INTEGRATING ECOSYSTEM VALUES INTO COST-BENEFIT ANALYSIS

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INTRODUCTIONS

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Integrating Ecosystem Values into Cost-Benefit Analysis

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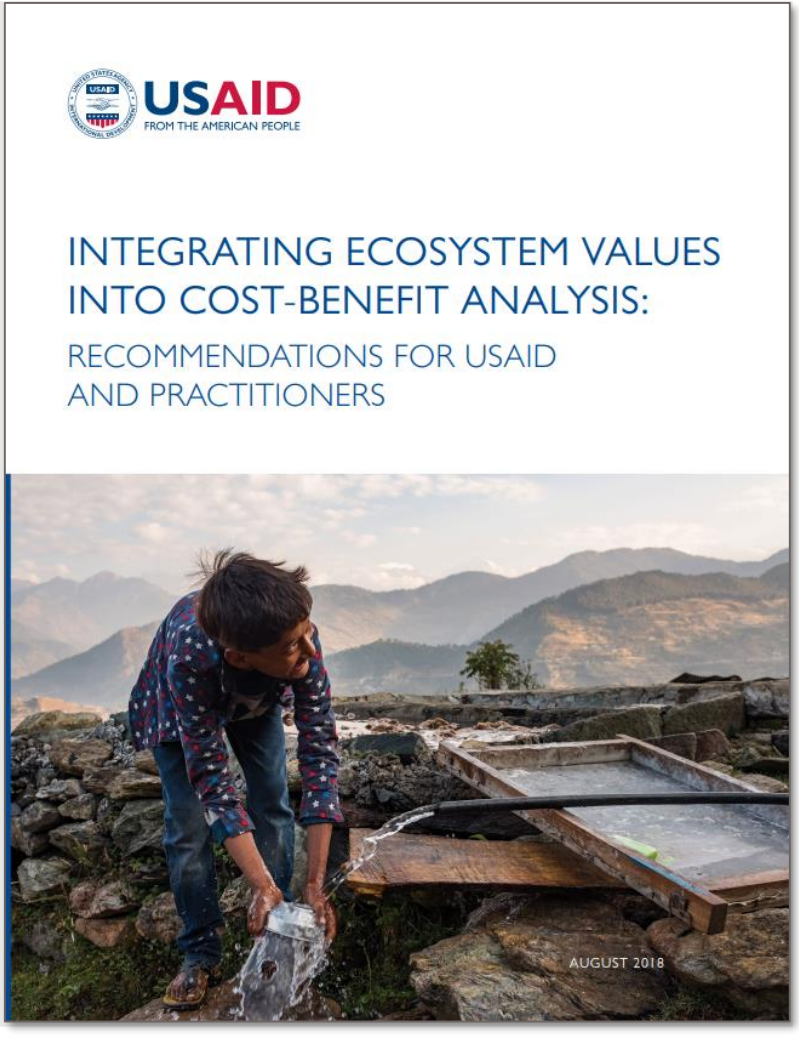
REPORT

- Joint product of the Offices of Forestry and Biodiversity and Economic Policy
- Developed through the USAID BRIDGE project



OUTLINE

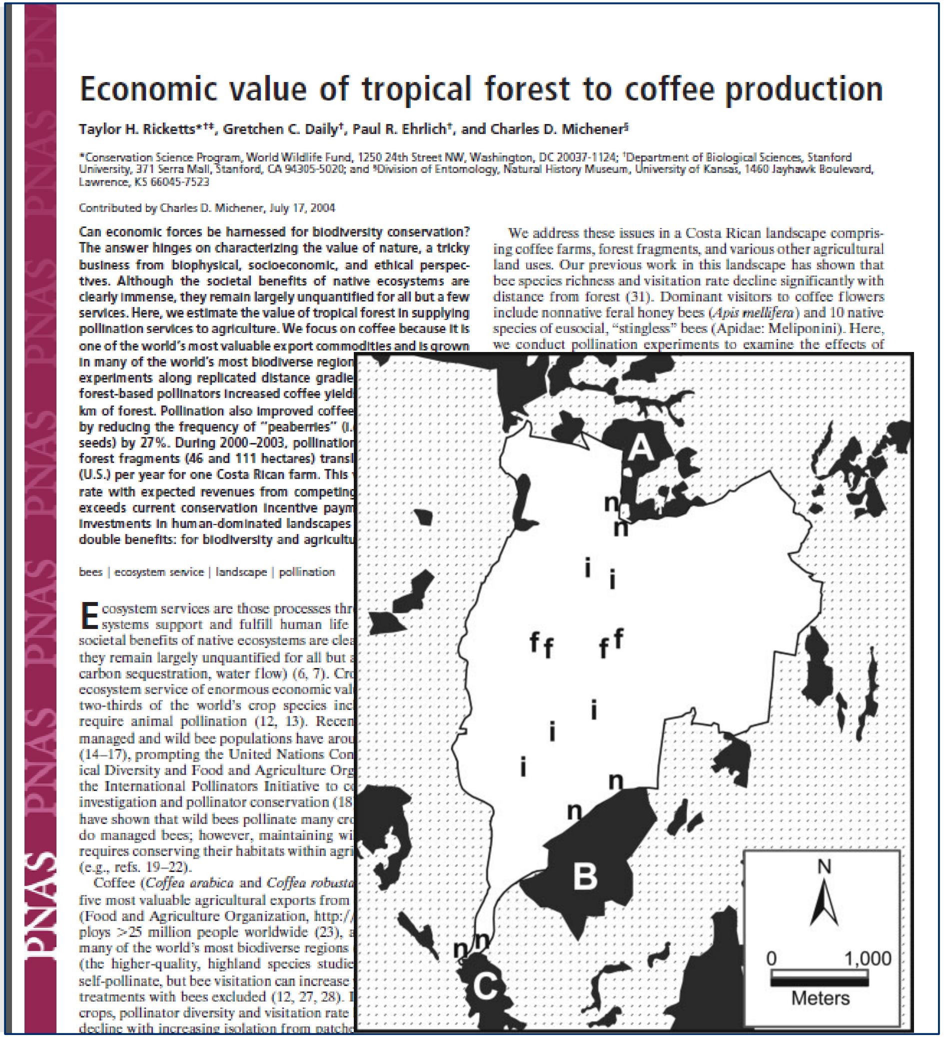
1. Why include ecosystem services in USAID cost-benefit analysis?
2. Consultation and point of departure
3. Recommendations - steps for practitioners
4. Institutional recommendations, USAID teams and mechanisms
5. Discussion

1. WHY INCLUDE ECOSYSTEM SERVICES IN AGENCY CBA?

EXAMPLES

1. Pollination (Food Security):
   - Coffee farms 1km from forest patches get more native bees
   - Production 20% higher
   - **Nearby forest provides US$130/ha/year in pollination services**

Source: Ricketts et al. (2004)



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Economic value of tropical forest to coffee production

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Contributed by Charles D. Michener, July 17, 2004

Can economic forces be harnessed for biodiversity conservation? The answer hinges on characterizing the value of nature, a tricky business from biophysical, socioeconomic, and ethical perspectives. Although the societal benefits of native ecosystems are clearly immense, they remain largely unquantified for all but a few services. Here, we estimate the value of tropical forest in supplying pollination services to agriculture. We focus on coffee because it is one of the world's most valuable export commodities and is grown in many of the world's most biodiverse region
experiments along replicated distance gradie
forest-based pollinators increased coffee yield
km of forest. Pollination also improved coffee
by reducing the frequency of "peaberries" (i.
seeds) by 27%. During 2000–2003, pollination
forest fragments (46 and 111 hectares) transl
(U.S.) per year for one Costa Rican farm. This
rate with expected revenues from competing
exceeds current conservation incentive paym
investments in human-dominated landscapes
double benefits: for biodiversity and agricultu

bees | ecosystem service | landscape | pollination

Ecosystem services are those processes thr
systems support and fulfill human life
societal benefits of native ecosystems are clea
they remain largely unquantified for all but a
carbon sequestration, water flow) (6, 7). Cro
ecosystem service of enormous economic val
two-thirds of the world's crop species inc
require animal pollination (12, 13). Recen
managed and wild bee populations have arou
(14–17), prompting the United Nations Con
ical Diversity and Food and Agriculture Org
the International Pollinators Initiative to c
investigation and pollinator conservation (18
have shown that wild bees pollinate many cro
do managed bees; however, maintaining wi
requires conserving their habitats within agri
(e.g., refs. 19–22).

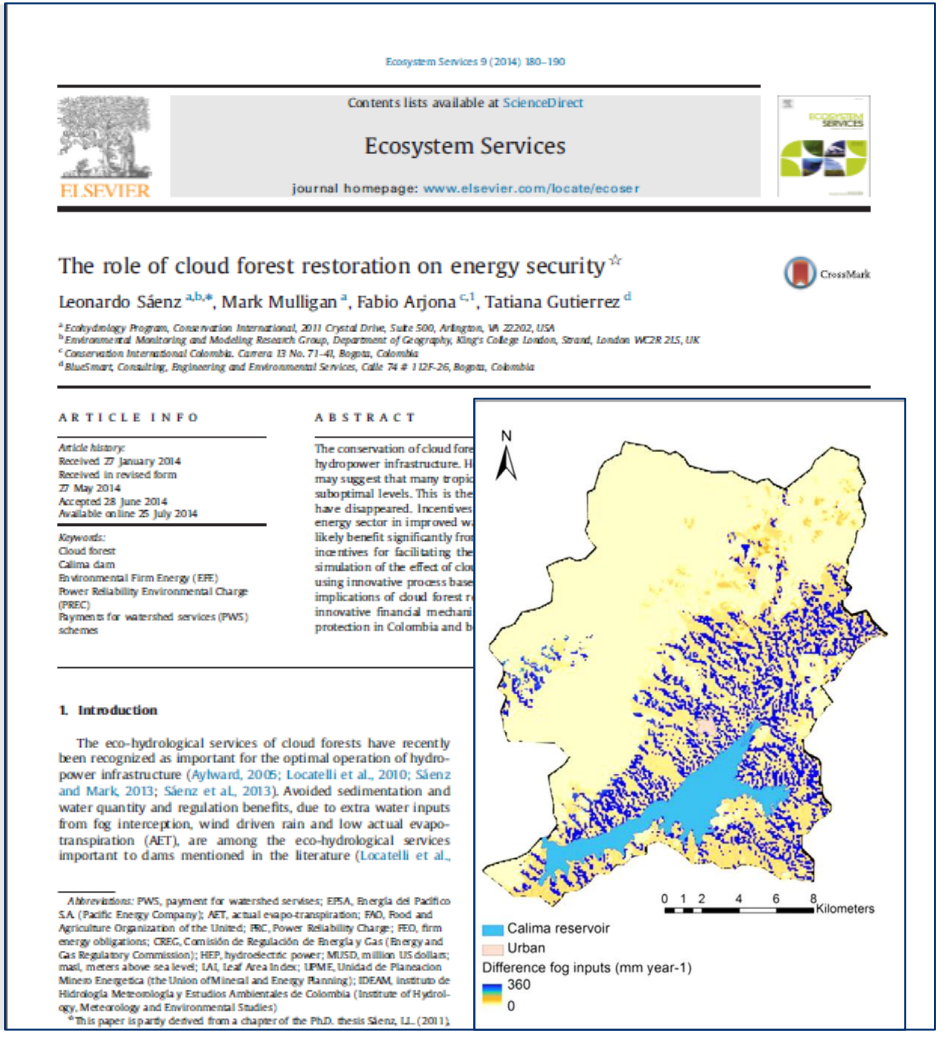
Coffee (*Coffea arabica* and *Coffea robusta*
five most valuable agricultural exports from
(Food and Agriculture Organization, http://
ploys >25 million people worldwide (23), a
many of the world's most biodiverse regions
(the higher-quality, highland species studie
self-pollinate, but bee visitation can increase
treatments with bees excluded (12, 27, 28). I
crops, pollinator diversity and visitation rate
decline with increasing isolation from patche

We address these issues in a Costa Rican landscape comprising coffee farms, forest fragments, and various other agricultural land uses. Our previous work in this landscape has shown that bee species richness and visitation rate decline significantly with distance from forest (31). Dominant visitors to coffee flowers include nonnative feral honey bees (*Apis mellifera*) and 10 native species of eusocial, "stingless" bees (Apidae: Meliponini). Here, we conduct pollination experiments to examine the effects of

EXAMPLES

2. Water for hydropower (Energy and Infrastructure):
   - Cloud forest reduces sedimentation by 3.5x, increases water by 6%
   - Increased flow especially valuable in dry years
   - **Cloud forest provides US$120/ha/year in water services**

Source: Saenz et al. (2014)



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The role of cloud forest restoration on energy security ☆

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ABSTRACT

The conservation of cloud fore
hydropower infrastructure. H
may suggest that many tropic
suboptimal levels. This is the
have disappeared. Incentives
energy sector in improved w
likely benefit significantly fro
incentives for facilitating the
simulation of the effect of clo
using innovative process base
implications of cloud forest r
innovative financial mechani
protection in Colombia and b

1. Introduction

The eco-hydrological services of cloud forests have recently been recognized as important for the optimal operation of hydropower infrastructure (Aylward, 2005; Locatelli et al., 2010; Sáenz and Mark, 2013; Sáenz et al., 2013). Avoided sedimentation and water quantity and regulation benefits, due to extra water inputs from fog interception, wind driven rain and low actual evapotranspiration (AET), are among the eco-hydrological services important to dams mentioned in the literature (Locatelli et al.,

Abbreviations: PWS, payment for watershed services; EPSA, Energía del Pacífico S.A. (Pacific Energy Company); AET, actual evapotranspiration; FAO, Food and Agriculture Organization of the United; PRC, Power Reliability Charge; FEO, firm energy obligations; CREG, Comisión de Regulación de Energía y Gas (Energy and Gas Regulatory Commission); HEP, hydroelectric power; MUSD, million US dollars; masl, meters above sea level; LAI, Leaf Area Index; UPME, Unidad de Planeacion Minero Energetica (the Union of Mineral and Energy Planning); IDEAM, Instituto de Hidrología Meteorología y Estudios Ambientales de Colombia (Institute of Hydrology, Meteorology and Environmental Studies)

[☆] This paper is partly derived from a chapter of the PhD. thesis Sáenz, LL. (2011).

EXAMPLES

3. Tourism (Economic growth; Biodiversity):
   - Bwindi NP supports gorillas and gorilla tourism
   - Road *through* park cheapest by US$ 4M (NPV)
   - **Road *around* avoids gorilla tourism losses of US$35M**

Source: USAID BUILD – Barr et al. (2015)

OTHER EXAMPLES

4. Agricultural pest control by bats
5. Coastal protection by mangroves
6. Disease control by vultures
7. Etc.!

ECOSYSTEM EVALUATION SERVICES IN PROGRAM DESIGN

1. Modify design
2. Compare traditional and "green" infrastructure approaches
3. Identify non-viable projects due to dependencies or impacts
4. Validate projects with more complete information
5. Evaluation (*ex-post*)

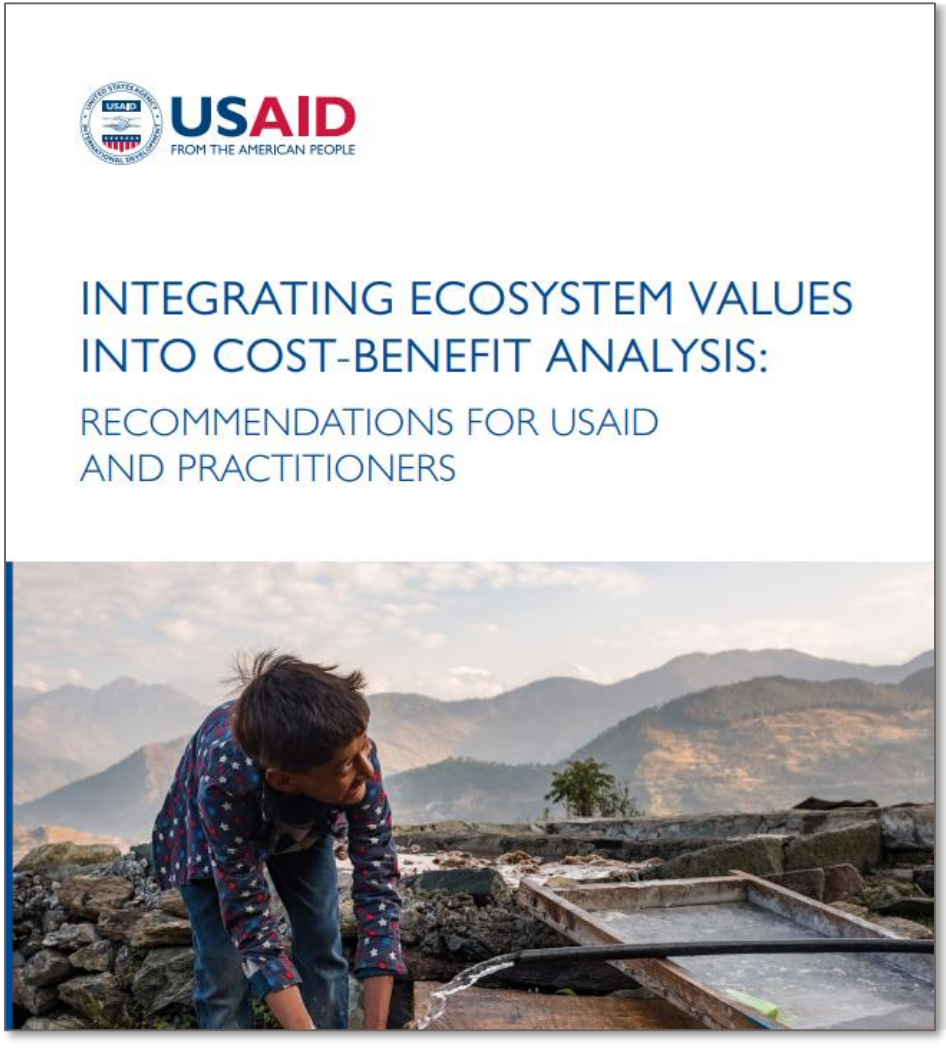
2. CONSULTATION AND POINT OF DEPARTURE

SOURCES OF INFORMATION

1. 17 USAID interviews
2. 7 external interviews (MCC, Duke University, USFS, USACE, retired experts)
3. Literature review – principles, case examples, models, databases

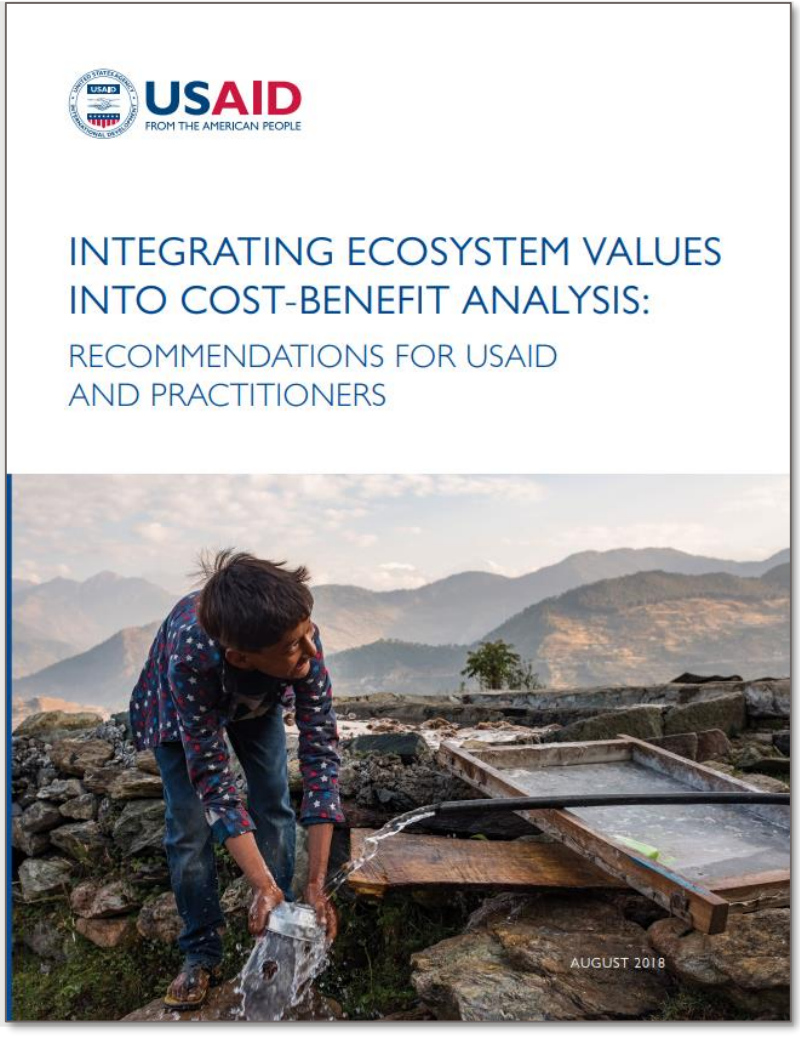
POINT OF DEPARTURE FOR RECOMMENDATIONS

1. Ecosystem services valuation is valid; best examples often outside of CBA
2. CBA useful (among multiple tools) in design and *ex post* assessment
3. Guidance needed – existing resources not known or organized to USAID process
4. Guidance is a first step – then need testing, capacity building, etc.



3. PRACTITIONER RECOMENDATIONS

CONTENT



4 STEP PROCESS FOR PRACTITIONERS

1. Identify ecosystem interactions (dependencies and impacts)
2. Prioritize ecosystem interactions for inclusion
3. Assign value to selected interactions
4. Integrate ecosystem service valuations into CBA

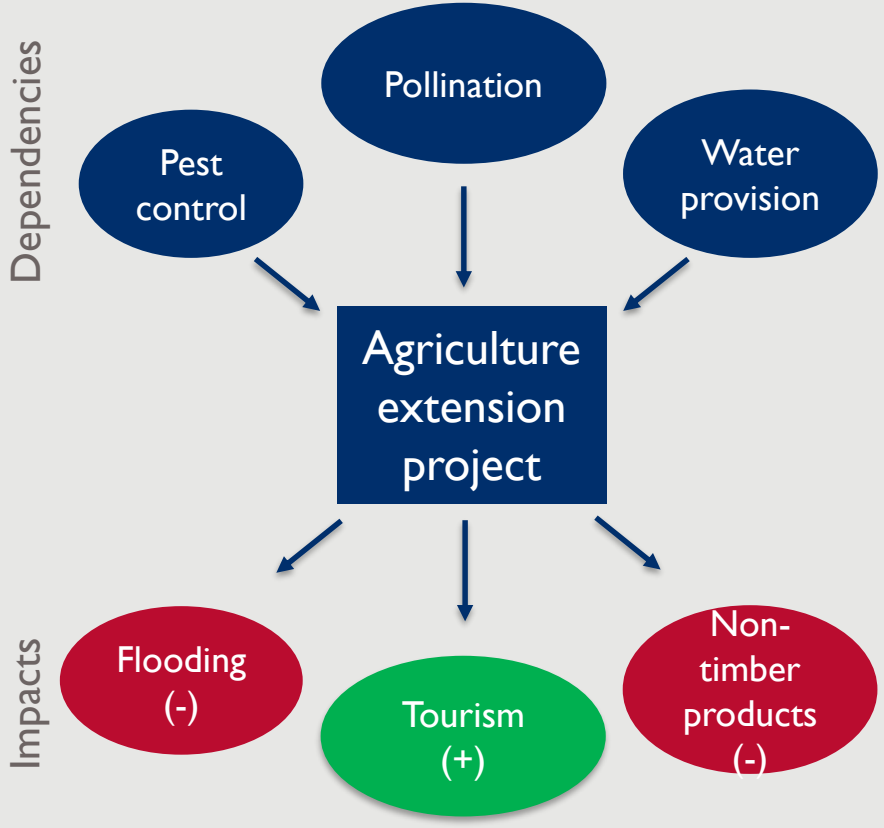
STEP 1: IDENTIFY ECOSYSTEM INTERACTIONS

Resources:

1. Key questions to ask
2. Sources of information

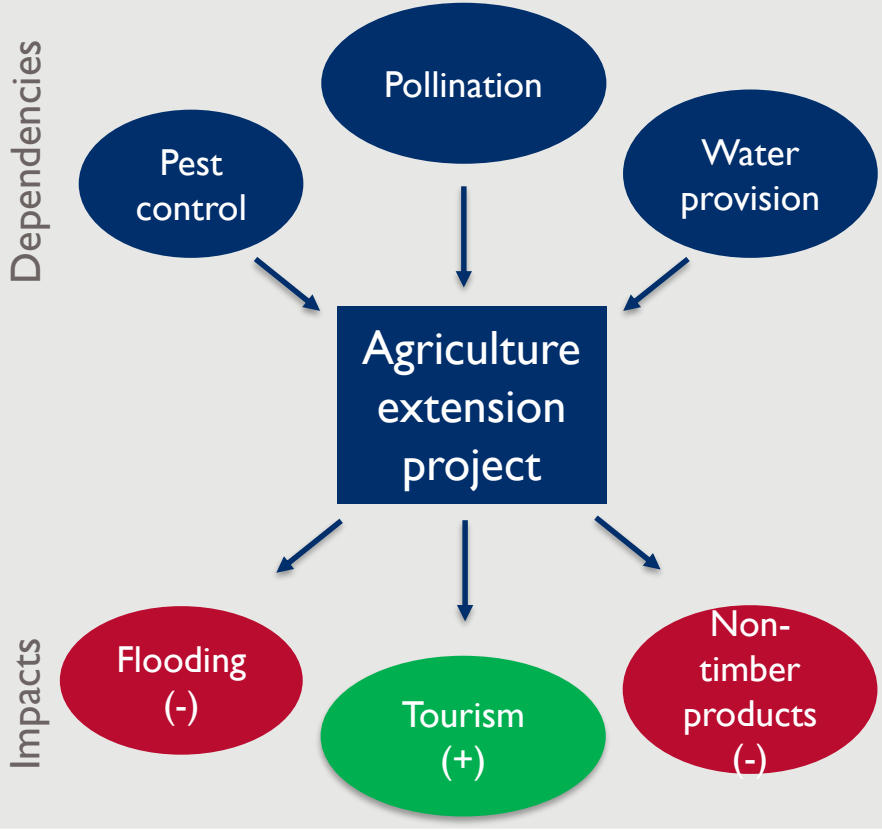
Supporting: Example Interactions (Annex IV)

Activity	Impacted Ecosystem	Impacted Ecosystem Service	Cause of Impact	Impact
Fertilizer application	River	Fish provision	Fertilizer application reduces water quality for fish	Reduced fishery yields (adverse)
More efficient irrigation	River	Fish provision	Water savings increase habitat availability for fish	Increased fishery yields (positive)
Land conversion to agriculture	Forest	Provision of nontimber forest products (NTFPs)	Forest conversion reduces harvesting of NTFPs	Reduced income from NTFPs (adverse)



STEP 2: PRIORITIZE ECOSYSTEM INTERACTIONS FOR INCLUSION

Criteria



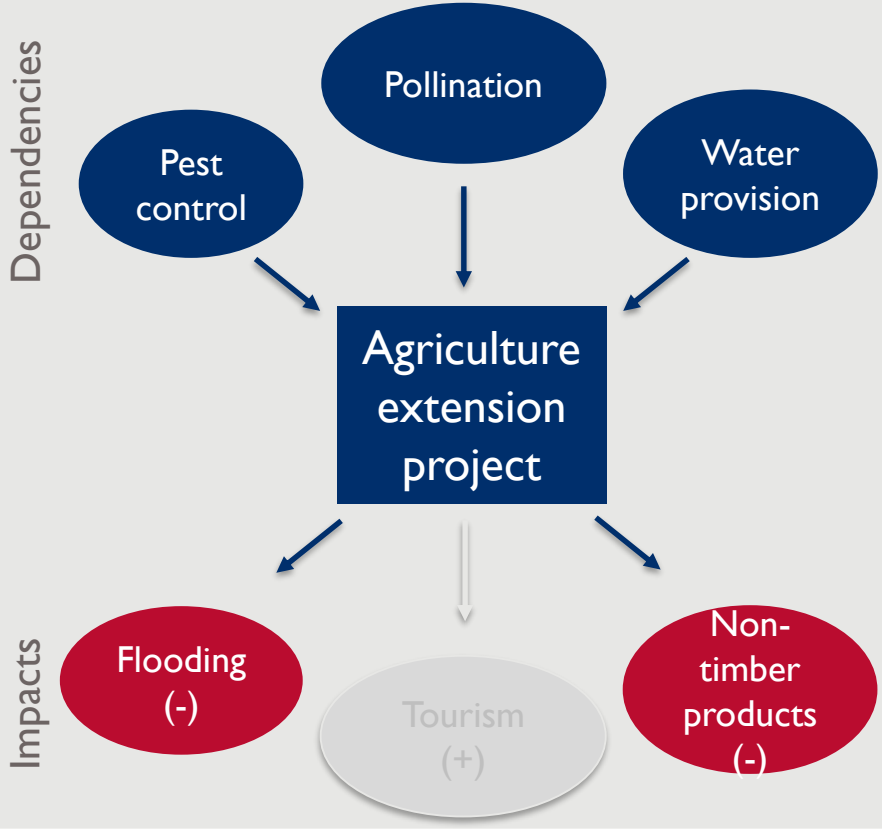
Supporting: Key concepts (Annex I), Case studies (Annex II)

STEP 2: PRIORITIZE ECOSYSTEM INTERACTIONS FOR INCLUSION

Criteria

1. Can impact on the ecosystem service be assigned to CBA stakeholders?

Supporting: Key concepts (Annex I), Case studies (Annex II)

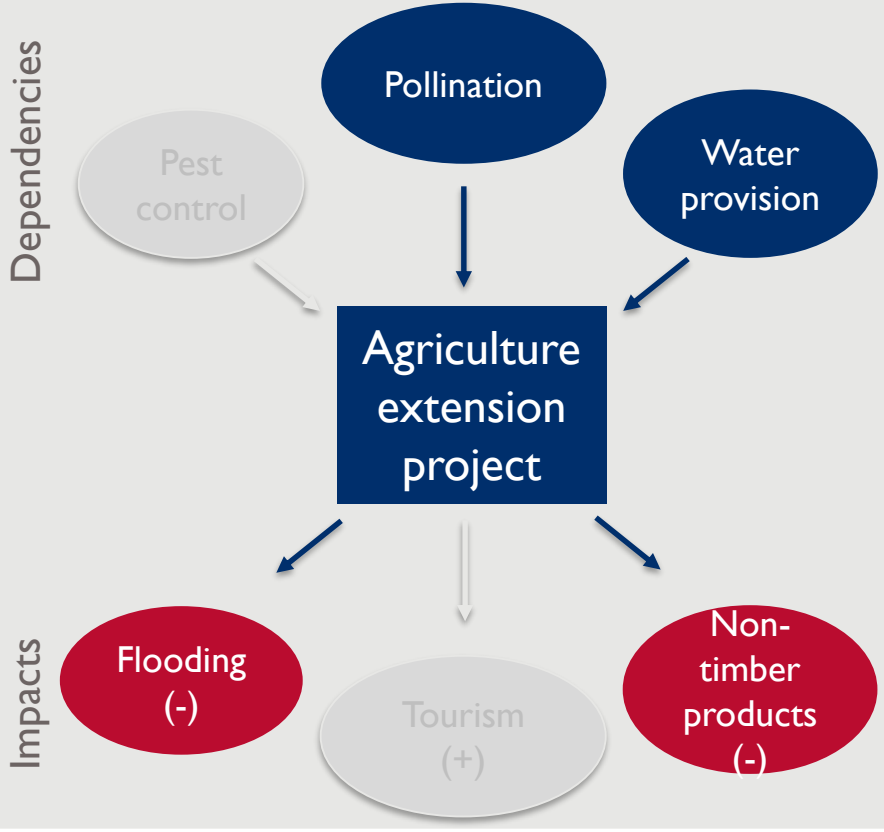


STEP 2: PRIORITIZE ECOSYSTEM INTERACTIONS FOR INCLUSION

Criteria

1. Can impact on the ecosystem service be assigned to CBA stakeholders?
2. Can the ecosystem service be reliably valued in the project?

Supporting: Key concepts (Annex I), Case studies (Annex II)

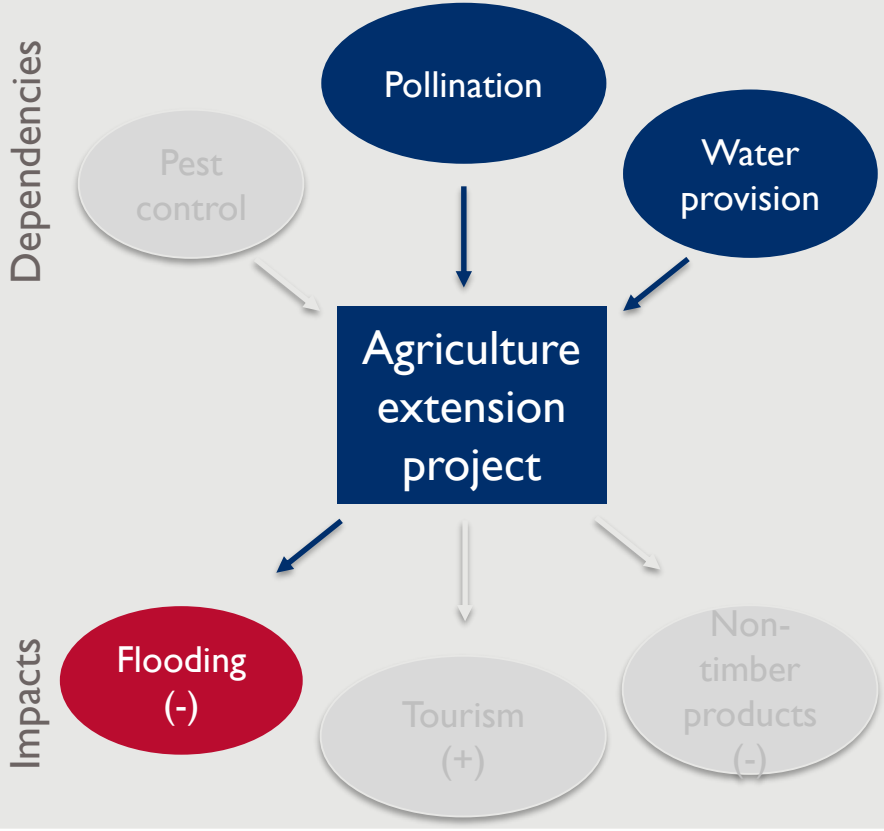


STEP 2: PRIORITIZE ECOSYSTEM INTERACTIONS FOR INCLUSION

Criteria

1. Can impact on the ecosystem service be assigned to CBA stakeholders?
2. Can the ecosystem service be reliably valued in the project?
3. Is the ecosystem service interaction likely to be large?

Supporting: Key concepts (Annex I), Case studies (Annex II)

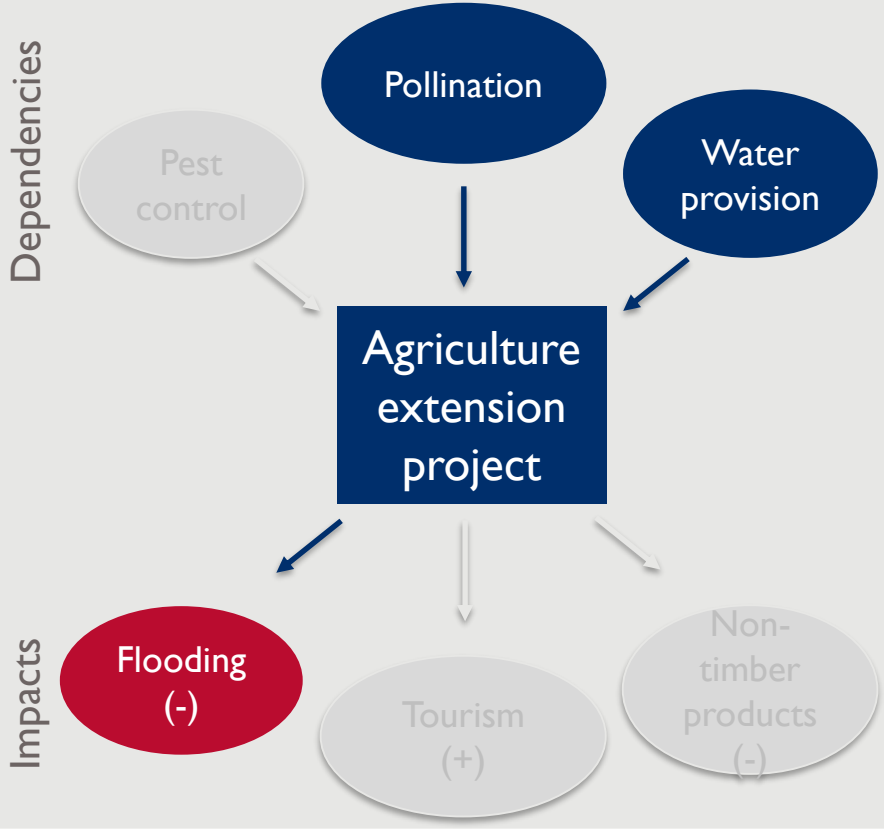


STEP 2: PRIORITIZE ECOSYSTEM INTERACTIONS FOR INCLUSION

Criteria

1. Can impact on the ecosystem service be assigned to CBA stakeholders?
2. Can the ecosystem service be reliably valued in the project?
3. Is the ecosystem service interaction likely to be large?
4. Is the link between the project and change in ecosystem service robust?

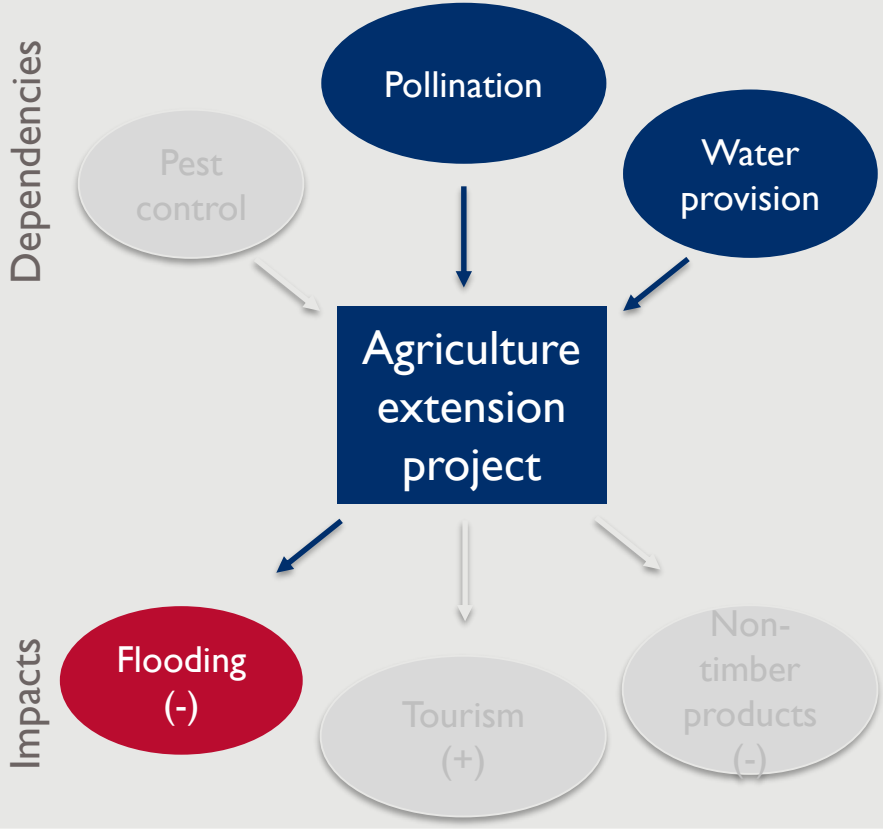
Supporting: Key concepts (Annex I), Case studies (Annex II)



STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS

Approaches to valuation in declining order of accuracy and cost

Supporting: Theoretical foundation and methods (Annex I), Case studies (Annex II), Data Catalog (Annex III)

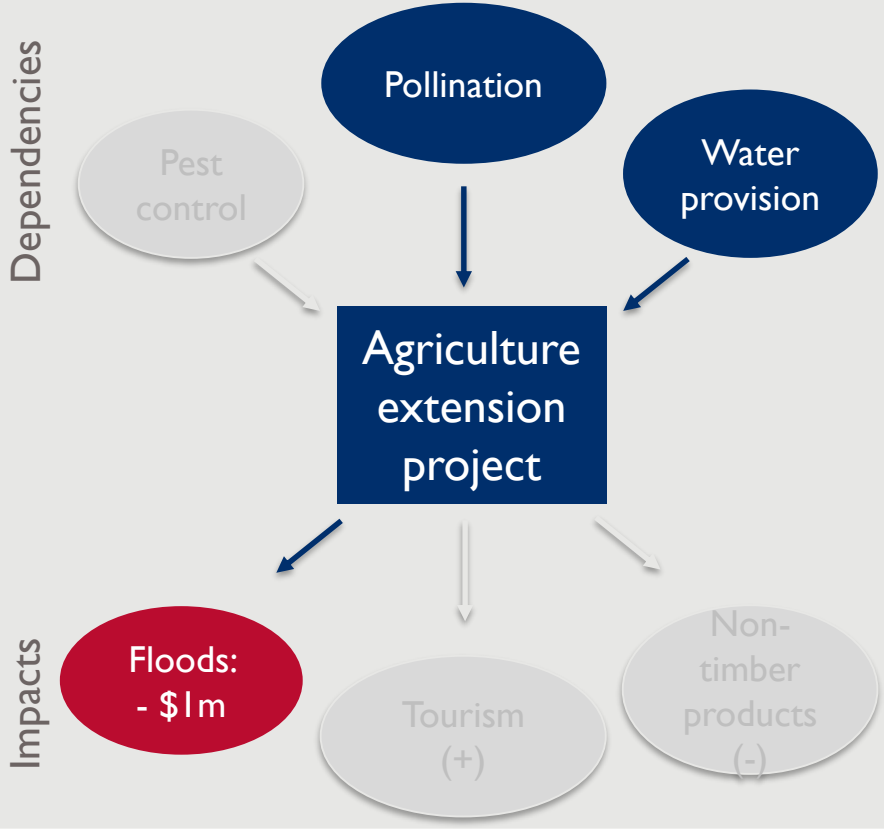


STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS

Approaches to valuation in declining order of accuracy and cost

1. Primary study

Supporting: Theoretical foundation and methods (Annex I), Case studies (Annex II), Data Catalog (Annex III)

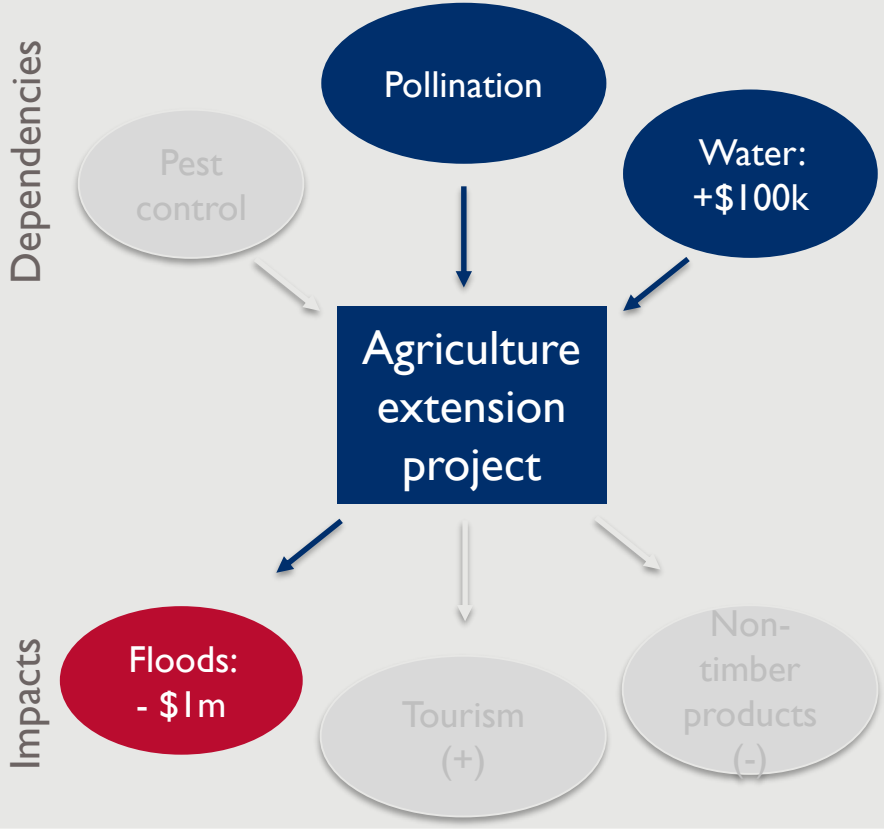


STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS

Approaches to valuation in declining order of accuracy and cost

1. Primary study
2. Modeling platform

Supporting: Theoretical foundation and methods (Annex I), Case studies (Annex II), Data Catalog (Annex III)

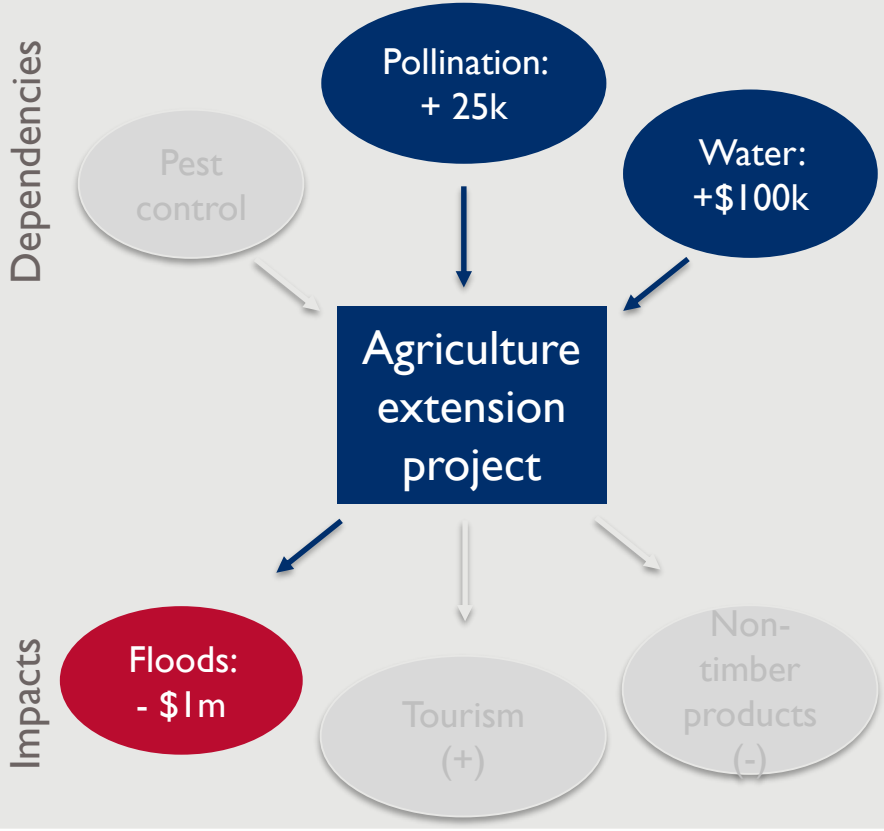


STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS

Approaches to valuation in declining order of accuracy and cost

1. Primary study
2. Modeling platform
3. Function transfer
4. Unit transfer

Supporting: Theoretical foundation and methods (Annex I), Case studies (Annex II), Data Catalog (Annex III)



STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS - MODELS

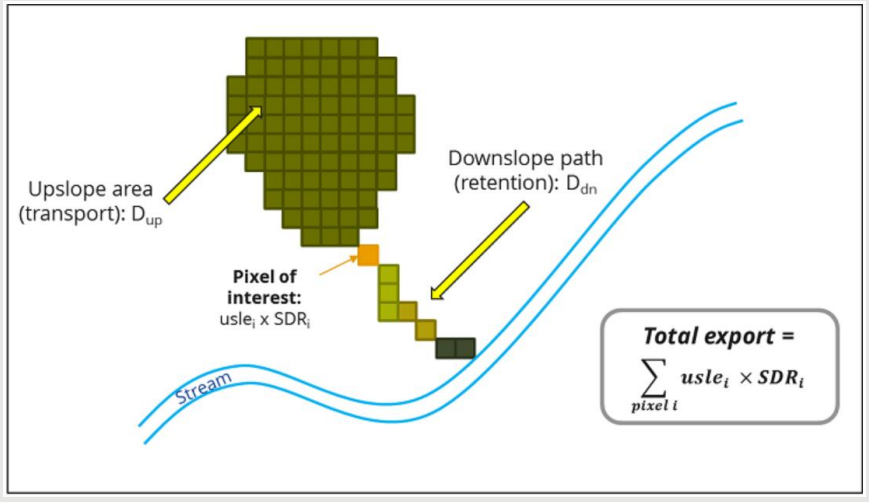
Δ land cover → Δ physical quantities (Δ $ value):

1. InVEST Sediment: tons/sediment/year delivered to stream

2. InVEST Water Yield: NPV energy sales, based on surface flow, reservoir recharge, total annual production

3. SWAT: tons/sediment/day & gallons/water/day based on surface and subsurface flows

Supporting: Data Catalog (Annex III); Neugarten et al., 2018.



data.naturalcapitalproject.org

TABLE 5B: MODELING PLATFORMS

Name	Geographic coverage	Relevance to USAID sectors	Ecosystem services considered	Valuation methods employed/included
Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)	Global	FS, GCC, WASH, EG	Carbon, coastal protection, pollination, fisheries, habitat quality, recreation, water yield, scenic quality, sediment retention, water purification	Market pricing, revealed preference
ARtificial Intelligence for Ecosystem Services (ARIES)	Global	FS, GCC, WASH, EG	Carbon, scenic quality, coastal protection, flood protection, sediment retention, fisheries, recreation, water purification	Benefit transfer

STEP 3: ASSIGN A VALUE TO SELECTED INTERACTIONS – BENEFIT TRANSFER

TABLE 5A: DATABASES

Name	Geographic coverage	Relevance to USAID program areas	Ecosystem services considered
Ecosystem Services Valuation Database	Global	FS, GCC, WASH, EG	All
Environmental Valuation Reference Inventory	Global	FS, GCC, WASH, EG	All
Coastal and Marine Ecosystem Services (Torres and Hanley 2017)	Global (coastal and marine)	FS, GCC, EG	Fisheries production, recreation, coastal protection, nonuse values
National Ocean Economics Program (NOEP) Valuation Studies Search	Global (coastal and marine)	FS, GCC, EG	Fisheries, tourism and recreation, option value, existence value, bequest value

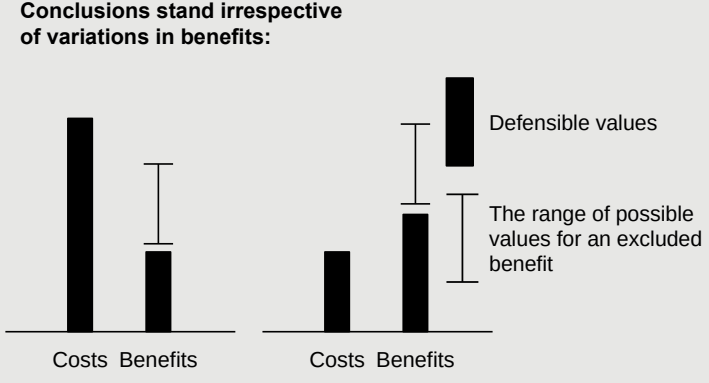
TABLE 5C: META-ANALYSES

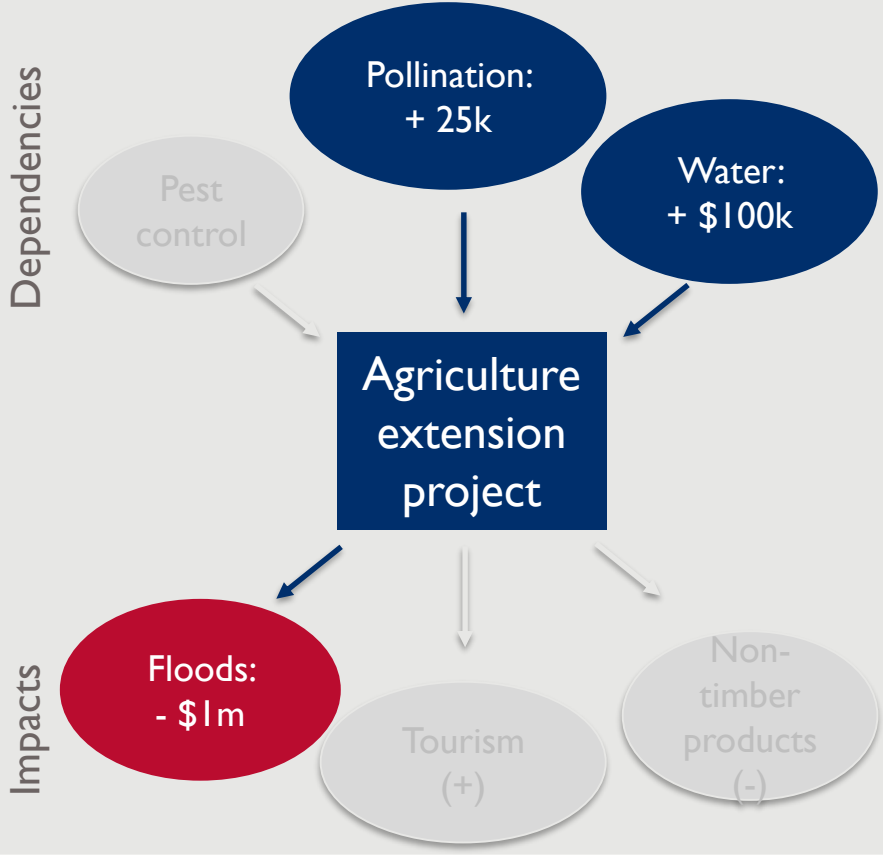
Name	Geographic Coverage	Relevance to USAID Sectors	Ecosystem Services Considered
Forests (Siikamäki et al. 2015)	Global	FS, GCC, WASH, EG	Forest products, recreation, water purification and regulation, carbon
Wetlands (Chaikumbung et al. 2016	Global	FS, GCC, WASH, EG	Recreation, food protection, water supply, sediment retention, carbon, water purification, non-use values
Lakes (Reynaud & Lanzanova 2017)	Global	FS, GCC, WASH, EG	Sediment retention, flood protection, water purification, recreation non-use values

E.g.: ln(recreational value per hectare of forest) = - 8.375 + 0.562 · ln(population density) + 0.566 · ln(GDP per capita) + 0.0178 · ln(av. annual temperature) +1.133 · ln(species richness)

STEP 4: INTEGRATE ECOSYSTEM SERVICE VALUATIONS INTO CBA

1. Starting point: existing USAID CBA Guidelines
2. Focus here: including ecosystem services
    1. Accounting
    2. Uncertainty/incomplete info

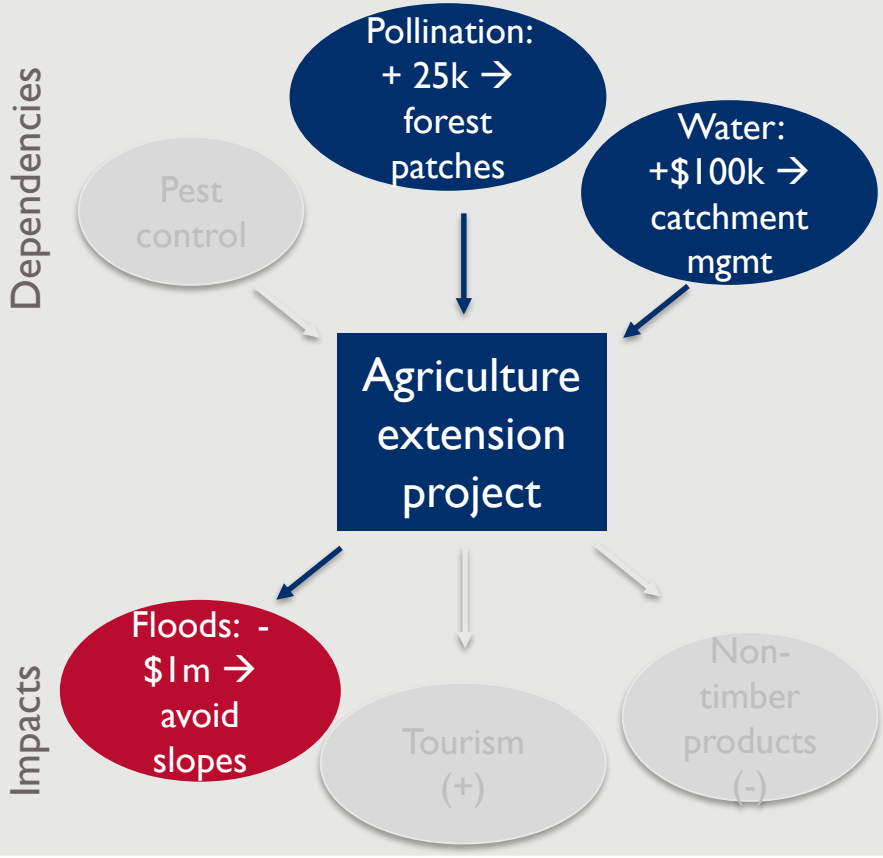




STEP 4: INTEGRATE ECOSYSTEM SERVICE VALUATIONS INTO CBA

1. Starting point: existing USAID CBA Guidelines
2. Focus here: including ecosystem services
    1. Accounting
    2. Uncertainty/incomplete info

→ Improved delivery of objectives



4. INSTITUTIONAL RECOMMENDATIONS, USAID TEAMS AND MECHANISMS

INSTITUTIONAL RECOMMENDATIONS

1. Guidance and data
2. Training
3. Champions
4. Evidence gap
5. CBA of biodiversity projects

USAID TEAMS

- These recommendations are a joint product of the USAID Offices of Forestry and Biodiversity, and Economic Policy, located in the USAID Washington Bureau for Economic Growth, Education and Environment
- The Office of Economic Policy is the lead for CBA across the agency, providing CBA services in a variety of sectors
- The Office of Forestry and Biodiversity is providing additional support for the inclusion of ecosystem services into CBAs
- The ultimate goal is to support USAID field missions in their use of these tools

USAID MECHANISMS

- Support to missions for including ecosystem services in CBA can range from initial consultations, to specific calculations as part of a CBA, to a full analysis of ecosystem services in CBA
- This work can be completed in-house at USAID or outsourced using one of our contracting mechanisms
- The new USAID LEAP III mechanism (5-year award) managed by the Office of Economic Policy offers a full range of CBA services including ecosystem valuation
- The USAID BRIDGE project is producing research and guidance on the value of natural ecosystems to USAID's development objectives

THANK YOU

DISCUSSION

THANK YOU