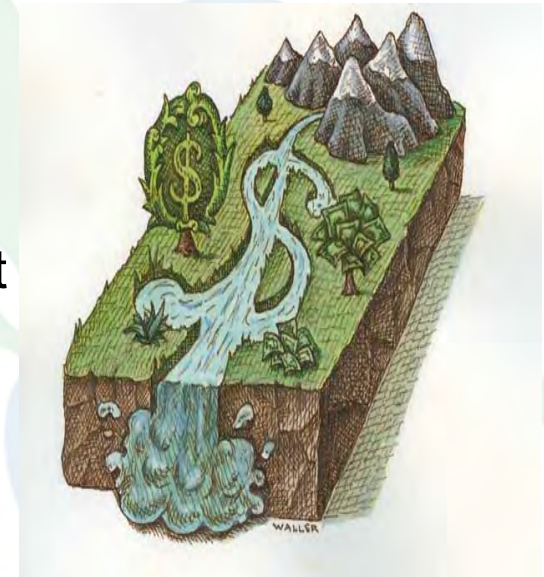


# ***Economics of Genetic Resources Conservation and Use: An Overview***



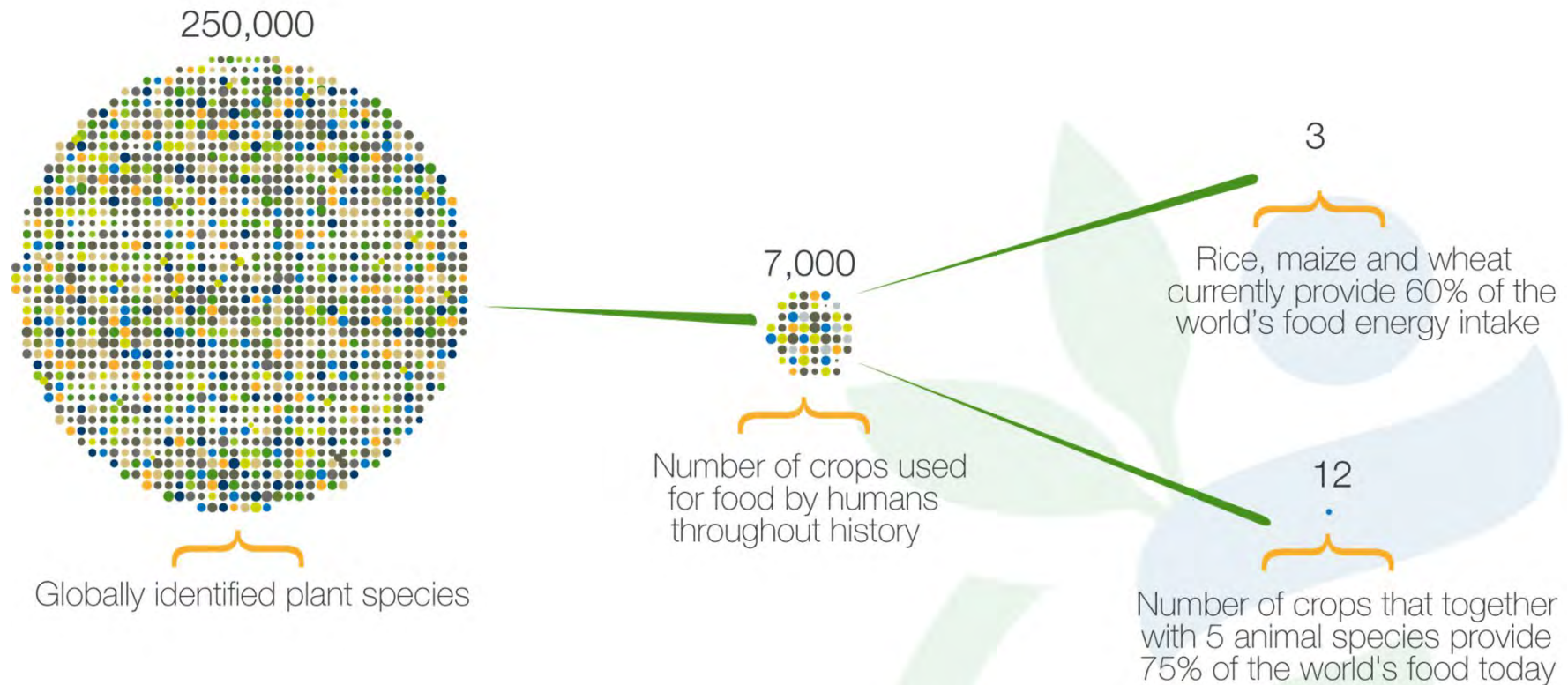
Adam G. Drucker  
Principal (Ecological) Economist  
Bioversity International, Rome  
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# The need for agricultural biodiversity

The heavy reliance on a narrow diversity of crops puts future food and nutrition security at risk.



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Source: 'Dimensions of Need: An atlas of food and agriculture'. FAO, 1995.

# Introduction - Concepts



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# Economic Perspective of the Loss of Biodiversity: The Conversion Process



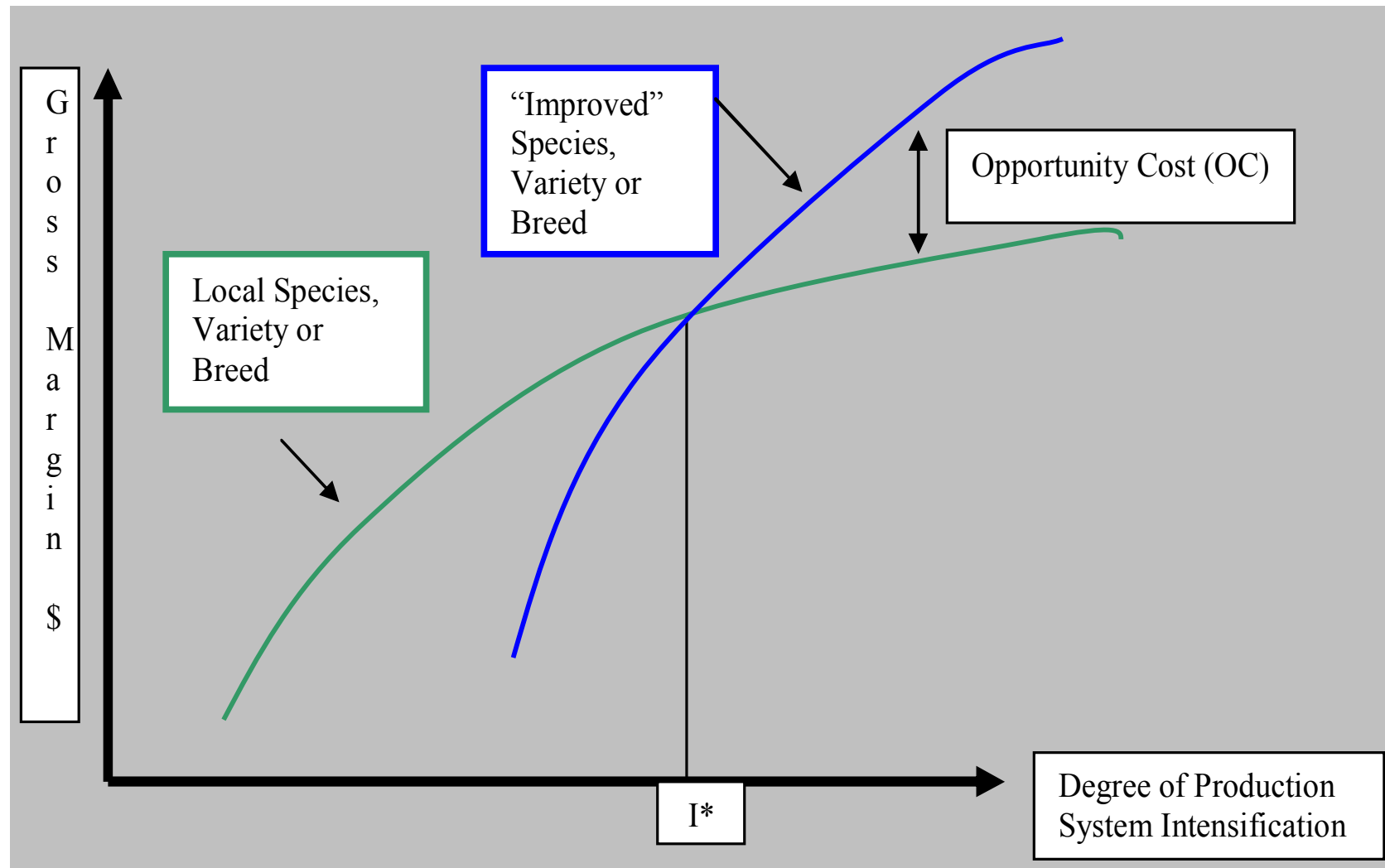
- Replacement of the existing slate of diverse natural habitats and resources with a selection from a small range of specialised productions systems that provide more direct benefits to humans
- (Swanson, 1997)



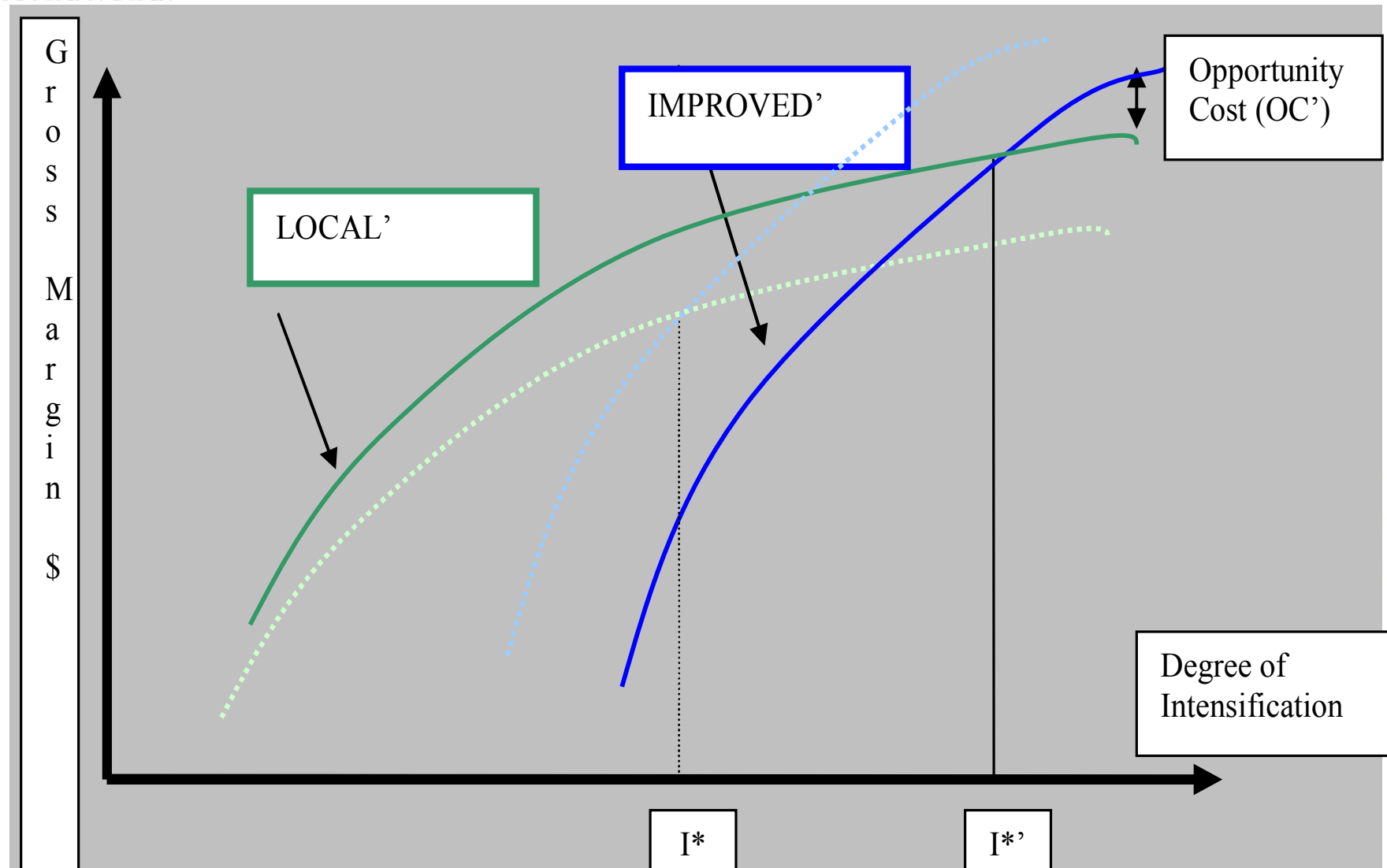
# Total Economic Value

DUV	IUV	OV	BV	XV
Direct Use Values	Indirect Use Values	Option Values	Bequest Values	Existence Values
Food	Agroecosystem resilience;	(for an uncertain future)	Satisfaction arising from passing specific genetic resources/ diversity on to future generations	Satisfaction arising from knowing that a specific genetic resource / diversity exists
Animal feed	Maintenance of evolutionary processes & future option values			
Fibres	Maintenance of indigenous knowledge and culture			
Fuel				
Construction materials				
Traction and transport				
Private Goods	Public Goods			

# Economics of Agrobiodiversity Replacement (Financial/Private Perspective)



# Economics of Agrobiodiversity Replacement (Economic/Social Perspective)





## Importance of Development of Methods and Decision-Support Tools

- Key constraint to implementing conservation strategies is existence of pervasive externalities such that value of ABD is often not fully accounted for by individuals and society.
- Agricultural biodiversity needs to be properly valued
- Mechanisms needed to permit the “capture” of those values
- Requires development of appropriate economic methods, decision-support tools and policy intervention strategies.

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## Method and Tool Development (Status)

- Significant development of methods over last 10-20 years for PGR and AnGR
  - e.g. see Drucker and Smale, 2005 for state of the art review covering over 170 publications plus associated 2008 updated database.  
(link on Bioversity International and IFPRI websites)
- A wide range of decision-support tools and analytical approaches successfully tested
  - Across different crop species/varieties and livestock breeds
  - Across different production systems and locations
  - In situ and ex situ.

## A Diversity of Methods and Tools

- econometric methods;
- optimization models (including Weitzman);
- Monte Carlo simulations;
- search theoretic frameworks;
- contingent valuation and choice experiments;
- experimental games
- production loss, opportunity cost, least-cost and safe minimum standards methods;
- economic surplus methods;
- cross-sectional farm and household methods;
- farm simulation and breeding programme evaluation;
- use of genetic production functions



## Policy Relevance – Types of questions such research can be expected to answer

- Which species/varieties or breeds should be conservation **priorities** (given that we cannot save everything)?
- How important are particular local species/varieties or breeds to **livelihoods** and how can such values be harnessed to support poverty alleviation efforts?
- **Which traits and functions** (both marketed and non-marketed) are the most important and degree they can be traded off against each other?
- What are the **costs of ABD conservation** programmes and how can we minimise these? What are the related benefits?

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# Selected Methods, Tools and Research Findings



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# Targeting and Prioritization: What to Board on Noah's Ark?







# 1. “Weitzman” decision-support tool for identifying breed/variety conservation priorities

- Analytical tool for cost-effective allocation of a given budget among a set of breeds/varieties such that the diversity conserved is maximized.
- Integrates genetic distance, extinction probability and economic (conservation cost, livelihoods contribution) data.
- Where sufficiently specified framework can be used for rational decision-making on national, regional or global scales.
- African Zebu cattle example identifies priorities of 3-9 out of 23 Zebu breeds. These are not necessarily the most endangered ones.

(Source: Simianer et al., 2003)

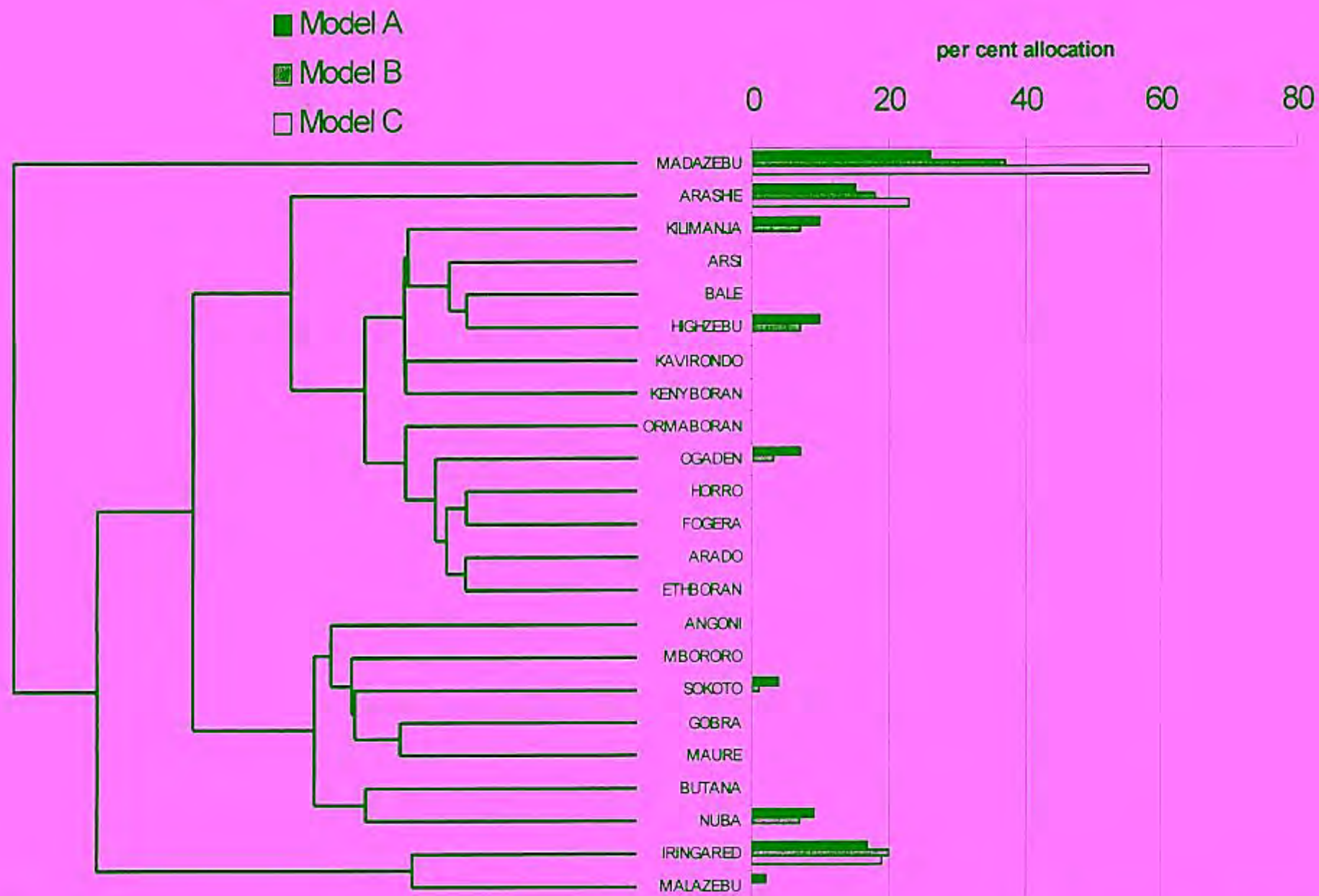


Fig. 2. Maximum likelihood tree from the application of the Weitzman (1992) algorithm and optimum allocation of resources resulting from the three models considered.

## **Case Studies 2 - 3: Choice Experiment, Pigs-Mexico & Cattle-Kenya and Burkina Faso**

- Multi-attribute stated-preference methods used to value phenotypic traits expressed in indigenous breeds.
- Potential to investigate values of genetically-determined traits currently not prominent in livestock populations, but desirable candidates for breeding/conservation.
- Permits analysis of how household characteristics determine differences in preferences.

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# Farmer trait preferences can differ



For a long time, Farmer Hansen and his tall chickens enjoyed immense popularity—until Farmer Sutton got himself a longcow.



Choice Card 17

Sex: Bull/ ወያኔ



Tryps Tolerance: Medium/

ጥንቁጥ ጥንቁጥ ይቀባል

Traction: Suitable/ ለክርክር ተስማሚ



922002 (ክፍል 4-6 ዓመት)

Price (AGE 4-6 YRS)—BIRR 600/



Choice Card 18

Sex: Bull/ ወያኔ



Tryps Tolerance: Medium/

ጥንቁጥ ጥንቁጥ ይቀባል

Traction: Unsuitable/ ለክርክር አይስማምም



922002 (ክፍል 4-6 ዓመት) Price (AGE 4-6 YRS)—BIRR 400/





# Net benefits of creole pig rearing (Yucatan, Mexico)

	Creole	Crossbreed	Exotic
Sale weight at 6 months (kg)	35	65	90
Weight gain (kg) at 6 months	25	55	80
Total value to farmer (Mex\$)	112.5	247.5	360
Feed cost (Mex\$)	0	60	120
Bath cost (Mex\$)	0	18	36
Veterinary cost (Mex\$)	0	43.5	87
<b>Total [Pooled Sample]</b>	<b>112.5</b>	<b>126</b>	<b>117</b>
Total [Small, Poorer HH]	186	95.5	-32.3
Total [Large, Richer HH]	76.5	87.5	83.3

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(Source: Scarpa et al., 2003a)

US\$ 1 ≈ Mex\$10 in 2002

## Case Study 4: Vietnamese Pig Subsidies

- 15 potential types of subsidy were identified.
- Total subsidy for imported breeds and their crosses is in the region of 460,000 VND/sow/year (approximately US\$31).
- Represents 19-70% of the gross margin typically associated with sow production.
- Mitigating measures for AnGR conservation urgently need to be implemented rather than, or in addition to, simply advocating the removal of distorting subsidies.



## Case Study 5: EU Rural Development Plan (RDP) Conservation Costs

- Many breeds on FAO WWL receive no support as not included in country RDPs
- Payments do not account for different degrees of extinction risk
- Based on opportunity cost measure, support payments are inadequate
- EU support measures need to be reviewed

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## Case Study 6: Safe Minimum Standard (SMS)

- Adapts SMS approach from wildlife applications to livestock breeds, using FAO criteria of “not at risk” (1,000 breeding females, 20 males, stable population trend).
- Conservation costs in EU, Italy and Mexico determined for variety of species/breeds based on opportunity cost differential plus administration.
- Results: Costs of SMS small (<1%) compared to existing subsidies and benefit-cost ratio (>2.9).

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Maremmana cattle in a 'buttero' display

## Case Study 7: Assessing Total Economic Value (TEV) of 3 Italian and Spanish Cattle Breeds



Modicana cattle in their traditional landscape

Attribute of the conservation programme		Option 1	Option 2	Status-quo option
Maintenance of breed-related special food products		Yes	No	No
Maintenance of breed-related rural landscape		Stable	Stable	Declining
Possibility to re-establish the breed in case of extinction		High	Low	Low
Certainty of the continued existence of live animals over the next 50 years		50 %	10%	10%
One-off contribution to the conservation programme (Euro)		100	10	0

- TEV assessed using choice experiments
- Most respondents (85% in Italy) supported conservation. Willingness-to-pay easily justifying EU support.
- High landscape maintenance, existence and future option public good values (around 80-90% of their TEVs) justify need for support.
- Conservation strategy identification: Interventions with the highest potential to maximise societal welfare would be those that secure the breed-related functions that people value most.



Alistana-Sanabresa

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Zander et al., 2013; Martin-Collado et al., 2014





# PACS and Market Chain Development Complementarity

*Not everything can be conserved through niche product market development*

- Some PGR/AnGR do not currently have niche market potential
  - Successful market chain development of other PGR/AnGR can lead to displacement
  - Where conservation goals are modest, alternative interventions may be more cost-effective given required magnitude of market development costs
- 
- Need for complementary instruments within a priority conservation and use portfolio context

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# Priority Conservation Portfolio Triage

**GR with no current  
market potential  
(thousands)**



**GR with  
current  
market  
potential  
(dozens)**

**GR with unknown  
current market  
potential (thousands)**

Only some  
genetic  
resources (GR)  
have  
transformation  
potential

High initial  
investment  
costs

Long  
development  
time horizons

Low success  
rates



## 8. Payments/Rewards for Agrobiodiversity Conservation Services (PACS/RACS)

Payments for Agrobiodiversity Conservation Services (PACS) *tested /being applied since 2009 (for crops) in Peru, Ecuador, Bolivia, Guatemala, Nepal , India & Zambia. Slovenia for livestock*

*Involves:*

- Prioritization protocols (Weitzman)
- Competitive tenders to minimise intervention costs
- Transparent accounting of not only cost-effectiveness criteria but also social-equity criteria
- Conditional rewards paid in-kind and at a group level
- Participatory justice, implementation of Farmers' Rights and Fair & Equitable Sharing of Benefits

*Outcome:*

- Diversification of farmer livelihoods from being based largely on agricultural production to one including the provision of public good conservation services.

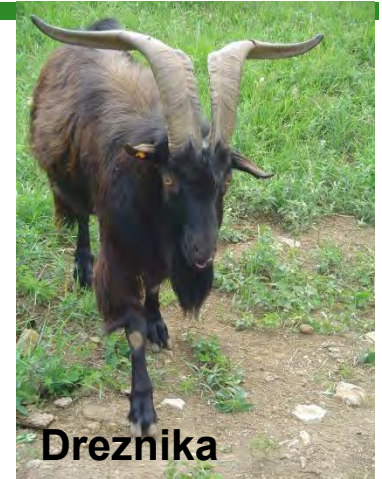


**Recommendation of SIRGEALC 2011: PACS is an innovative tool that should be promoted in the region and with the ITPGRFA and CGRFA**



## PACS AnGR Slovenia

- Review of conservation history, threat status, conservation goals and strategy, existing incentive mechanisms/support payments.
- Assess whether existing levels of support adequate.
- Competitive conservation tender approach applied to reveal farmers' true and differentiated opportunity costs and identify least-cost conservation service providers.
- Recommendations for implementation/uptake of a cost-effective conservation strategy.

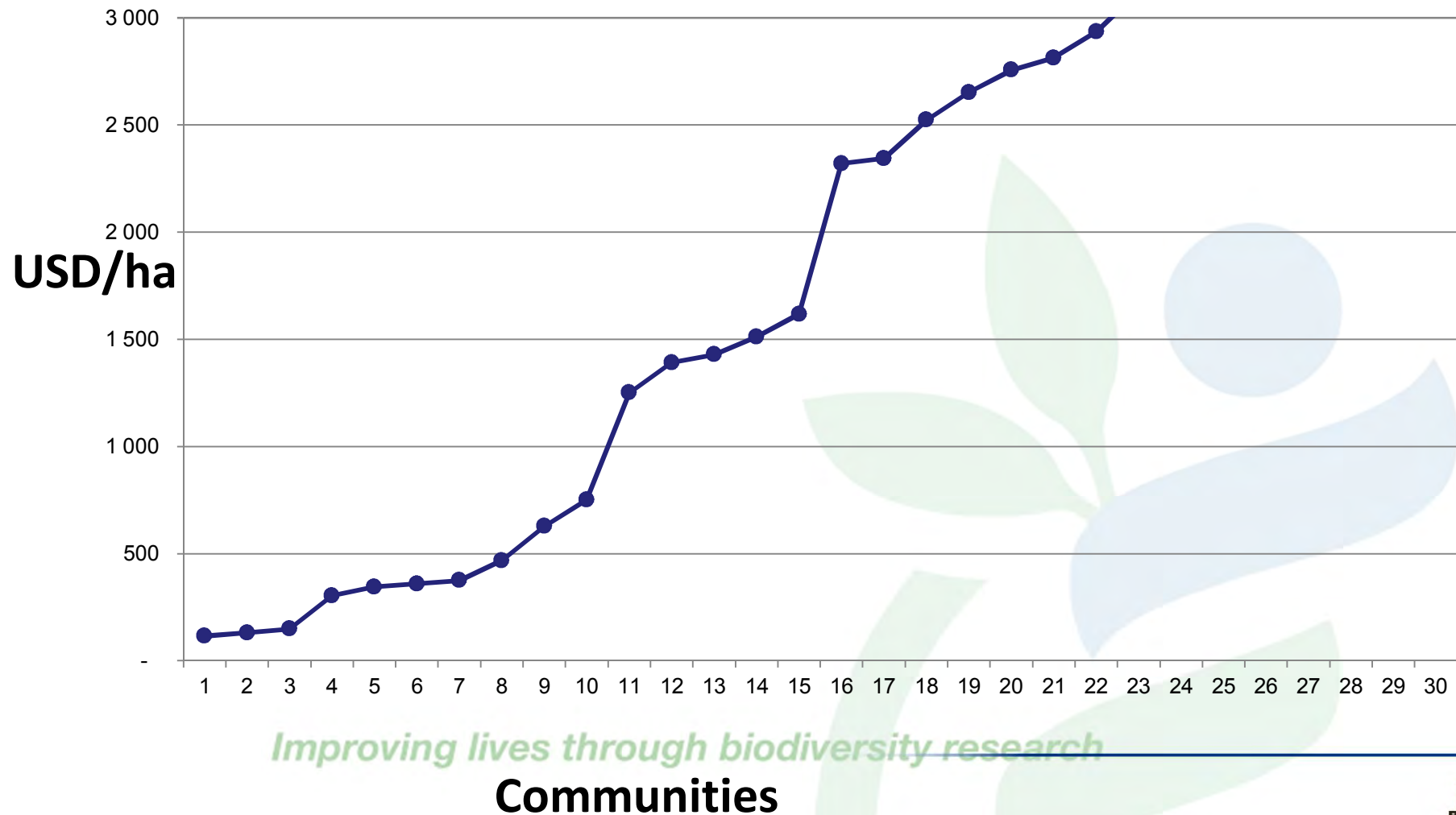


# PACS Implementation Steps

- A. Define the conservation strategy (*what do we want to conserve?*)
- B. Define the conservation goal (how – at what level – do we want to conserve it?)
- C. Assist individual farmers or communities to develop a conservation service offer
- D. Assess farmer Willingness to Accept (WTA) rewards to undertake conservation
- E. Identify how rewards can be financed by the project (i.e. sources of rewards/funding)



# Conservation of 5 Priority Varieties of Quinoa: Bid Offers (USD/ha)



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**Communities**

# Types of PACS In-Kind Rewards (2011)









**Now that we have  
realized the virtues  
of these varieties,  
we will strive to  
keep them alive,  
even if the project  
does not go on.**

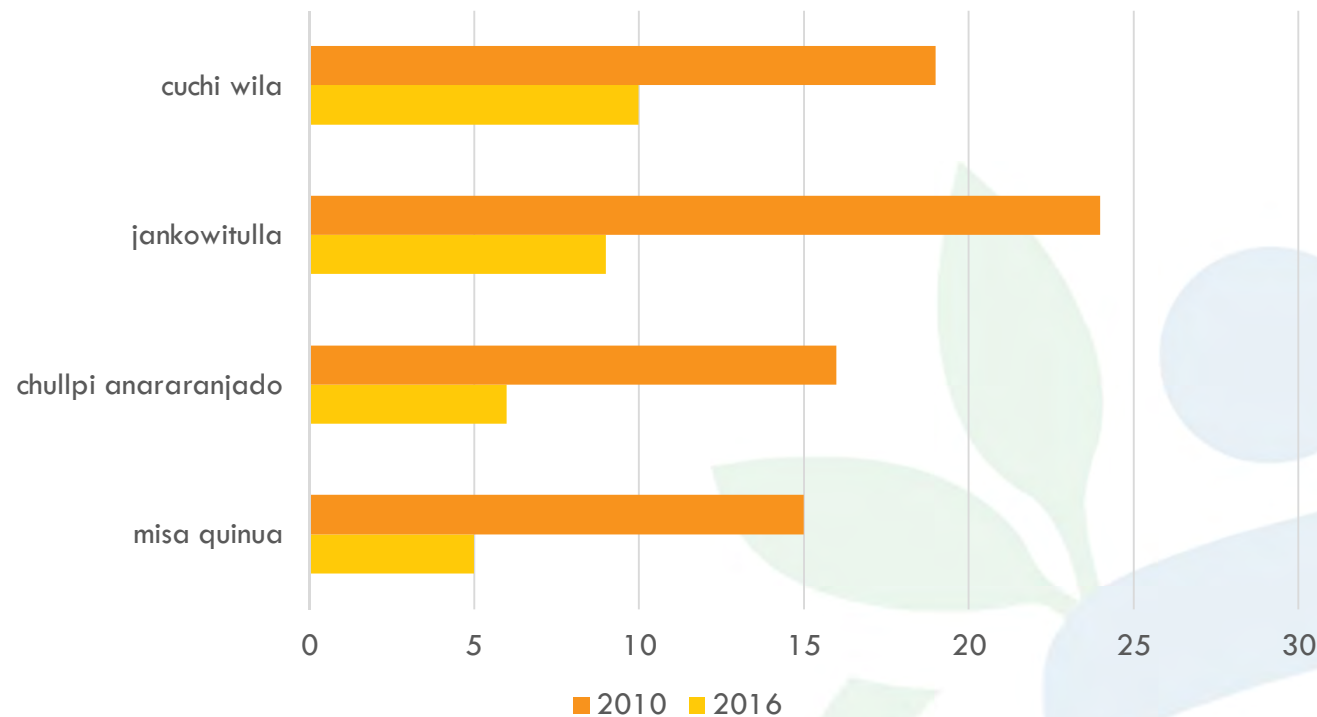
Santusa de López  
Community of Aguaquiza  
Nor Lipez Province  
Potosi, Bolivia





# Persistence of Quinoa Varieties at Risk

(30-50% of farmers had maintained the re-injected varieties after 5 years even in the absence of further intervention)




% farmers	misa quinua	chullpi anararanjado	jankowitulla	cuchi wila
continues	33.3%	37.5%	37.5%	52.6%
stopped	66.7%	62.5%	62.5%	47.4%

Source: LAVOIE, ARPAZI, RAMIREZ y DRUCKER. 2017.

# Total Conservation Costs may be Modest!

## (< \$200k p.a. for 300 varieties)

by contrast OECD spends >\$260 billion p.a. in agricultural

Time Horizon (years)	Total Cost (Present Value, US\$ millions)	Annualized Cost (US\$ millions)
	5.	0.19
	10.	0.18
	20.	0.17
	50.	0.15

### Assumptions:

300 species/varieties

Intervention carried out on 20% of the priority conservation portfolio each year

Conservation goal: 5 ha y 100 farmers per species/variety

Persistence: Interventions need to be repeated for 70% of the portfolio every 5 years

Cost/ha US\$500 + 10% monitoring and administration

Discount rate = 5%



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# Future Challenges

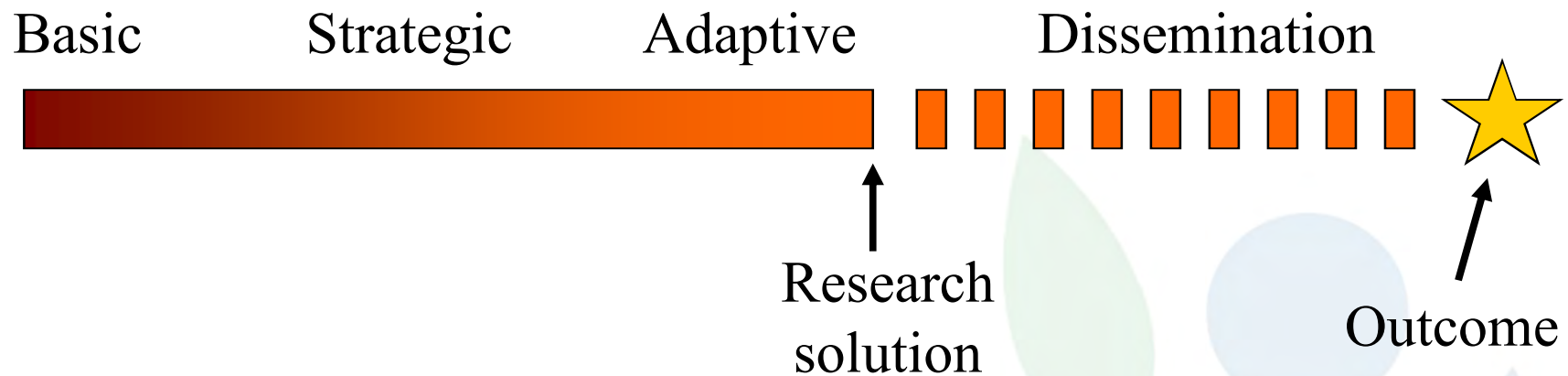
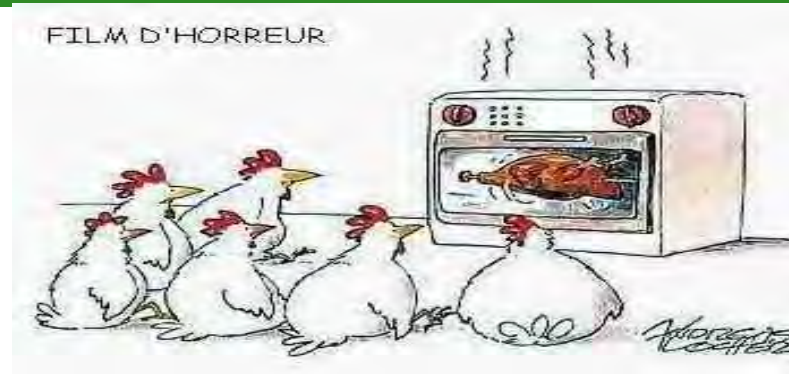


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# Constraints to the Economic Analysis of AnGR

- Methodological
- Limited data availability
- Existence of non-market values
- Type of data needed requires use of rural appraisal techniques



- Economics has contributed relatively little to debate about value of genetic resources & diversity.
- Relatively limited uptake of associated tools & methods



# Economics-related References by SoW-AnGR Country Report

## Economic Valuation

1. Fiji
2. Dominica
3. Germany
4. Indonesia
5. Kiribati
6. Malaysia
7. Netherlands
8. Pakistan
9. Samoa
10. Syria
11. United States of America

## Prioritization and Cost-Effectiveness

1. Finland
2. Germany
3. Iran
4. United Kingdom

## Subsidies and Compensation

1. Germany
2. Latvia
3. Netherlands
4. Sweden
5. United States of America

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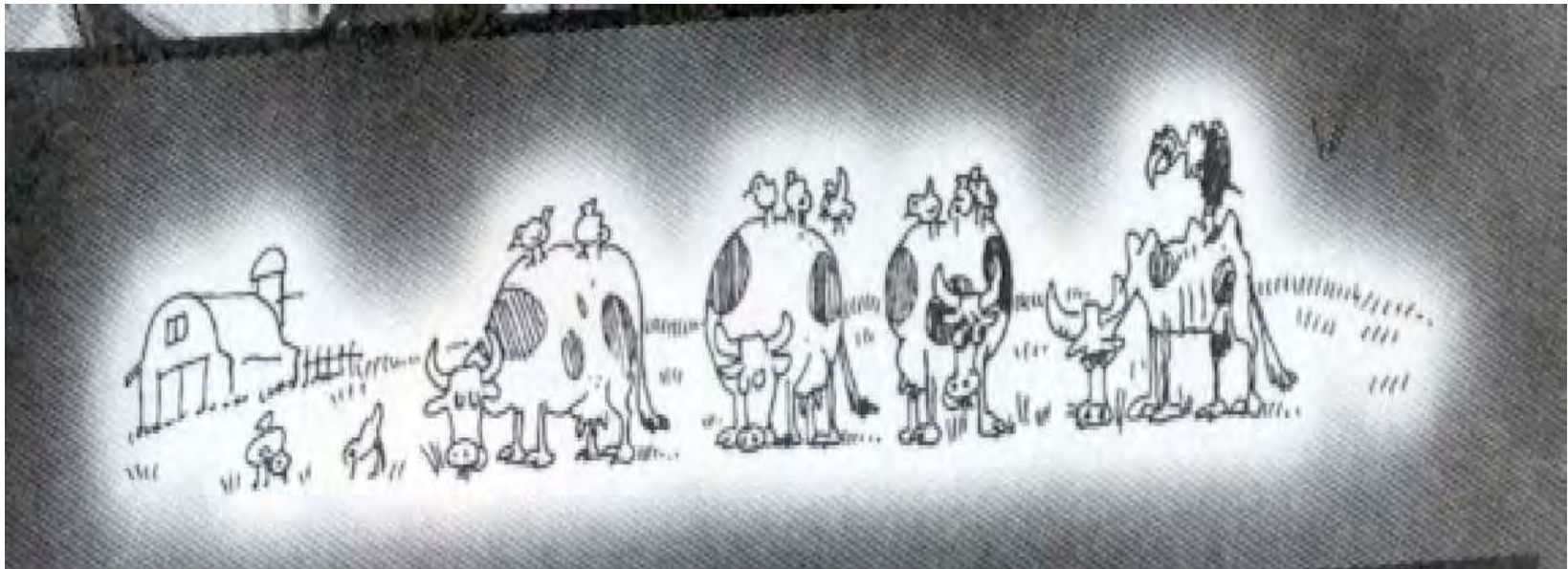
Drucker (2010). AGRI

# The Challenges Ahead

- **Raise awareness** among national policy-makers regarding existence of & benefits of (e.g. in terms of improved cost-effectiveness) using such tools
- Improve national genetic resource economics **analytical capabilities**
- Link total economic values with specific **ecosystem service provision**
- **Generate input data** required (availability/"get-ability")
  - Data needed related to farmers' preferences for different genetic resource attributes and value placed on these across species, varieties/breeds and production systems.
  - Tools/methods frequently rely on intensive, primary data collection (particularly given problems of missing markets & imperfections). Need to be applied in conjunction with participatory rural appraisal methods.
  - Strong capacity building component required.
- Estimate AnGR **conservation costs and benefits** both in situ and ex situ
- Apply in circumstances where tools/methods may be expected to have a significant **impact** on actual conservation and livelihood outcomes (inc. from a gender perspective).
- Collaborate closely with communities and policy makers required in order to facilitate **uptake** ("ownership")



# Thank You



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