Eco- functional intensification and food security: Synergy or Compromise?

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Actual and forecasted intake of animal protein per region

Westhoek et al. 2011
Eroding the functional integrity of farming systems
Chapter 7. Food security and Food production systems

“All aspects of food security are potentially affected by climate change, including food access, utilization and price stability (high confidence)”

Climate change report: 'The worst is yet to come' – as it happened Climate change “already affecting food supply”

The poor will suffer most from climate change – The Guardian
Sustainable intensification

A productive agriculture that conserves and enhances natural resources.

- uses an ecosystem approach that draws on nature's contribution to crop growth
  - soil organic matter, water flow regulation, pollination and natural predation of pest
  - and applies appropriate external inputs at the right time, in the right amount

CPI represents a major shift from the homogeneous model of crop production to knowledge-intensive, often location-specific, farming systems.

Is there a paradigm shift undergoing?

FAO, 2011
SUSTAINABLE INTENSIFICATION

- Intensification of agriculture, especially in Europe is not primarily about the use of more fertilisers, pesticides and machinery applied per hectare,

- but the development of much more knowledge intensive management of scarce resources to produce food outputs with minimal disturbance to the natural environment, and more environmental outputs too.

- A suggested shorthand to describe what sustainable intensification means is more knowledge per hectare!

Buckwell et al., 2014, The Sustainable intensification of European Agriculture. Rise Foundation
The overall objective: Eco-functional intensification

Intensification of land use and agriculture by means of

- improved knowledge and application of biological principles and agro-ecological methods
- increased cooperation and synergy between different components of agro-eco systems and food systems,

with the aim of enhancing the health and productivity, adaptability and resilience of all its components.

Niggli et al., 2008
The relation between Ecofunctional intensification and food security:
Two perspectives:
the immediate needs vs the long term perspective

• Within a foreseeable future how to improve yields based on locally available resources,
• Potential of agroecological methods and eco-functional intensification already well established with smallholders in Africa and Asia
Harnessing Ecosystem based Approaches for Food Security and Adaptation to Climate Change In Africa
Farmer Field Schools for family food security in West Uganda
Advantages

- Ecosystem-based approaches resulted in emerging opportunities that included alternative livelihoods.
- Replication has in many cases been organic;
- Scientific evidence gathered from pilot projects is quickly moved forward to facilitate larger policy initiatives.
- Larger policies are now informed of the success, failures, benefits, and replication potential of EbA projects through demonstration projects.
Challenges to the long term success and impact of EbA projects

• Weak policy frameworks and that compromised the success of the projects
• Unclear land rights and high population densities led to widespread encroachment and degradation of fragile ecosystems
• Inadequate awareness and sharing of research findings
• Inadequate monitoring and evaluation structures for the EbA approaches limited and continue to hamper upscaling
Food security of small holding farmers in relation to organic farming in India

| Tamilnadu (CIKS) | Madhya Pradesh (BioRe India) | Uttaranchal (Navdanya) |
|------------------|-------------------------------|-----------------------|
| **Organic products** | Rice, Peanut, sorghum, banana, corn | Cotton, soybean, wheat, corn | Wheat, Mustard, millets, potato, rice |
| **Market access** | Domestic | Export | Domestic |

Quantitative and qualitative data from household survey: 40 organic and 40 conventional HHs per case area
## Intercrop yield (Uttaranchal region)

|         | Yield (kg/farm/yr) | Home consumed (kg/farm/yr) |
|---------|-------------------|---------------------------|
|         | CON               | ORG                       | CON | ORG |
| Cereals | 200(15)           | 390(24)                   | 135 | 253 |
| Pulses  | 125(13)           | 164(21)                   | 59  | 90  |
| Oilseeds| 42(17)            | 60(19)                    | 21  | 54  |
| Others  | 104(10)           | 708(12)                   | 60  | 225 |

Note: Values in ( ) number of farms out of 40.
## CONCLUSION, case studies India

Comparison of organic farms with conventional farms

|                        | UT | MP | TN |
|------------------------|----|----|----|
| **Food availability**  |    |    |    |
| Total farm production  | +  | -  | NC |
| Wheat / Rice yield     |    | -  | -  |
| Maize yield            |    | +  |    |
| Intercrop production   | +  | +  |    |
| Food kept for home consumption | +  | +  |    |
## CONCLUSION, case studies India

|                          | TN | MP | UT |
|--------------------------|----|----|----|
| **Food access**          |    |    |    |
| Lower input cost food crops | +  | +  |    |
| Higher net margin        | -  | +  | +  |
| Improved credit / reduced dept | +  | +  | +  |
| Improved market access (cash revenue) | +  | +  | +  |
| **Food utilization**     |    |    |    |
| More intercrops          | (+)| +  | +  |
| **Food stability**       |    |    |    |
| Agro ecological methods  | + ?| + ?| +  |
CONCLUSION, case studies India

- Organic farming improved food security of smallholding farms by
  - Increasing income
  - Decreasing input cost and debts
  - Producing more for home consumption, and
  - Adopting ecologically sustainable practices with locally available resources

But, further improvement is needed in all dimensions of food security also in organic HHs
## Farm holdings in India

| Farm types                  | Share in total no. holding | Share in total area |
|-----------------------------|----------------------------|---------------------|
| Smallholders(<2ha)          | 83                         | 41                  |
| Mediumholders (2-10ha)      | 16                         | 47                  |
| Largeholders(>10ha)         | 1                          | 12                  |

### Smallholders in Tamil Nadu and Madhya Pradesh

|                  | Share in total no. holding | Share in total area |
|------------------|----------------------------|---------------------|
| Tamil Nadu       | 90%                        | 60%                 |
| Madhya Pradesh   | 70%                        | 27%                 |
Source of credit

Marginal, Tamil Nadu:
- Money lenders: 56%
- Govt. Insti: 34%
- Others: 3%
- Friends: 7%

Marginal, Madhya Pradesh:
- Money lenders: 41%
- Govt. Insti: 30%
- Others: 12%
- Friends: 17%
Economic comparison

% change in OA compared to baseline (Tamil Nadu)

Cost A = variable cost
Cost B = Cost A + cost of fertilizer subsidy (simulating “flexible subsidy”)
Crop value = yield * market price + 10% premium for organic products
Grossmargin A = Crop value – Cost A
Grossmargin B = Crop value – Cost B
Food production

% change in TN

-4.5 state level: Totalfood -4.5, Pulses 68, Foodgrains 24

-13 rainfed: Totalfood 13, Pulses 58, Foodgrains 24

-20 irrigated: Totalfood -20, Pulses 85, Foodgrains 24

% change in organic compared to baseline
CONCLUSION

• OA has potential to improve smallholders food security through
  – increasing own diversified food consumption in low input areas 
    (Food availability and access), and
  – increasing income through decreasing production cost and price 
    premium in high input areas (Food access).
• Large-scale conversion could increase the income of 
  smallholders without any major negative impacts on overall 
  state production
• Higher protein rich food in organic “model” has potential to 
  alleviate/reduce the protein malnutrition and reduce the 
  import of pulses
• ! But: Effects on food security beyond household levels?
• Eg. Surplus for urban poor?
Modelling food security with IFPRI’s IMPACT model

- Modelling food projections to 2020 relative to baseline scenario

Conclusions in brief:

1. Possible to convert 50% of Europe and North America to OA without significant effects on food security in Sub-Saharan Africa

2. Converting 50% of Sub-Saharan Africa to OA can reduce needs for food import and improve local food access

New developments in land use for bioenergy not included!
Changes in net trade for Sub-Saharan Africa under large-scale conversion to organic farming in Sub-Saharan Africa (negative means increased import)

Results: Increased import needs could be reversed

Assumptions may be disputed!
Scenarios and challenges for feeding the world in 2050

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The “AGO” and “AG1” worlds

Two scenarios “reprocessed”

The "AGO" scenario (AGO)

Source: Griffon M., 2006. Nourrir la planète. Pour une Révolution doublement verte, Odile Jacob, Paris

The Doubly Green Revolution scenario

The Green Revolution, which was introduced on a world scale after World War II, made it easy to ignore the threat of hunger. But the Green Revolution also encouraged overpopulation; it ravaged the environment in many places; it created inequalities in the sharing of the planet’s wealth, and these inequalities have made the threats we must face in the coming decades even greater than those the world had to confront in the early twentieth century.

The "AG1" scenario (AG1)

Source: MEA, 2005. Ecosystems and Human Well-being: Scenarios, The Millennium Ecosystem Assessment, Washington DC.

The Millennium Ecosystem Assessment scenarios

Global Orchestration

A globally connected society that focuses on global trade and economic liberalization and takes a reactive approach to ecosystem problems but that also takes strong steps to reduce poverty and inequality and to invest in public goods such as infrastructure and education. Economic growth in this scenario is the highest of the four scenarios, while it is assumed to have the lowest population in 2050.

Techno-Garden

A globally connected world relying strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services, and taking a proactive approach to the management of ecosystems in an effort to avoid problems. Economic growth is relatively high and accelerates, while population in 2050 is in the midrange of the scenarios.

Order from Strength

A regionalized and fragmented world, concerned with security and protection, emphasizing primarily regional markets, paying little attention to public goods, and taking a reactive approach to ecosystem problems. Economic growth rates are the lowest of the scenarios (particularly low in developing countries) and decrease with time, while population growth is the highest.

Adapting Mosaic

Regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems. Economic growth rates are somewhat low initially but increase with time, and population in 2050 is nearly as high as in Order from Strength.

Reactivity

Globalization

Proactivity

Regionalization

The "Agrimonde 1" scenario (AG1)

The "Agrimonde GO" scenario (AGO)
**Scenario 2050 – AGO:**

*Global economic growth to ensure food security*

**Scenario 2050 - AG1:**

*Feeding the planet and by preserving the ecosystems*
What lessons from the 2 scenarios?

The planet can feed properly 9 billions people in 2050 but...

- What is in our plates (total calories, %Veg/Ani, macro/micro-nutrients…) is a key driver for:
  - preserving some ecosystem services (carbon sequestration, soil, water, pollination…)
  - and/or saving the use of some agricultural inputs (water, fertilizers, pesticides…)
  - reducing some important human health problems (from under-nutrition to obesity)
  - opening larger opportunities for non-food productions (bio-energies, biomaterials…)
  - and reducing substantially post-harvest losses and food wastes
  - maintaining a diversity of production systems, landscapes and environments

*There is no necessary convergence of world diets towards today’s OECD mean diet.*

- Food trade can secure some regional food needs and avoid huge migrations, provided the net-deficit regions/populations can:
  - pay for their food imports (local opportunities of incomes?)
  - rely on a fair and transparent international trade regulation system
  - ...also aware of poor farmers incomes and environmental externalities
Preserving or improving agricultural yields calls for breakthroughs:

(a) Need for much less polluting & less dangerous techniques (for workers, flora, fauna…) founded on:  
- much better exploitation of ecosystem services  
- new technologies (ITC, genetics, monitoring…)  
- mobilizing jointly scientific & local knowledge (social learning processes)  

and need for organizational breakthroughs (markets, regions, food chain, diversification of food systems…)  

(b) Need to reframe the usual yield / area dilemma and production / protection divide:  
- urban & peri-urban agriculture…  
- agro-forestry, agro-ecology…  
- complementarities between differentiated areas (…and not setting land aside)  

(c) “Ecological intensification” might emerge as an interesting option for sustainable biomass production and for food security of poor farming families, provided institutional and technological lock-in situations can be overcome
Transition to organic / ecological / resilient agriculture

IAASTD
(a) All countries into six regions

Daily plant food production (kcal) per cultivated hectare

Asia
World
MENA
LAC
TRAN

800,000 daily kcal per worker
400,000 daily kcal per worker
200,000 daily kcal per worker
100,000 daily kcal per worker
50,000 daily kcal per worker
25,000 daily kcal per worker

6,250
12,500
25,000

Cultivated hectare per agricultural worker

Dorin, 2013
So, what options to consider in a Systems re-design approach?

- Site specific solutions respecting diets and nutrition?
- Landscape level integration?
- Rural – Urban integration?

Explore synergies within the systems

- Overall better utilization of the sunlight for photosynthesis (producing OM above and below ground)
- Combinations of crops with longer growing period
- Better utilization of crop rotations effects
- Integration of outdoor livestock production with cropland and woodland
- ....
Conclusions

• Eco-functional intensification for improved local food security documented in practice in poor rural regions:
• Little documentation of potential for upscaling to cover urban food demand now and in future
• Consequences for upscaling eco-functional intensification in high intensive areas without changes in diets are unclear
• Diets must necessarily be endogenous factors in global food security scenarios
• Need for better foresights and scenario’s for global and regional food security based on eco-functional intensification:
• What are the necessary improvements in production, diets, ecosystems services, sustainability and resilience:
• Need for "systems re-design", agriculture, landscape, food system?
• To what extent are organic systems demonstrating a development pathway to systems redesign based on eco-functional intensification?
