Designing agroecological systems based on crop diversification in sheltered market-gardening: Combining plot and agrifood system studies

Amélie Lefèvre
INRAE, Agroecological Vegetable Systems experimental facility (Alénya, France)

Mireille Navarrete
INRAE Ecodéveloppement (Avignon, France)
Designing agroecological systems based on crop diversification in sheltered market-gardening: Combining plot and agrifood system studies

How to crop fresh vegetables under shelters

Trade-off

To comply with agroecological crop protection principles
To comply with food value chain specifications

Plot Farm Food systems Landscape

INRAE
Design of agroecological protected vegetable systems using crop diversity
16 June 2021 / ISHS HortDialogs Research for agroecology based management of horticultural production systems / Lefèvre A;& Navarrete M
Designing promising vegetable agroecological systems?

Diversity is a key element interacting with many others, not only at field management levels but also at territorial and food system levels:

- manage day by day relevant and compatible agronomic practices at field and farm levels
- consider constraints and opportunities at the agrifood system level.
Agronomy research to design higher crop diversified systems in market-gardening under shelter: from plot to agrifood scale

- Inspiring resources for local stakeholders
- Lessons from design in action: How to diversify? Spatial and temporal arrangements under such shelter? Pathways? Drivers for design?
- Reports on multi-performances of cropping systems (or trade-offs)
- Understand biological process involved in such diversified systems at plot level
At plot scale: multiple ways to organize crop diversity in time and space

Temporal arrangement

Longer crop rotations
Multi-species cover crops

Spatial arrangement

Several ways to implement intercropping under a shelter... In rows, strips, patches...

INRAE
Design of agroecological protected vegetable systems using crop diversity
16 June 2021 / ISHS HortDialogs Research for agroecology based management of horticultural production systems / Lefèvre A;& Navarrete M
At plot scale: experimenting crop diversity in time and space

SuperMarket Low-Pesticide farming

SuperMarket Organic farming

Local direct sale low-pesticide
Or
DS organic Farming

Sole crop

3 species intercropped

INRAE
Design of agroecological protected vegetable systems using crop diversity
16 June 2021 / ISHS HortDialogs Research for agroecology based management of horticultural production systems / Lefèvre A; & Navarrete M
At plot scale: are **marketable yields** satisfying?

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>K</th>
<th>F</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMA</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS-O</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>L</td>
<td>K</td>
<td>F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Distribution of the qualitative level of satisfaction for marketable yield according to cropping system and crop (winter season only shown)**

- Satisfactory
- Moderately satisfactory
- Unsatisfactory

The specialised system failed in high production standards for lettuce.

But alternatives were not always a success to produce (and sell in their targeted value chain).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber</td>
<td>Cs celery stick</td>
</tr>
<tr>
<td>Eggplant</td>
<td>F fennel</td>
</tr>
<tr>
<td>F French beans</td>
<td>Gm green manure in cover crop</td>
</tr>
<tr>
<td>K kohlrabi</td>
<td>L lettuce</td>
</tr>
<tr>
<td>M charentais type melon</td>
<td>O small onions</td>
</tr>
<tr>
<td>patté tomato</td>
<td>SC small chard</td>
</tr>
<tr>
<td>So soil solarization</td>
<td>Sp sweet pepper</td>
</tr>
<tr>
<td>T tomato</td>
<td>Z zucchini</td>
</tr>
</tbody>
</table>

Lefèvre et al., 2020; data from Perrin, 2020

Less pests and diseases pressure, less pesticides requirements.

Crop management organisation, workload.

Marketing yields...
Co-design and co-assess diversified systems

Open workshops → How to organize and implement diversity?

Local stakeholders (farmers, agricultural advisors, researchers, collect firms ...)

- discussed which level of diversity, which new crop would be relevant according to local food value chain specifications, farming system (organic or not?), etc.

- were inspired and interested in technical knowledge on low-referenced specie

- shared knowledge and know-how, contributed to identify relevant thresholds to assess those new crops and systems

Co-creation and sharing of knowledge: agricultural innovations respond better to local challenges when they are co-created through participatory processes.
Developing diversified cropping systems requires studies at agri-food system level

Socio-technical lock-in at the agri-food system level
(Alaphilippe et al, in press; Boulestreau et al 2021)

To comply with agroecological crop protection principles

Fresh fruits & vegetables with high quality standards

To comply with food value chain specifications

INRAE
Design of agroecological protected vegetable systems using crop diversity
16 June 2021 / ISHS HortDialogs Research for agroecology based management of horticultural production systems / Lefèvre A;& Navarrete M
Studies on crop diversification in Provence area (South-east France)

Current sociotechnical problem: a high level of crop specialisation on vegetable farms that fosters telluric pests and diseases

Coupled innovations (Meynard et al. 2017)

involving several actors (input supply, production on farm, processing, distribution, and/or consumption) and considering various levels together
To conclude

Required steps to build coupled innovations:

- Identify stakeholders’ strategies and sociotechnical lock-in in the territory
- Design and assess coupled innovations with stakeholders at various scales
- Fill in gaps of knowledge (multicriteria performances of the systems designed; agroecological mechanisms)

Discussing about coupled innovations with a range of stakeholders:

- favors the design and adoption of innovations
- Enables to share individual knowledge from different persons
To go further...


- INTERLUDE project: https://www.picleg.fr/Projets/Les-projets-en-cours/INTERLUDE