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Choosing Appropriate Methods for Impact evaluation

Jian Wang & Yuan Chou

CSIRO & Acil Allen Consulting Pty Ltd

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The International School on Research Impact Assessment

MELBOURNE | 19-23 SEPTEMBER 2016



Learning outcomes

- Identify frameworks for choosing appropriate methods
- Approaches for economic/social/environmental evaluation
- Use economic evaluation (such as cost benefit analysis) more effectively for funding decisions



What we mean by ‘impact evaluation’

An impact evaluation needs to answer questions about:

What happened? – *descriptive questions*

What made this happen? – *causal questions*

What was the overall value of this? – *methods for answering evaluative questions*

Different methods are needed to answer each type of question



Methods for answering evaluative questions

TYPICAL QUESTIONS: *Did it work? For whom and in what ways did it work? Was it worth it?*

DETERMINE CRITERIA AND STANDARDS FOR SUCCESS

Formal values – stated goals and policy commitments

Tacit values - hierarchical card sorting, photovoice, rich pictures, stories of change, values clarification interviews, public opinion polls

Negotiating values – concept mapping, delphi study, dotmocracy, public consultations

SYNTHESISE EVIDENCE AND VALUES

Techniques– Multi-criteria analysis, numeric weighting, qualitative weight and sum, rubrics

Techniques also considering resources- cost-benefit analysis, cost effectiveness analysis, cost utility analysis, social return on investment, value for money

Processes – consensus conference, expert panel



Methods need to be appropriate for the situation

The choice of methods needs to take into account:

Nature of the evaluation— *what questions are being asked?*

Nature of what is being evaluated— *complicated or complex aspects*

Resources and constraints — *available time, expertise, money, data*



Example - CSIRO Collaboration with SMEs

Descriptive questions

What was turnover and employment data before and after the program:

- existing data (if it is adequately accurate and accessible)
- interviews using a structured questionnaire with business managers in a random sample of participating and non-participating firms (if it was expected that the informants could provide accurate data)

Causal questions

Did the program made a difference?

- Regression discontinuity (if data available from firms that were just eligible and just missed out, and reasonable comparison)

What other factors combined with the program to produce the results?

- Comparative case study of purposeful sample (least, most successful, and outliers)

Evaluative questions

Was the programme successful?

- Rubric (Global Scale) combining program intent and negative impact

Example - Atlas of Living Australia (ALA)

Descriptive questions

Where do you go to discover and access biodiversity data and information before and after the existence of ALA:

- existing data (if it is adequately accurate and accessible)
- interviews using a structured questionnaire with ALA users

Causal questions

Did the program make a difference (culture change, productivity gains and new services and products?)

- Interviews using a structured questionnaire with ALA users
- Regression discontinuity (if data available from firms that were just eligible and just missed out, and reasonable comparison)

What other factors combined with the program to produce the results?

- Comparative case study of purposeful sample (least, most successful, and outliers)

Evaluative questions

Was the money well spent?

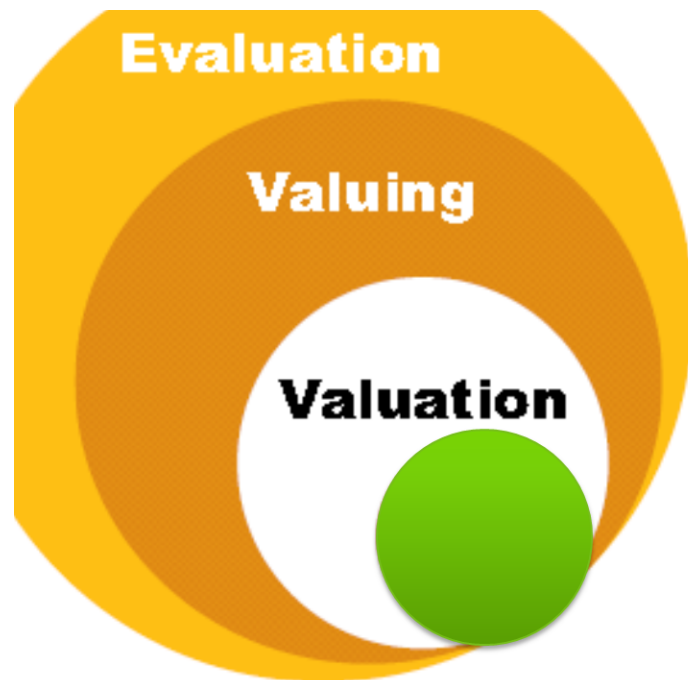
- Cost benefit analysis combining policy intent and negative impacts

Valuation



Valuation

Expressing \$ value on inputs, outcomes and/or impacts



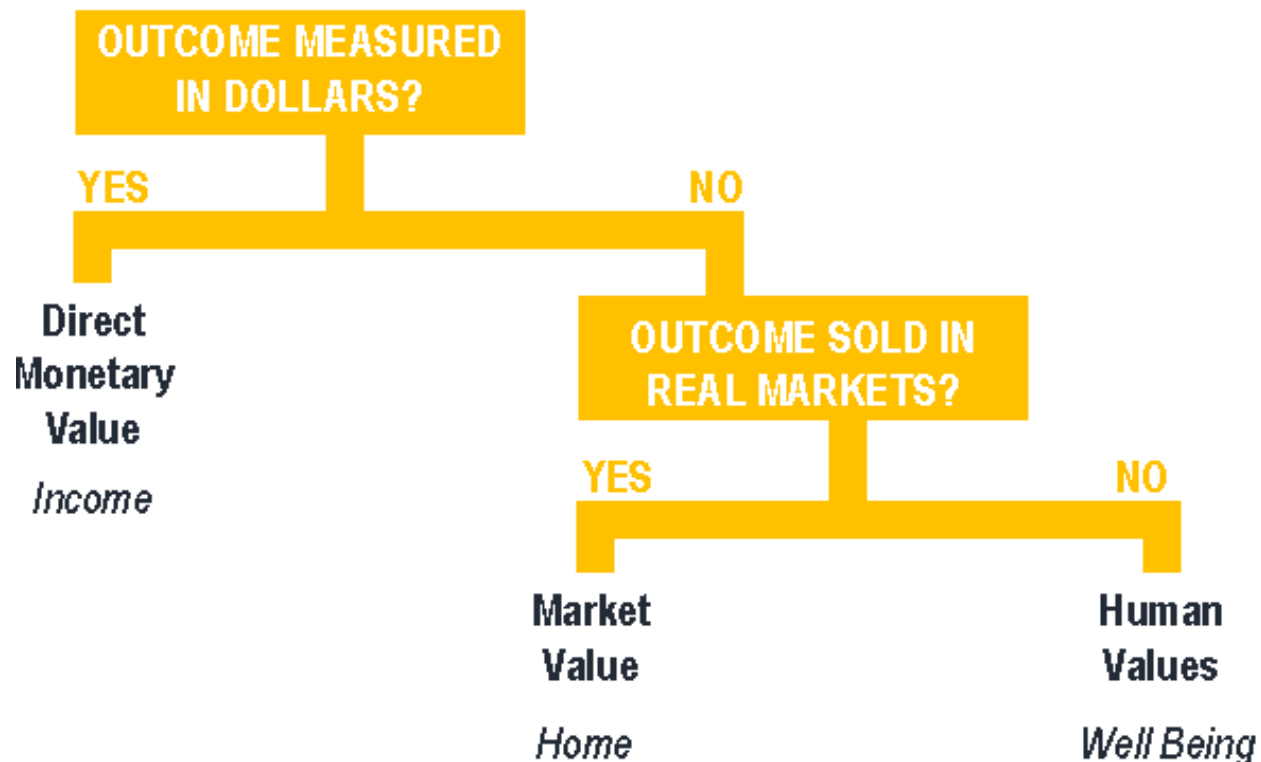
Study: Price tag of autism in the U.S. exceeds \$236 billion per year



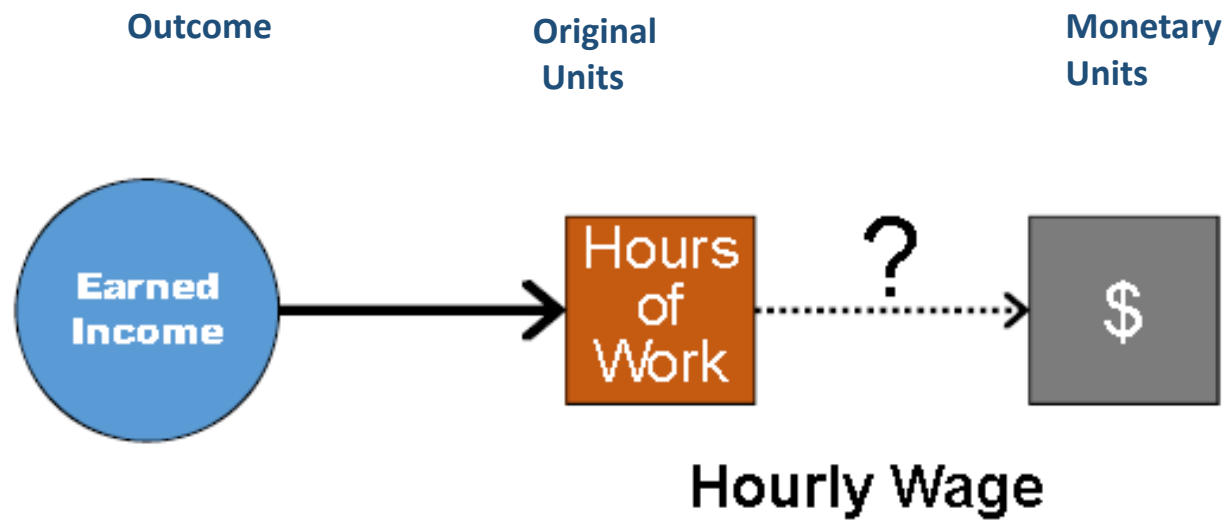
WSIPP: Every dollar spent on peer tutoring adds about \$11 of value to society.



Type of Value

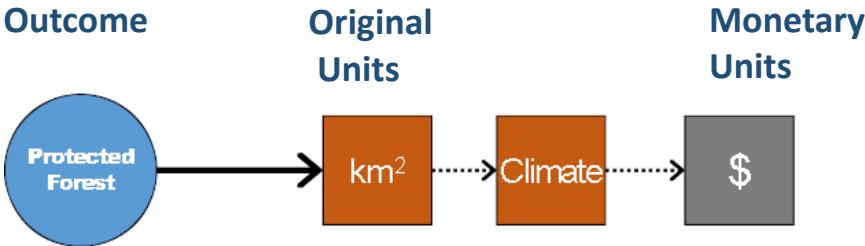


Example: Market Valuation

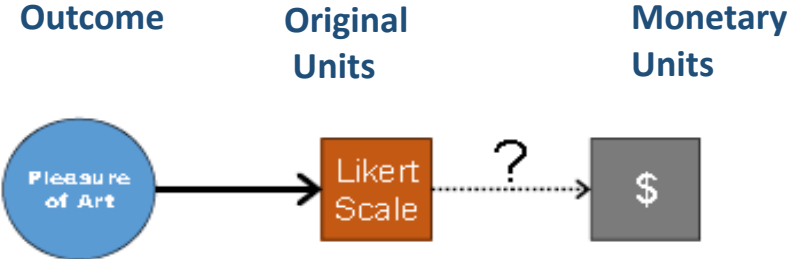


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Example: Non-market Valuation

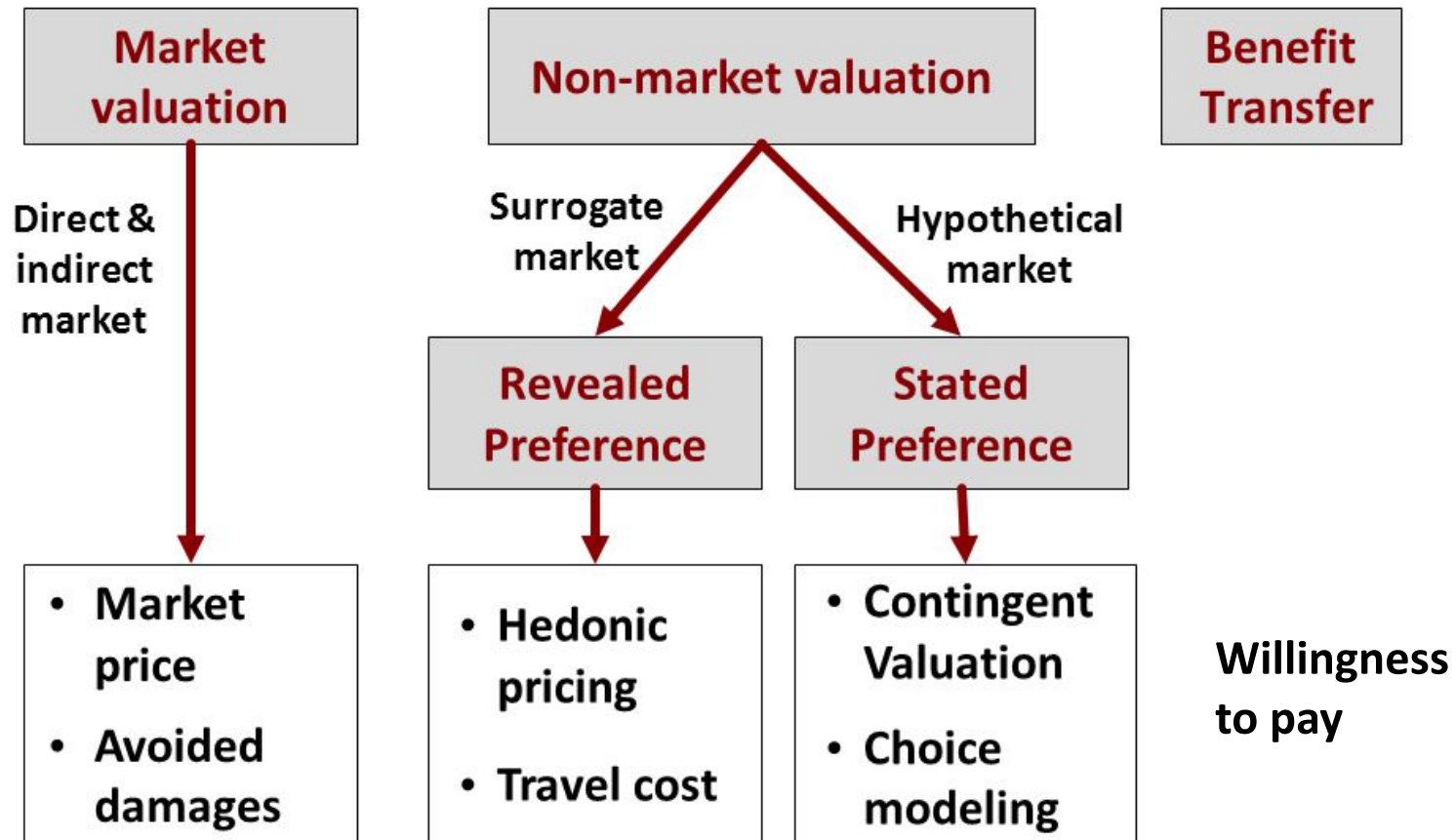


Economic value of a positive impact on climate change per km² of protected forest



The monetary value museum patrons place on the pleasure they get from art per Likert scale unit

Valuation Methods



Examples

Case Study	Impact	Techniques	Approach
Yield Prophet	Increased Yield	Market-based techniques	Productivity approach
Cereal Rust	Damage cost avoided	Market-based techniques	Replacement cost approach
Grape wine breeding	Price premium from blending	Non-market based techniques	Willingness to pay approach

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

Background

- AAHL established in 1984 to protect health of Australia's livestock, aquaculture species and wildlife from the impact of infectious diseases, which will ensure ongoing competitiveness of Australian agriculture and trade
- AAHL has capability to respond rapidly to disease outbreaks that could have serious national impact
- ACIL Allen estimated the potential benefits of AAHL's disease surveillance and vaccine R&D activities in reducing the adverse economic impacts of a potential Foot and Mouth Disease (FMD) outbreak in Australia
- Modelling draws on findings of a 2005 ABARE report and a 2013 ABARES report

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

ABARES (2013)

- Modelled FMD disease control strategies for 3 scenarios:
 - **Small outbreak in North Queensland** (where most cattle are raised on extensive rangelands)
 - **Small outbreak in Victoria's Goulburn Valley** (which has a high density of livestock and intensive dairy farms)
 - **Large multi-state outbreak**, spread from Victoria to NSW, Queensland, South Australia and Tasmania
- Examined 3 disease control strategies:
 - **Stamping out** (destruction and disposal of animals) in infected premises
 - **Stamping out with extensive vaccination** (vaccination of all FMD-susceptible animals within designated ring surrounding high-risk premises)
 - **Stamping out with targeted vaccination** (vaccination of all cattle and sheep on mixed cattle and sheep farms within designated ring)

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

ABARES (2013)

- Present value of total direct costs of an FMD outbreak over 10 years by type of outbreak and control strategy (\$billion)

Type of outbreak and control strategy	Total direct costs (\$billion)
Large multi-state outbreak	
Stamping out	\$52.21
Stamping out with extensive vaccination	\$49.89
Stamping out with targeted vaccination	\$49.62
Small outbreak in Victoria	
Stamping out	\$6.00
Stamping out with extensive vaccination	\$6.26
Small outbreak in Queensland	
Stamping out	\$5.64
Stamping out with extensive vaccination	\$5.96

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

Impact of vaccination option on costs of FMD outbreak

- PV of total direct costs of an FMD outbreak over 10 years by type of outbreak and availability of vaccination option (\$billion)

Type of outbreak and control strategy	Total direct cost (\$billion)
Large multi-state outbreak	
With vaccination option	\$49.62
Without vaccination option	\$52.21
Small outbreak in Victoria	
With vaccination option	\$6.00
Without vaccination option	\$6.00
Small outbreak in Queensland	
With vaccination option	\$5.64
Without vaccination option	\$5.64
Composite small outbreak	
With vaccination option	\$5.82
Without vaccination option	\$5.82

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

Relevant AAHL activities which will assist in control of FMD

- AAHL's disease surveillance activities, in conjunction with other State/Territory and Commonwealth government agencies, reduce likelihood of delayed detection of FMD outbreak and optimise response to the outbreak (preventing small outbreak from becoming a severe one)
- Australia maintains vaccine bank with private company in Europe; AAHL is involved in testing these vaccines and developing knowledge on how effectively these work for strains of FMD currently circulating in South East Asia and internationally
- AAHL works closely with World Organisation for Animal Health (OIE) and UN Food and Agriculture Organisation (FAO) to improve FMD surveillance and response capacity across SE Asia to decrease likelihood of FMD spreading from Asia into Australia

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

ABARE (2005)

- On-time detection
 - Probability of large outbreak under stamping out strategy = 0.19
 - Probability of small outbreak under stamping out strategy = 0.81
 - Probability of large outbreak under stamping out with vaccination = 0
 - Probability of small outbreak under stamping out with vaccination = 1
- Delayed detection (by 2 weeks)
 - Probability of large outbreak under stamping out strategy = 0.93
 - Probability of small outbreak under stamping out strategy = 0.07
 - Probability of large outbreak under stamping out with vaccination = 0
 - Probability of small outbreak under stamping out with vaccination = 1

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

- Expected cost of a FMD outbreak in Australia with and without AAHL (in present value terms over 10 years)

Type of outbreak	Relative probability	Direct economic costs	Expected direct economic costs
With AAHL (vaccine and timely disease detection)			
Large outbreak	0.00	\$49.62	\$0.00 billion
Composite small outbreak	1.00	\$5.82	\$5.82 billion
Aggregate			\$5.82 billion
Without AAHL			
Large outbreak	0.93	\$52.21	\$48.56 billion
Composite small outbreak	0.07	\$5.82	\$0.41 billion
Aggregate			\$48.96 billion

Net benefit per outbreak = \$43.14 billion (PV over 10 years)

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

- Difficult to estimate probability of FMD outbreak in Australia
- Minor outbreaks occurred in 1801, 1804, 1871 and 1872
- CSIRO estimates likelihood in the order of 1 in 50 years (i.e. 2% probability per year) due to increase in international travel, selective (rather than 100%) testing of luggage at custom checkpoints and threat of bioterrorism
- Assume AAHL contributes 50% to effectiveness of FMD surveillance system once outbreak has occurred, AAHL's benefits ("insurance value") in relation to FMD is approx. \$431 million per year

Case Study: CSIRO Australian Animal Health Laboratory (AAHL)

Sensitivity analysis

- Estimate of AAHL's annual benefits in relation to FMD under alternative assumptions

Contribution of AAHL to effectiveness of national animal disease surveillance system	FMD outbreak probability = 0.01	FMB Outbreak probability = 0.04	FMB Outbreak probability = 0.04
AAHL contribution = 25%	\$108 million	\$216 million	\$431 million
AAHL contribution = 50%	\$216 million	\$431 million	\$863 million
AAHL contribution = 75%	\$324 million	\$647 million	\$1,294 million

ACTIVITY

TIME



Hands On Exercise: Willingness to Pay or Accept

The National Library is funded primarily through general taxation. In the unlikely event that this funding ceased to be provided, would you be willing to pay an amount per month, for example through donation or subscription, to help support the continuation of the National Library and its services.

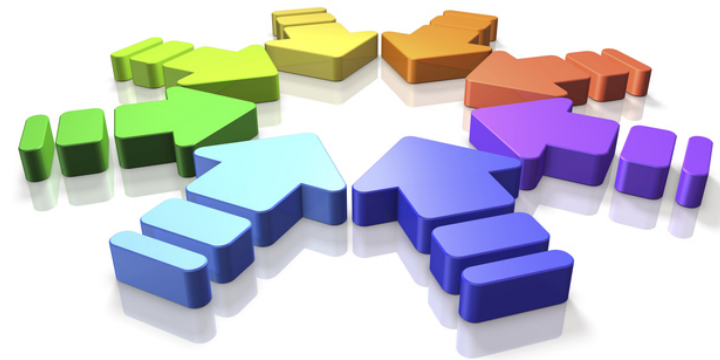
Total (\$)

Imagine that the National Library ceased issuing readers passes but allowed existing readers to sell their pass what is the minimum amount you would be willing to accept as a monthly payment in return for your pass? You would give up your readers card forever in return for a monthly payment?

Amount (\$)



Comparing valuation of benefits against investment and aggregation



Cost Benefit Analysis



Steps to CBA



A comprehensive CBA consists of main three steps (Samuelson, Marks, 1998):

- 1) **Identification** of all the costs and benefits which can flow into community because of that research.
- 2) **Valuation** of costs and benefits
- 3) **Estimates** of the Cost Benefit Ratio or net benefits

Jian and Yuan's Law

The credibility of an CBA ratio can never be greater than the credibility of the impact estimates upon which it was based
(And it is typically lower)

CBA is not an alternative to impact evaluation.

It depends on impact evaluation



Cost Benefit Ratio = 2.5

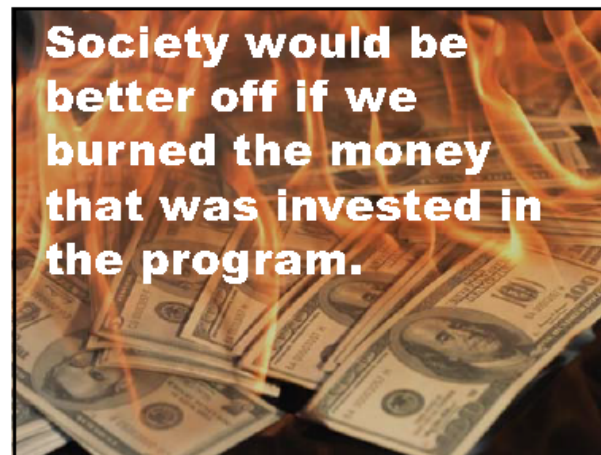
What does that mean?

It depends

Cost Benefit Ratio = 0

IF INPUTS ARE LIMITED TO THE BUDGET

For every dollar invested in the research program, \$2.50 of economic value was created on average.



Example: CSIRO's Salmon Breeding Program



Impact	Techniques	Approach
Increased volume of catch	Market-based techniques	Productivity approach
Reduced treatment cost of AGD	Market-based techniques	Productivity approach

Cost Benefit Ratio 13:1 = $\frac{\text{Present value of benefits } \$183\text{m}}{\text{Present value of investments } \$14\text{m}}$

Example: Research Impact of Noise Mitigation



Impact	Techniques	Approach
Property value	Non-market based techniques	Hedonic pricing
Health benefits	Non-market based techniques	Willingness to pay

Changes in property values=median house prices * number of properties*noise sensitivity depreciation index (NSDI)

Health benefits= changes in number of people annoyed * WTP per person per decibel per year*changes in noise level (decibel)

Cost Benefit Ratio= 7:1 for track improvement research

Case Study: CSIRO Prawn Breeding & NOVACQ

Background

- Approx. 50% of prawns consumed in Australia imported from overseas, e.g. Vietnam, China (pacific white shrimp, regarded as inferior in taste to Australian black tiger prawn)
- Global stocks of wild prawns under increasing pressure due to overfishing, capture of juveniles, coastal habitat degradation, illegal trawling and destruction of seagrass beds
- CSIRO developed breeding techniques to eliminate need to use wild caught prawns as broodstock for each generation of farmed black tiger prawns
- CSIRO also developed NOVACQ, a novel prawn feed additive derived from agricultural waste through microbial action

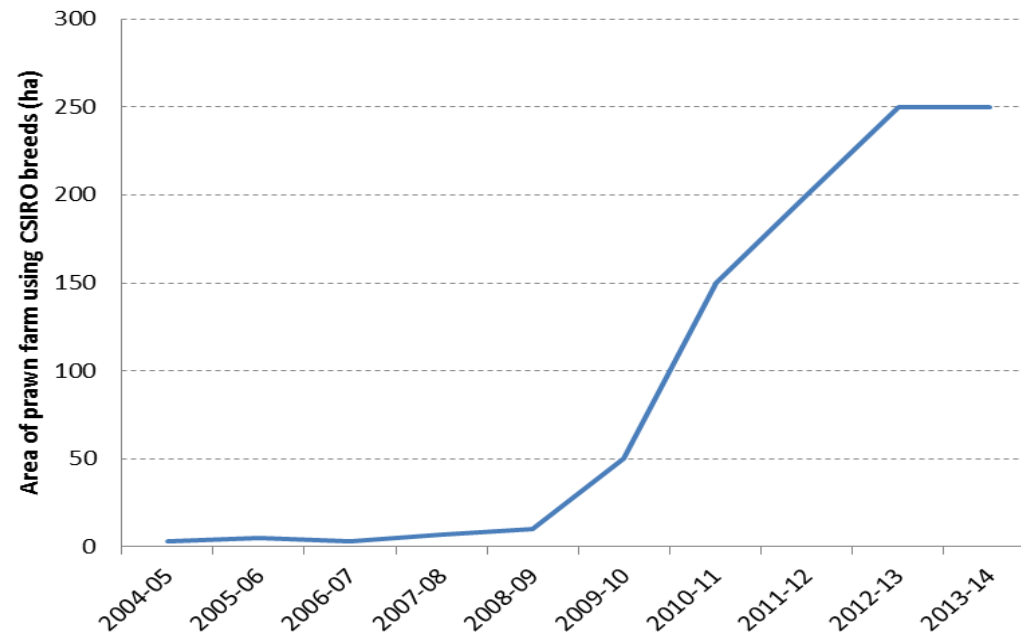
Case Study: CSIRO Prawn Breeding & NOVACQ

CSIRO capabilities deployed

- Prawn breeding
 - Breeding system management
 - Software development – databases and software to track prawn pedigree, mate allocation, select for desirable genetic traits, control inbreeding
 - Molecular virology – selective breeding for disease resistance
 - Molecular genetics – developed genetic markers to monitor genetic diversity and locate genes that control traits of commercial interest
 - Quantitative genetics – analyse breeding values to optimise selective breeding
 - Media communications – use media outreach as strategy to increase industry awareness to boost adoption rates
- Novel prawn feed
 - Microbiology and nutrient dynamics
 - Organic chemistry
 - Crustacean nutrition
 - Feed technology
 - Media communications

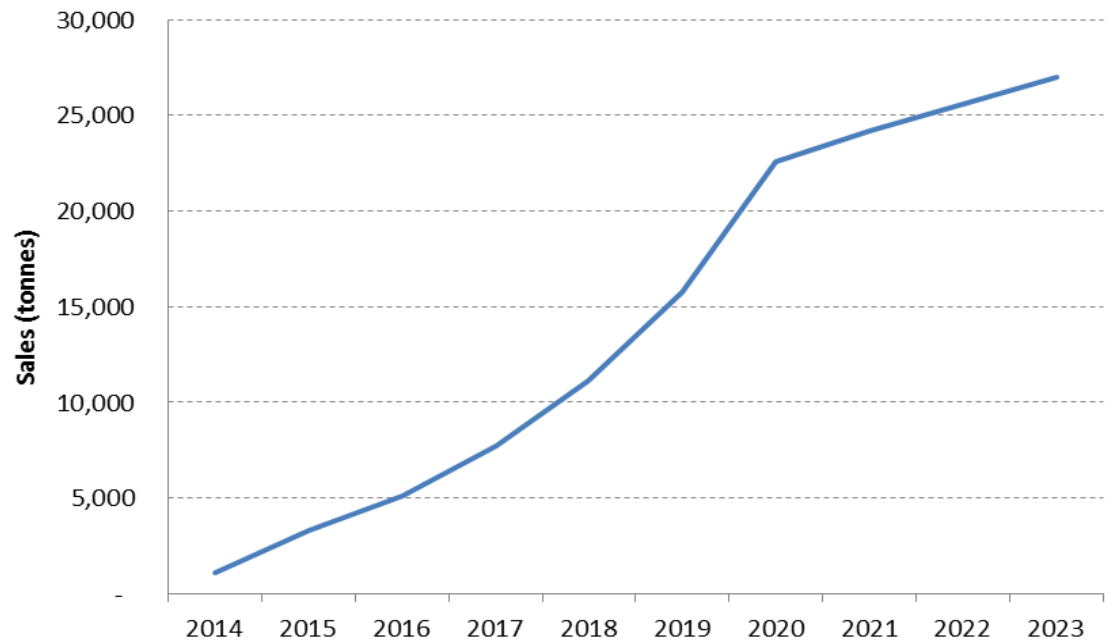
Case Study: CSIRO Prawn Breeding & NOVACQ

Australian uptake of CSIRO prawn breeds



Case Study: CSIRO Prawn Breeding & NOVACQ

Projected sales of NOVACQ



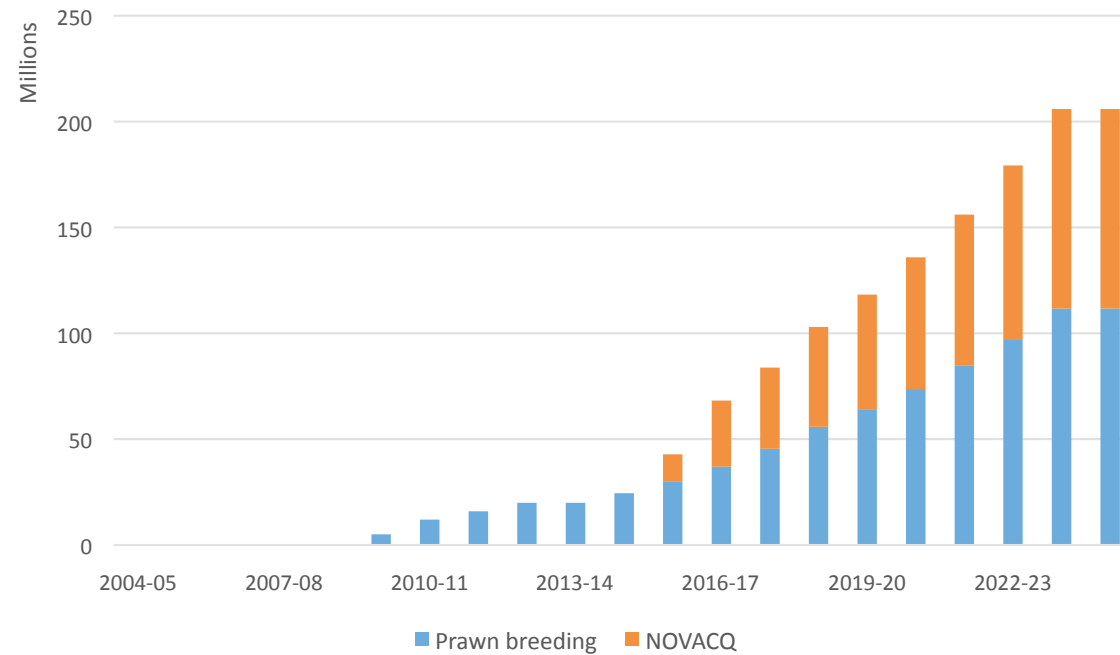
Case Study: CSIRO Prawn Breeding & NOVACQ

Prawn breeding & NOVACQ benefits

Year	Area under production (domesticated)	Average yield (wild)	Average yield (domesticated)	Price	Value (wild)	Value (domesticated)	Increased production costs	Net benefit	NOVACQ royalties	Total benefits
	(ha)	(t/ha)	(t/ha)	(\$/t)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
2004-05	3	4	5.5	15,000	180,000	247,500	32,130	35,370	0	35,370
2005-06	5	4	5.6	16,000	320,000	448,000	57,120	70,880	0	70,880
2006-07	3	4.2	5.9	16,000	201,600	283,200	36,414	45,186	0	45,186
2007-08	7	5.1	7.1	16,000	571,200	795,200	99,960	124,040	0	124,040
2008-09	10	6.2	10.5	17,000	1,054,000	1,785,000	307,020	423,980	0	423,980
2009-10	50	7.8	17.5	17,500	6,825,000	15,312,500	3,462,900	5,024,600	0	5,024,600
2010-11	150	7.8	15.5	17,500	20,475,000	40,687,500	8,246,700	11,965,800	0	11,965,800
2011-12	200	7.8	15.5	17,500	27,300,000	54,250,000	10,995,600	15,954,400	0	15,954,400
2012-13	250	7.8	15.5	17,500	34,125,000	67,812,500	13,744,500	19,943,000	0	19,943,000
2013-14	250	7.8	15.5	17,500	34,125,000	67,812,500	13,744,500	19,943,000	0	19,943,000
2014-15	307	7.8	15.5	17,500	41,928,012	83,318,484	16,887,313	24,503,160	714,200	25,217,360
2015-16	377	7.8	18.8	17,500	51,515,257	123,834,753	29,506,354	42,813,141	1,151,800	43,964,941
2016-17	464	7.8	22.0	17,500	63,294,719	178,523,568	47,013,370	68,215,478	3,080,200	71,295,678
2017-18	570	7.8	22.0	17,500	77,767,670	219,344,709	57,763,432	83,813,607	6,011,700	89,825,307
2018-19	700	7.8	22.0	17,500	95,550,000	269,500,000	70,971,600	102,978,400	8,520,940	111,499,340
2019-20	804	7.8	22.0	17,500	109,758,128	309,574,207	81,524,960	118,291,119	11,844,622	130,135,741
2020-21	924	7.8	22.0	17,500	126,078,981	355,607,382	93,647,588	135,880,813	14,959,091	150,839,905
2021-22	1061	7.8	22.0	17,500	144,826,718	408,485,615	107,572,830	156,086,067	17,458,069	173,544,135
2022/23	1,219	7.8	22.0	17,500	166,362,213	469,226,754	123,568,733	179,295,808	18,257,086	197,552,895
2023/24	1,400	7.8	22.0	17,500	191,100,000	539,000,000	141,943,200	205,956,800	19,225,829	225,182,629

Case Study: CSIRO Prawn Breeding & NOVACQ

Prawn breeding & NOVACQ benefits



Case Study: CSIRO Prawn Breeding & NOVACQ

Prawn breeding & NOVACQ project costs

Year	CSIRO support	External cash co-invested support	External in-kind support
	\$ million	\$ million	\$ million
2004-05	1.20	.26	.09
2005-06	1.23	.25	.08
2006-07	1.22	.20	.07
2007-08	1.23	.35	.12
2008-09	1.25	.27	.09
2009-10	1.00	.16	.05
2010-11	1.20	.24	.08
2011-12	1.30	.37	.12
2012-13	1.20	.54	.18
2013-14	1.10	.40	.13
Total	11.93	3.04	1.03

Case Study: CSIRO Prawn Breeding & NOVACQ

Comparison of costs and benefits (2004-05 to 2024-25, 2013-14 \$)

- **Overall project**

- PV of benefits (7% real discount rate) = \$898.1M
- PV of project costs (7% real discount rate) = \$20.5M
- NPV = \$877.6M
- BCR = 43.9

- **From CSIRO perspective**

- Benefit attribution to CSIRO: 75% (prawn breeding), 100% (NOVACQ)
- PV of benefits (7% real discount rate) = \$772.18
- PV of project costs (7% real discount rate) = \$15.4M
- NPV = \$757.3M
- BCR = 50.0

Case Study: CSIRO Prawn Breeding & NOVACQ

Other project benefits (not quantified)

- **Environmental impacts**

- Protecting existing wild fish stocks – NOVACQ removes need to harvest wild fish for fish meal and fish oil to supplement prawn feed
- Improved sustainability – black tiger prawn domestication removes need to harvest wild prawns to provide broodstock for each generation of prawns

- **Social impacts**

- Access to cheaper high-quality prawns for Australian consumers (increased affordability for lower-income households)
- More reliable incomes streams – increased consistency of prawn production due to CSIRO breeding project (more consistent prawn sizes, yield sizes and lower stock loss from disease) may help increase food security and income security for producers

Example: CSIRO's Impact and Value

- The **annual value** delivered by CSIRO is at least **\$5 billion***
- The **Return on Investment** ratio is **5:1***

The assessment uses a “weight of evidence” approach.

- 2014 ACIL Allen assessment - 6 case studies, forward value of approx. \$1bn per year that will flow over the next ten years (2014-15 to 2024-25).
- Separately, in 2013 Deloitte Access Economics examined 4 case studies and identified benefits attributable to CSIRO research of \$1.264 billion a year.
- Internally, 2014 Flagship Performance Reports identified annual benefits in the order of \$1.5 to \$2 billion arising from the work undertaken.

Other benefits (not quantified):

- Options not valued within case studies
- Insurance value beyond expected returns
- Value of standing capability

Hands-On Exercise: What is the ROI for the National Library?

Impact: the National Library's contribution to the national economy (economic, cultural, social and intellectual). The number of library cardholders is \$1000.

Budget: the National Library has a total annual budget of \$200,000.

Valuation: construct a financial proxy by asking each member of your group a willingness-to-pay or a willingness-to-accept questions.

ROI ratio: multiply the proxy by the number of cardholders. Divide that number by the cost of the program.



Social Return on Investment (SROI)

- SROI can help you manage, plan and make decisions to increase the **value created** for your **stakeholders** by your activities
- SROI can be used to **forecast** or to **evaluate** the value of any activity
- At its core, it seeks to 1) **understand** 2) **measure** and 3) **value what matters**
- An **SROI ratio** compares the investment made in an activity, program or organisation to the value generated by that investment – consider it as a **full stop!**

SROI PRINCIPLES	
1	Understand what changes
2	Involve stakeholders
3	Value the things that matter
4	Only include what is material
5	Do not overclaim
6	Be transparent
7	Verify results

Example: SMiS Program

“Social Return on Investment is a framework for measuring and accounting for a broad concept of value” UK Cabinet Office, 2009.

SROI Ratio 4:1 = Present value of benefits \$44m
Present value of investments \$11.5m

A ratio of 4:1 means that for every \$1 investment in SMiS Program \$4 of social value is generated.



Counterfactual



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Giving impacts a
haircut

Rough Impact Estimate



Impacts that would have happened without the program
Decline in impact over time
Adjustment for attribution

Adjusted Impact



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Reflection



- How does various valuation methods fits in your practice?
- What are the benefits?
- What are the risks?

The best method is the appropriate combination of methods



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