, controlling for wealth, education, gender of head, etc.)



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CHANGE IN *SMALL FISH* CONSUMPTION

Diff R3-R1 (grams)	Child	Female caregiver
No USAID program exposure	*Reference*	*Reference*
Exposed to one USAID program	-0.308	0.154
Exposed to multiple USAID programs	**3.736***	**7.041***
N	2791	2801

β-coefficients are shown in the table above; * p<0.05

Models adjust for engagement in aquaculture and horticulture, baseline fish consumption, female caregiver's education level, HFIAS

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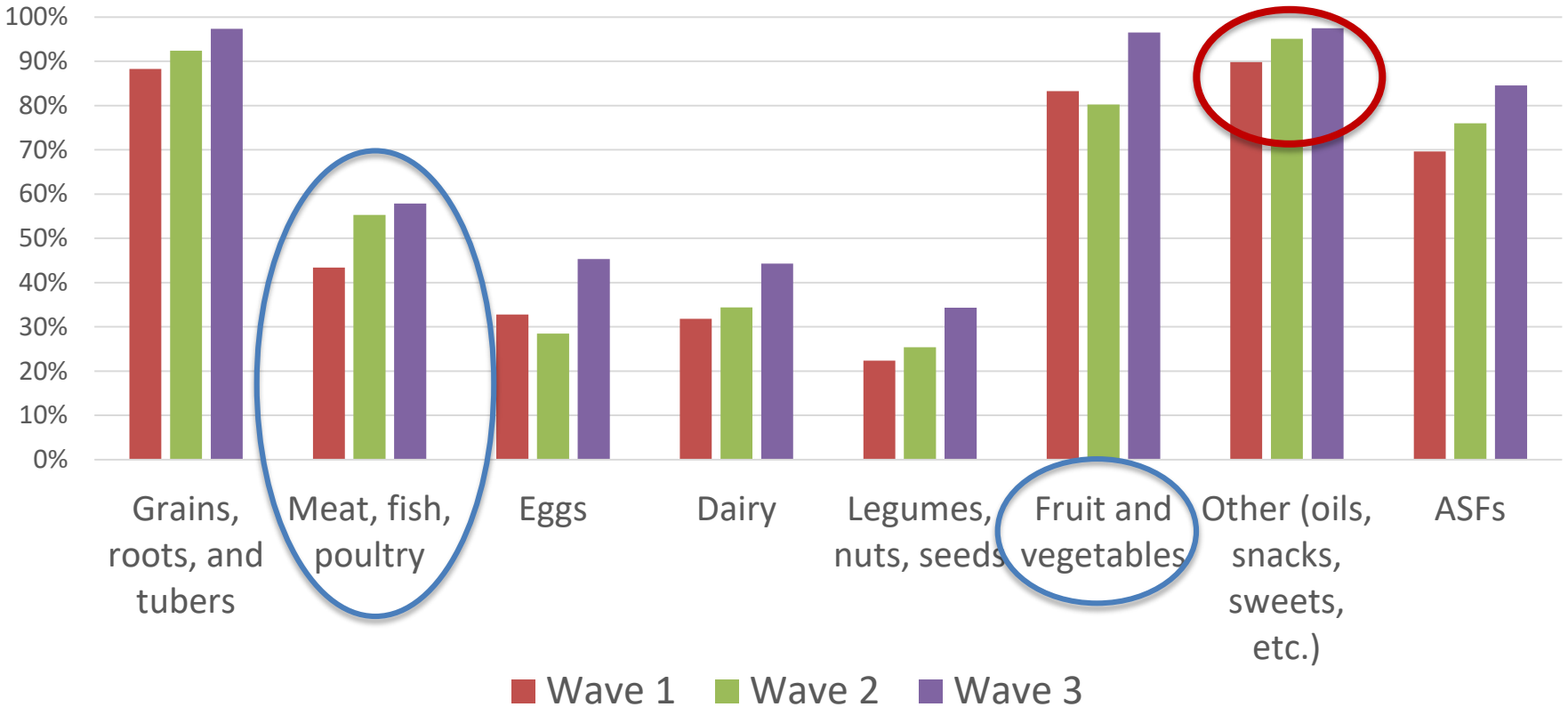
CHILD INTAKE BY FOOD GROUP – INCLUDING NON-PRODUCERS



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EATING ASF REGULARLY REDUCES STUNTING

Length-for-age Z-score	Age group: 12-24 months		
Child consumed 1 type of ASF **yesterday**	0.060		0.058
Child consumed >2 ASFs **yesterday**	**0.245****		**0.221****
Child consumed 1 type of ASF **6 months ago**		0.095	0.084
Child consumed 2 types of ASF **6 months ago**		**0.231****	**0.192****
N	1,381	1,381	1,381

Reported estimates are from OLS regressions. * p<0.05; ** p<0.01.

Model controls for starchy staples, consumed any fruit and vegetables, consumed legumes nuts and seeds, age, age^2, age^3, gender, child had diarrhea in the past 2 weeks, caregiver's education, caregiver's height, type of latrine. Regressions include district x survey round fixed effects.

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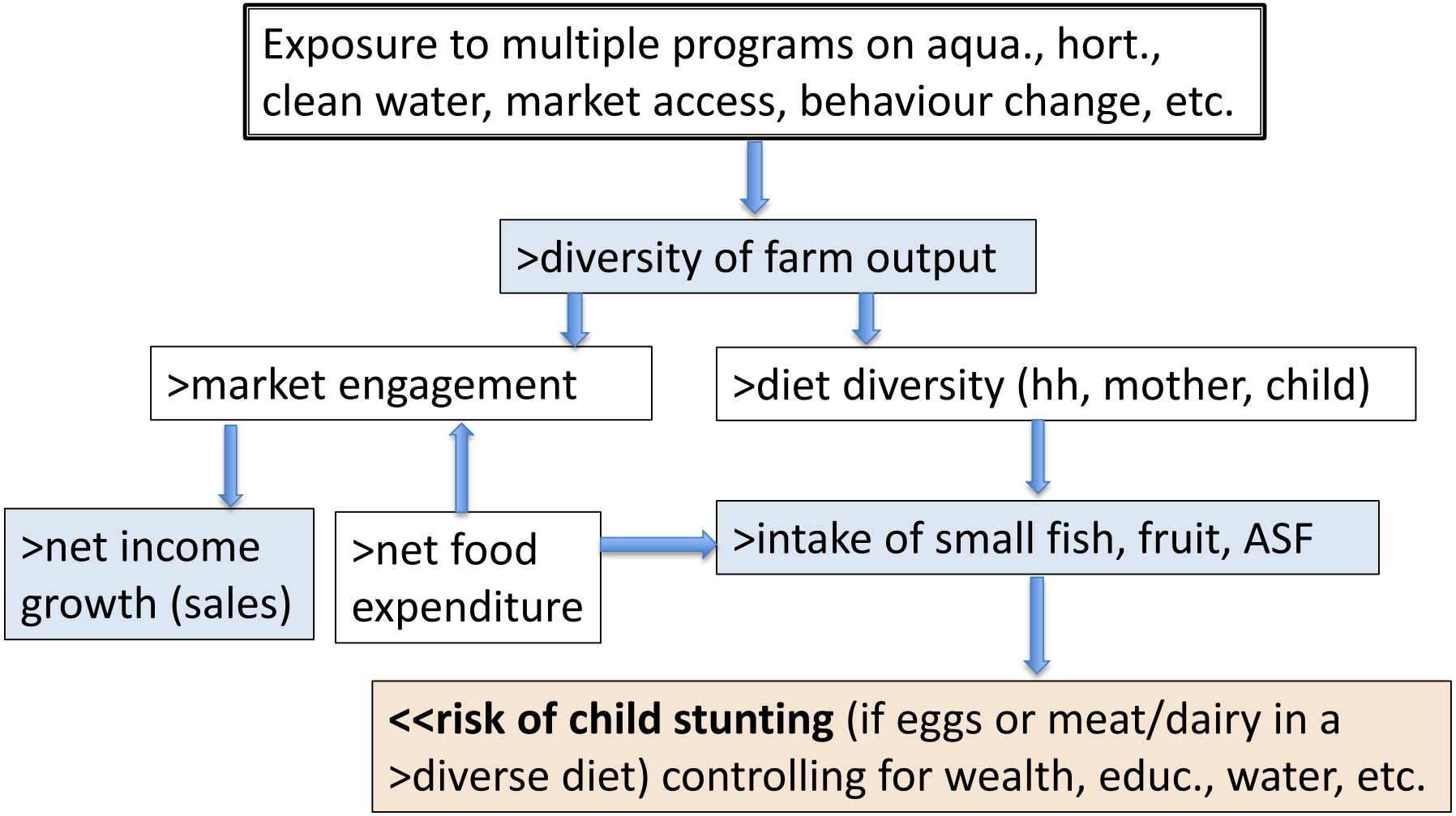
Exposure to multiple programs on aqua., hort., clean water, market access, behaviour change, etc.
>diversity of farm output
>market engagement
>diet diversity (hh, mother, child)
>net income growth (sales)
>net food expenditure
>intake of small fish, fruit, ASF
<<risk of child stunting (if eggs or meat/dairy in a >diverse diet) controlling for wealth, educ., water, etc.

FINDINGS SO FAR

1. Positive multipliers from concentrating investments by geography *and over time;* not once-and-done.

2. SBCC helps promote fish (and dairy) and OFSP. More to do.

3. Success in aquaculture: i) more educated, ii) less poor, iii) more labor, iv) more investable cash, v) self-trading (to more distant markets). Hort. products sold locally.

4. Yes, farm diversification can impact stunting, *with* access to markets. Not just roads; trucks, credit access (making it feasible to adopt risk), information and inputs; and technology.

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Adoption of Innovative Supply Chain Technologies in Rural Bangladesh

Feed the Future Innovation Lab for Nutrition team

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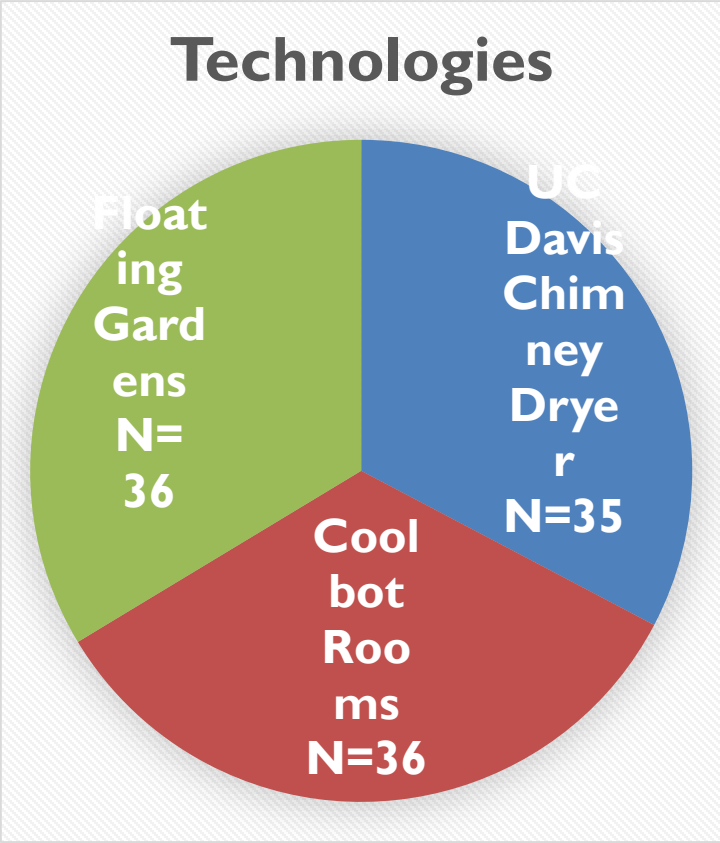
RESEARCH APPROACH

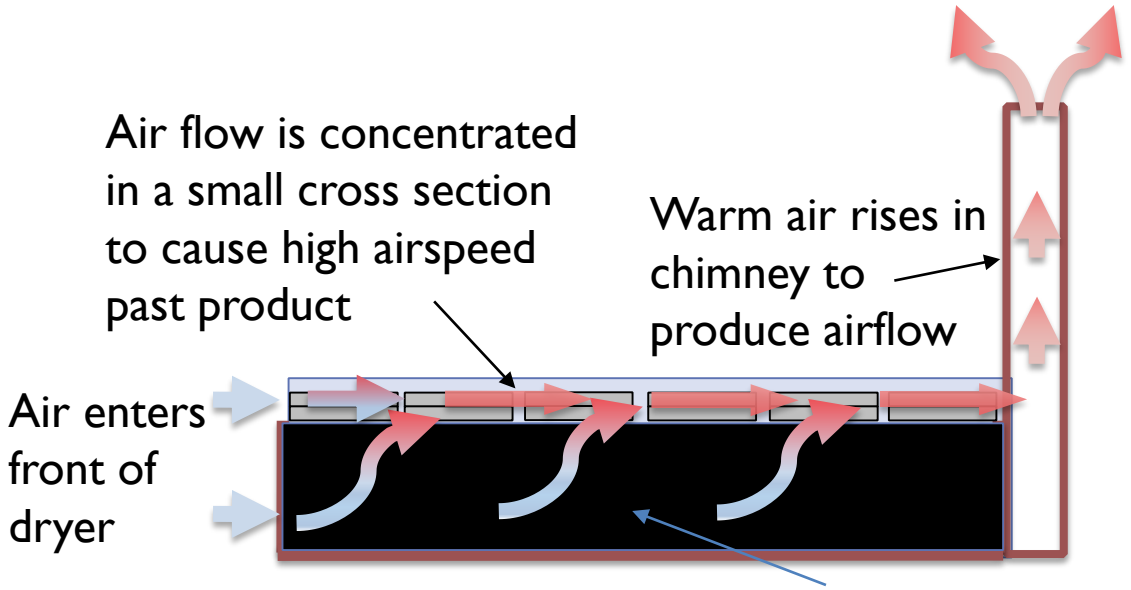
- A sub-study on cost-effectiveness and adoption of technologies to improve access to higher quality diet

- Three technologies - 107 households
- Data collected bi-weekly over 3 years

- Cost-benefits analysis using a Land Use System (LUS) approach



1. CHIMNEY SOLAR DRYER



80 cm high 'table' covered with black plastic or cloth. Clear plastic film is placed over the trays and the sides of the table.

CHIMNEY SOLAR DRYERS

- 3 Dryers: 1 used for fish, 2 for fruits/vegetables

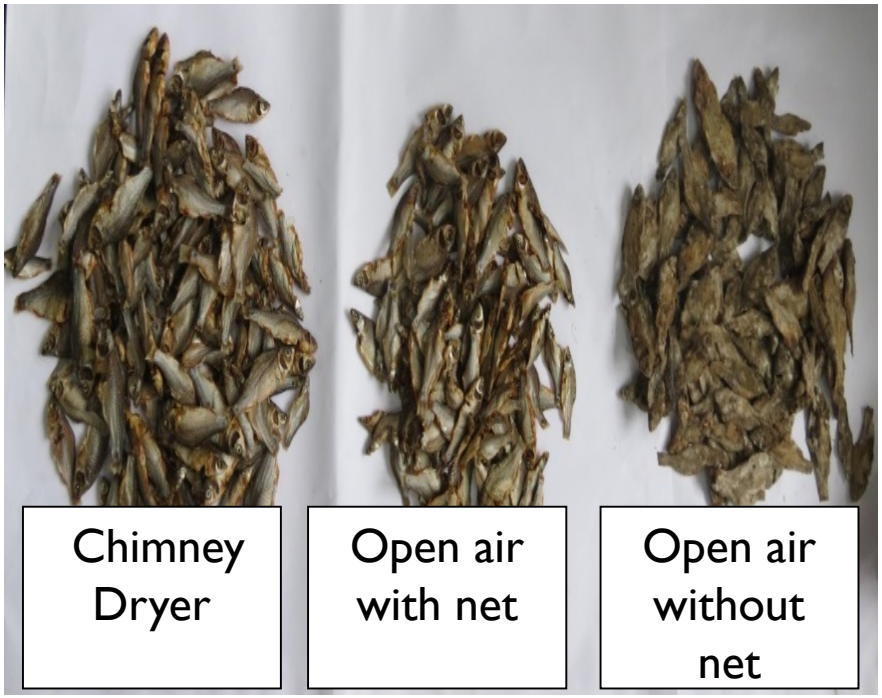
- Cost per dryer:
  - *Establishment cost*: US $138
  - *Operations & maintenance cost*: US $64/year

- Training: 41 Farmers and local traders (27 males, 14 females)
- Duration of operation (annual basis): 2-8 months

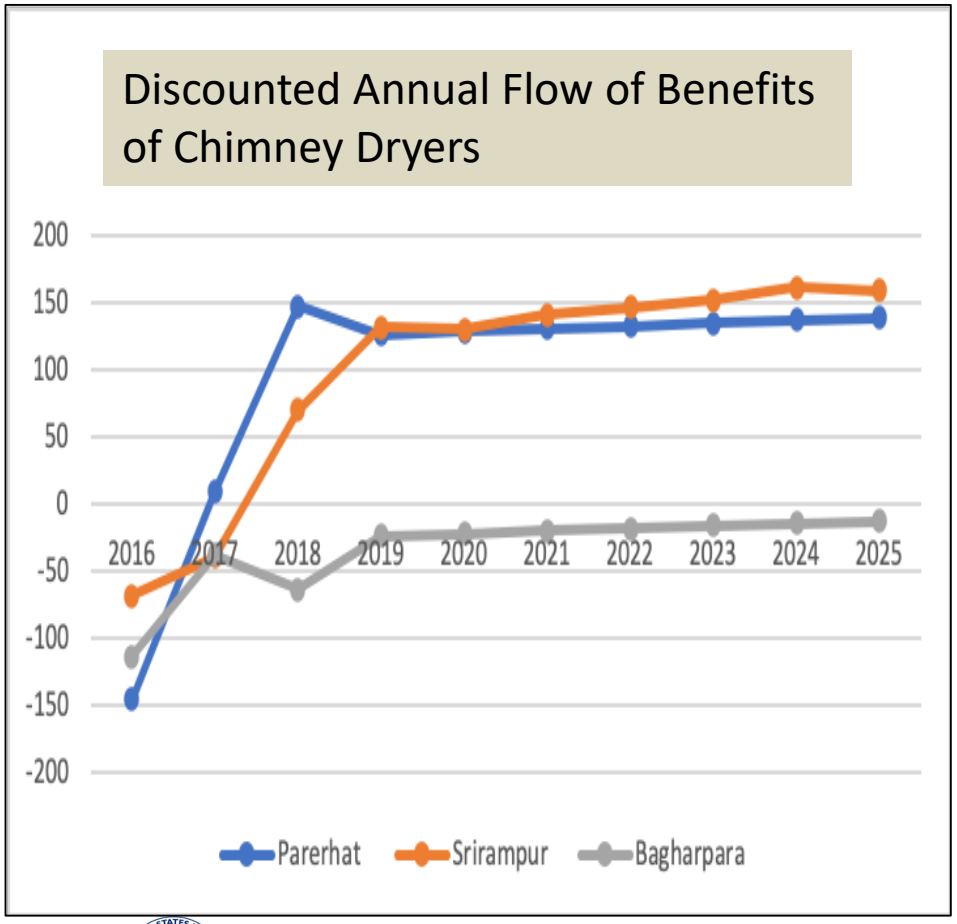
LESSONS LEARNED

Effect on Quality of products (compared to traditional open sun):

- drying time reduced by 34%
- higher % of relative humidity
- Reduced % of weight loss
- better visual quality
- No use of chemicals (insecticides)
- Reduced contamination with rodent, flies, insects, dusts



ECONOMIC ASSESSMENT - DRYERS



Strengths:

- low start-up cost (cheaper, uses local materials)
- market demand and price (dry vs fresh)

Weaknesses:

- types of products dried (low vs high market value)
- market distance
- *Demand for larger commercial dryers but higher establishment costs*

2. CoolBot Cold Rooms

CHARACTERISTICS OF COOLBOTS

- 3 Coolbot rooms - used for storing fruits and vegetables

- Cost per room:

  Establishment cost: US $13,065

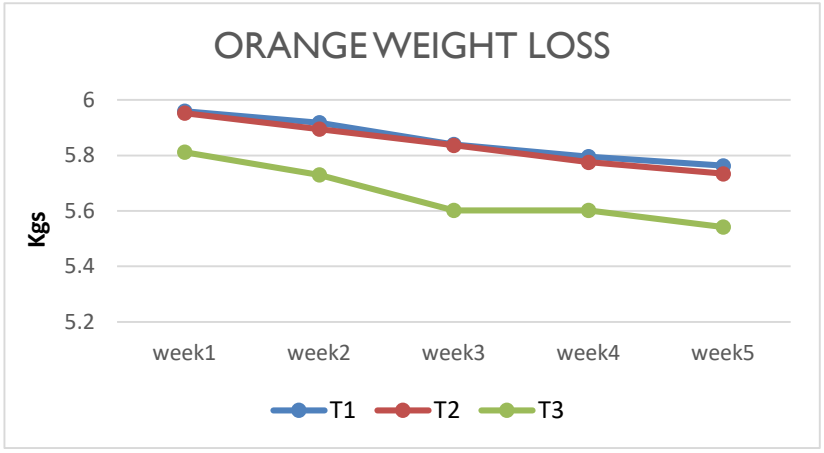
  Operations and maintenance: US $ 278/year

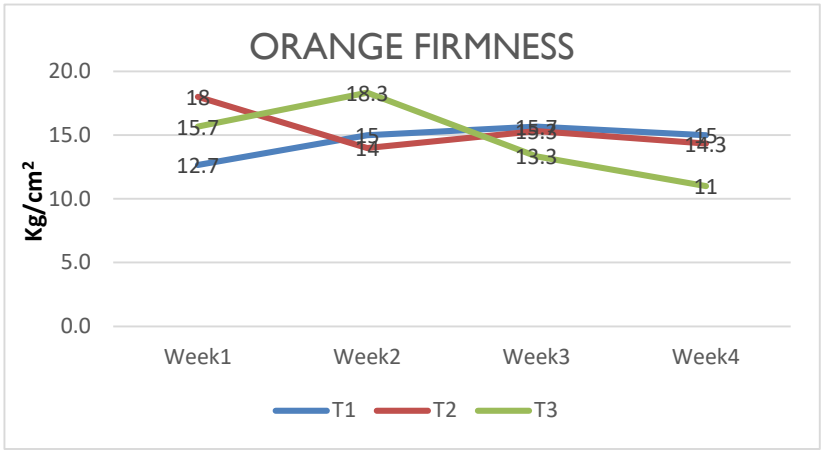
- Training: 34 mostly Farmers (30 males, 4 females)
- Duration of operation: 3-8 months per year
- Capacity utilization – 2-7% per year

LESSONS LEARNED - COOLBOTS

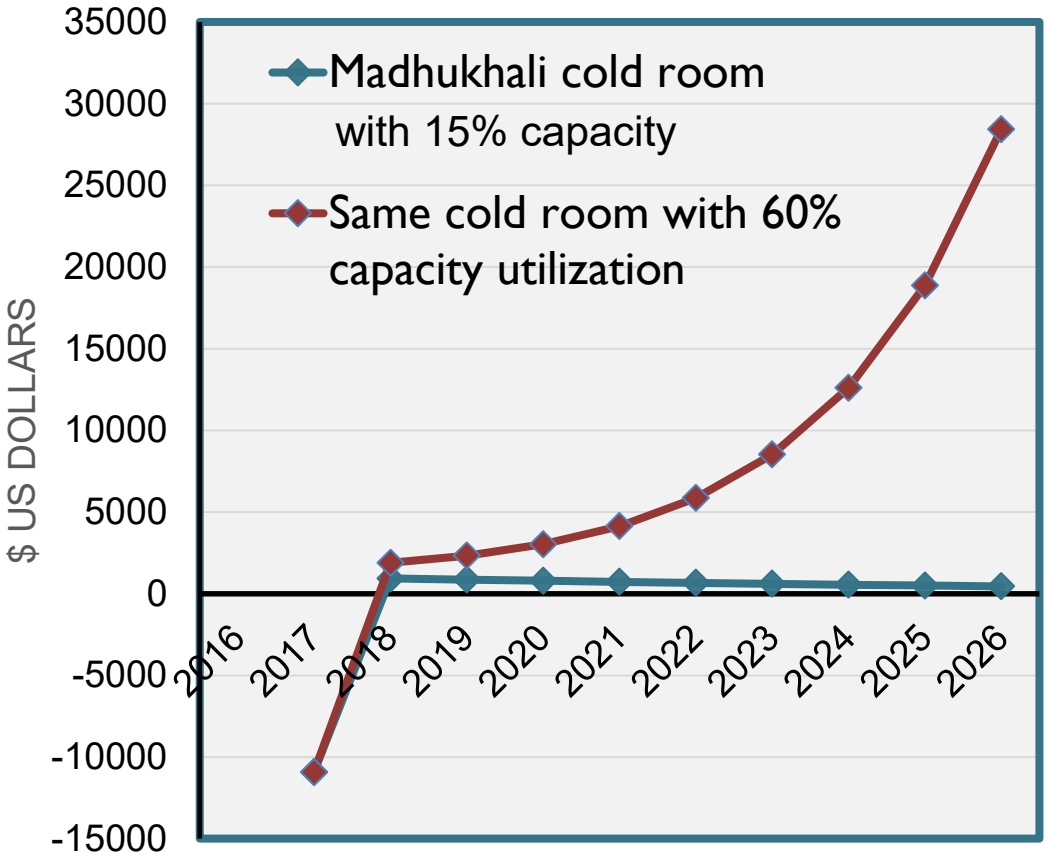
Effect of Cooling Methods on quality of stored products:

- minimal product weight loss in when stored over 5 weeks
- Better visual quality and firmness
- No need for insecticides
- Reduced risk of decay or contamination





ECONOMIC ASSESSMENT - COOLBOTS



Strengths:

- Market demand high in off-season
- Better market prices

Weaknesses:

- High set-up costs
- Low capacity utilization
- Limited farmer understanding of economic value-addition via storage of products
- Market access

FLOATING GARDENS

Indian spinach vines

Growing tomato plants in the garden

Farmer in front of her floating garden bearing bottle gourd vine tomato and red amaranth

Floating garden with turnip and tender Chinese cabbage

Freshly cut Indian spinach from floating garden

CHARACTERISTICS - FLOATING GARDENS

36 Floating gardens; 1 per household, used for producing vegetables, seedlings and fruits

Costs:

- *Establishment cost*: US $123
- *Operations and maintenance*: US $55/year

Trainings: 41 Farmers and local traders (27 males, 14 females)

Duration of operation: 3-5 months per year

- Better growth performance, visual quality, yield and phytochemical composition in medium with 50% water hyacinth+30% charcoal+20% vermicompost.
- No use of chemicals (insecticides)

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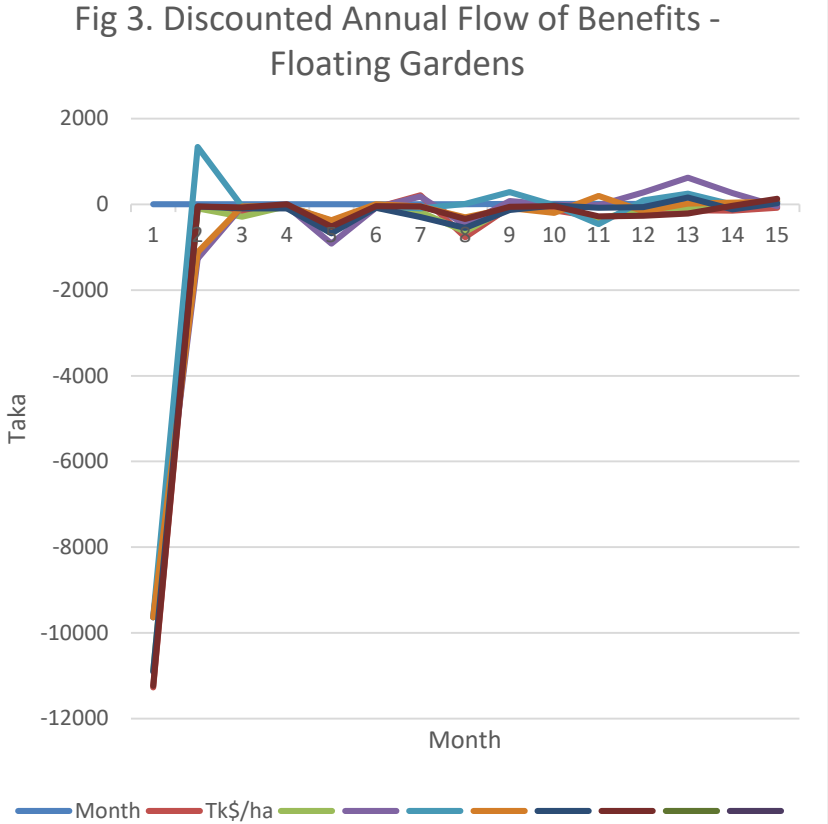
ECONOMIC ASSESSMENT OF FLOATING GARDENS



Strengths

- Relatively low start-up cost

Weaknesses

- Profit insufficient to offset establishment and maintenance cost
- Types of products dried (low vs high market value commodities)
- Cannot be used during rainy season
- Longer-term environmental impacts unknown

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KEY TAKE-AWAYS

- Of the technologies tested, the UCD Chimney dryer shows the most promise
- Economic viability (adoption, scaling, profitability) depends on access to markets and relative prices
- Actual costing of any innovation must be integrated into all future assessments of technological effectiveness
- Future programs promoting outputs and sales of perishable foods may need to include SBCC aimed at producers *and* consumers

FINAL THOUGHTS

- Investments in agriculture still matter. They directly contribute to improved diets, ASF and hort. intake of children and women, and even to reduced stunting…
- …if projects provide additionality: multiple entry points, reinforcement of messages, building knowledge and appetite for innovation. This means not just adding SBCC, but technology interventions, market literacy, credit access.
- Next generation research on ag-nut must focus on cost-effectiveness of programs from uptake lens, time to delivery of nutrition outcomes, and costing of cross-program effects.

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