Università degli Studi di Firenze

DEISTAF

Dept of Agricultural and Forest Economics, Engineering, Sciences and Technologies

ECONOMIC AND AGRONOMIC RESPONSE OF INDUSTRIAL CROPS TO DRIP AND HOSE-REEL SPRINKLER IRRIGATION: RESULTS OF A THREE YEAR RESEARCH PROJECT IN NORTH ITALY

Graziano Ghinassi
graziano.ghinassi@unifi.it

Co-authors: L. Zammarchi and S. Cecchi

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Università degli Studi di Firenze
Dipartimento di Economia, Ingegneria, Scienze e Tecnologie Agrarie e Forestali
Sezione Ingegneria dei Biosistemi Agrari e Forestali

Comparazione dell'Efficacia Agronomica ed Economica dell'Irrigazione Effettuata con Macchine Irrigatrici Semoventi e Linee Gocciolanti

Graziano Ghinassi
(Responsabile Scientifico)

RAPPORTO FINALE

AIM OF THE RESEARCH

- A triennial research project started in 2009 under the scientific supervision of the Department of Agricultural and Forest Economics, Engineering, Sciences and Technologies (DEISTAF) of the University of Florence;

- Aim of the project was to compare agronomic and economic performance of some industrial crops, irrigated by drip and hose reel systems under the same agronomic and climatic conditions.

SELECTION OF THE FARMS

- Field activity was carried out in 11 medium-sized farms, from 50 to 170 ha, normally using both drip and hose reel irrigation;
- 15 comparisons (=30 case studies);
- Comparison refers to the use of drip and sprinkler irrigation on the same crop during the same season, according to the ordinary on-farm procedures.

CROPS

- ✓ Sugar beet
- ✓ Onion
- ✓ Maize (forage)
- ✓ Potato
- ✓ Tomato
- ✓ Tobacco

BASIC PREREQUISITES

- Farmers:

  -experience and skills in the use of both methods;

  -no preference for one irrigation type vs the other;

  -stated objective of the irrigation practice is maximal yield (= no water stress allowed):

Hose-reel with guns and booms

Drip systems


Locations of the farms
Florence
Rome

PROJECT OUTPUTS ON

- AGRONOMY
- ECONOMY
- IRRIGATION

AGRONOMIC OUTPUTS

- Net Irrigation Requirement (evapotranspiration, effective rainfall, exposed and wetted soil area);
- Gross Irrigation Requirement (=supplied water);
- Market yield;
- Other (i.e., yield quality parameters);

CROP WATER NEEDS AND SUPPLIES

- ✓ Evapotranspiration (Hargreaves + site specific kc):

$$ET_{oH} = C * Ra * (T_{mean} + 17.8) * \sqrt{T_{\max} - T_{\min}}$$

- ✓ Effective rainfall (USDA, 1970):

ER = fc (1.253 * $R^{0.824}$ – 2.935) (10 $^{0,001\ ETc}$)

- ✓ Exposed and wetted soil area: FAO, 1998

- ✓ Supplied water: water meter

MARKET YIELDS

FARM	CROP	YIELD (q/ha)	
		SPRINKLER	DRIP
AR-1 2009	Tomato	1053	1124
PI-1 2009	Forage Mais	572	626
AR-1 2010	Tobacco	199	235
PI-1 2009	Forage Mais	852	703
BO-2-09(*)	Onion	541	568
FE-1-09	Tomato	920	804
PR-1-09	Tomato	623	718
VR-1-09	Tobacco	205	195
B0-2-10(*)	Onion	462	395
FE-3-10	Tomato	750	750
PR-1-10	Tomato	620	711
VR-1-10	Tobacco	225	226
BO-2-11(*)	Onion	497	511
PR-1-11	Tomato	861	901
VR-1-11	Tobacco	224	228

(*) Boom

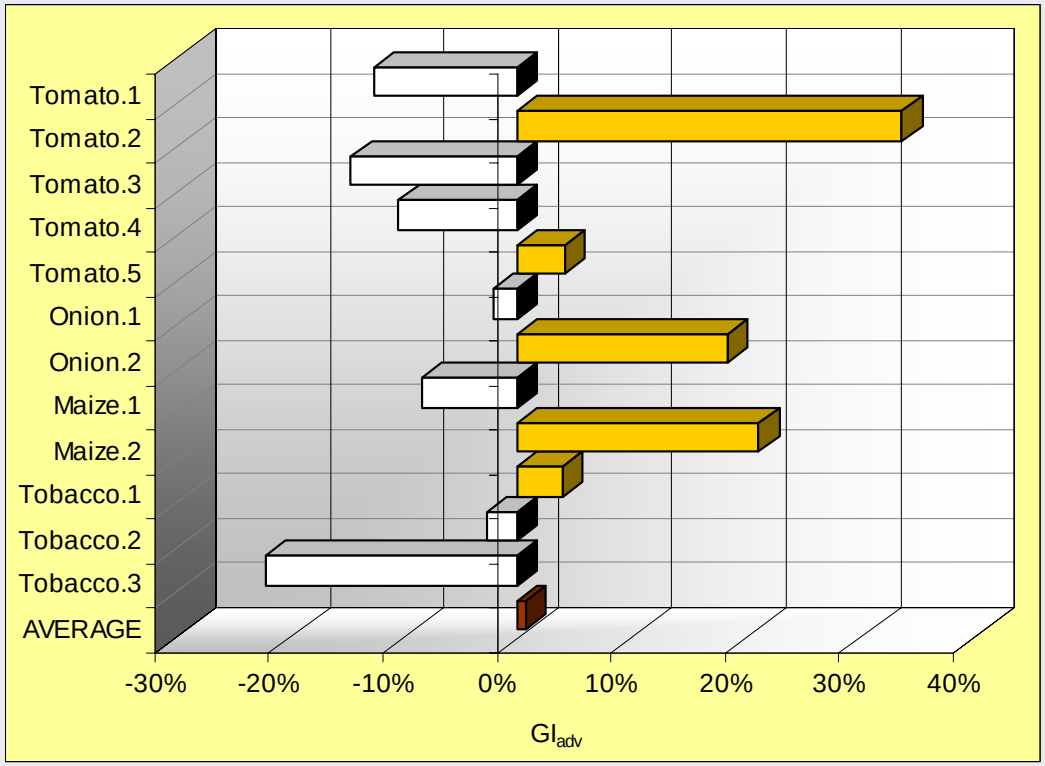
ECONOMIC OUTPUTS

Given as *indexes* in order to allow comparisons both within the individual case study and between case studies, regardless of the absolute value of each variable;

- **Production index**
- **Cost index**
- **Productivity index**
- **Relative Water Surplus**
- **other….**

Each index is arranged as *advantage* (either positive or negative) of sprinkler irrigation, assuming drip irrigation as the benchmark.

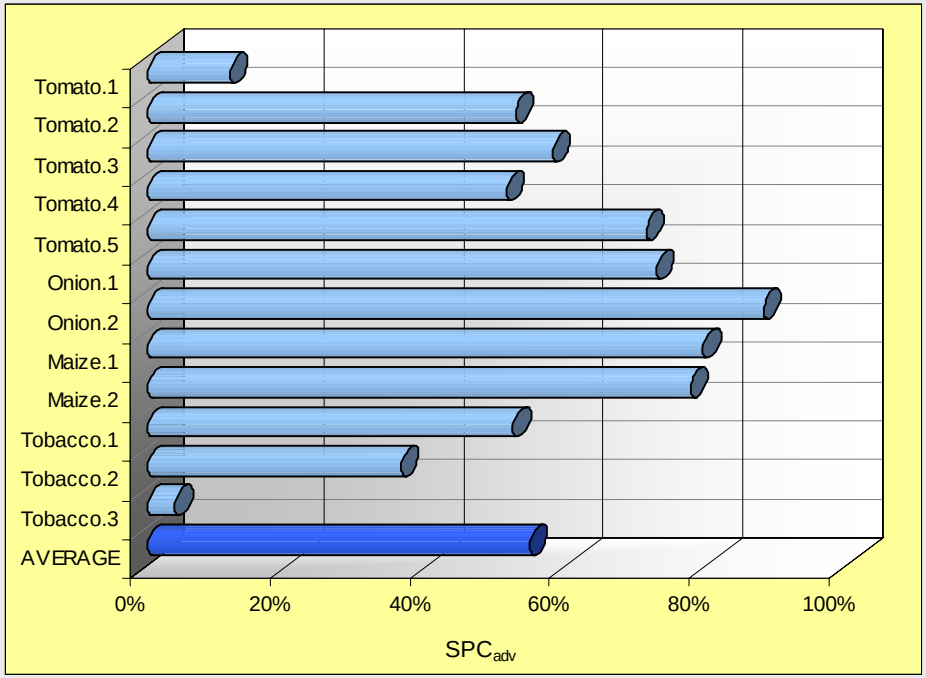
Production index - Gross Income (GI)



- The index varies from -22% to 34%.
- Negative in 10 cases out of 15, the mean value is -0.8%.
- There is no evidence for the superiority of one method to the other (I.e., results can be opposite between two subsequent seasons).

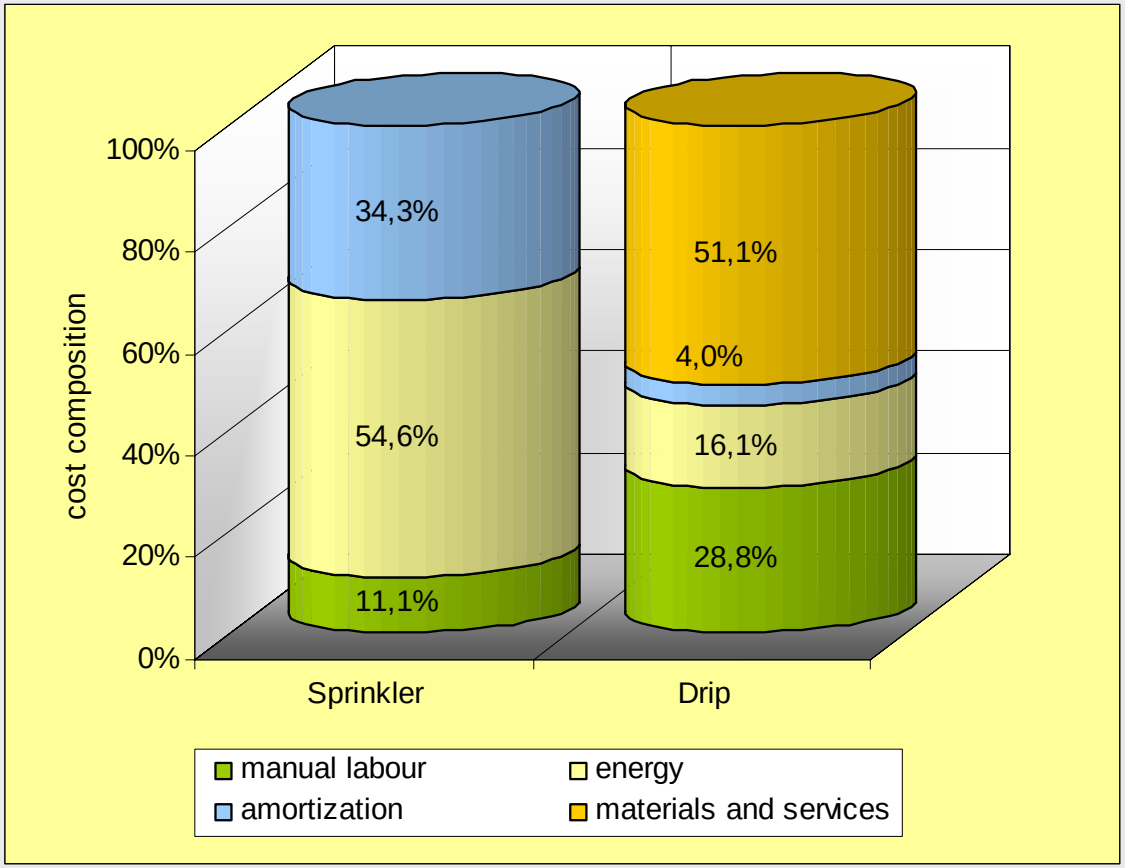
Cost index – Specific Cost (SPC)

Specific costs given by the sum of monetary and calculated costs



- Great variability among farms.
- The index ranges from 0.6% to 88%.
- Sprinkler is less expensive than drip in all cases.
- Advantage is about 48% on average.

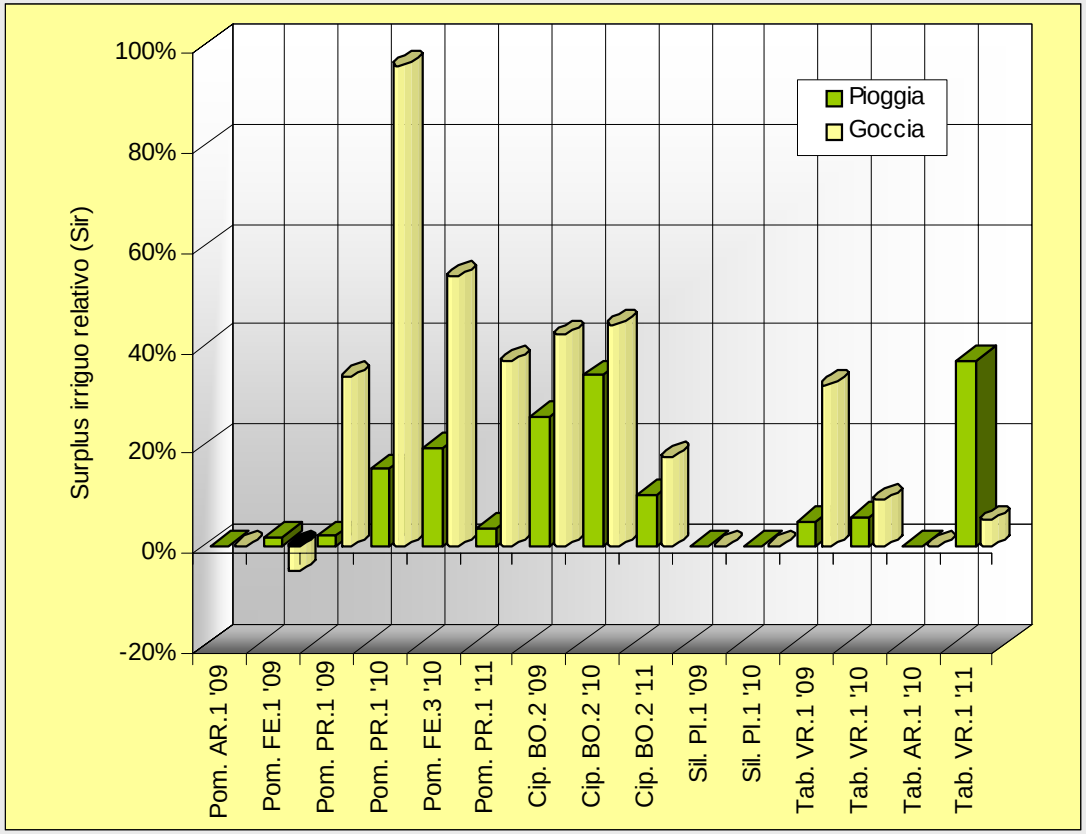
Cost index – Composition of SPC



- Energy is the main cost of hose reel irrigation (54.5% of SPC).
- Purchasing and disposal of drip lines is more the half of the drip SPC (52.5%).

Relative Water Surplus (RS)

Compares seasonal irrigation supply (SIS) to net irrigation requirement (NIR)



- RS can provide for comprehensive evaluation on equipment performance and professional skill.
- Surplus is nil in four cases, in 10 cases out of 11 RS is lower under sprinkler irrigation.

IRRIGATION OUTPUTS

FARM	SPRINKLER			DRIP		
	NIR (mm)	GIR (mm)	SE (%)	NIR (mm)	GIR (mm)	SE (%)
BO-2-09(*)	192	268	72	192	303	63
FE-1-09	141	160	88	93	115	81
PR-1-09	171	194	88	140	245	57
VR-1-09	162	189	86	154	238	65
B0-2-10(*)	150	224	67	150	241	62
FE-3-10	100	133	75	85	171	50
PR-1-10	94	120	78	80	204	39
VR-1-10	106	125	85	101	129	78
BO-2-11(*)	182	223	82	150	238	63
PR-1-11	230	263	87	196	348	56
VR-1-11	123	188	65	117	144	81
BO-1-09(*)	**96**	**111**	**86**			
BO-3-09	**123**	**207**	**59**			
CR-1-09	**209**	**240**	**87**			
FE-2-09	**71**	**100**	**71**			
FE-2-09	**110**	**140**	**79**			
AVERAGE			**78,4**			**63,2**

(*) Boom

CONCLUSIONS

- According to the economic evaluation, sprinkler hose reel irrigation performs better than drip irrigation in the farms under analysis.
- This does not provide us with final assessment, due to the extent and nature of the sample.
- Crop yields under the different irrigation types are equivalent in the case studies;
- Conversely, operational limits of hose reel irrigation were detected at farm level under particular environmental and farmland characteristics.

CONCLUSIONS

- These conditions (constraints) partially account for the spread of drip irrigation in the study areas.
- Management of sprinkler irrigation seems easier than drip irrigation in the study farms.
- Sprinkler and drip systems play a complementary role in actual farming system.
- The question is not to establish which of the two methods is to be preferred, but to decide on what is the most suitable combination of them at farm level.


Thank you
for your attention