

How does public agricultural research impact society? Towards a characterization of various patterns

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Objective of the research:

The evaluation of PROs' performance faces major challenges :

- Various impact dimensions related to multiple missions
 - Multiple actors involved in impacts' generation
- ⇒ Concept of impact patterns

Objective:

to characterize different impact patterns of research results of a PRO by

- classifying INRA's innovation forms and
- analysing the various impact generation processes defined

Evaluating public research impacts: a review of the literature

1. Economic impact evaluation:

- Calculation of rate of return... through econometry without actors interaction processes analysis ... (Jaffe, 1989; Evenson, 2001)
- ATP tradition: assessment of a wider range of economic impacts with econometry, bibliometry, statistics, social network analysis and historical tracing on case studies (Ruegg & Feller, 2003; Prest, 2002; Georghiou & Rosner, 2001)
- Focus on the influence of public research on industrial R&D through a diversity of outputs of PROs mainly for industrial beneficiaries (Mansfield, 1998; Cohen et al, 2002; Salter & Martin, 2001; Klevorick et al, 1995)

⇒ **Different methods focusing on several intermediaries using various indicators but still to assess only economic impact**

2. Other single impact evaluation (health or environment):

- Environmental performance assessment of product, process, activity, organization: LCA, multi-criteria analysis... (Hermann et al, 2006)

⇒ **Scores for specific performance indicators but time consuming, data intensive, no impact calculation, no concern for science role and other stakeholders involvement**

3. Broader impact approaches:

- Public Value Mapping: knowledge valued by its use and outcomes with a price in a market. The « knowledge value alliance » includes scientists but also government, private funding agents, end-users... environmental quality, healthcare,... is considered (Bozeman, 2003)

⇒ **Large scale programs and policies of science aiming broad social goals but no focus on research evaluation**

- Payback Framework with non linear logic model of research processes and various categories of paybacks (Donovan, Haney, 2011)
- SIAMPI: large range of stakeholders and beneficiaries providing efforts to apply research results (Spaapen & van Droge, 2011)

⇒ **Case studies, not statistically representative**

Database description

The database:

- Sources: most significant research results of INRA (significant cases and press releases)
- Content: 1048 forms (=individuals), described by title, theme, topic, abstract, patents, contacts...

Data management:

- Codification of 3 variables: beneficiaries, outputs, impacts
- Independent codification by 3 persons

Categories	Beneficiaries	Outputs	Impacts
Modalities	<ul style="list-style-type: none"> <input type="checkbox"/> Public institutions <input type="checkbox"/> Technical centres <input type="checkbox"/> Lines, professional organisations <input type="checkbox"/> High technology industries <input type="checkbox"/> Low technology industries <input type="checkbox"/> Territory <input type="checkbox"/> Group concerned, lobbies <input type="checkbox"/> Research and higher education 	<ul style="list-style-type: none"> <input type="checkbox"/> Innovation incorporated in technical objects <input type="checkbox"/> Innovation non incorporated (eg: know-how) <input type="checkbox"/> Metrology, standards <input type="checkbox"/> Expertise <input type="checkbox"/> Coordination structure, institution <input type="checkbox"/> Training <input type="checkbox"/> bank, collection, database 	<ul style="list-style-type: none"> <input type="checkbox"/> Economic competitiveness <input type="checkbox"/> Environment <input type="checkbox"/> Healthy security <input type="checkbox"/> Social (autonomy, social network...) <input type="checkbox"/> Structuration of a territory, a sector or market <input type="checkbox"/> Public policy <input type="checkbox"/> Maintaining of options for the future

Each variable takes 7 to 8 non exclusive modalities
 ⇒ 22 modalities

Method

Codification robustness:

- 953 forms are equally codified by the 3 codifiers on at least 14 modalities (/22) and with a rate of error lower than 15% on all the modalities
- ⇒ **Conciliation in sample size** between codification errors and bias in form selection

Classification

- Clustering around k-medoids algorithm to define classes
- ⇒ **One class = one combination of outputs, beneficiaries and impacts = a specific impact pattern**
- ⇒ **7 classes defined** by its size and some exemplary forms

Distribution of modalities among classes

- 3 classes NE (42% of forms) : **innovations non embedded in technical objects** (methods, know-how...) impacting economy, environment or health
- 2 classes P (34% of forms) : **technical product** outputs (software, device, variety...) impacting either environment or health
- 1 class Ex (17% of forms): **expertise** which impacts public policies
- 1 class Ba (7% of forms): **biobanks** (collections, biobanks, databases...) contributing to maintain options for the future

7 patterns

Class	Title	% of 953 forms
Patterns related to innovations impacting agricultural sectors economy		
NE1	Methodological breakthroughs supporting the economic competitiveness of agricultural sectors and food industry	17%
P1	Embedded technologies and standards to support the economic competitiveness of the agricultural sector	20%
Patterns related to innovations tackling health issues		
NE3	Methodological development for professionals impacting health issues	14%
P2	Embedded technologies for private firms and research generating health impacts	14%
Patterns related to innovations impacting the conservation of natural resources		
NE2	Methodological breakthroughs benefiting PROs for environmental issues of today and tomorrow	11%
Ba	Management of biobanks for public and private R&D to maintain options for the future	7%
Patterns related to accumulated knowledge enlightening public decisions		
Ex	Empowerment of public institution on sustainable development issues	17%

These 7 patterns...

Match current (and past) **INRA's missions:**

- Generate and diffuse scientific knowledge
- Develop innovations and know-how benefiting the society
- Enlighten public and private decision through expertise

Are coherent with literature results, reporting a diversity of roles of agricultural PROs on:

- Economic competitiveness (Salter & Martin, Rosenberg, Von Hippel, Heisey)
- Natural resources management (Abler & Shortle, Brundtland, Beddington, Heisey)
- Public health insurance (Cockburn and Henderson, Bozeman), and coordination structures (Callon, Salter&Martin, Rappa & Debackere)
- Public decision enlightening (Weiss, Kingdon, Cozzens)

Are applicable to other agricultural PROs worldwide (EMBRAPA, USDA, ACIAR, CSIRO...). Their case studies fit our 7 patterns.

Conclusion and perspectives

- 7 impact patterns for 7 mechanisms toward societal impact
- A wide sphere of influence of INRA on a large spectrum of impact dimensions
- Large range of outputs considered and impacts often generated by a set of complementary actors
- Useful for communication by INRA while external evaluation.

Limits and perspectives:

- These patterns do not account for relevant parts of the impact pathway: inputs and intermediaries
 - No analysis of intensity of impacts generated
 - Despite cross-codification and statistical tests, codification remains qualitative and subjective
- => This is a first step for a wider complementary evaluation based on case studies analysis with qualitative and quantitative indicators aiming at defining complete impact pathways and quantified impacts.

Thank you for your attention

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**Some more insights
to understand these results?**