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Productivity, emissions intensity and pollution swapping effects in dairy farming

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1 Motivation & Method

- Reducing emissions intensity through **technical and efficiency changes** might be costly and also pollution swapping effects[1]

- P**ollution swapping** occurs when practices aimed to decrease a pollutant result in increases of another (e.g. livestock feeds high in fiber may reduce ammonia emissions but increase GHG emissions[2])

→ ***Does technical and efficiency change in dairy farming result in productivity losses and pollution swapping effects between GHG and ammonia emissions intensity?***

- We estimate a by-production frontier model and quantify the contribution of technical and efficiency change to the productivity of economic output, GHG and ammonia emissions[3]

- Last, we assess the correlation of technical efficiency with respect to economic output and environmental efficiency with respect to ammonia and GHG emissions[3]

2 Data & Results

- We use a panel farm level data of 171 dairy farms (2009-2020, N=623) from Swiss farm accountancy data network and the agri-environmental data network[4,5]

TABLE 1: Summary statistics, sample of Swiss dairy farms (2009-2020)

Variable	Unit	Mean	St. deviation
Economic output (Y)	1000CHF	172.6	114.5
Ammonia emissions ($B1$)	KG of CO_2 equiv.	29.3	13.1
GHG emissions ($B2$)	KG of CO_2 equiv.	150.9	71.8
Capital (x_1)	1000CHF	238.8	258.4
Labour (x_2)	Standardized working days	518	179
Area (x_3)	hectares(ha)	23.7	11.2
Materials (x_4)	1000CHF	100.6	59.2
Valley (R_1)	1 if located in valley region, 0 otherwise	0.2	
Hill (R_2)	1 if located in hill region, 0 otherwise	0.5	
Mountain (R_3)	1 if located in mountain region, 0 otherwise	0.3	
Stocking density (z_1)	Livestock units per ha	1.38	0.5
Share of family Labour (z_2)	Fraction	0.7	0.2
Use of drag hose (z_3)	Binary	0.5	

TABLE 4: Spearman rank correlation coefficients

	Technical efficiency change	GHG efficiency change	Ammonia efficiency change
Technical efficiency change	1.000		
GHG efficiency change	-0.182*	1.000	
Ammonia efficiency change	-0.236*	-0.248*	1.000

Note: * indicates statistical significance at 5%.

- -0.182 and 0.236 suggest that **abatement is costly**

- -0.248 suggests **pollution swapping effect**

3 Conclusion & Future Research

- Holistic policy perspectives are required to reduce trade-offs between productivity growth and emissions intensity reduction

- Results-based schemes could give farmers freedom to choose optimal options to reduce trade-offs

- Future research should focus on the impact of results-based schemes on reducing trade-offs

4 Contribution to Sustainable Food Systems

Balancing between increasing agricultural productivity and reducing emissions intensity contributes to achieving the following UN SDGs:

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References:

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