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Participatory approach for developing knowledge of organic rice farming in Italy

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RISOBIOSYSTEMS

Research, development and transfer project in support of organic rice cultivation

Supported by the Italian Ministry of Agriculture and Forests (MIPAAF 2018-2020)

Composed by 6 work packages (WP)

Project's coordinator (WP1): CREA - Consiglio per la Ricerca in Agricoltura, Cereal and industrial crops sector

Partners:

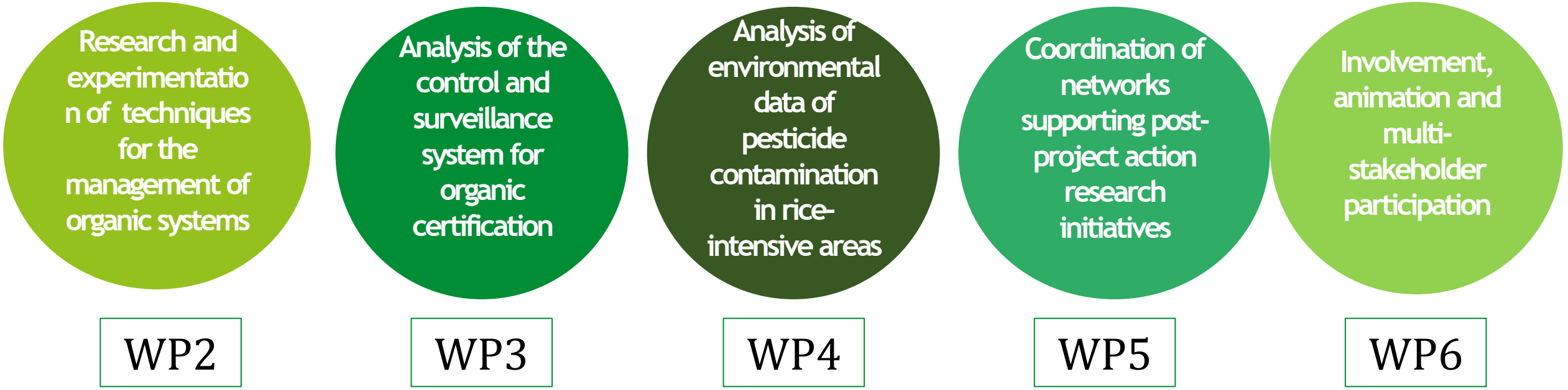
Ente Nazionale Risi (ENR) – WP2;

Università di Torino DISAFA, WP4, WP3, WP2;

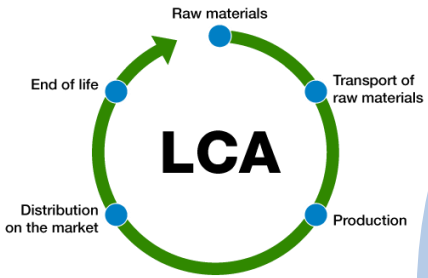
Università di Milano ESP, WP5, WP2, WP6;

CREA- Centro Politiche e Bioeconomia, Politics and Bioeconomy, WP3;

CNR-IRCRES l'Istituto di Ricerca sulla Crescita Economica Sostenibile del Consiglio Nazionale delle Ricerche, WP6.



RESEARCH



Study III

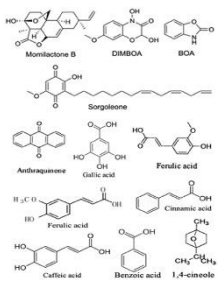
LCA to study the environmental impacts of organic rice farming

Study I

Understanding organic rice farming management strategies and productive performance

Study II

Evaluation of the allelopathic effect of cover crops in the management of rice weeds



RESEARCH

STUDIES

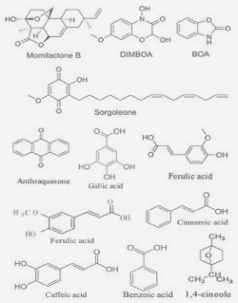
AIM

I. Understanding organic rice farming management strategies and productive performance

Develop location-specific crop management strategies in order to promote larger-scale organic rice farming

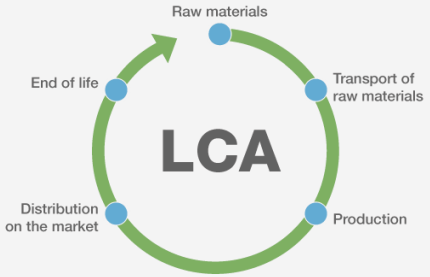
II. Evaluation of the allelopathic effect of cover crops in the management of rice weeds

Define the inhibitory action for weed control of *Lolium multiflorum* Lam. used as a cover crop before rice sowing



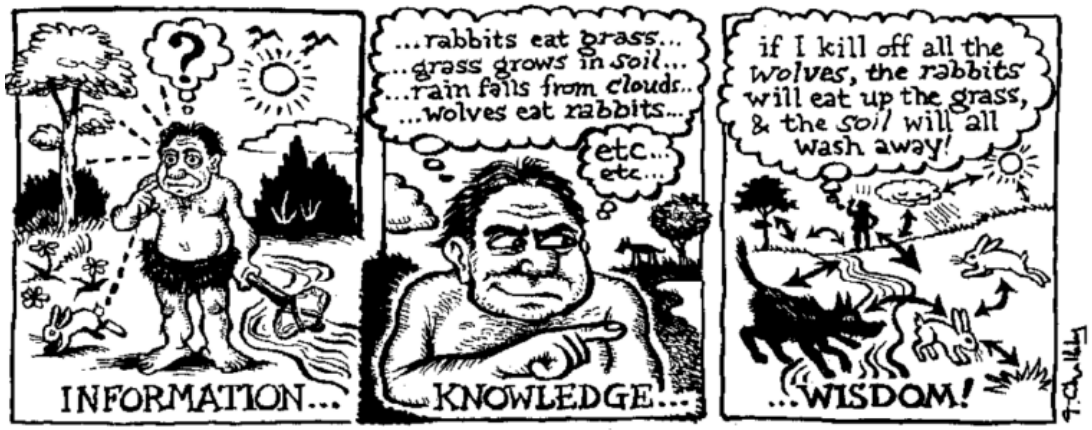
III. LCA to study the environmental impacts of organic rice farming

Update the current research scenarios about LCA analysis on organic rice farming



RESEARCH

I. Understanding organic rice farming management strategies and productive performance



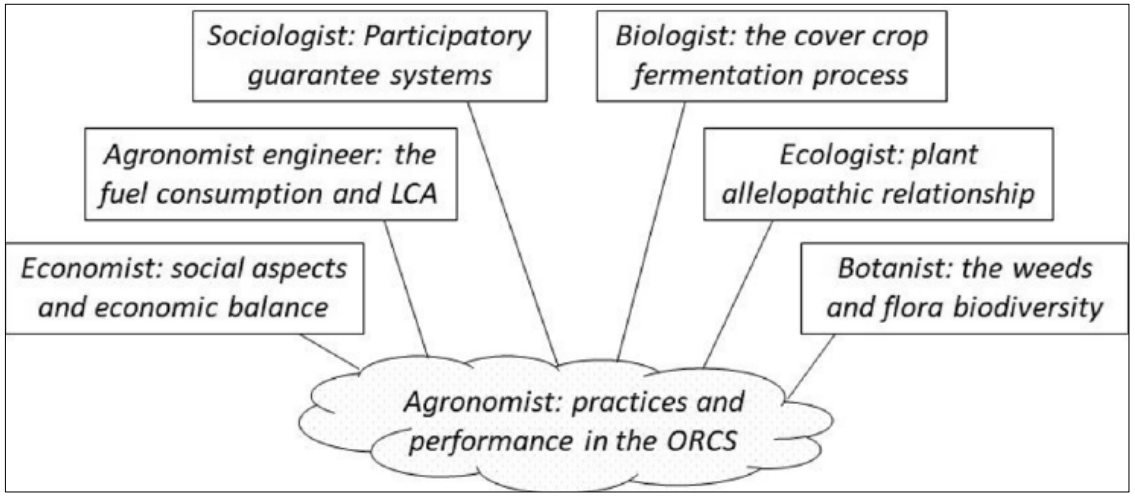
Data-Information-Knowledge-Wisdom (DIKW)

Interviews

Fields monitoring

Plenary meeting

Participatory Approach



RESEARCH

I. Understanding organic rice farming management strategies and productive performance

Features of monitored farms. Legend: P = Pavia Province (Lombardy); V = Vercelli Province (Piedmont); M = male; F = female; UAA = Utilised Agricultural Area; Y = yes.

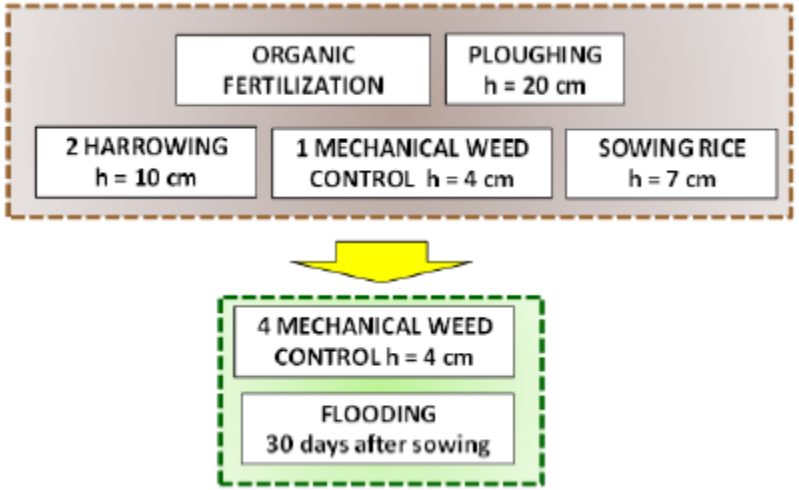
Farm ID	Site	Gender	Testing organic since	UAA (ha)	Organic crops (% UAA)	Rice (% UAA)	Set-aside	Rotation	Rotational Crops		
									Legumes	Cereals	Other crops
1	P	M	1976	476	100	29	Y	Y	soybean, pea	maize, rye	rapeseed
2	P	F	2006	106	100	30	Y	Y	soybean, bean, field bean	barley, spelt, triticale, wheat	buckwheat, rapeseed, sunflower
3	P	M	2008	13	100	12	Y	Y	bean, pea	maize	
4	P	F	2008	29	100	24	Y	Y	soybean, pea	mile, spelt	buckwheat
5	P	F	2016	103	100	18	Y	Y	alfalfa	maize	
6	P	M	2016	210	14	40	Y	Y	soybean	maize, barley, rye	
7	V	M	2015	125	100	80	Y				
8	V	F	2015	82	100	46	Y	Y	soybean		
9	V	M	2015	33	100	64	Y	Y	soybean		
10	V	M	2016	64	100	50	Y	Y	soybean		

→ Active role of women
→ Experienced organic farmers + beginners

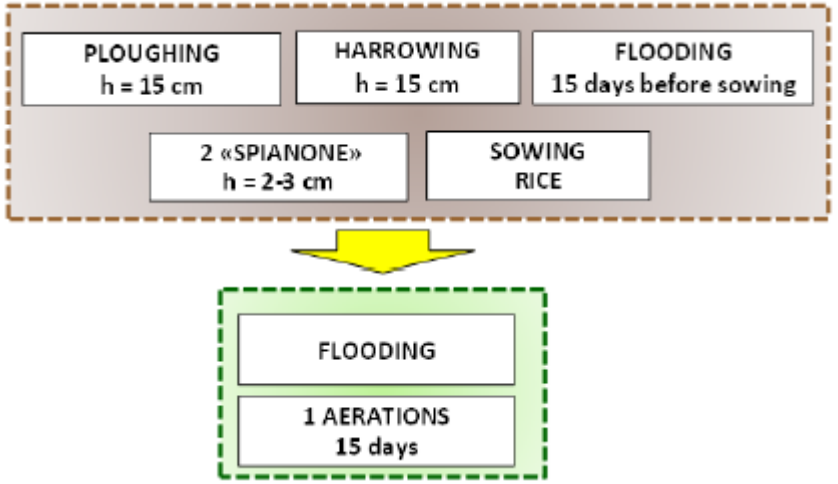
RESEARCH

I. Understanding organic rice farming management strategies and productive performance

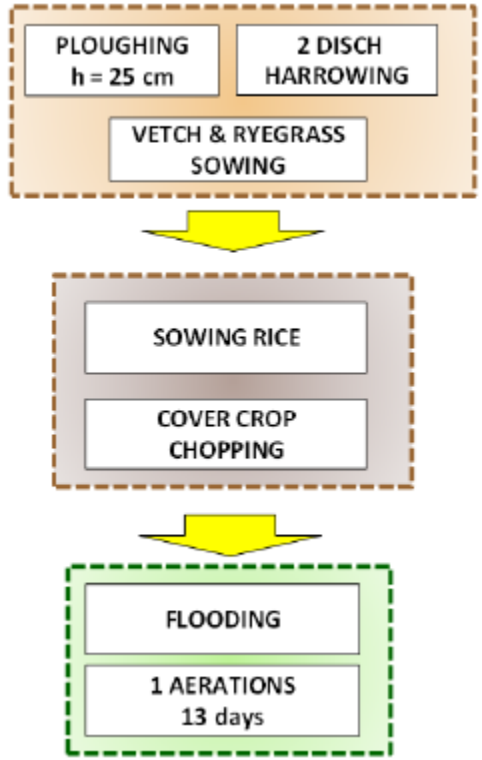
SD = Stale seedbed in Dry paddy, mainly using comb harrow



SF = Stale seedbed in Flooded paddy, using different types of machines



CC = use of green mulch from different Cover Crops



RESEARCH

I. Understanding organic rice farming management strategies and productive performance

Features of monitored organic rice cropping systems. Legend: SA-LO = sandy-loam; SI-LO = silty-loam; LO-SA = loamy-sand; SI = silt; Y = yes; SD = Stale seedbed in Dry paddy, in combination with comb harrow; Stale seedbed in Flooded paddy, in combination with minimum tillage machines; CC = Flooding of green mulch from different Cover Crops.

Farm ID	Rice varieties		Soil texture	Testing techniques			Monitored fields (n.)		
	Name	n°		SD	SF	CC	2016	2017	2018
1	Rosa Marchetti, Ronaldo, Baldo	3	SA-LO	Y	Y	Y	2	2	2
2	Rosa Marchetti, Ronaldo, Loto	3	SI-LO	Y	Y	Y	3	3	3
3	Ronaldo, Loto, Tondo cerere	3	SA-LO	Y			1	1	1
4	Carnaroli, Ermes, Venere	3	SA-LO	Y			2	2	1
5	Sant'Andrea, Baldo	2	SA-LO			Y	0	4	2
6	Sant'Andrea	1	LO-SA			Y	1	1	0
7	Rosa Marchetti, Pato	2	SI		Y	Y	2	3	1
8	Carnaroli	1	SI-LO			Y	3	3	2
9	Rosa Marchetti	1	SI-LO			Y	0	2	1
10	Rosa Marchetti, Carnise	2	SI-LO		Y	Y	1	1	0

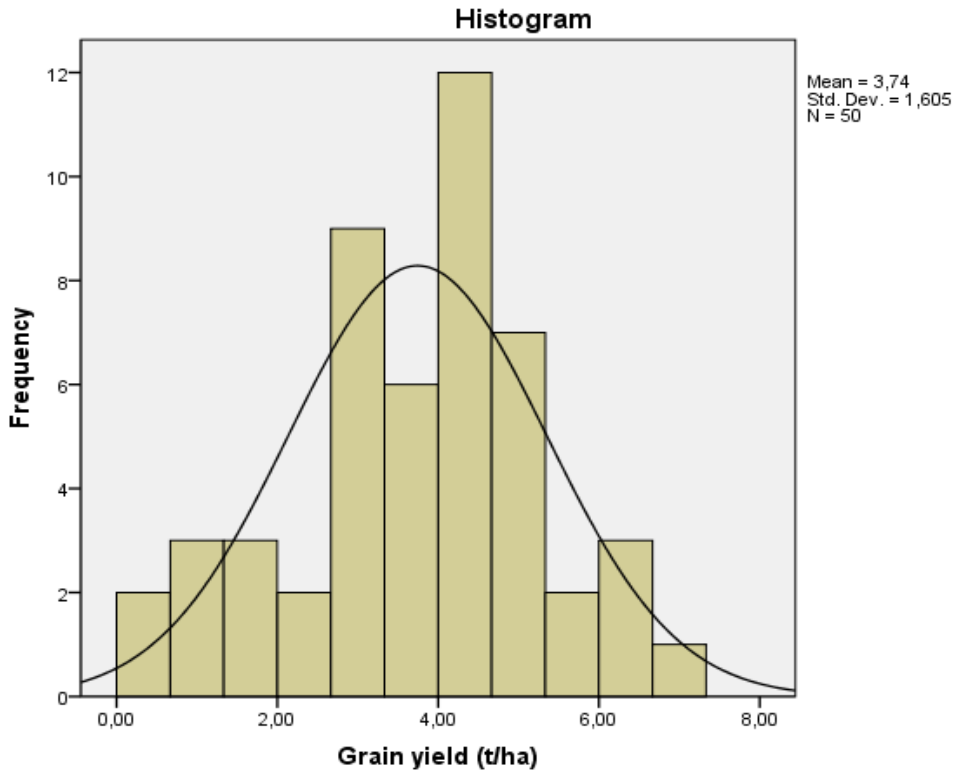
→ 50 monitored fields

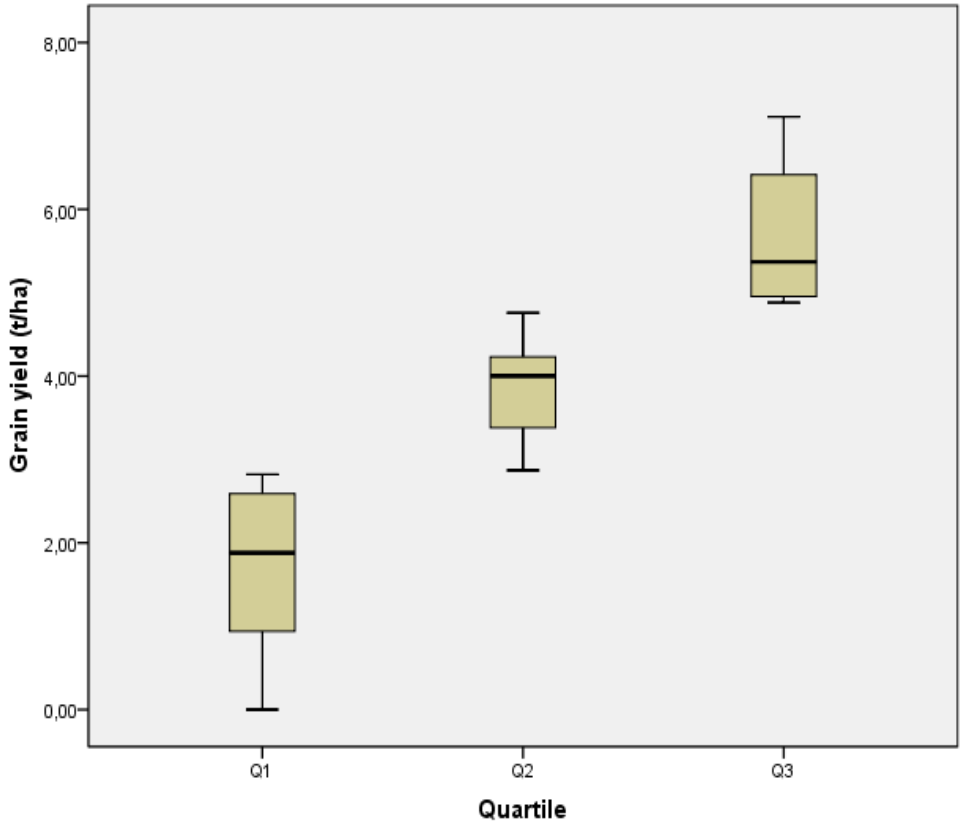
→ monitoring continued in 2019 (12 fields)

RESEARCH

I. Understanding organic rice farming management strategies and productive performance

Yield variability (0–7 t/ha) and normal distribution (median 4 t/ha).





The lower, middle and upper quartiles of yield showed a mean of about 2, 4 and 6 t/ha, respectively, with high variance associated with upper and lower quartiles.

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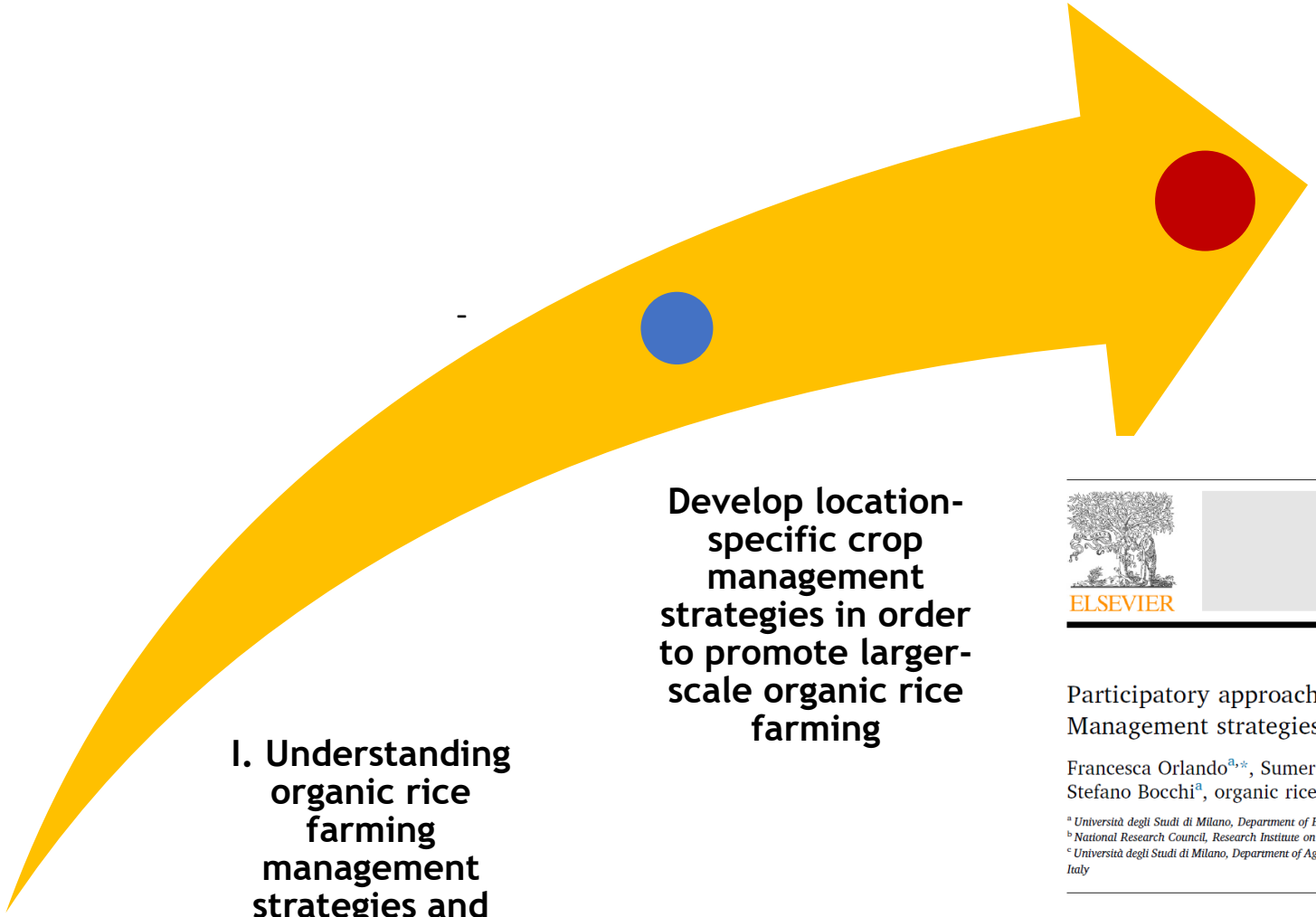

I. Understanding organic rice farming management strategies and productive performance

Develop location-specific crop management strategies in order to promote larger-scale organic rice farming

- **Organic farming management strategies and production performance in the Italian context were described**
- **The agro techniques described are not universal recipes but offer a flexible scenario of adaptive management**
- **Participatory research generate farmers aggregations**

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Participatory approach for developing knowledge on organic rice farming: Management strategies and productive performance

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ARTICLE INFO

Keywords:
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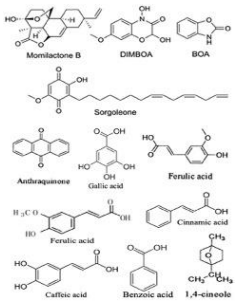
Bottom-up innovation
Farm-led research
Adaptive management
Organic rice
Yield variability

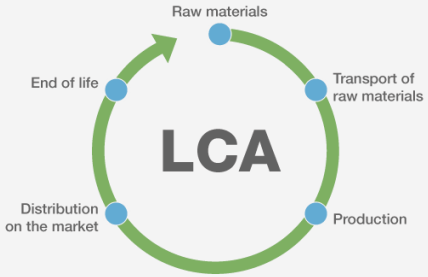
ABSTRACT

Rice is the third grown crop worldwide and responsible of significant environmental impacts. Nevertheless, there is a lack of knowledge concerning the organic rice' performance and management, probably due to the limits encountered by the reductionist approach in studying complex systems such as an organic paddy. The study proposes a knowledge-intensive and qualitative research methodology based on researcher-farmer participatory approach, with the aim to improve the state of knowledge on organic rice, explore the yield potential and variability, and identify the successful agronomic practices. A wide range of cropping systems placed in North Italy were monitored and analysed during three years by a multi-actor network. Knowledge was generated from

RESEARCH

STUDIES	AIM
I. Understanding organic rice farming management strategies and productive performance	Develop location-specific crop management strategies in order to promote larger-scale organic rice farming
II. Evaluation of the allelopathic effect of cover crops in the management of rice weeds	**Define the inhibitory action for weed control of *Lolium multiflorum* Lam. used as a cover crop before rice sowing**
III. LCA to study the environmental impacts of organic rice farming	Update the current research scenarios about LCA analysis on organic rice farming

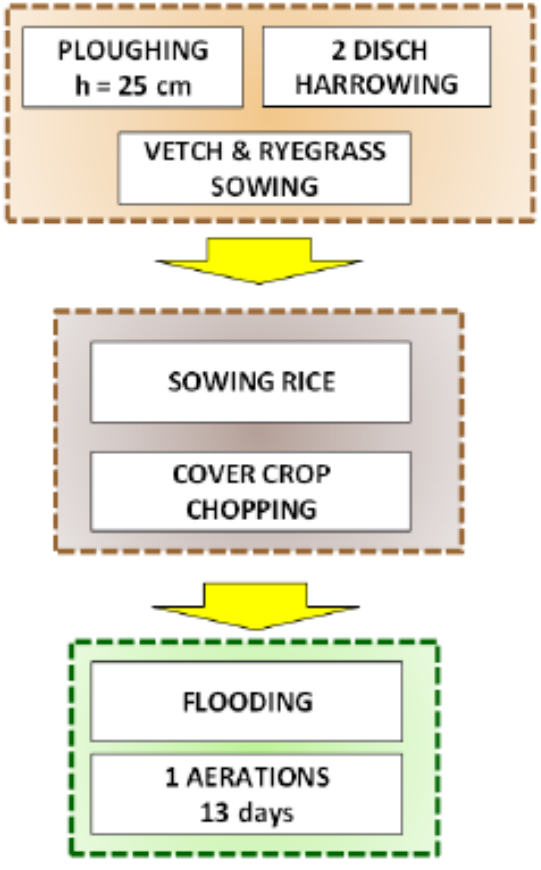




RESEARCH

II. Evaluation of the allelopathic effect of cover crops in the management of rice weeds

C.C. = Cover Crop is the green mulching technique



Define the inhibitory action of *Lolium multiflorum Lam*.

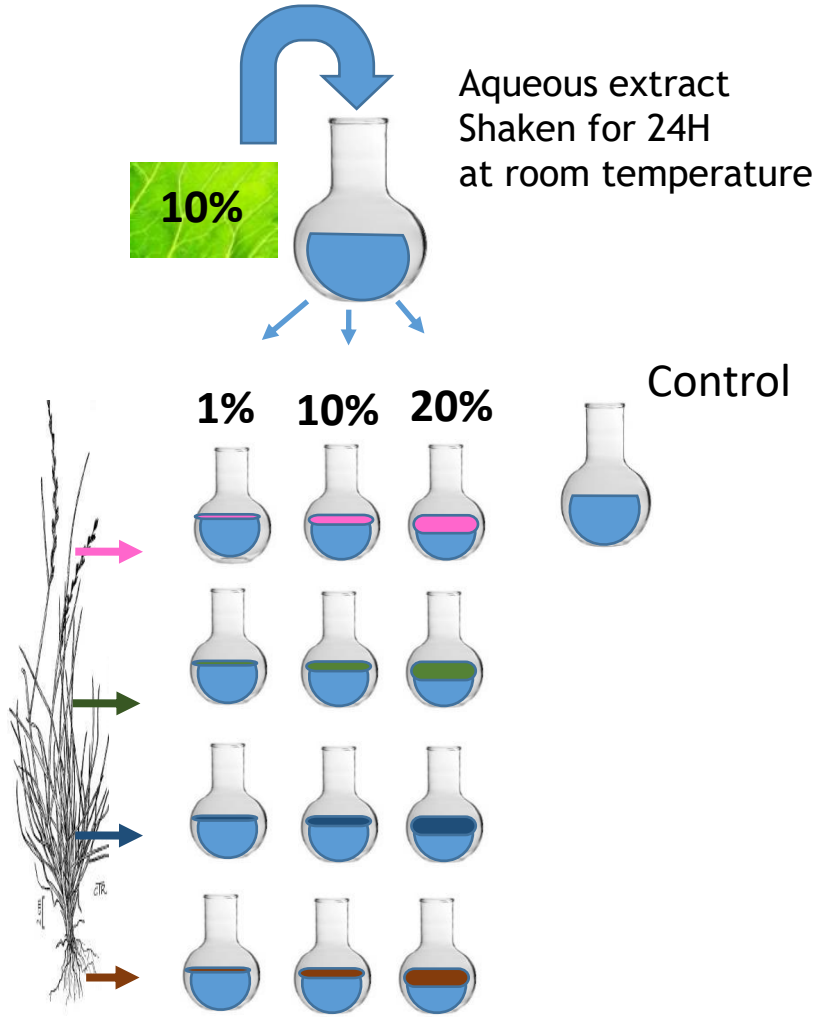
used as a cover crop before rice sowing,

against *Echinochloa oryzoides* (Ard.) Fritsch.

RESEARCH

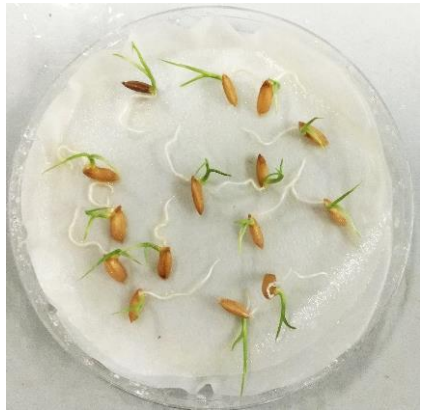
II. Evaluation of the allelopathic effect of cover crops in the management of rice weeds

Treatment



***Echinochloa oryzoides* (Ard.) Fritsch.**

***Oryza sativa* L.**



Dependent variables:

- Germination (%)
- Root length (mm)
- Shoot lenght (mm)
- Mean germination time
- Seedling vigour index (SVI)

Simple factorial experiment design
10 seeds in each Petri dishes
5 replicates for treatment

RESEARCH

II. Evaluation of the allelopathic effect of cover crops in the management of rice weeds

Define the inhibitory action for weed control of *Lolium multiflorum* Lam. used as a cover crop before rice sowing

- *Lolium multiflorum Lam.* was able to reduce the seed germination of *Echinochloa oryzoides* (Ard.) Fritsch. in laboratory experiment mainly considering aqueous leaf extract
- *Lolium multiflorum Lam.* leaf characterization by NMR and UPLC-HR-MS analyses identified compounds (e.g., protocatechuic and gallic acids) already known as allelochemicals

plants

MDPI

Article

Potential Role of *Lolium multiflorum* Lam. in the Management of Rice Weeds

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check for updates

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https://doi.org/10.1007/s11356-020-09573-8

RESEARCH ARTICLE

Check for updates

Different phytotoxic effect of *Lolium multiflorum* Lam. leaves against *Echinochloa oryzoides* (Ard.) Fritsch and *Oriza sativa* L.

Sara Vitalini [1] · Francesca Orlando [2] · Alessandro Palmioli [3] · Sumer Alali [4] · Cristina Airoldi [3] · Ivano De Noni [5] · Valentina Vaglia [4] · Stefano Bocchi [4] · Marcello Iriti [1]

Received: 16 April 2020 / Accepted: 1 June 2020 / Published online: 11 June 2020

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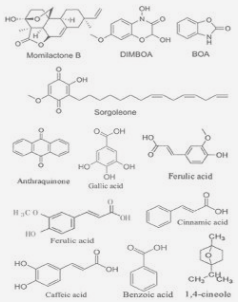
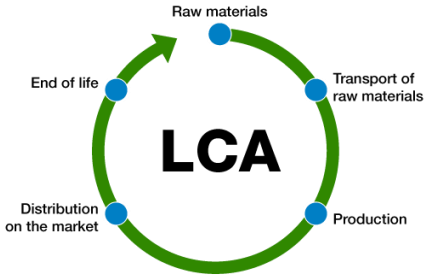
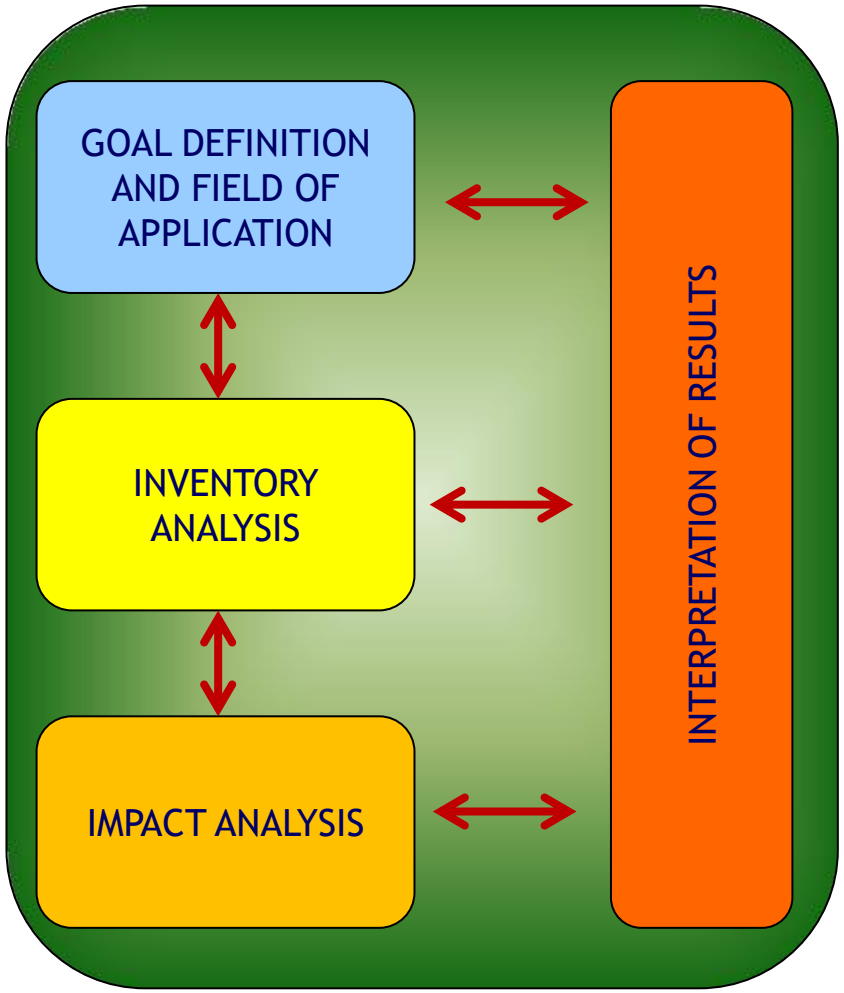




RESEARCH

Life Cycle Assessment (LCA) to study the environmental impacts of organic rice farming



1 - GOAL DEFINITION
Definition of the objectives of the analysis and the field of application (boundaries and functional unit)

2 - INVENTORY ANALYSIS
Inventory analysis. aimed at finding the necessary data regarding system inputs and outputs

3 - IMPACT ANALYSIS
Conversion and aggregation of inventory data into a few synthetic numerical indices

4 -INTERPRETATION OF RESULTS
and definition of potential improvement actions

IDENTIFY the processes that - within the analyzed system - are responsible for the greatest potential impact on the environment.

COMPARE DIFFERENT SOLUTIONS in order to identify the one with the lowest impact

CO_2

RESEARCH

Life Cycle Assessment (LCA) to study the environmental impacts of organic rice farming

LCA methodology to compares:
four alternative agricultural practices

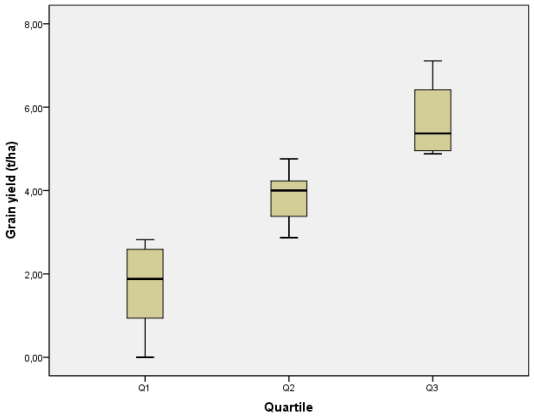
and two production potential levels observed during three-year monitoring on 10 farms.

The environmental performance took into account two productive levels recorded:

- 3.91 t/ha (Q2)
- 5.65 t/ha (Q3)

FU =

(PADDY RICE RH= 14%)



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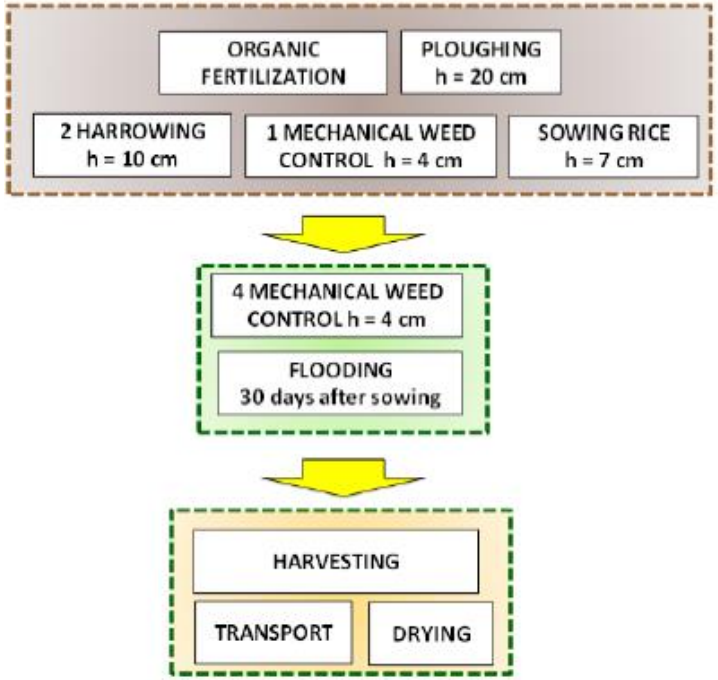
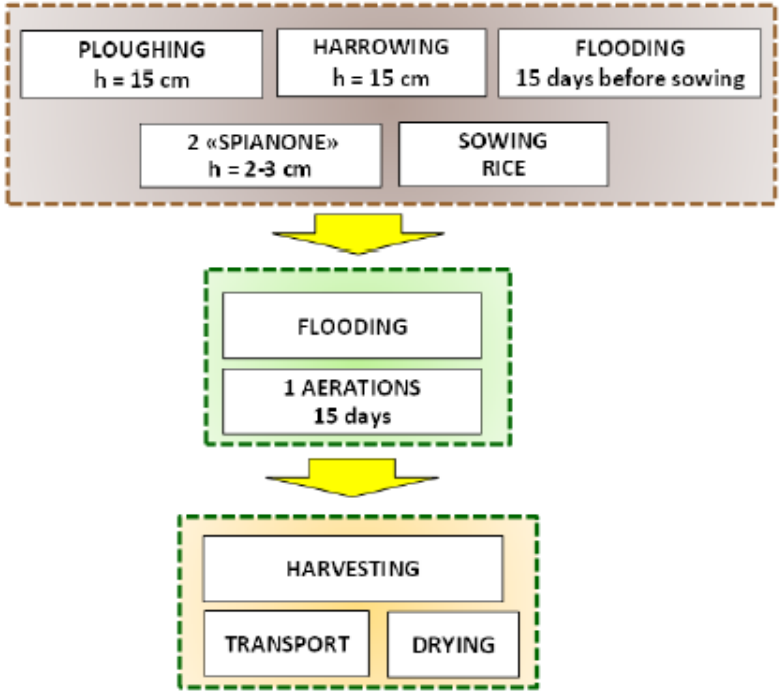
Life Cycle Assessment (LCA) to study the environmental impacts of organic rice farming

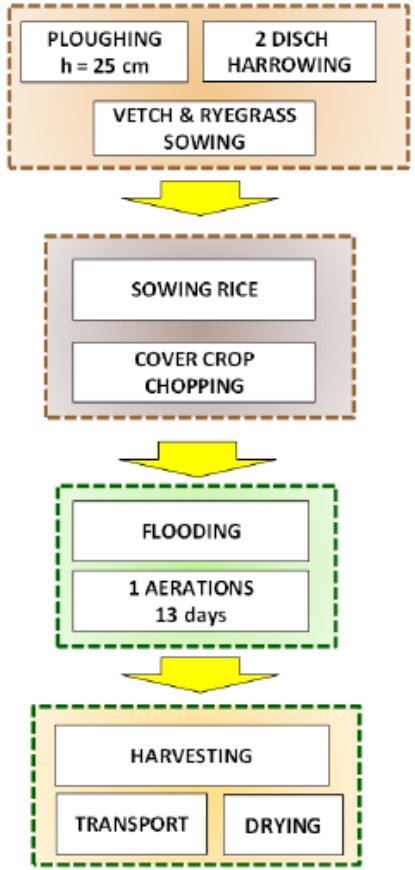
SD = Stale seedbed in Dry paddy, mainly using comb harrow



SF = Stale seedbed in Flooded paddy, using different types of machines



CC_1: green mulching with broadcast rice sowing
CC_2: green mulching and in-row (underground) sowing



CONCLUSIONS

- **The C.C. ="cover crop-based" management showed decrease potential of impact and it involves good practices supported by the CAP**
- **LCA outcomes point out the need to integrate this tool with others for the evaluation of the environmental benefits and ecosystem services**

III. LCA to study the environmental impacts of organic rice farming

Update the current research scenarios about LCA analysis on organic rice farming

ELSEVIER

Science of The Total Environment

Volume 853, 20 December 2022, 158365

The environmental impacts of different organic rice management in Italy considering different productive scenarios

Valentina Vaglia [a], Jacopo Bacenetti [a], Francesca Orlando [c], Sumer Alali [b], Ezio Bosso [a], Stefano Bocchi [a]

FARM EXPERIENCE

GREEN MULCHING TECHNIQUE

Autumn crop cover: ryegrass, vetch

Sowing of rice in May on the biomass of the Cover crop

FARM EXPERIENCE

GREEN MULCHING TECHNIQUE

Strategy based on:

→the use of a cover crop (mixture of grasses i.e., Italian Ryegrass *Lolium multiflorum* Lam. and legumes i.e., Vetch, *Vicia sativa* L..

→The direct sowing of rice on the cover crop that is not buried but cut down and then submerged with water.

→The water is removed from the paddy field when the rice begins to germinate for about 20 days.

FARM EXPERIENCE

The **cover crop competes** against weeds through multiple functional processes:

1. competition for water, light and nutrients during its cycle, against potential weed species of the soil seed bank;

2. mulching effect of the biomass, the so-called green mulching, whose role in the containment of weeds for light and space on the soil surface;

3. allelopathic interactions between cover crop and weeds or pests;

4. toxicity of organic acids in the water generated by fermentation of submerged mulching biomass

FARM EXPERIENCE

4. toxicity of organic acids

Focusing on the last mechanism of action (4. toxicity of organic acids), it should be emphasized that the fermentation environment is harmful to rice and weeds. However, the latter seems to show greater sensitivity than rice.

However, excessive fermentation can lead to a low density of rice plants with reduced final investment, causing problems with yield.

For this reason, the efforts of farmers are oriented toward performing variations of the technique, considering soil and climatic conditions to

optimize the use of cover crops, minimizing the impact of fermentation on rice and, therefore, reducing the intensity and duration of the process.

FARM EXPERIENCE

The next image shows a field of Ryegrass that can be sown by autumn with dose:

- Ryegrass 45 kg/ha if pure
- In mixture Ryegrass 45 kg/ha and Vetch 25 kg/ha

FARM EXPERIENCE

APRIL

FARM EXPERIENCE

The next image shows a field where it was:

- sown rice (about 220 kg/ha) by mid-May
- chopped crop cover
- added water

FARM EXPERIENCE

MAY

The next image shows

a field where rice grows where the cover crop is finished and forms a layer of mulch that helps compete against weeds.

FARM EXPERIENCE

JUNE

RICE

The next image shows a field where rice grows, and some weeds emerge.

Among the main weeds of organic rice fields there are:

Echinocloa crus-galli(L.) P.Beauv. subsp. *crus-galli*

Cyperus esculentus L., *C. rotundus* L., *C. microiria* Steud.

Persicaria lapathifolia (L.)

FARM EXPERIENCE

JULY

FARM EXPERIENCE

The next image shows a field where rice grows, and when it's time to dry the field (from waxy grain ripening)

on the soil surface, you can see the layer of mulch that looks like a carpet

FARM EXPERIENCE

AUGUST

FARM EXPERIENCE

When all the agronomic processes presented go well, the rice fields are healthy and rich in cobs.

This is not always the case.

But it should be emphasized that

when weeds have a cycle or height that does not compete strongly with rice because it is well-grown and developed even in the most infested fields, good yields are obtained (between 4 and 5 t / ha)

FARM EXPERIENCE

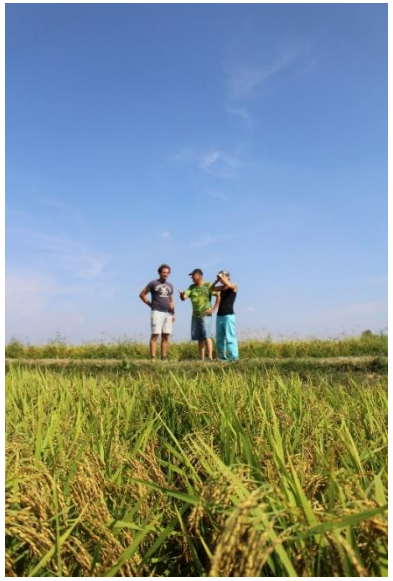
SEPTEMBER.. Towards harvesting

FARM EXPERIENCE

.. the rice is ready!!

FARM EXPERIENCE

EXCHANGE OF TECHNIQUES AND RESULTS..



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Organic Rice farming network

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See you at ORP V