Marginal Abatement Cost Curves for Latin American Dairy Production: A Costa Rica Case Study

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SUSTAINABLE FUTURES FOR THE COSTA RICA DAIRY SECTOR: OPTIMISING ENVIRONMENTAL AND ECONOMIC OUTCOMES (SUSCORIDA)

To develop sustainable futures for food production in the tropics

using the Costa Rican dairy sector as a case study.

Proof of concept:

- Explore existing data on dairy farm systems
- Measure field-scale nutrient losses (ammonia and nitrate)
- Model a range of scenarios - of improved management practices at the farm scale (on production, socio-econ. & environ. outcomes)
- Work with stakeholders to propose and model promising pathways of sustainable intensification for the dairy and wider land use sectors – assessing synergies and trade offs between production, socio-economic and environmental outcomes
- Provide training to Costa Rican researchers, technicians, industry: environmental loss measurements, LCA approaches

OUTLINE

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Dairy Sector in Costa Rica

- Annual milk consumption: 212 kg per capita
- 12% of value added in agriculture sector
- Free trade agreement (DR-CAFTA)
- Greenhouse gas (GHG) emissions
- Toward “Carbon Neutral Economy”
- Dairy farms must remain competitive whilst reducing environmental impact
- Potential mitigation measures, but at what cost

Objectives

- To develop Marginal Abatement Cost Curves (MACC) to assess the feasibility of selected GHG mitigation measures for Costa Rican dairy farmers
- To illustrate the economic and technological feasibility of mitigation action across the wider Latin American Countries sector



Methods

Data collection

96 dairy farms (5 typologies), members of Dos Pinos
Done by CATIE: July-December 2018 and March-May 2019

Life cycle assessment

Scope: from cradle (production of inputs) to farm gate (milk production)
Goal: GHG emissions (kg CO_2 eq) per kg of milk

Mitigation measures

Workshops in September 2019 and January 2020 with multi stakeholders

Abatement cost

$$Abatement\ cost_i = \frac{Cost_i - benefit_i}{reduced\ GHG_i} \times -1$$

Number of farms in each typology

Farm typologies (Vargas-Leitón et al. 2013)	**Number of the farms**
Dual Purpose Extensive Lowlands **(DP_E_L)**	5
Specialised Dairy Extensive Lowlands **(SD_E_L)**	34
Specialised Dairy Intensive Lowlands **(SD_I_L)**	21
Specialised Dairy Intensive Uplands **(SD_I_U)**	19
Specialised Dairy Semi Intensive Uplands **(SD_SI_U)**	17
Total farms	n = 96

Mitigation measures

Efficiency measures (EF)

EF AH	Animal health
EF GI	Genetic improvement
EF IC	Increase Concentrate

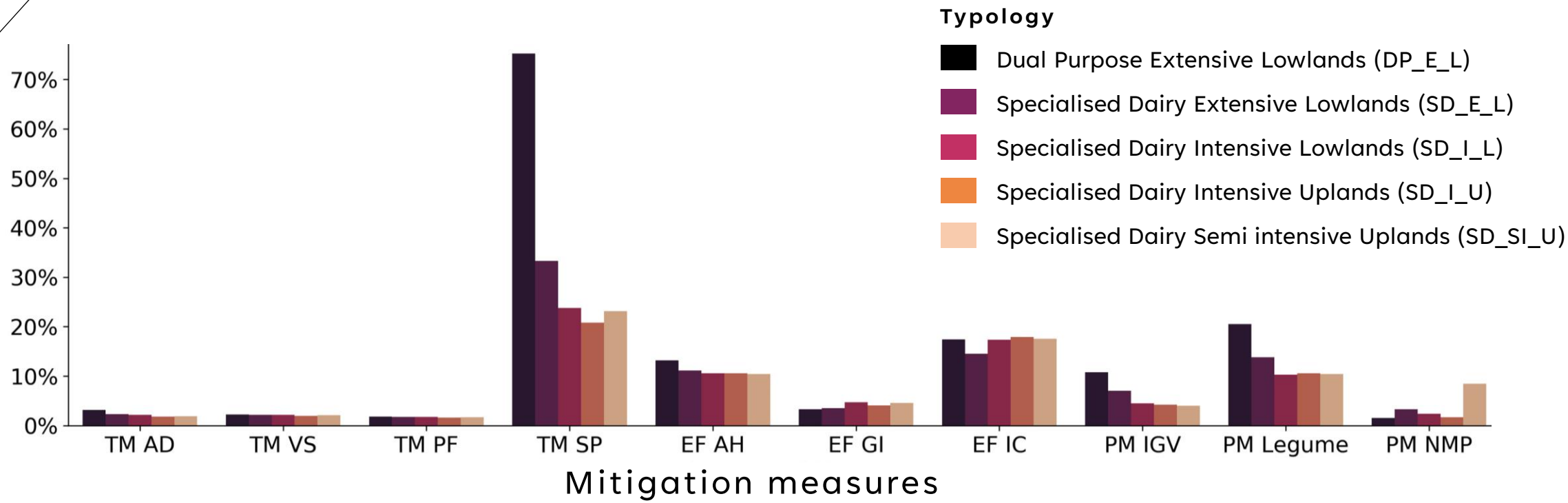
Pasture measures (PM)

PM IGV	Improved grass variety
PM LM	Legume
PM NMP	Nutrient management plan

Technical measures (TM)

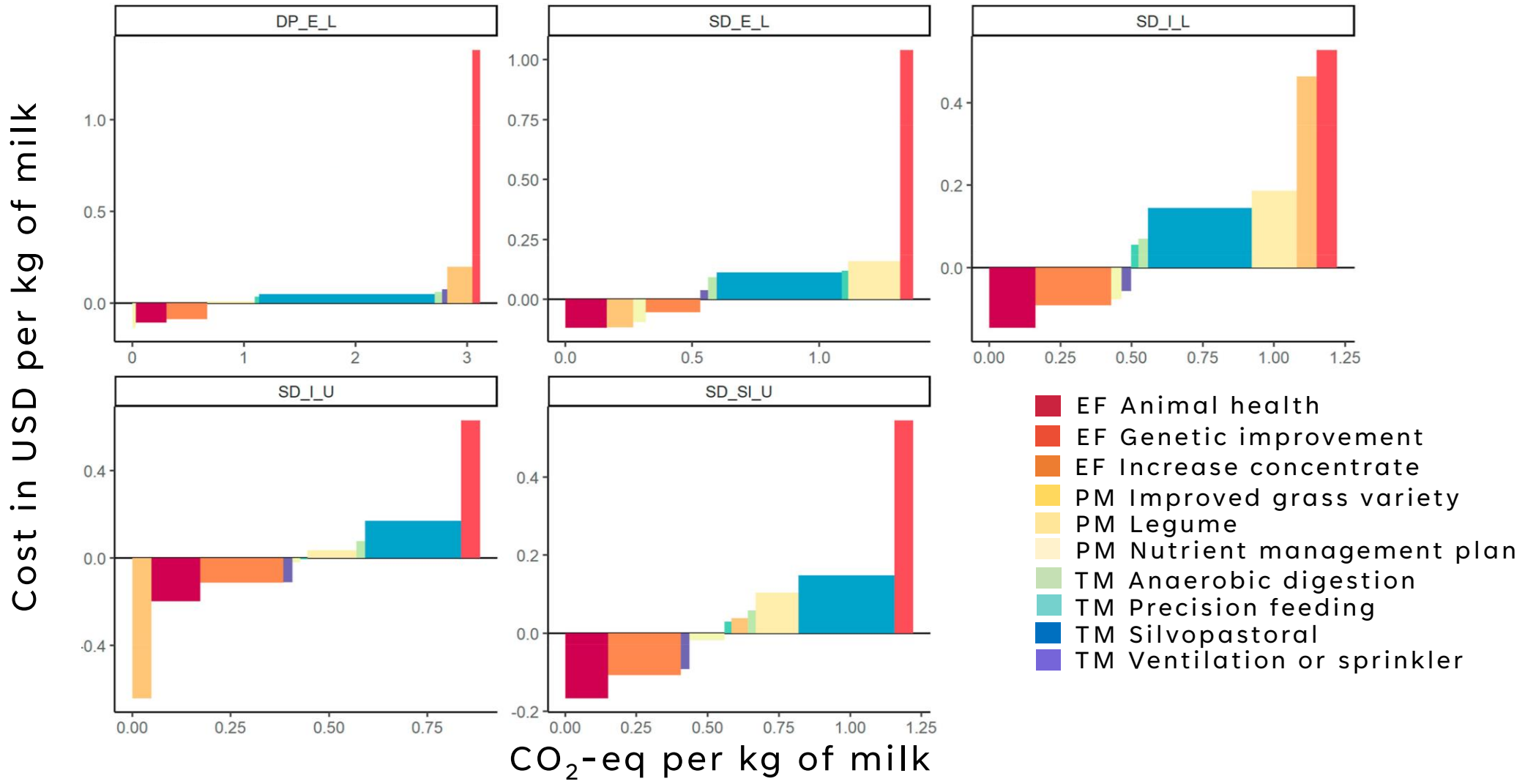
TM AB	Anaerobic digestion
TM VS	Ventilation or sprinklers
TM PF	Precision feeding
TM SP	Silvopastoral system

Potential abatement of GHG per kg of milk



- All measures show potential to abate GHG per unit of milk
- Silvopastoral system had the highest potential of GHG abatement
- Precision feeding had the lowest potential of GHG abatement

MACC for each typology



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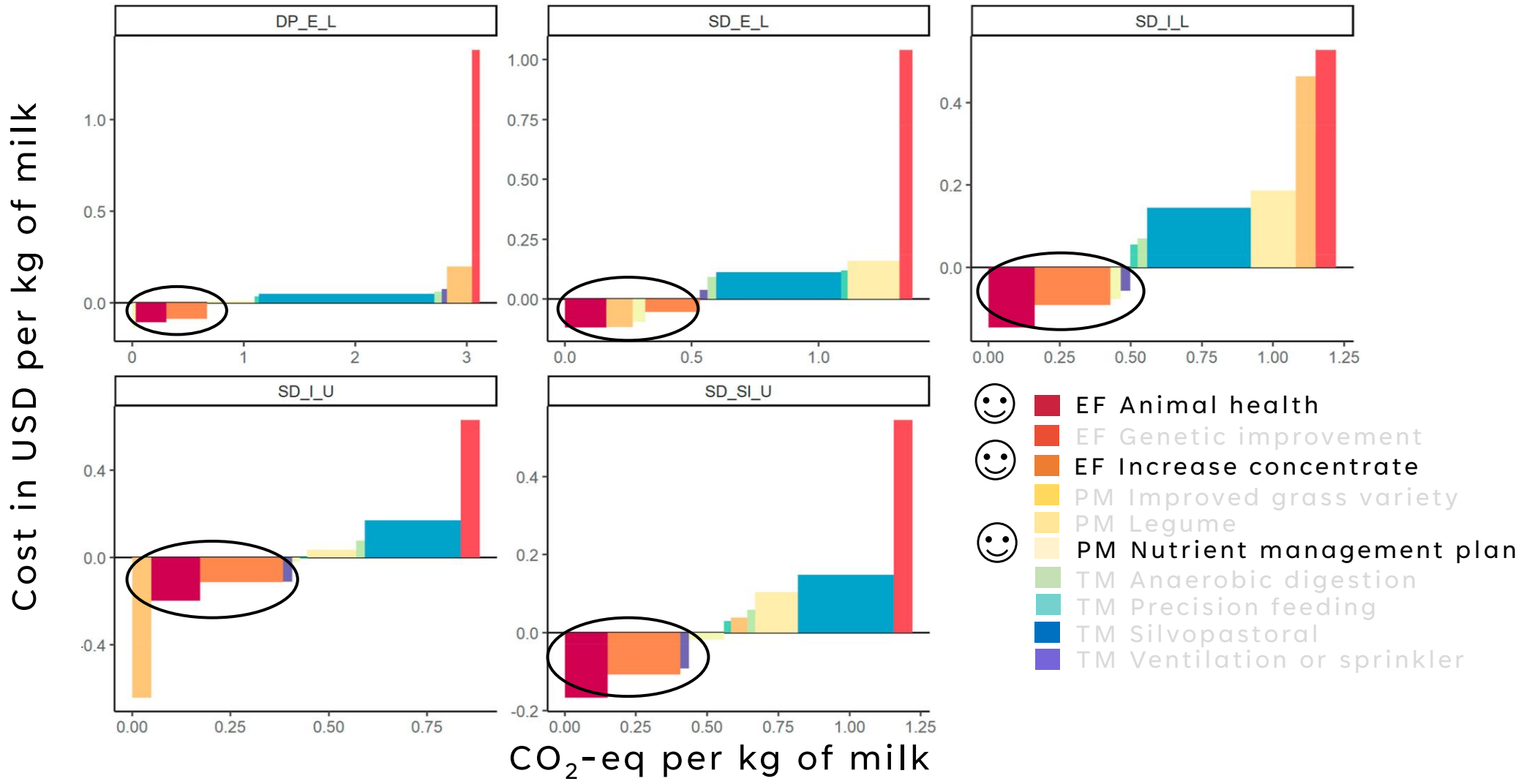
MACC for each typology



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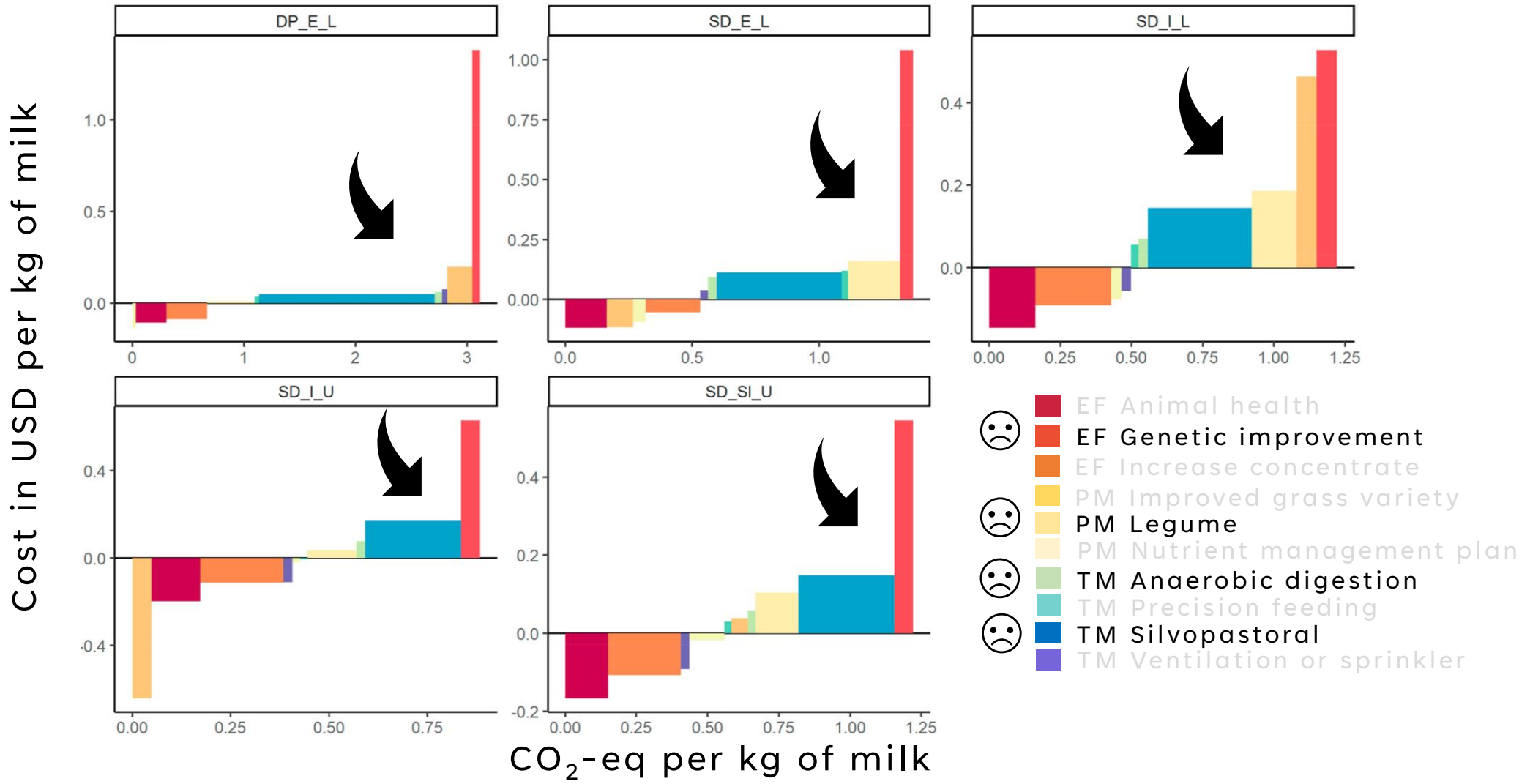

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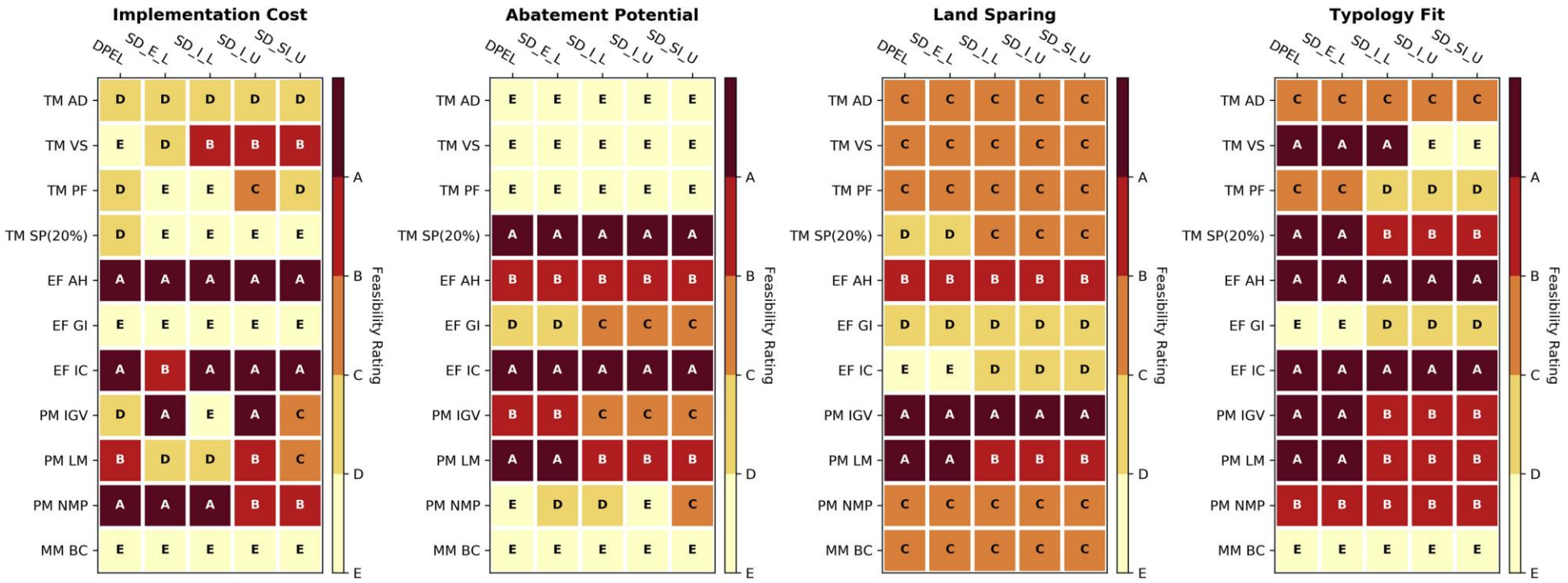
Take home messages

- Effective strategies for mitigation are highly context-specific, mitigation measures must be assessed for individual typologies
- Further analyses need to be undertaken with a broader system boundary to consider inter-system consequences of mitigation options

THANK YOU

Feasibility assessment



TM Anaerobic digestion

TM Ventilation or sprinkler

TM Precision feeding

TM Silvopastoral

EF Animal health

EF Genetic improvement

EF Increase concentrate

PM Improved grass variety

PM Legume

PM Nutrient management plan

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