Frame conditions for a more sustainable pesticide use: evidence from smallholding potato producers in Boyacá, Colombia.

Giuseppe Feola* and **Claudia R. Binder***§

* Social and Industrial Ecology, Department of Geography, University of Zurich, Switzerland

§ Institute of System Science, Innovation and Sustainability Research, University of Graz, Austria

PROBLEM

Pesticide overuse causes environmental, economic and health effects which undermine agricultural sustainability. Understanding farmers' decisions on pesticide use is fundamental in fostering a transition towards more sustainable agricultural practices.

RESEARCH GOALS

i) to analyse pesticide use and identify different fungicide and insecticide application types;

ii) to investigate the determinants of adoption by farmers of fungicide/insecticide application types.

PROCEDURE

1 Theoretical background: **integrative agent centred (IAC) framework** (Feola and Binder 2009)

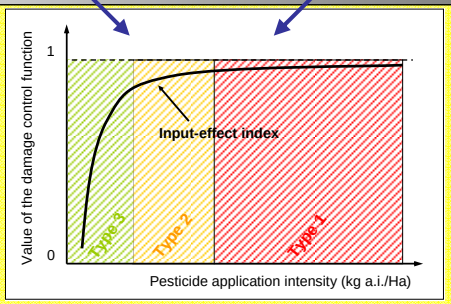
2 **Data collection** (survey, N=197)

3 Estimation of **production functions** with **damage control function** specification (Lichtenberg and Zilberman, 1986)

4 Calculation of the input-effect **(I-E) index** for fungicide and insecticide respectively

5 Identification of fungicide / insecticide **application types** and respective **clusters** of farmers

6 Analysis of the **determinants of adoption** of a fungicide/insecticide application type (multinomial logistic regression)



Farmers can achieve the same level of damage control (i.e. pest abatement) by applying pesticide at different intensity levels.

STUDY AREA: Vereda La Hoya, Boyacá, Colombia

Altitude: 2,800 m
Area: 840 ha
Population: ~747 inhabitants (~ 130 households)
Smallholding farming (< 3 ha)
Main agricultural product: potato (also carrots and others)

RESULTS

Fungicide and insecticide **application types**

FUNGICIDE application types.

	Units	Type1 (n=27)		Type2 (n=27)		Type3 (n=26)
I-E index	-	0.04 *(0.02)*	***	0.16 *(0.05)*	***	0.38 *(0.09)*
Intensity of application	kg a.i./ha	27.63 *(15.30)*	***	7.13 *(2.63)*	***	1.97 *(0.87)*
Number of applications	-	9.70 *(3.33)*	**	5.89 *(3.71)*	**	3.12 (3.30)
Damage control (Exponential specification)	-	1.0000 *(0.0001)*	***	0.9744 *(0.0284)*	***	0.6814 *(0.1858)*
Productivity	ton/ha	15.6 *(10.9)*		13 *(8.8)*	*	8.9 *(6.7)*

INSECTICIDE application types.

	Units	Type1 (n=31)		Type2 (n=31)		Type3 (n=31)
I-E index	-	0.20 *(0.09)*	***	0.55 *(0.12)*	***	1.64 *(0.93)*
Intensity of application	kg a.i./ha	6.72 *(4.48)*	***	1.90 *(0.40)*	***	0.74 *(0.36)*
Number of applications	-	8.35 *(5.10)*		6.42 *(3.98)*	**	4.23 *(2.85)*
Damage control (Exponential specification)	-	1.0000 *(0.0000)*	***	0.9998 *(0.0004)*	***	0.9089 *(0.1483)*
Productivity	ton/ha	16.8 *(9.8)*	**	12 *(7.8)*		10.1 *(8.7)*

Average values (standard deviation in brackets)
*Significant difference between types (1-2 and 2-3): *** 1%, ** 5%, * 10% (Mann-Whitney test)*

Significant **determinants** of adoption of application types

Fungicide	
Determinant	**Effect on: I-E index**
Farmer was trained by pesticide producers	-
Farmer's income mainly depends on agriculture	-
Farmers has high sense of compliance with other farmers' opinion	+
Area of farmer's parcel	+
Farmer is member of a cooperative	+

*Fungicide use model's facts: AIC: 135.076; Chi-square: 36.609***; Nagelkerke R sqr: 0.413.*

Insecticide	
Determinant	**Effect on: I-E index**
Farmer was trained by pesticide producers	-
Farmer's level of education	-
Farmer had sources of income not coming from agriculture	-
Area of the parcel	+

*Insecticide use model's facts: AIC: 183.419; Chi-square: 30.984***; Nagelkerke R sqr: 0.319.*

CONCLUSIONS

Pesticide use positively contributed to productivity. However, a trade-off existed between maximization of productivity and I-E index. Therefore, there is room to improve pesticide use efficiecy while aiming at high productivity.

Essential to promote a better pesticide use is i) to involve pesticide producers in the interventions, and ii) to foster cooperatives of farmers.

REFERENCES

- Feola G., Binder C.R., 2009. The integrative agent-centred (IAC) framework as a conceptual tool to investigate transition processes in local agricultural systems. Short paper presented at the *First European Conference on Sustainability Transitions: Dynamics and Governance of Transitions to Sustainability*, 4-6 June 2009, Amsterdam

- Lichtenberg E., Zilberman D., 1986. The Econometrics of Damage Control: Why Specification Matters. *American Journal of Agricultural Economics* 68:261-273

University of Zurich Department of Geography

This project was funded by the Swiss National Science Foundation

For more detailed information please contact Giuseppe Feola: **giuseppe.feola@geo.uzh.ch**

SIE social industrial ecology