Malica
Markets and agriculture linkages for cities in Asia

« Récentes évolutions autour de la qualité dans les filières agricoles et l'alimentation au Viet Nam : enjeux institutionnels et méthodes »

CIRAD

Organic Agriculture and Crop protection

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Where organic agriculture fits in

- Has increased in the last 10 years but < 1%.
- 31 million ha (2006). In Vietnam 6000 ha
- / 100 million GMP's.
- 0.01 to 13.5% (Austria): fruit and vegetables.
- 0.01 to 2% (Bangladesh): plants for export.
- Problem: Lack of knowledge / skills.

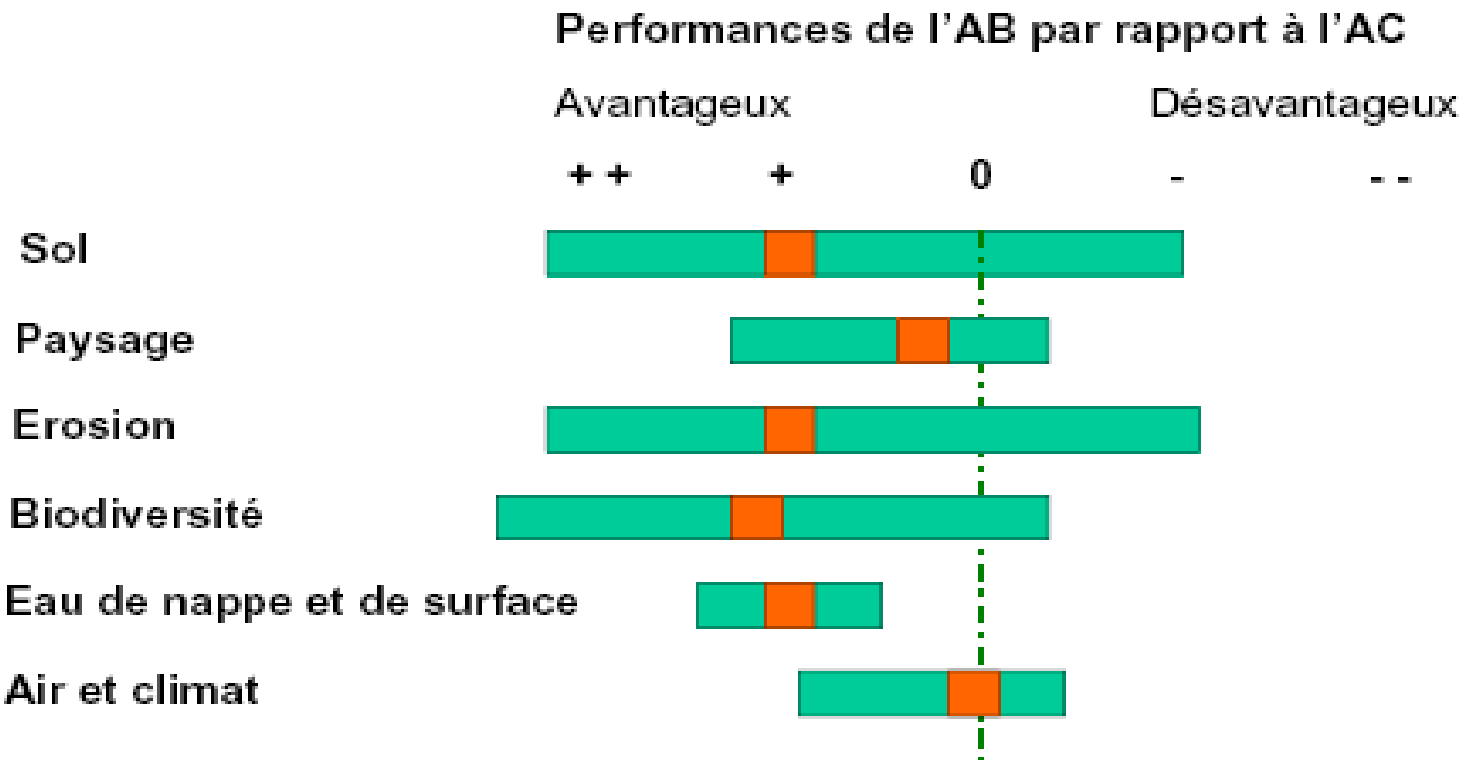
The value of organic agriculture:

- On environmental impact.
- On energy consumption.
- On soil quality.
- On landscape quality.

- On products quality
(zero chemical pesticides)

Figure 1 – Comparaison de l'impact environnemental de l'AB et de l'AC d'après différentes composantes environnementales

Figure 1 - Comparison of the impact of OA and of CA on environmental criteria



Performance de l'AB par rapport à l'AB :

++ : bien meilleure, + : meilleure, 0 : semblable, - : plus mauvaise, - - : bien plus mauvaise

représente l'évaluation finale associée à un intervalle de confiance subjectif

Source : Stolze *et al.*, 2000 (d'après plus de 300 études en Europe) et Lotter, 2003, modifié

Tableau 1 – Comparaison de la consommation d'énergie en AB et en AC

Tableau 1 – Comparison of energy consumption in OA and in CA

Productions et pays d'étude	Énergie consommée GJ ha^{-1}			Énergie consommée GJ t^{-1}		
	AC	AB	AB-AC en % AC	AC	AB	AB-AC en % AC
Blé d'hiver						
Allemagne	18,3	10,8	**- 41**	4,21	2,83	**- 33**
	17,2	6,1	**-65**	2,70	1,52	**- 43**
	16,5	8,2	**-51**	2,38	1,89	**- 21**
Pommes de terre						
Allemagne	38,2	27,5	**- 28**	0,07	0,08	**+ 7**
	24,0	13,1	**- 46**	0,08	0,07	**- 29**
	19,7	14,3	**- 27**	0,05	0,06	**+ 29**
Citrons						
Italie	43,3	24,9	**- 43**	1,24	0,83	**- 33**
Olives						
Italie	23,8	10,4	**- 56**	23,8	13,0	**-45**
Pommes						
Allemagne	37,35	33,8	**- 9,5**	1,73	2,13	**+ 23**
Lait						
Suède	22,2	17,2	**- 23**	2,85	2,41	**-15**
Allemagne	19,1	5,9	**- 69**	2,65	1,21	**-54**

Source : Stolze *et al.*, 2000 ; Alföldi *et al.*, 2002.

Lack of knowledge / skills and research.

- Underlying principle = AES management tactics putting priority on the prevention of infestations.
- This principle needs to be delineated in specifications.
- In keeping with the principles of agro-ecology.
- In keeping with the ecological principles of IPM (Kogan, 94), but organic tools are not very suitable (bio-insecticides).

Protection principle of OA

Approach (Zehnder et al, 2007).
Conceptual framework (Wyss et al, 2005).

Indirect preventive measures, 4 phases:

- Phase 1: Location; agricultural practices compatible with natural processes (rotations, soil management, plant resistance, etc.).
- Phase 2: Management of vegetation so as to promote beneficial insects, to the detriment of insect pests.
- Phase 3: Inundative or inoculative releases.
- Phase 4: Accepted insecticides (organic, mineral) and sexual confusion.

Protection principle of OA

Conceptual framework (Wyss et al, 2005):

Strategic pillars of Phases 1 and 2:

- 1) Crop escapement:
  - In time and space.
  - Based on bio-ecological knowledge of pest insects.
  - E.g.: Choice of site, rotations, management of time and work, prophylactic measures (residues, resting stages).
- 2) Poor acceptability of the crop for pest insects:
  - By modifying their behaviour (egg laying, reconnaissance, location of the plant).
  - E.g.: Companion crops, bait plants.

Protection principle of OA

Phase 1:

1) Location of site:

- Look at conditions on the farm.
- Environment: Agricultural, climatic, pedologic.
- Because later on: Will not take.
- Conventional and phytosanitary factors:
  - Regional distribution of insect pests (choice of site, choice of crops).
  - Landscape: In isolation or mixed / farms not practicing organic agriculture.
  - Locally: Structure of flower communities at edges of parcels.

Protection principle of OA

Phase 1:

2) Agricultural practices relating to the site's location:

- Strategy based on agricultural practices regarding the crops, in a long-term perspective of the farm's operation and limiting risks of infestation.
- Very old practices used in traditional agriculture, pre-dating the use of inputs.
- Examples:
  - Agricultural precedent and background of crop rotations.
  - Properly selected rotations.

Protection principle of OA

Phase 1:

3) Soil quality management:

- Essential with habitat management for sustainable functioning of AES's and crop protection.
- Strategy: Healthy management of habitats, on and under soil surface.
- Rotations, soil covering, organic matter (animal, crop residues): Indirect methods of preventing infestations.
- Mulches: Reduce temperature, increase moisture (reduces insect populations).

Protection principle of OA

Phase 1:

4) Tillage:

- Light tilling (conservation), often associated with soil covering practices: For soil management, water management, as well as for management of bio-aggressors.
- Klaviko (2001): Number of species of soil organisms > in soil that is not subject to much tilling.
- Adoption of minimum tilling in Europe also includes management of bio-aggressors (Holland, 2004).

Protection principle of OA

Phase 1:

5) Resistance of host plant:

- Basis of IPM (Maxwell, 1985).
- Not prevalent in the context of conventional agriculture, since the basis is agro-chemistry, with too much disturbance created by insecticides.
- In OA: Given level of knowledge, use of varieties tolerant of diseases more that varieties resistant to insect pests.
- For insects: In addition to the difficulty of taking into account interactions with secondary pests and beneficial insects.
- There is a real demand for pest-resistant varieties in organic agriculture.

Protection principle of OA

Phase 2:

Approaches in ecological engineering:

- Implemented subsequent to Phase 1 recommendations.
- Where there are constraints relating to site location, soil quality, varieties, … they are limited.
- Measures that can also be implemented in the process of converting to OA.

Protection principle of OA

Phase 2:

1) Conservation organic control:

- Major recommendation in agro-ecological approaches (Barbosa, 1998).
- Suitable for OA because there is no chemical insecticide treatments.
- Beneficial fauna present plays the role of regulator in the ecosystem.
- Plant biodiversity: Promotes the action of natural enemies: shelter, shade, food source, alternately host and prey (enemies hypothesis, Root, 1973).
- Examples: “Beetle banks”, flower strips, mixtures of grasses and flowers.

Protection principle of OA

Phase 2:

2) Companion crops:

- Dilute the attention of insect pests (resource concentration hypothesis, Root, 1973).
- Host plants can be used within or around parcels.

Protection principle of OA

Phase 2:

3) Bait plants:

- Sometimes used in Conventional, but very relevant in OA.
- The bait plant is more attractive than the crop plant (food, egg-laying site).
- Scale goes beyond that of the parcel.
- Push-pull: Combines the effects of bait plants (insect pests, beneficial insects).
- Example in OA: *Nezara virudula:* Mustard around corn fields.

Protection principle of OA

Phase 2:

Responses and effects of biodiversity in OA:

- Increase in biodiversity: Consistent with OA approaches.
- Reduction in abundance of insect pests, increase in beneficial fauna.
- Examples in OA: Tomato (Drinkwater et al, 1993), rice (Hesler et al, 1993), apple (Wyss et al, 1995).
- Abundance and richness > in OA (Bengtsson et al, 2005) confirmed for beneficial insects, general predators, seed-corn beetles (Zenhder et al, 2007).
- Impacts on yield and economics?

Protection principle of OA

Phase 2:

Limits of Phase 2 measures:

- Classic organic control: Promotes control from the top down and increases biodiversity (invertebrates, vertebrates, plants).
- Whereas bottom-up approaches of habitat management contribute to colonisation, ovi-position and food taking by pest insects.
- Lack of study in OA.
- Particularly well adapted for OA (not compatible with conventional agriculture).

Protection principle of OA

Phase 3:

1) Role of organic agents in AB:

- Inoculative or inundative organic control: Breeding and releasing; an adjunct to COC; costly (often > chemical control).
- IFOAM (International Federation of Organic Agriculture Movements): OK for predators and parasitoids, but not GMO.
- Release of predators and parasitoids:
  - Success in OA in greenhouses: Predator acarina (pest acarina), Hymenoptera parasites (whiteflies).
  - Success in OA in the field: parasitoids on vegetable caterpillars, on plant lice attacking grain plants, grapevine caterpillars.
  - Sometimes has the effect of population reduction after the release.

Protection principle of OA

Phase 3:

1) Role of organic agents in OA:

- Use of entomo-pathogens (*Bacillus thuringiensis*, virus).
- Introduction of agents previously designed for conventional agriculture.

- Despite releases and (sometimes) reduction of pest insect populations, thresholds remain above tolerable level.
- OA can tolerate this and use additional means.

- Classical organic control is not discussed in OA because it is under regional or national authorities.

Protection principle of OA

Phase 3:

Limits of Phase 3 strategies:

- Cost of inundative-inoculative OC.
- In the field: Agents native to the region.
- Greenhouse: Introduced species.
- Many have not moved beyond the experimental stage.

Protection principle of OA

Phase 4:

Reglulations governing insecticides, pheromones, repellents:

- Phase 4: Use of organic or mineral based insecticides, sexual pheromones, repellents. Organic agriculture only uses these as a last resort (because they are curative).
- IFOAM: Benchmarks for the production and use of such products (condition 1: non-synthetic origin).
- Para-pheromones (=exception) since they do not come in contact with the crop.

Protection principle of OA

Phase 4:

Reglulations on insecticides: Inconsistency:

- Standards vary from one organisation to another:
  - EU does not allow tobacco products, OK in the USA. Reason: Poisonous for man and side effects on beneficial insects.
- National restrictions:
  - Rotenone: OK in Europe, prohibited in Germany (toxic for fish).
- Differences between the EU / USA:
  - E.g.: Spinosad (insecticide made from bacteria fermentation). USA and Switzerland OK for purified toxin, EU OK only for products made from microbial production.

Protection principle of OA

Phase 4:

Regulations on repellents*:*

- Large variety:
  - Herbs from tea, plant extracts, products of fermentation, clay-based products.
- Trend: Use of industrial products in preference to 'home-made' products.

Protection principle of OA

Phase 4:

Limits of Phase 4:

- Instability and degradation.
- Only effective if other measures taken beforehand.
- Research necessary: Thresholds for OA.
- Very small market for private group investment in research.
- Not a cure-all (curative measures).

Protection principle of OA

Conclusion (1)

- Priority for preventive measures.
- Necessity of integrating measures of the different phases, including hands-on.
- Phase 1: Potential in OA.
- Phase 2: Conventional organic control, to be combined with inundative-inoculative OC.
- Prospects: In parallel with “attract and kill” for insect pests, “attract and reward” for beneficial insects.
  - E.g. in NZ: Attraction of beneficial insects with attractive baits and “rewards” with flower strips (Berndt et al, 2006).

Protection principle of OA

Conclusion (2)

- Habitat management = crucial in OA:
  - Number and proximity of sources to sustain beneficial insects.
  - Sufficient corridors between parcels.
  - Make the crops attractive for the beneficial insects.
- Effects of scale:
  - Increased impact in OA at farm level.
  - Even greater impact at parcel level.
  - Weaker effect at scale of landscape:
    - Not serious as non-conventional environment.
    - Less pressure on beneficial insects as no chemical pesticides.
    - Needs further research.
- Research:
  - Minimal / research focuses on conventional.
  - To be expanded.