Enkele Valkuilen van de Introductie van Aquacultuur

Met voorbeelden van Aquaponics en Garnalen teelt

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24-11-2018, Roel H. BOSMA

Randvoorwaarden Aquacultuur Ontwikkeling

- Goede kwaliteit uitgangsmateriaal
  - Problemen met exoten.
- Milieu
  - Landgebruik (concurrentie met natuur en biodiversiteit)
  - Externalities.
- Markt
  - Keuze van systeem en soorten,
  - Rentabiliteit.
- Kennis en ervaring.

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Goede kwaliteit pootgoed vis/garnaal

- (In)vangen van wild pootgoed:
  - Extra stocking / inkomen, maar
  - Vergroot risico ziekte insleep en
  - Invang van predatoren.
- Aankopen van PL of fingerling
  - Aanpassing aan water van de vijver/tank
  - Gebruik hapa's voor 1e groei periode.
  - Import van exoten?
- Opzetten van hatchery / nursery
  - Moederdieren uit fokprogramma's?
  - Import van exoten?

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Overwegingen voor Import van Exoten

- Is aan andere randvoorwaarden voldaan?
  - Zo nee, wat is de grootste bottleneck?
- Is het echt nodig?
  - Wat zijn de lokale alternatieven?
  - Krijg je inderdaad de verwachte kwaliteit?
- Lokale goede fokprogramma's nog zeldzaam,
  - Fokprogramma vereist veel genetische variatie
  - Genetische vooruitgang groter naarmate variatie groter.
- Discussie op SARNISSA, n.a.v. vreemde soorten:
  - Natuurlijke migratie t.o.v. antropogene introductie.
  - Welke overwegingen zijn belangrijk?

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Waarom voorzichtig met nieuwe soorten

- Lokale soorten hebben vaak een goede marktprijs en het kan!
- Verband tussen Food security, Biodiversity & Ecosystems Services
- Verhoging risico op verspreiding ziekten;
- Zuivere genetische bronnen: verzekering onbekende stress factoren t.g.v. genetische selectie;
- Geslaagde introductie landdieren is echt geen argument;
- Aquatische introducties zijn een publieke zaak;
  - Je kunt een wet slecht vinden maar dit is geen reden overtreding;
- Respecteer de rol van de wetenschap en ondersteun deze;
  - Let wel: een exoot is niet automatisch een invasieve soort;
  - Dat soorten miljoenen jaren geleden voorkwamen is geen reden.
- Niemand wil beroemd worden omdat zij/hij een schadelijke exoot heeft geïntroduceerd.

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Randvoorwaarden Aquacultuur: Milieu

- Landgebruik (concurrent natuur & biodiversiteit)
  - Ook voor de productie van voer
  - Natuur levert EcoSysteem Diensten (ESS)
    - Belangrijk voor de visserij.
- Afvalstoffen en watervervuiling:
  - Extensieve natuurlijke systemen t.o.v. intensieve;
  - In EU = kosten post;
  - Hormonen => ...
- Water: Dreigend tekort schoon zoet water
  - Bezuinigen water kost energie,
  - RAS bezuinigd voer & medicijnen.
- Sociaal verantwoord ondernemer berekent 'externalities' = schade (kosten) aan milieu/natuur/derden.

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≠ Shrimp Farming in Mangrove Climax

Philippines
compared to
Indonesia

In latter, most Ecosystem Services of Mangrove are Lost

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Sylvo-Aquaculture & ESS

- Timber & seafood,
- Habitat birds & snakes, but :
  - No inundation/drying => little diversity of mangrove.
  - Disconnected from aquatic resources, except inlet to recruit seafood seeds => no contribution to nursery.

Thus, mangroves in ponds and on dikes look nice, but:

- ⇒ their long-term effect mostly negative: e.g. in canals roots obstruct flow => more flooding.
- ⇒ have low significance for ecosystem services such as habitat, regulating, supporting and cultural.
- ⇒ high land-use/kg aquatic product due to restrictions on use of technologies.

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Comparing Shrimp and Mangrove

- **T**otal **E**conomic **V**alue of *1 ha* Mangrove*:
  - Provision: 44 – 8,300 $
  - Habitat: 27 – 68,800 $
  - Regulating: 1,900 – **135,400** $
  - Cultural: 10 – 2,900 $

E.g. South Minahasa: 36,0000 USD **

- Shrimp farm earns 1,000 to 40,000 USD ha^{-1} yr^{-1}
- But NR we have and just need to maintain, in shrimp we invest capital.

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* Russi *et al.* 2013; **Mankay *et al.* 2012

Total Economic Value (TEV) of 12 ha**

- Cost-Benefit Analysis (CBA) for "farm" shows that:
  - Extensive shrimp: high private returns on investment, but no ESS;
  - Intensive shrimp: high yield and high risk, but ESS are lost;
  - Mixed systems has intermediate shrimp yield plus ESS:

For 12 ha Amounts in 1,000 USD	Exten- sive	7ha Mangrove + Intensive	Inten- sive
Ratio shrimp yield	1	20	90
Farm revenues /year	11	50	300
TEV Ecosystem Services/year	0	250*	0
Value shrimp + ESS / year	**11**	**300**	**300**

- **Including ESS, TEV Mangrove-shrimp = TEV Intensive.**
- One trade-off: less shrimp for market, processing, export.
- But more catch from fishing: Thus also political choice.

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* Data Minahassa
** Bosma Roel H., Eleonora A. Tendencia and Stuart W. Bunting, 2012. Asian Fisheries Science 25, 258-269.

The Economic Feasibility of Aquaponics

A post-hoc Cost-Benefit Analysis of investing in a fish vegetable farm near Dumaguette, Philippines

August 2016: Roel Bosma

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From
home-garden

to farm-size.

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Until 2015 economic feasibility little studied

Aquaponics = producing fish and vegetables
- ✓ in a closed-loop water system,
- ✓ reduces fertilizer use and effluent discharge,
- ✓ fish effluents suppress fungal diseases and stimulated root growth in tomato.

=> promoted as a sustainable venture.

Economic feasibility poorly studied since 1999:

Chaves P.A, Sutherland RM & Laird LM, 1999. An economic and technical evaluation of integrating hydroponics in a recirculation fish production system. Aquac. Econ. & Management 3(1): 83-91

Love DC., Fry JP, Ximin Li, Hill ES, Genello L, Semmens K, Thompson RE, 2015. Commercial aquaponics production and profitability: Findings from an international survey. Aquaculture 435 (2015) 67–74.

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Methods

ACT group of 7 MSc students from various nationalities:
- Literature and grey literature
- Survey by phone and e-mail;
- System simulation => Post-hoc cost-benefit analysis,

Nutrients in effluent of fish component =>
- volume of fish tank : area vegetables 1:30 to 1:100 depends on used species of both.

=> farm size set by quantity marketable fresh vegetables.

Kaikanen et al., 2012: N-output of the fish component.
Mori et al., 2008: Tomato's N-demand (vegetative & fruit).
De Pinheiro Henriques & Marcelis, 2000: Lettuce N-demand.

ACT= Academic Consultancy Training = Interdisci- -plinary Group Assignment on a real world question.

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Methods

- Discounted benefit-cost : $DBCR = [\sum_{t=0}^{n} B_t/(1+r)^t]/[\sum_{t=0}^{n} C_t/(1+r)^t]$
  Bt = benefit in yr t; Ct = cost in yr t; n = project length (yr);
  r =discount rate: 8%, similar projects between 6% and 10%.
- Investment (materials from local providers): 31,500 USD
- Operational cost insurances not included: 8,000 USD.
  For taxes two scenarios: without and with taxes.
  For fish two scenarios:
  - Fingerling catfish 12 PHP/pcs ; Jade perch 24 PH/pcs
  - Feed catfish 34 PHP kg^{-1}, Jade perch: 51 PHP kg^{-1}
- Revenues: wholesale prices, i.e. farm-gate price,
  - Tomato's: 18 PHP kg^{-1}; Lettuce: 55 PHP kg^{-1}.
  - Catfish: 79 PHP kg^{-1} ; Jade perch: 300 PHP kg^{-1}.
- For 25 kg fish, 40 kg tomato & 165 kg salad per week.

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Cost Benefit Analysis for catfish

CBA over 20 year for aquaponics with catfish only (*1000 PHP)

Year	1	3	4	8	11	12	Total
Total Disc. Investment	1,683	16	42	11	83	8	2,079
Total Disc. Operational	301	271				136	3,339
Total Disc. Revenus	407	510				255	6,115
Undisc. Net Benefits	1,150	259				259	3,336
NPV = Disc. Net Ben.	1.150	222	178	151	48	111	1,131

Disc. Benefit / Cost = TD Revenus / (TD Inv.+ TD Oper.)

	No VAT		**No VAT**		**Catfish / Jade perch**			
	Catfish		Jade perch		No VAT		10% VAT	
r	10 yr	20 yr	10 yr	20 yr	10 yr	20 yr	10 yr	20 yr
4	1.16	1.31	1.61	1.81	1.38	1.61	1.21	1.42
8	1.10	1.23	1.53	1.70	1.29	1.52	1.14	1.32
16	0.99	1.07	1.42	1.54	1.17	1.33	1.02	1.13

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Discounted Benefit Cost Ratio

Insurance not in Operational cost => DBCR > 1.3
Paying insurance = benefit shareholder = loss farmers.
Capital investors want >12% benefit on their investment.
Might be considered for infrastructure only.

In LDCs: Interest rate < 8% are rare =>
- Aquaponics with catfish only too risky;
- Fish needs to focus on niche markets (expensive fish);
- Start with catfish for testing and learning, but
- shift to e.g. Jade perch * as soon as possible;
- When paying tax need to find better paying buyers.

* Jade perch (*Scortum barcoo*); Kwabaal (*Lota lota*); Lobed river mullet (*Cestraeus plicatilis*).

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Contribution of fish component to revenue, investments and operation

Netherland's farmers did not adopt aquaponics with tilapia:
- fish component asks relatively too much capital and effort.

- Accounting to the fish component:
  - 100% of the cost for fingerling,
  - 50% for feed and electricity, and
  - 20% for transportation, repairs and labour.
- The operation cost attributable to
  - Catfish was estimated at 28%
  - Jade perch was estimated at 34%.
- In case of Catfish only, revenues from fish =17% of total
- After the shift to Jade perch this contribution > 40% of total.

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Integration of fish - vegetables

Aquaponics

Upscaling: good for fish,

but attention to market for vegetables.

Financially sustainable if:

1. High end niche market for fish,
2. large market for fresh organic vegetables.

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Randvoorwaarde Aquacultuur: Know-How

- Overbrengen / Leren van Kennis en Ervaring;
- Lokale opleide mensen vaak weinig creatief & praktisch;
- Approaches of Technology Transfer to farmers.

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Assumption of straightforward T-T to farmers

Technology & information available but:

- Information not available for the farmers, thus
- If this technology was communicated to the farmers,
- Their practices would be improved, and
- Their yield per hectare and income will increase.

= Top-down Extension approach of T-T.

Can you mention other approaches?

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Approaches for T-T to Farmers

- Top-down Extension (TE)
- Training & Visit (T&V)
- Value Chain Development (VC)
- Farmer Innovation Platform (VIP)
- Farmer Field School (FFS)
- Participatory Research for Development (PRD)

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(Dis)Advantages of AE, T&V, VC

- Advantage:
  - Emphasis on national priority commodities in extension program.
- Disadvantages:
  - Weak and ineffective linkages with research;
  - Lack of field demonstrations;
  - Extension agents have: Multiple duties, and
    - Insufficient pre-service and in-service training
    - Too vast operational area to give satisfactory coverage =>
    - Preferential treatment to larger and easy accessible producers
  - Often:
    - Ineffective organizational structure and programming;
    - Unorganized and ineffective visits to farmers.
  - **But worse of all: often telling the message only without checking if farmers understood or acquired know-how.**

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(Dis)Advantages of FFS and VIP

- Advantages of both: **Focus on product.**
- Disadvantages of FFS:
  - Requires good preparation:
    - Curriculum for full cropping season;
    - Training of Extension Agents;
  - Is expensive for the State;
  - Does not always consider marketing aspects.

- Disadvantages of VIP:
  - Requires well trained agents and network of experts;
  - Is expensive for the State.
- Advantages of VIP: **Aims to consider all factors.**

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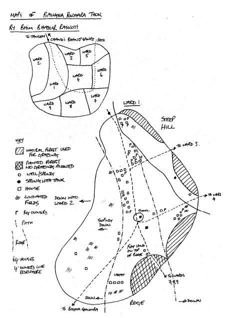
(Dis)Advantages of PRD

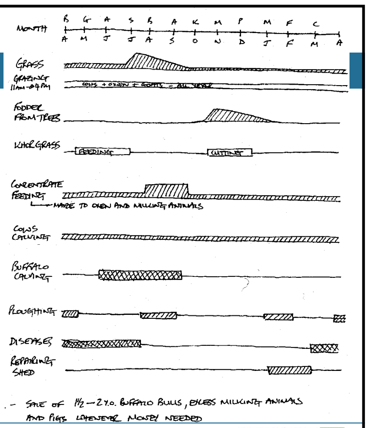
- Advantages of PRD: **innovation is**
  - » developed with the farmers, and
  - » matched with their local context.
  - – Good farmers can become local extension agent.
- Disadvantages of Participatory Research-Development
  - – = Testing and piloting an innovation;
  - – Constraints for upscaling often not studied;
  - – Is expensive for the State;
  - – Does not always consider marketing aspects.

Tools for participation

- Raising awareness for technology needs:
  - Participatory diagnostics,
  - Inter-villages visits
  - Participatory solution identification and prioritization.
- Using PRA tools, such as:
  - Calendars (weather, crop, labor, others),
  - Flow and relation diagrams,
  - Proportional piling to compare (results, ...),
  - Focused Group Discussions in breakout sessions:
    - Separated by gender and hierarchical levels.
    - Use spokes(wo)men.
- For complex innovations, offer more solutions: PRD

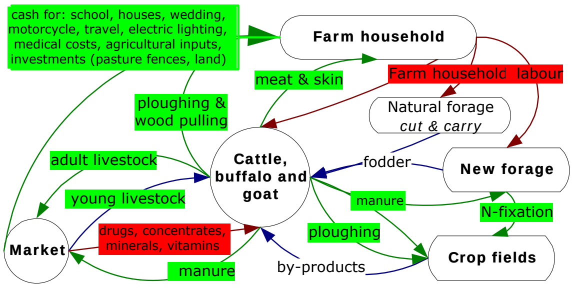
PRA tools





PRA tools

Figure 1: Ressource flow diagram of cattle husbandry system in Sepaku.

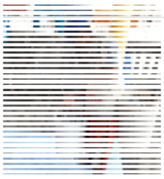


Technology adoption by farmers

When will a farmer adopt an innovation?

- Technology change demands:
  - Know-how and learning (transaction cost);
  - Capital;
  - Land;
  - Labor time.
  - ➢ Adoption occurs when:
    - – Awareness for need to change is high;
    - – Training is good;
    - – Land is available or productivity increases;
    - – Labor time decreases;
    - – Capital investment is reimbursed (IRR >150%).

Dank voor jullie aandacht



Inkomsten en werk
voor velen,

maar dat we zaken
als rechts mogen
voorkomen.

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