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VALUING TREATED WASTEWATER AND REUSE: A REVIEW OF APPLICATIONS AND ISSUES FOR FURTHER ACTIONS

*... How much are you
willing to pay to
improve wastewater
treatment and reuse it
for irrigation?*

Economist



Farmer



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Presentation outlines

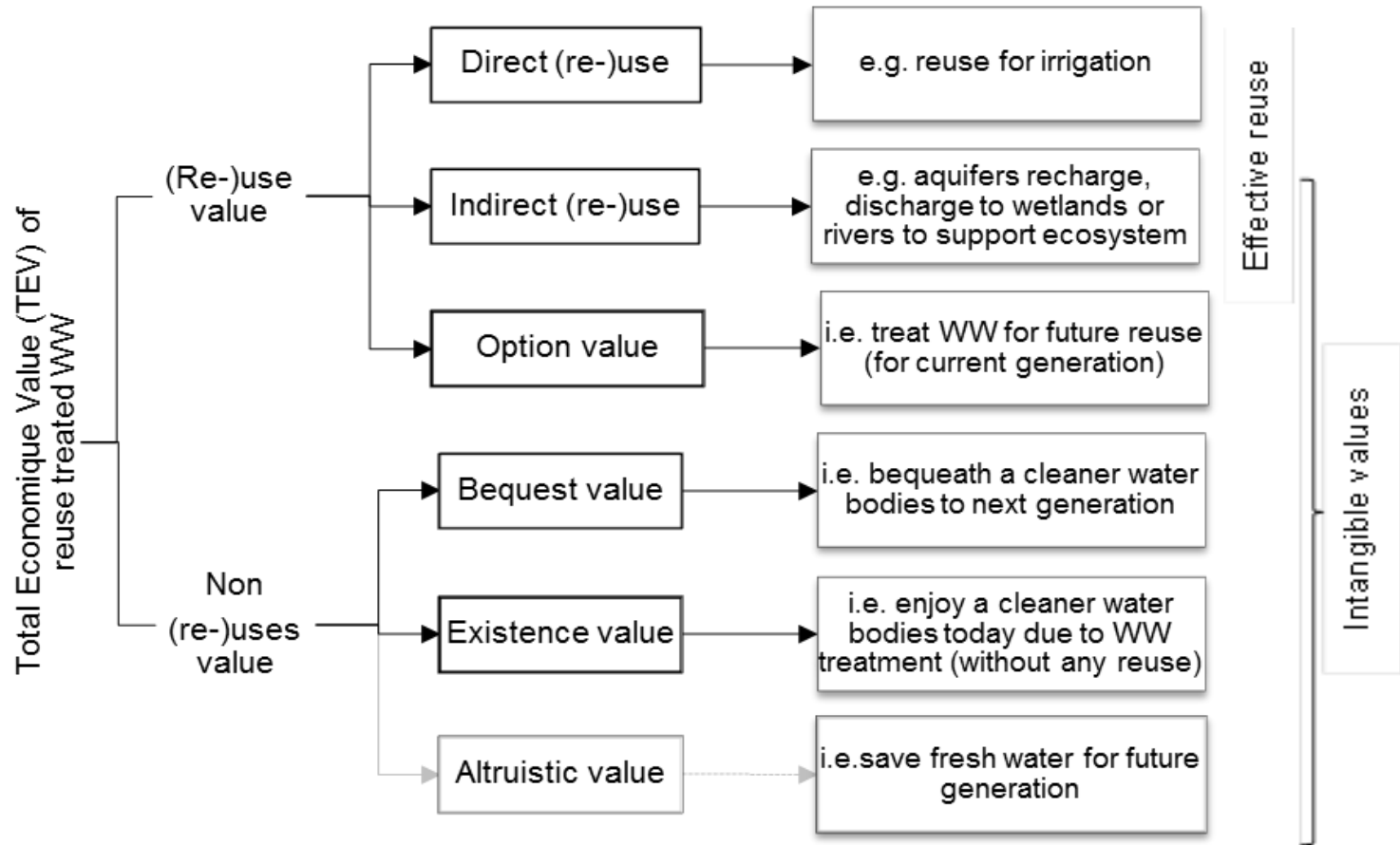
- 1. Benefits of the reuse of treated wastewater (WW)**
- 2. Total economic value (TEV) and valuation methods**
- 3. Comprehensive literature review**
- 4. Willingness to pay (WTP)**
- 5. Conclusions and perspectives**

1. Benefits of the reuse

Wastewater reuse (in agriculture) creates multiple potential benefits, such as:

- ❑ For agriculture:
 - Additional water supply for irrigation
 - Improve water supply reliability during periods of drought
 - Reduce need for fertilizers/nutrients and saving costs
 - ...
 - ❑ For urban development:
 - Increase availability of limited freshwater for potable uses
 - Cost saving in water treatment and/or in water supply expansions
 - Increase aesthetic values of river and coastal area (opportunity for recreation)
 - ...
 - ❑ For environment:
 - Reduce discharge to sensitive water bodies (improve their water qualities)
 - Reduce diversion of freshwater from sensitive water bodies (e.g groundwater)
 - Prevent pollution by wastewater
 - ...
- Most of these benefits are **not marketable** and hence have no price.
- Traditional **Cost Benefit Analysis (CBA)** do not accurately reflect the economic value that community places on the **benefits** generated by reuse project

2a. TEV of treated WW



➤ **Benefits = Δ TEV = TEV** with reuse project - **TEV** without reuse project

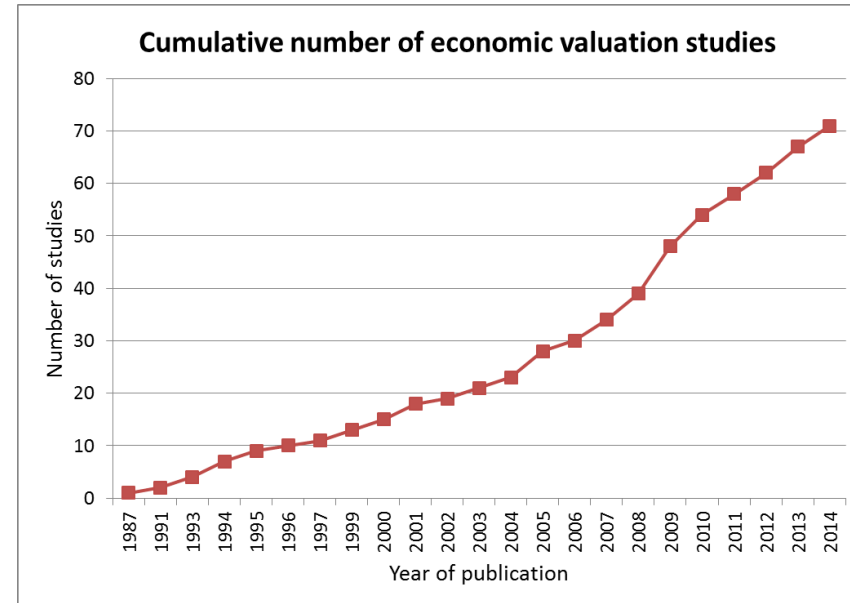
2b. Economic valuation methods

- ❑ Stated preference methods (hypothetical market)
 - Contingent Valuation (**CV**)
 - Choice Experiment (**CE**) or Conjoint Analysis (CA)
- Methods based on survey to elicit respondents' **willingness to pay (WTP)**
- Only methods that are supposed to capture both (re-)use and non-(re-)use values.

- ❑ Revealed preference methods (existing market)
 - Hedonic Pricing (HP)
 - Travel Cost (TC)
 - Cost of Illness (CoI)
 -
- ❑ Cost based methods (cost as proxy)
 - Replacement or Restoration Cost (RC)
 - (Avoided) Damage Cost (DC)
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- ❑ Other methods (existing empirical studies)
 - Benefit Transfer (BT)
 - Meta-Analysis (MA)

3a. Comprehensive literature review

- ❑ **Literature review** on the economic valuation of recycled wastewater:
 - Published papers in peer review journal (e.g. ISI web science)
 - Specific database on environmental economic valuation (e.g. EVRI, RED)
 - **71 studies**, of which **28** focusing **exclusively** on recycled WW valuation
 - **Limited** but growing number of empirical studies since 1987



- ❑ Development of **database of studies** with the following attributes:
 - Bibliographic detail (authors, title, year of publication, ...)
 - Field of applications (location, objective, service valued, function/reuse of treated ww, ...)
 - Methodological detail (valuation method, regression model, payment vehicle, type of scenarios, mode of extrapolation, ...)
 - Survey implementation (year, population surveyed, sample, survey technique, ...)
 - Valuation (mean value, measurement unit, equivalent value in €₂₀₁₄ ...)



3b. Overview of (28) studies

❑ **Geographic distribution:**

- Majority of studies were conducted in developed countries with scarce water resources such as: Australia (6 studies), Greece (5), Spain (3), Cyprus (2),
- Some studies in less scarce water countries: USA (3), Canada (2) and Switzerland (1)
- *Few studies for less developed countries:* India (3), Jordan, Kenya, Ethiopia (1).

❑ **Valuation method:**

- CV method the most used method (13 studies)
- CE method (9 studies)
- Others methods (6 studies)

❑ **Recycled water services valued:**

- 35% on water quantity improvement
- 42 % on water quality improvement
- 13% on WWT improvement (e.g. capacity or technology of sewage treatment)
- 10 % on others: groundwater recharge, water restriction avoidance, ...

4. Willingness to pay (WTP)

- Making monetary values comparable:
 - Converted to international \$₂₀₁₄ using PPP (Purchase Power Parity) conversion index developed by WB.
 - Normalized into a common monetary unit, i.e. **WTP per household (or per farm) per year.**

- But not all valuation results can be compared directly, the range of studies examined allows to derive a range of WTP estimates.

- WTP values (from total of 83 estimates derived from 28 studies):
 - Mean adjusted WTP is **\$ 52.62** per household (or per farm) per year
 - WTP value can range from **0.4 to 267.54 \$.**
 - Heavy bias towards studies focusing on benefits of water quality, and located in the developed countries.

❑ Main conclusions

- Qualitative literature review confirmed the lack of knowledge on the benefits valuation of wastewater reuse.
- Very few empirical studies in developing countries.
- Heterogeneity in scope and benefits being valued in the existing studies.
- Stated preference methods are the most accurate but more complex (lengthy and costly surveys).
- Number of problems still came up in the conversion of value in common monetary unit.

❑ Perspectives

- Generate benefit estimates according to categories of values for supporting CBA.
- Conduct systematic quantitative review of identified studies using developed database and **Meta-Analysis** method (ongoing analysis).