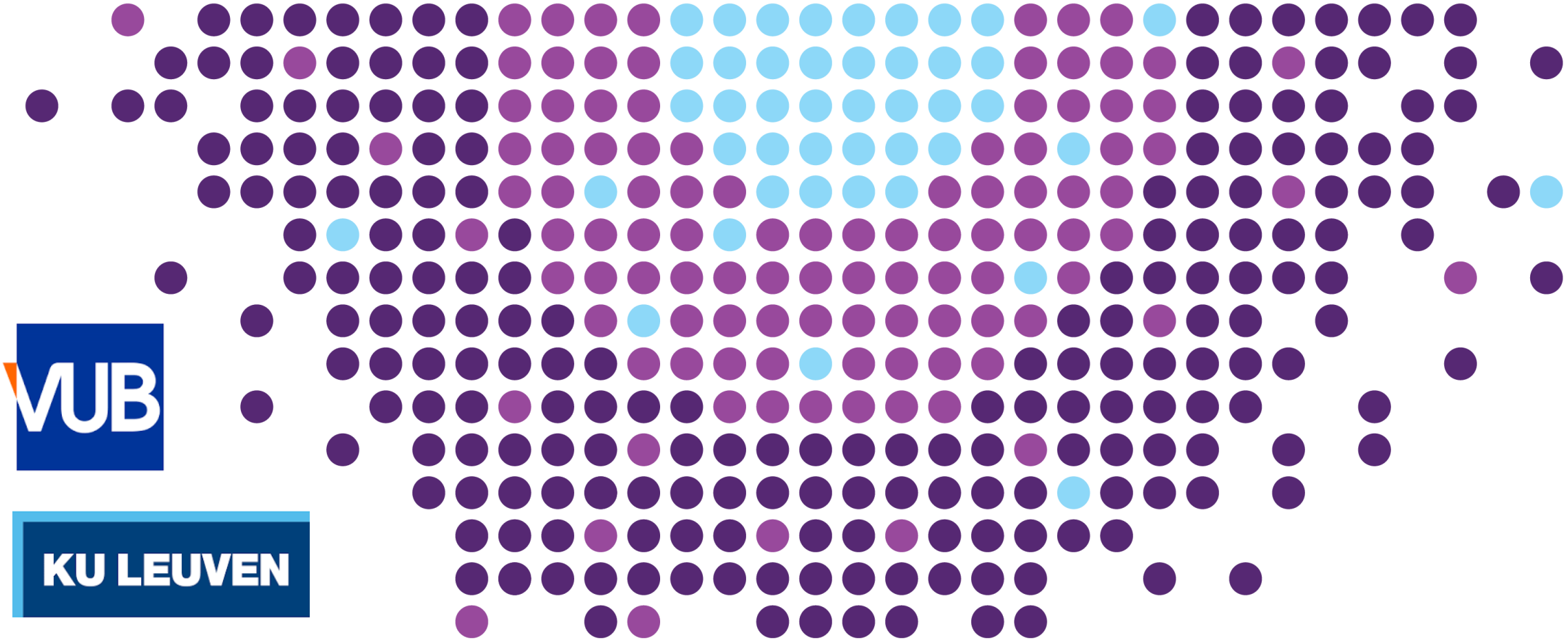


F. Panzarella; V. Cappuyns; B. Abelshausen; C. Turcanu

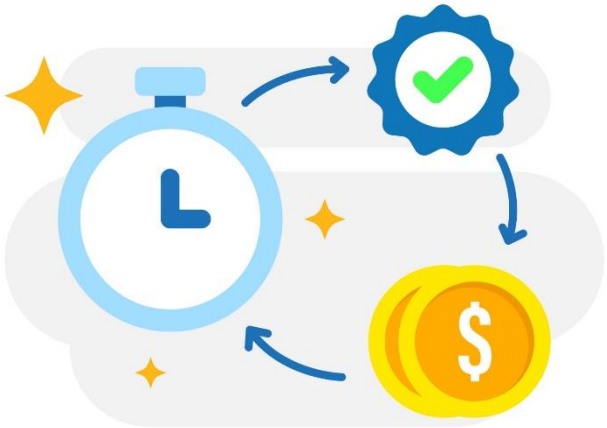
Site remediation and social sustainability: A case study

RemPlex 2023 Global Summit – Nov. 16, 2023

Belgian Nuclear Research Centre

Management of contaminated sites

Traditional approach → Green remediation → Sustainable remediation



voluntary, guiding principle

SER
+ Decision Support Tools (DSTs)

Adapted from: *Braun, A. B., Trentin, A. W. da S., Thomé, A., & Brandli, L. L. (2021). Sustainable Remediation: A New Environmentally Sustainable Paradigm in Urbanization and Industrialization. In Industry, Innovation and Infrastructure (pp. 1102–1113).*

*"**Social sustainability is**:*
a life-enhancing condition within communities, and a process within communities that can achieve that condition". (McKenzie, 2004)

- ✗ Standard measurement systems
- ✗ Quantitative indicators
- ✗ Conventional approaches

Image: Freepik

- Problem:

Lack of empirical research on the inclusion of social dimensions into SER

- Research objective:

Assessing the applicability of **the Community Capitals Framework (CCF)** as holistic approach to sustainability

- Research design:

Literature review → Empirical application → Theoretical framework

Panzarella et al. (2023) *Community capitals and (social) sustainability: Use and misuse of asset-based approaches in environmental management.*

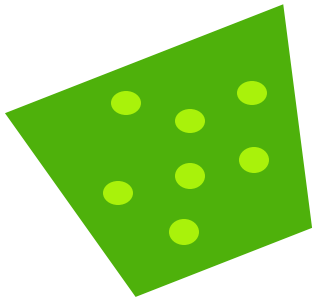
Case studies:

1. Winterbeek (BE) - completed
2. Crotone (IT) - ongoing

The Community Capitals Framework (CCF)

- Asset-based community development (ABCD)

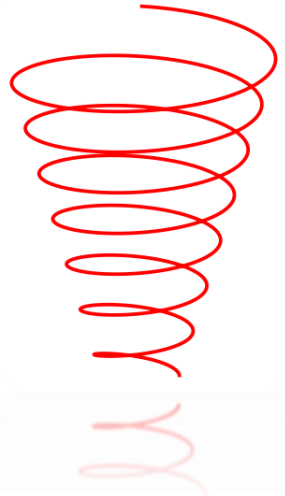
Adapted from: Flora, C. B., and Flora, J. L. (2008).
Rural Communities: Legacy and Change (Vol. 6): Avalon Publishing.



- Asset: stock of capital

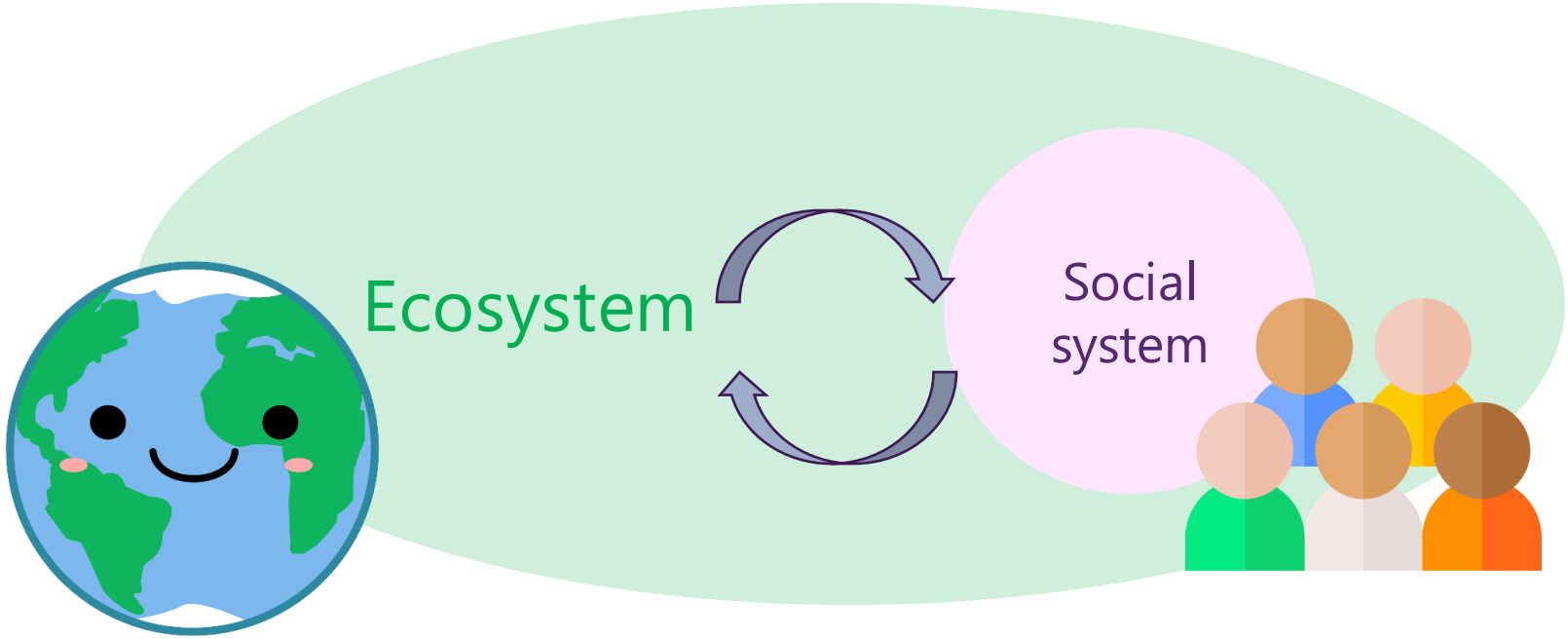
e.g. Human

Demographic and emotional assets possessed by individuals and groups (health, safety & nutrition; leisure & recreation; skills, knowledge & competencies)



- Spiraling-up

Positive effect that an investment on one capital may generate to other capitals



Advantages:

- Tangible and intangible assets
- Complex systems dynamics
- Flexibility, customization
- Stakeholder engagement & knowledge integration
  - Managing with vs. managing of/for
- Limiting adverse effects

Evidence: sustainable and resilient response to environmental challenges

! Never applied to ER

How community specific assets are envisioned by different stakeholders?

How are these taken into account in the project planning and decision-making of the remediation?

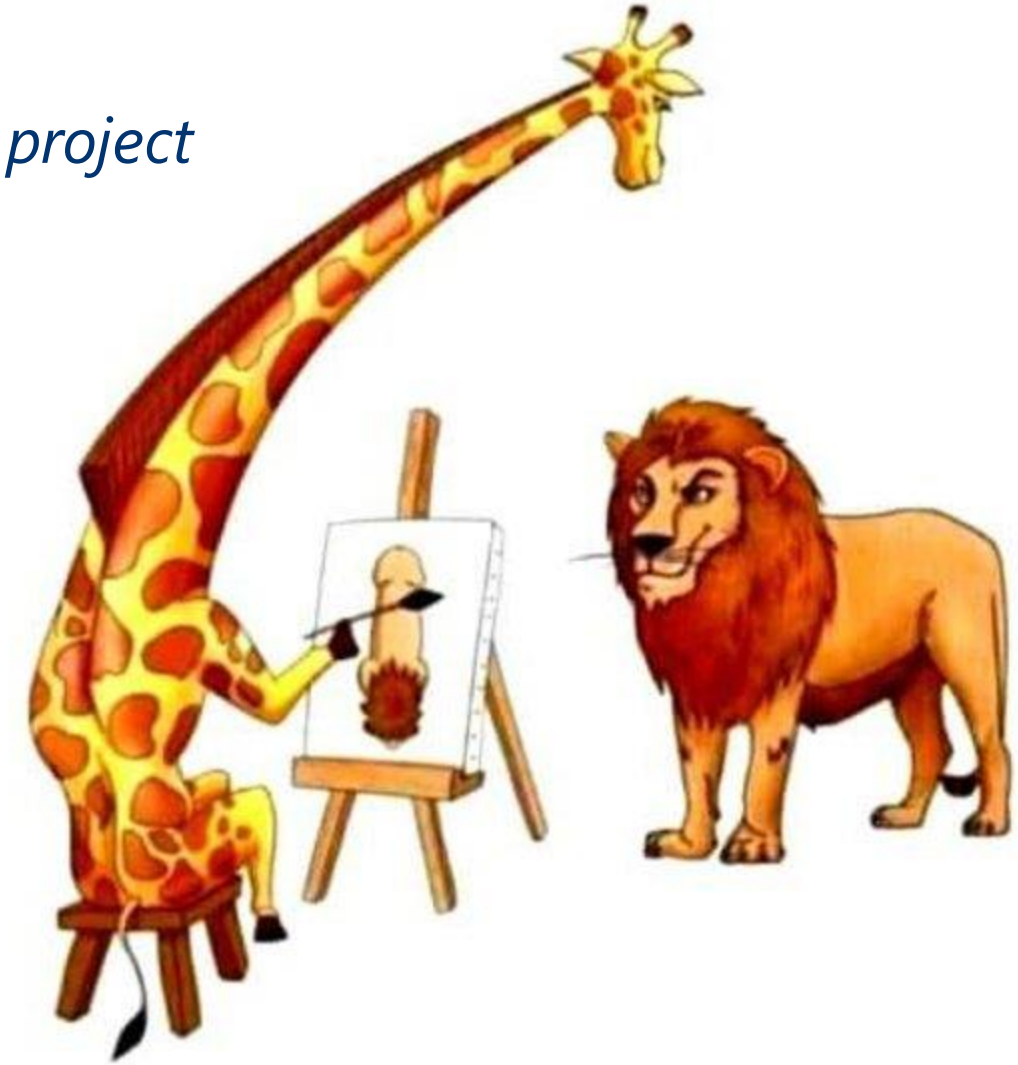
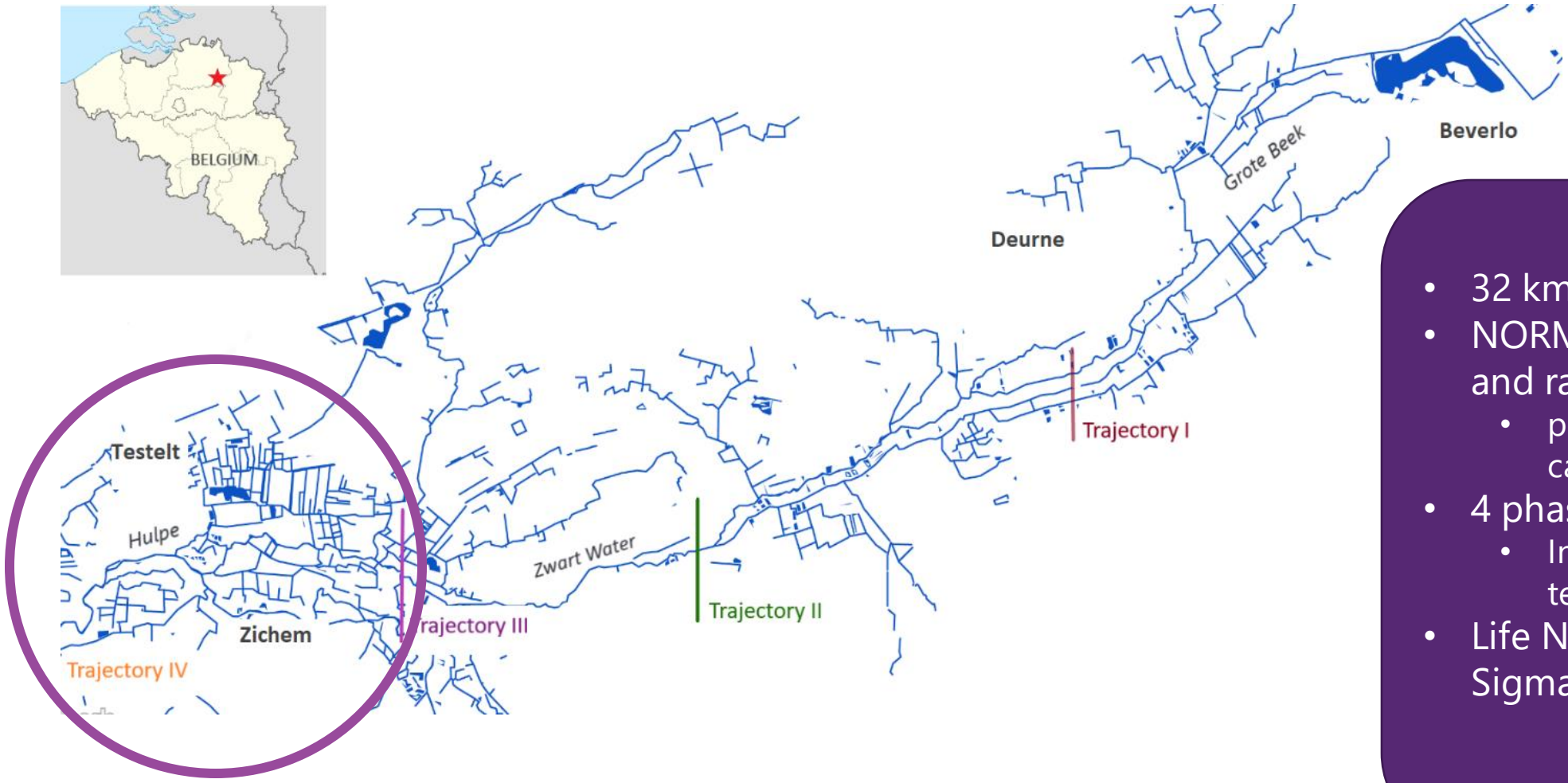


Image: Quora

Winterbeek (BE)



- 32 km watercourse
- NORM (heavy metals and radionuclides)
  - production of tri-calcium phosphate
- 4 phase remediation
  - Including different techniques
- Life NARMENA, Sigmaplan, Blue Deal

Qualitative, multi-modal research design

Document analysis (64)

(Winterbeek or Hulpe or Demerbroeken) AND (remediation or pollution or vervuil or saner* or gesanee* or besmet* or milieuverontreinig* or verontreining* or contaminatie or "zware metalen" or radioactive* or radium or "Sigma Plan" or Narmena or "Blue Deal")*

- **64** documents

Limo, SCK CEN, Nexis Uni, Google Scholar, Web of Science, Scopus

+

Interviews

- Community members (**14**): People living or conducting activities in the vicinity of the 4th trajectory of the Winterbeek
- Experts (**9**): People involved in the decision-making and project planning of the remediation

- English
- In person or on TEAMS
- Upon agreement with the IC

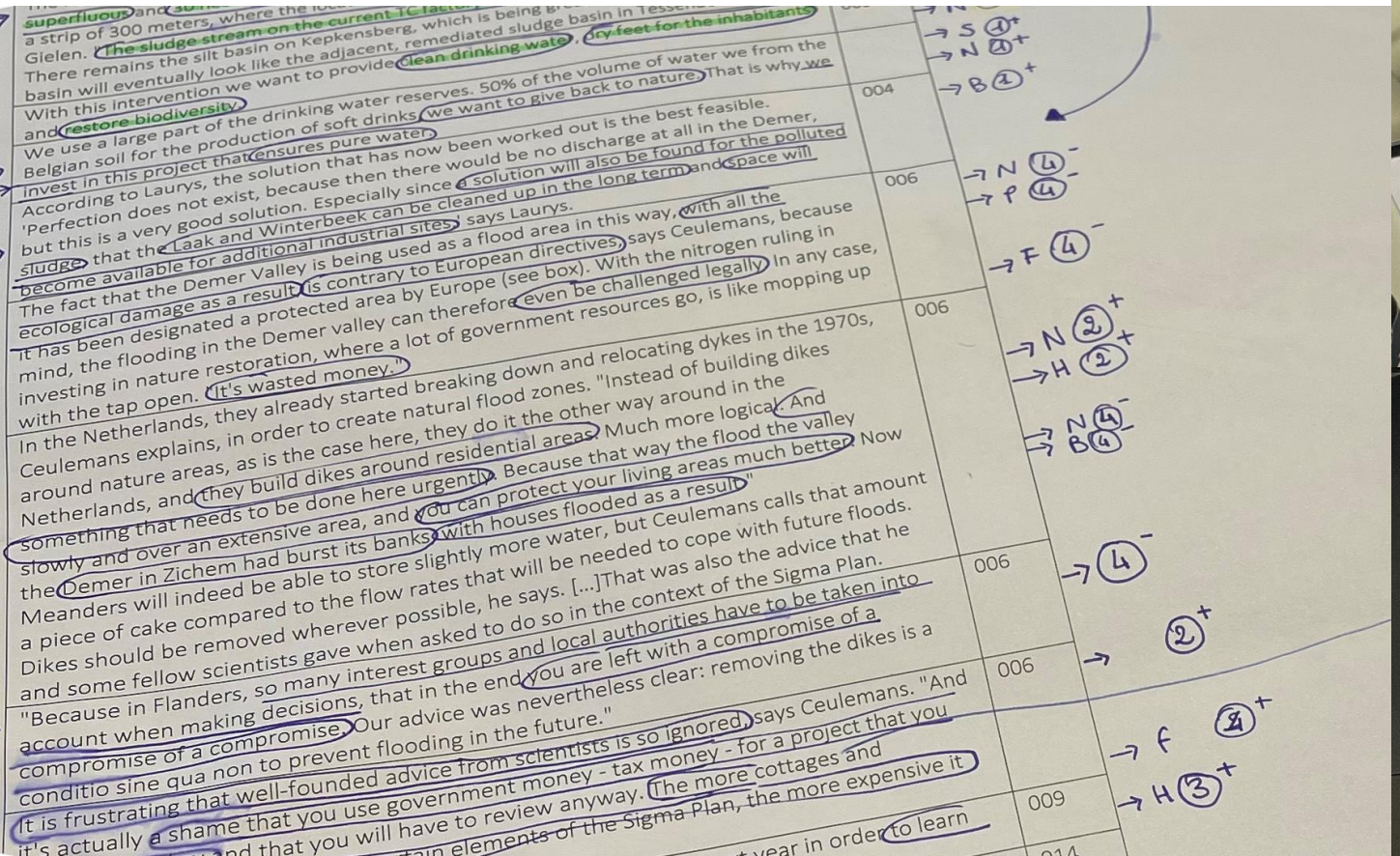
Identification of:
- **ASSETS**
- **IMPACTS**

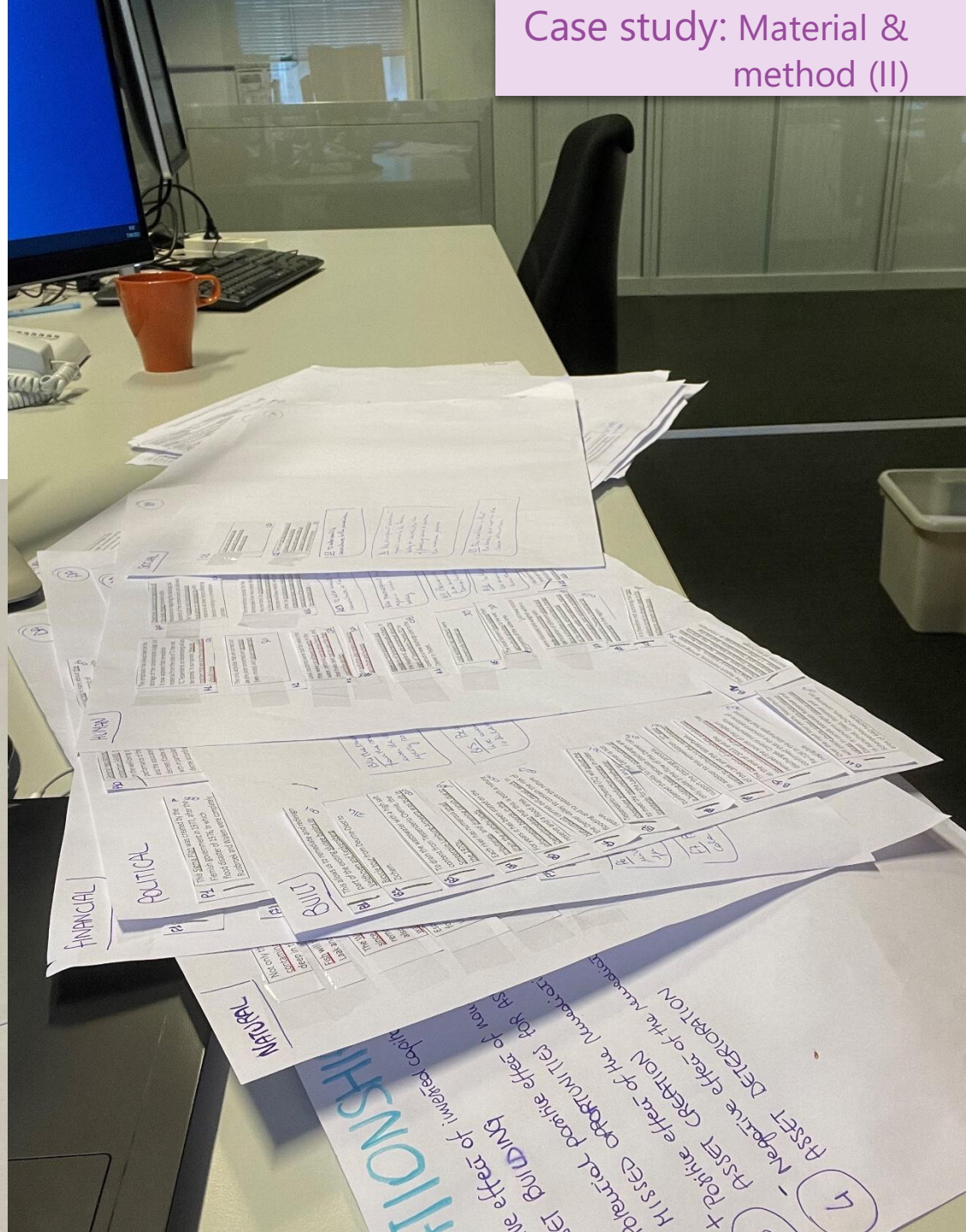
Case study: Material & method (II)

Identification of:

- **SPIRALING-UP and -DOWN**

Manual coding





1. Asset identification

- The assets identified from the interviews with CMs remarkably differed from the ones mentioned by experts:

Experts

"So we did some inspections regularly. We checked where the material was going, we characterized the material in terms of radionuclides. We did the communication with the public and with other related stakeholders".

"Well, when the remediation plan was launched and everybody can speak out their concerns as just official procedure. When we launched the remediation plan we have made communications through a local papers and the City Hall, some websites… We also tried to media. So we have… We did reach out to the people".

"Well, we also do a stakeholder meetings. So a meeting where everybody who has a stake in the area is involved and can express their concerns".

Political (engagement)
Social (working together & cooperation)

Community members

"I'm a bit lucky because they invited me to several meetings but otherwise all I would have known are the yellow papers of the community and the public letters of OVAM. That's all. It's because I'm a volunteer in Natuurpunt that I know a bit more and because I'm responsible for the cows and the horses in the Demerbroeken".

"And I think they value, the economic value is more important for them than the value that nature is for people. There is practically never evaluation of what nature can mean for the wellbeing of people".

2. Impacts of the remediation

- Both positive and negative:
  - *"This rewetting of the Kloosterbeemden not only means added value for tackling the drought problem, it also ensures that pollutants no longer spread further and are less bio-available"*
  - *"The work will be accompanied by noise and dust nuisance"*
  - Since the wetlands are anthropogenic, worries were raised in relation to the post-remediation management – high maintenance

- Assets not recognized as such by remediation decision-makers may be nevertheless fruitfully mobilized

- Vice versa, remediation projects may lead to asset creation, independently from asset identification

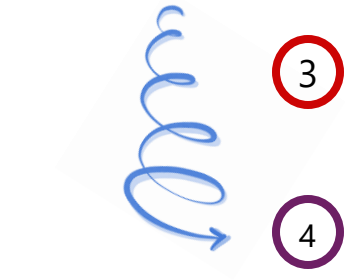
3. Spiraling-up and down

- Complex relationships between capitals

Existing capital used as leverage point to generate additional capital

Spiraling-up:
"The positive effect that an investment on one capital may generate to other capitals" (Emery & Flora, 2006)

1. Asset building: *"Too much water… So, there is too much water in the villages and it floods sometimes and this project aims to use this polluted area as a water retention area"*
2. Asset creation: *"The Flemish Region has decided to tackle the Winterbeek first next year in order to learn lessons from it for the Grote Laak"*



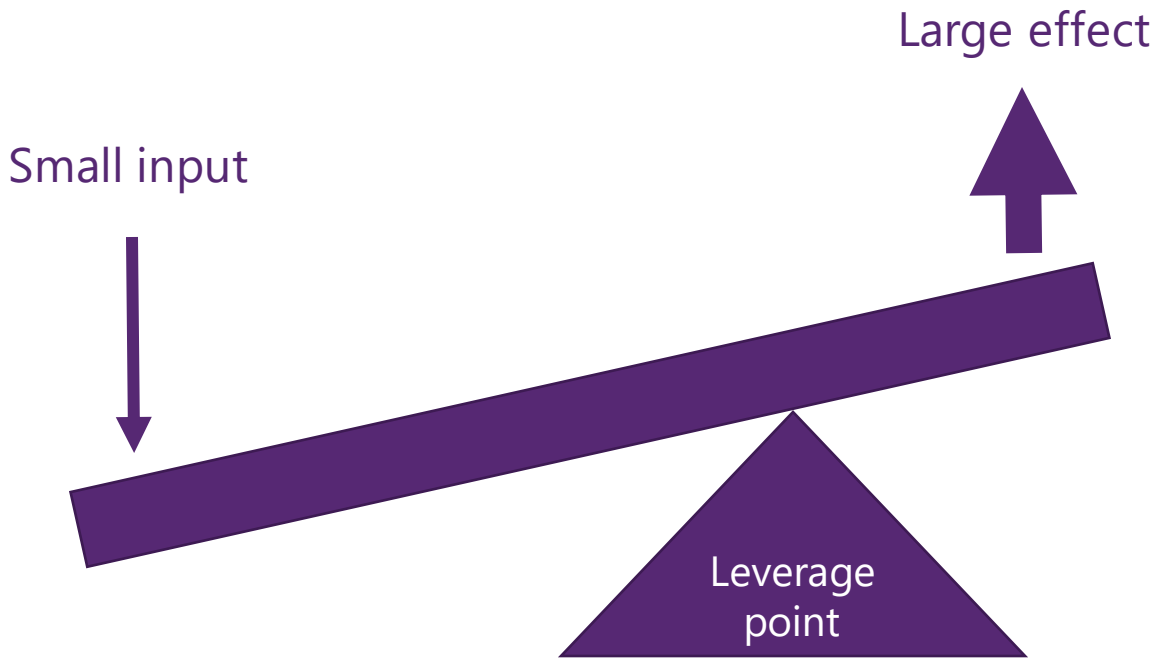
3. Missed opportunities for asset building: *"And it's actually a shame that you use government money - tax money - for a project that you know is not okay and that you will have to review anyway"*
4. Asset deterioration: *"The salt discharges from TC in the Demer will seriously affect the water quality"*

4. Additional considerations

- Local and technical knowledge integration:
  - accounting for assets as they are envisioned by different stakeholders may help to limit adverse effects of the remediation and in using local resources more efficiently

- Tracking of assets over time:
  - while the a priori asset identification is essential to inform the decision-making process, an ex-post asset identification can be relevant for the follow-up of the project
    - Post-remediation: maximization of employment of local resources for achieving the long-term site remediation objectives (e.g. human capital)

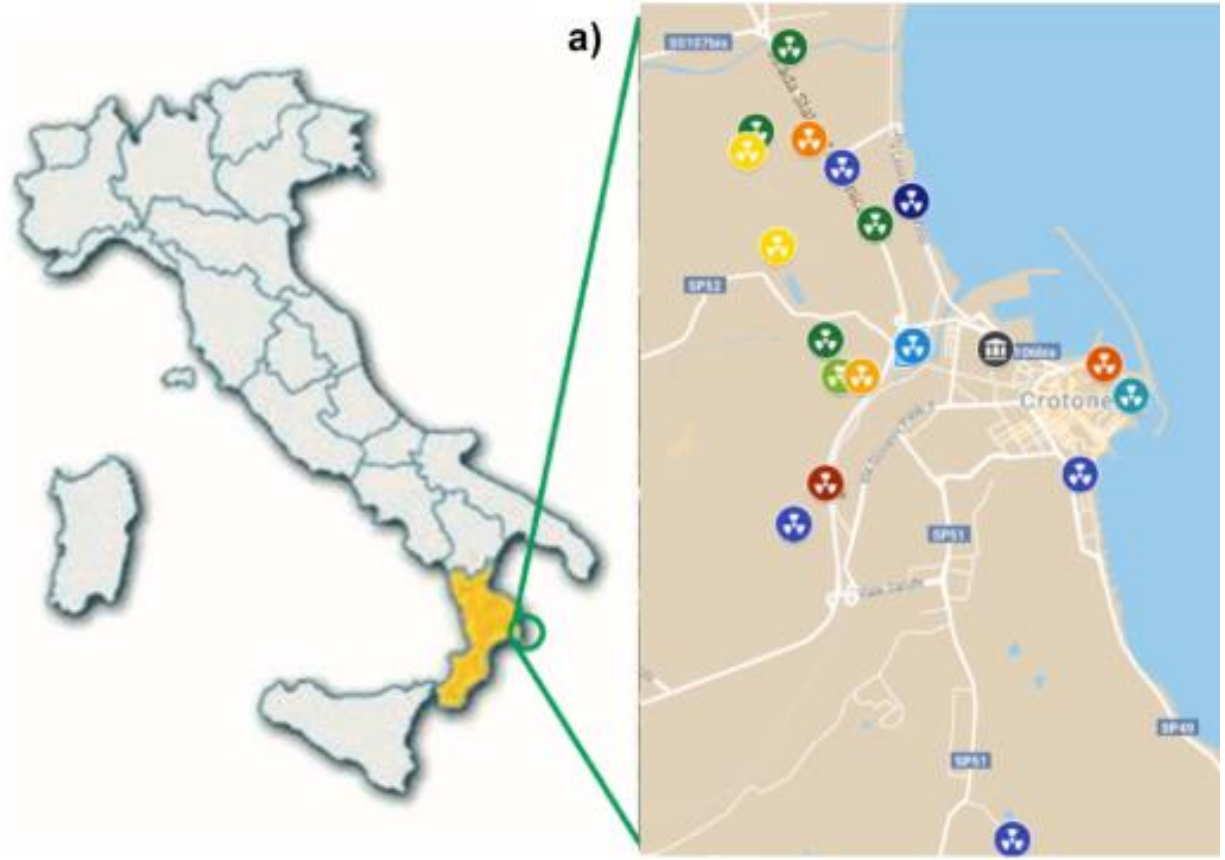
By leveraging available assets and taking into account weak areas for intervention, a CCF-based approach can contribute to diminishing adverse effects while maximizing positive outcomes:



Need for:

- More comprehensive understanding of the applicability of the CCF for sustainability assessment of site remediation projects
  - Multi case study
  - A priori vs. ex post
  - High vs. low doses of radioactivity

- Methodological reflections
  - Visual methods



Mastroberardino, A., Casaburi, F., Canino, R., Iannone, M., & Procopio, S. (2023). Toxicity evaluation of the contaminated area of Crotone from biological indicators: a multispecies approach. *Environmental Monitoring and Assessment*, *195*(4), 473.

Thank you!

Questions? Comments? Feedback?

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References

- Braun, A. B., Trentin, A. W. da S., Thomé, A., & Brandli, L. L. (2021). Sustainable Remediation: A New Environmentally Sustainable Paradigm in Urbanization and Industrialization. In Industry, Innovation and Infrastructure (pp. 1102–1113).
- Mulders, S. & De Mildt, E. (2021) " 'De vraag is niet óf de dijken breken, maar wanneer'; Klimaat. Natuurgebied Demerbroeken is verwoest door de regenval, en dat is te wijten aan gebrekkig beleid", De Morgen, 7 August, pp. 1-6.
- Dhakal, S. P. (2018). Analysing news media coverage of the 2015 Nepal earthquake using a community capitals lens: implications for disaster resilience. Disasters, 42(2), 294-313.
- Döberl, G., Ortmann, M., & Frühwirth, W. (2013). Introducing a goal-oriented sustainability assessment method to support decision making in contaminated site management. Environmental Science & Policy, 25, 207-217. https://doi.org/10.1016/j.envsci.2012.10.013
- European Environment Agency (EEA). (2020). *Contamination from local sources*. European Environment Agency. Retrieved from https://www.eea.europa.eu/themes/soil/soil-threats#:%7E:text=Reports%20from%20countries%20across%20Europe%20indicate%20that%20heavy,a%20contaminant%20is%20reported%20at%20the%20investigated%20site.
- Flora, C. B., and Flora, J. L. (2008). *Rural Communities: Legacy and Change* (Vol. 6): Avalon Publishing.
- Miles, B., & Morse, S. (2007). The role of news media in natural disaster risk and recovery. *Ecological economics*, *63*(2-3), 365-373.
- Ministerie van de Vlaamse Gemeenschap (2004). De Winterbeek. Naar een ecologisch herstel van waterloop en vallei, pp. 1-22. Available at: https://www.vlaanderen.be/publicaties/de-winterbeek-naar-een-ecologisch-herstel-van-waterloop-en-vallei
- OVAM - Openbare Vlaamse Afvalstoffenmaatschappij (2016). Sanering Winterbeek van start, 25 March, pp. 1-2. Available at: https://emis.vito.be/en/artikel/sanering-winterbeek-van-start
- OVAM - Openbare Vlaamse Afvalstoffenmaatschappij (2016). *Een nieuwe toekomst voor de Winterbeek*, 23 March, pp. 1-12
- Pigg, K., Gasteyer, S. P., Martin, K. E., Keating, K., & Apaliyah, G. P. (2020). The community capitals framework: An empirical examination of internal relationships. In *50 Years of Community Development Vol I* (pp. 117-127). Routledge.

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Coding frame (I)
Capitals & Assets (a priori):

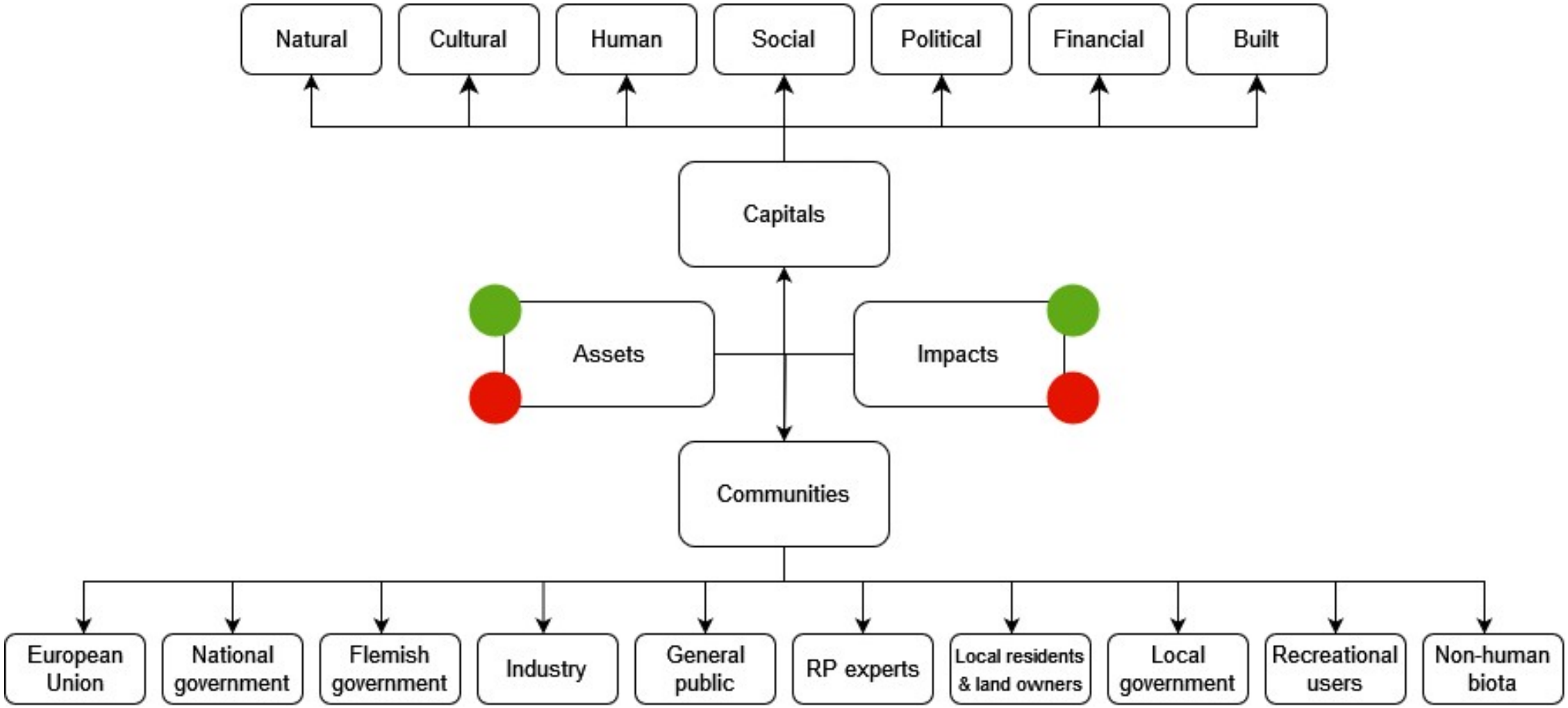
Capitals	Categories of assets (sub-codes)
Natural capital	Agriculture & farming; air quality; fauna & flora; land & common property; landscape; soil & water; weather; geographical location
Cultural capital	Ceremonies, festivities & festivals; cultural & religious institutions; language; norms, beliefs & values; taboos; traditions & customs; habits
Human capital	Anxiety & fears; aspiration & expectations; demographics; education; employment & social security; health, safety & nutrition; human rights; leisure & recreation; skills, knowledge & competencies
Social capital	Collective identity; community services; leadership; mutual trust; perceived wellbeing; sense of future; social networks; societal security; working together & cooperation
Political capital	Engagement; laws & guidelines; power relations; representation; resource allocation
Financial capital	Expenses; income, wages, salaries & pensions; industry & businesses; investments, funds, loans, savings, liabilities & subsidies; economic valuation of natural resources
Built (or infrastructural)	Communication; industrial buildings (production & other facilities); residential areas; river infrastructures; sewer & water systems; technical equipment, machinery & other tools; transportation & road infrastructures; recreational infrastructures

Panzarella, F., Turcanu, C., Abelshausen, B., & Cappuyns, V. (2023). Community capitals and (social) sustainability: Use and misuse of asset-based approaches in environmental management. *Journal of Environmental Management*, *329*, 117122.

Coding frame (II)

Communities (emergent coding):

Community	Locational boundaries
European Union	Europe
National government	Belgium
Flemish government	Flanders
Industry	whole course of the Winterbeek
General public	whole course of the Winterbeek
RP (Radiation Protection) experts	whole course of the Winterbeek
Local residents and land owners	4th trajectory
Local government	4th trajectory
Recreational users of the land	4th trajectory
Non-human biota	whole course of the Winterbeek and/or 4th trajectory



+ Spiraling-up and down

Coding frame (III)

Impacts of the remediation (emergent coding):

- Positive

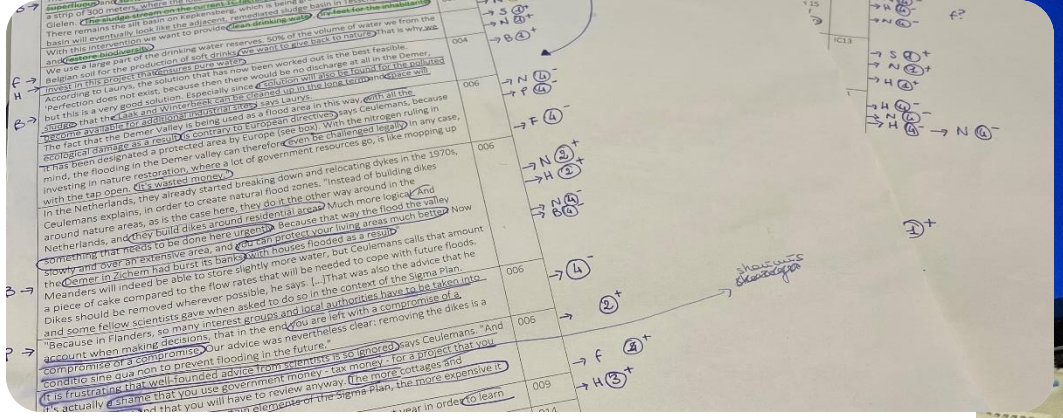
  Ex: "*This rewetting of the Kloosterbeemden not only means added value for tackling the drought problem, it also ensures that pollutants no longer spread further and are less absorbed by organisms*"

- Negative

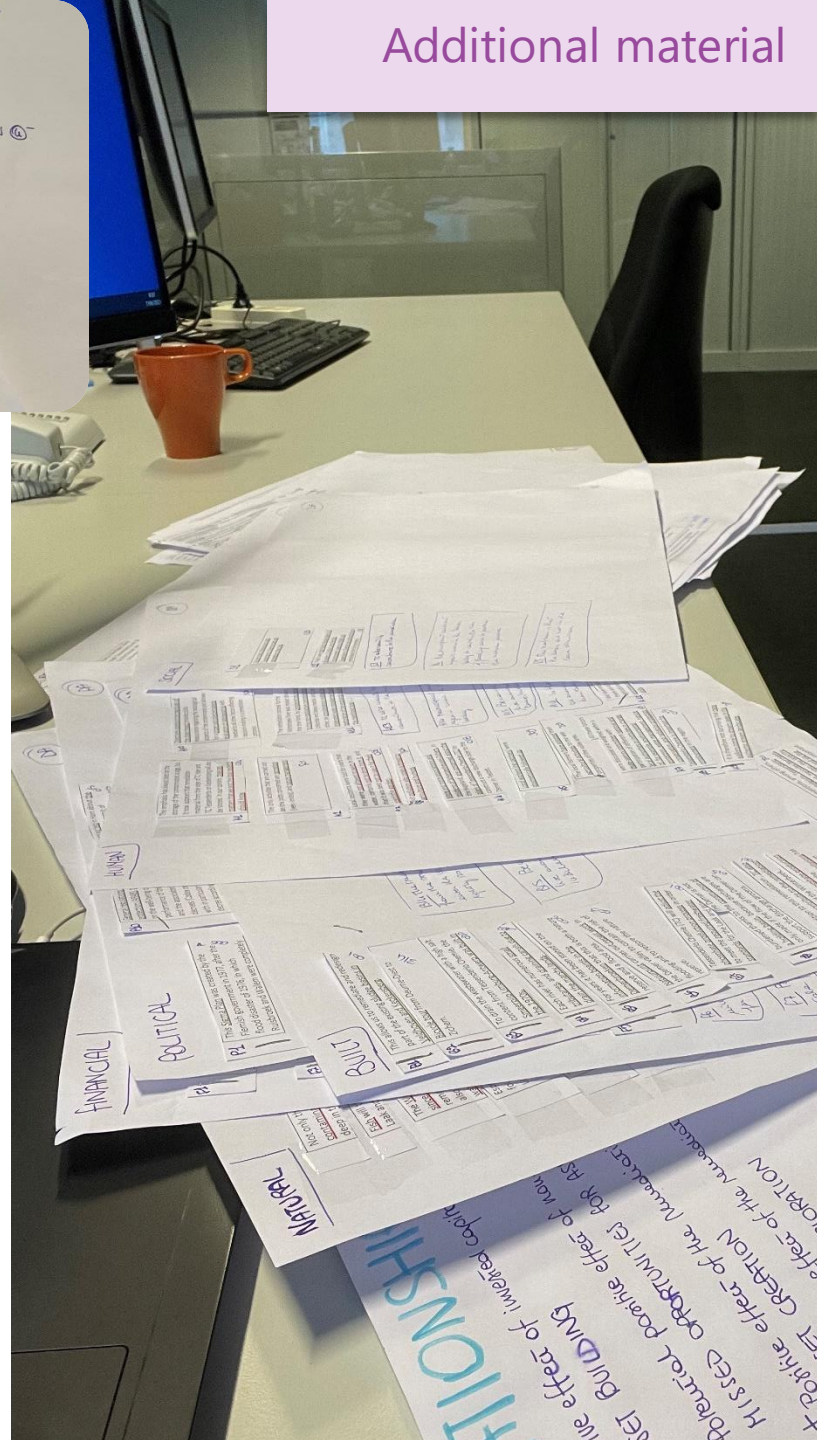
  Ex: *"The work will be accompanied by noise and dust nuisance"*

Spiraling-up and down

Manual coding



Additional material



1. Assets were numbered
2. Numbers preceded by the letter of the capital of belonging (B=Built; C=Cultural; H=Human; F=Financial; P=Political; S=Social; N=Natural)

Source	Assets	Capitals	Asset's owner	Asset number
001	Tessenderlo Chemie (TC) will adjust the phosphate production process in order to meet the required freshwater standards for the Laak and Winterbeek.	Built (industrial buildings – production & other facilities) Political (laws & guidelines)	Industry	B7 P14

sck cen

Spiraling-up and down

Manual coding

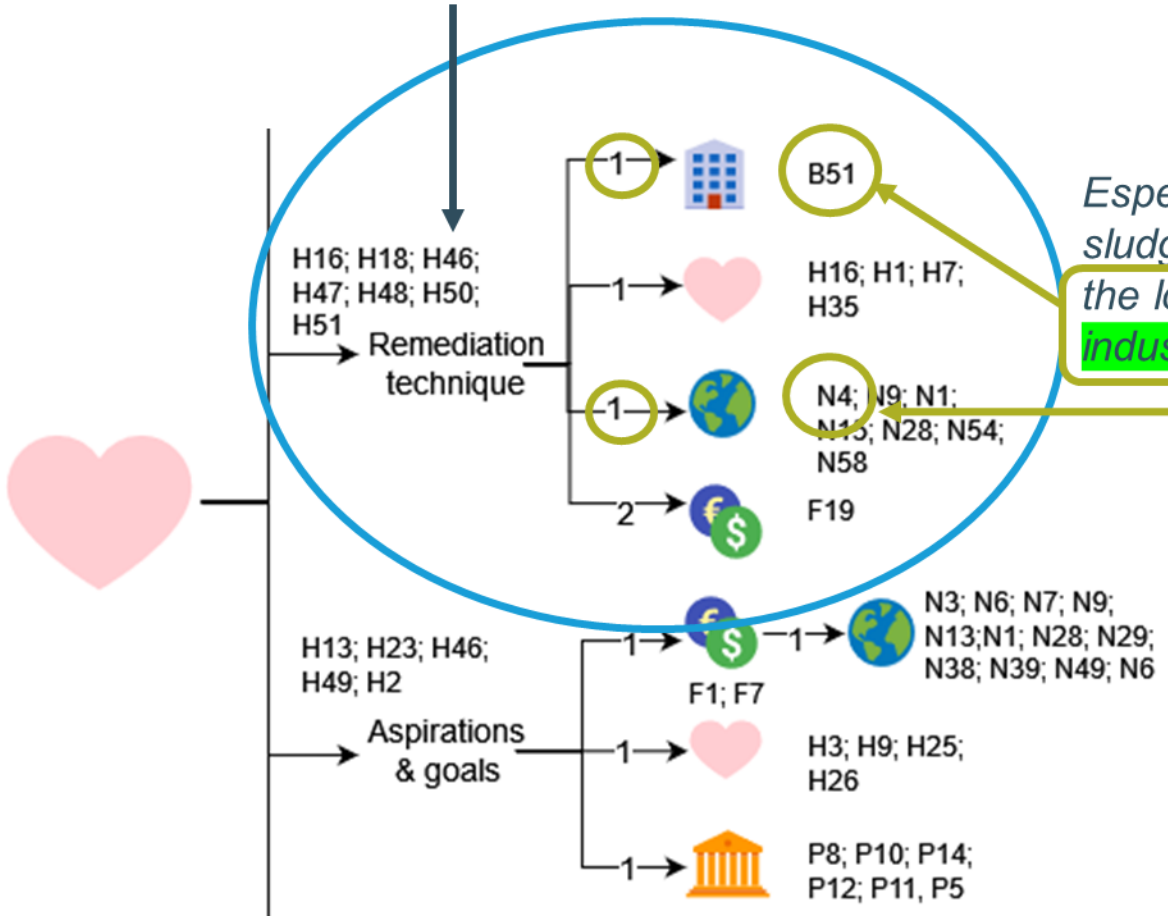
Ex: P= Political
1= Asset building

3. Numbers from 1-4 to describe relationships (spiraling up and down)

Capitals	Actions related to the remediation	Invested assets	Impacts	Impacted assets
BUILT	1. Changes in the production process	B10; B7; B8; B9; B12 F4	• Tessenderlo Chemie (TC) will adjust the phosphate production process in order to meet the required freshwater standards for the Laak and Winterbeek . "Fish will therefore be able to swim in the Laak and Winterbeek again". • The new way of producing does require fewer workers, but there will be no naked layoffs. • This production change not only affects the salt discharges, but also ensures that considerably less sludge has to be stored. This allows us to remediate and redesign part of the existing sludge basins in Veldhoven and Kepkensberg. In addition to this remediation , TC also wants to contribute to the remediation of the Laak and the Winterbeek. The polluted sludge will be stored on the TC sites, for example. • The new production process means that the sludge basin in Veldhoven will become superfluous and 30 hectares of land will be freed up for new industrial estates. • The salt discharges from TC in the Demer will seriously affect the water quality», says Wim Van Gils of Bond Beter Leefmilieu.	**P1** (P14; P12; P11; P5; P10; P22; P25; P30; P32) **N1** (N20; N2; N7; N9; N19; N28; N38; N39; N47; N53; N56) **H4** (H4; H8) **B4** (B10) **F2** (F19) **N4** (N23)

Example (I)

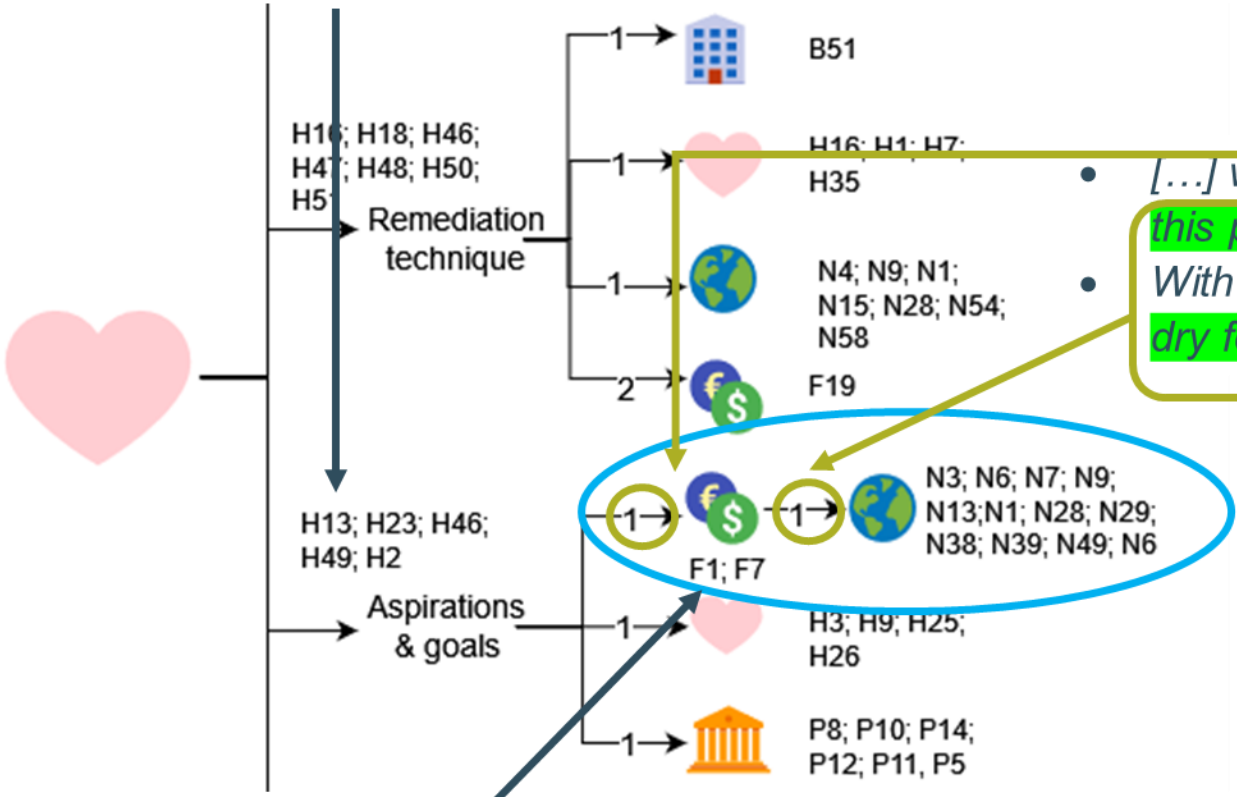
H46: *[…] we already have a vision made for the project area, which involves the re-naturalization of natural groundwater levels, which means we have to raise the groundwater levels with a high amount.*



Especially since a solution will also be found for the polluted sludge, that the Laak and Winterbeek can be cleaned up in the long term and space will become available for additional industrial sites

Example (II)

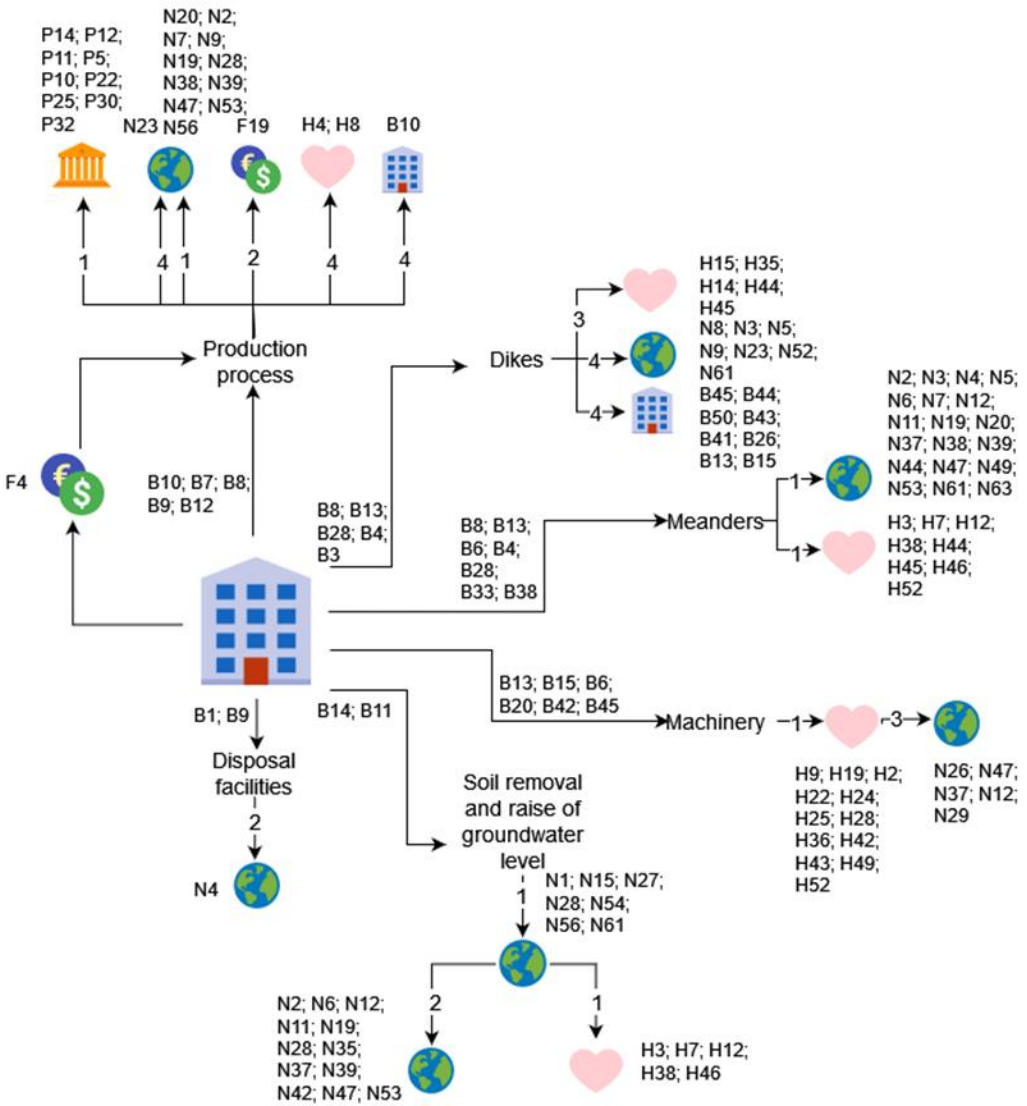
H13: […] *TC also wants to contribute to the remediation of the Laak and the Winterbeek.*



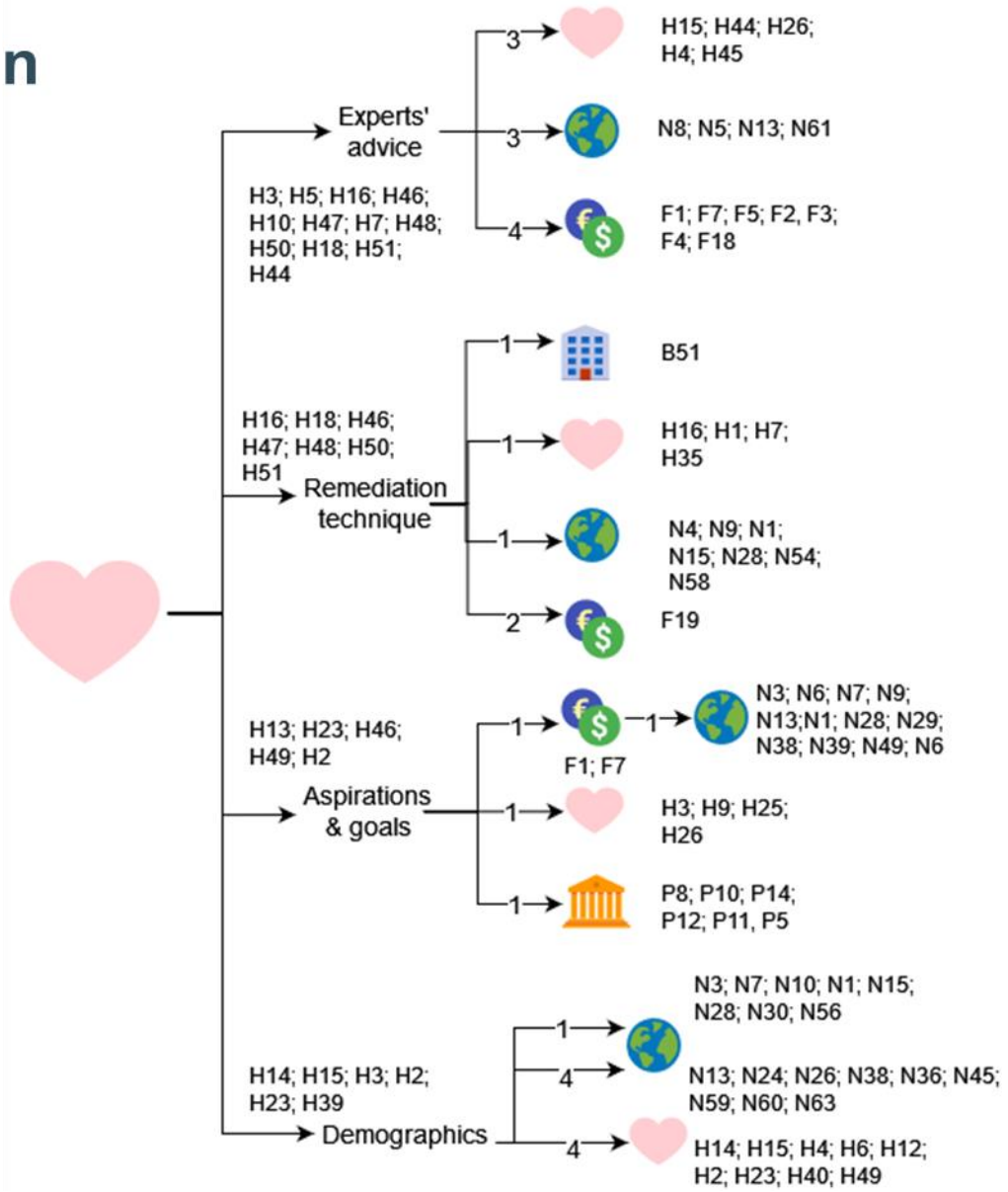
- […] we want to give back to nature. That is why we invest in this project that ensures pure water.
- With this intervention we want to provide clean drinking water, dry feet for the inhabitants and restore biodiversity.

F1; F7: The works cost 900,000 euros. Europe pays half through the LIFE project and curiously enough, beverage giant Coca-Cola pays the other half.

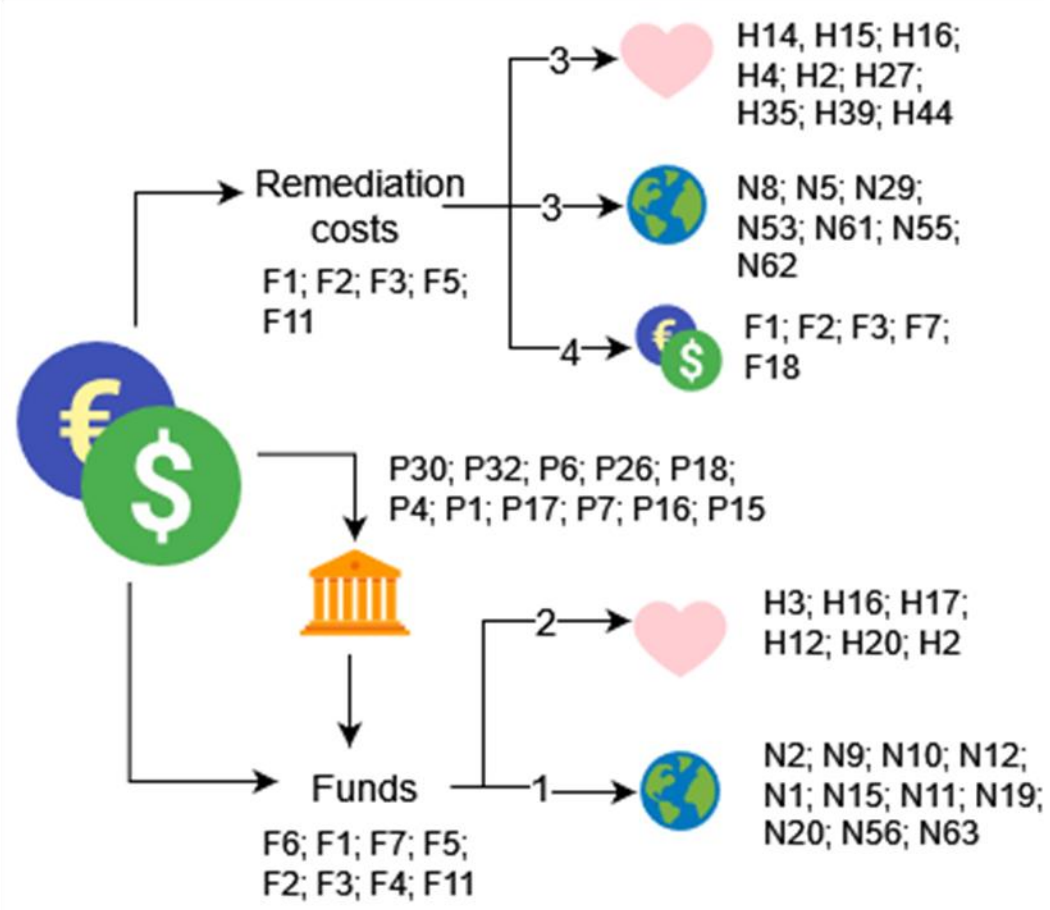
Built


P14; P12; P11; P5; P10; P22; P25; P30; P32
N20; N2; N7; N9; N19; N28; N38; N39; N47; N53; N23 N56
F19
H4; H8
B10
1
4
1
2
4
4
Production process
Dikes
3
4
4
H15; H35; H14; H44; H45
N8; N3; N5; N9; N23; N52; N61
B45; B44; B50; B43; B41; B26; B13; B15
F4
B10; B7; B8; B9; B12
B8; B13; B28; B4; B3
B8; B13; B6; B4; B28; B33; B38
Meanders
1
1
N2; N3; N4; N5; N6; N7; N12; N11; N19; N20; N37; N38; N39; N44; N47; N49; N53; N61; N63
H3; H7; H12; H38; H44; H45; H46; H52
B13; B15; B6; B20; B42; B45
Machinery
1
3
H9; H19; H2; H22; H24; H25; H28; H36; H42; H43; H49; H52
N26; N47; N37; N12; N29
B1; B9
B14; B11
Disposal facilities
2
N4
Soil removal and raise of groundwater level
1
N1; N15; N27; N28; N54; N56; N61
2
1
N2; N6; N12; N11; N19; N28; N35; N37; N39; N42; N47; N53
H3; H7; H12; H38; H46

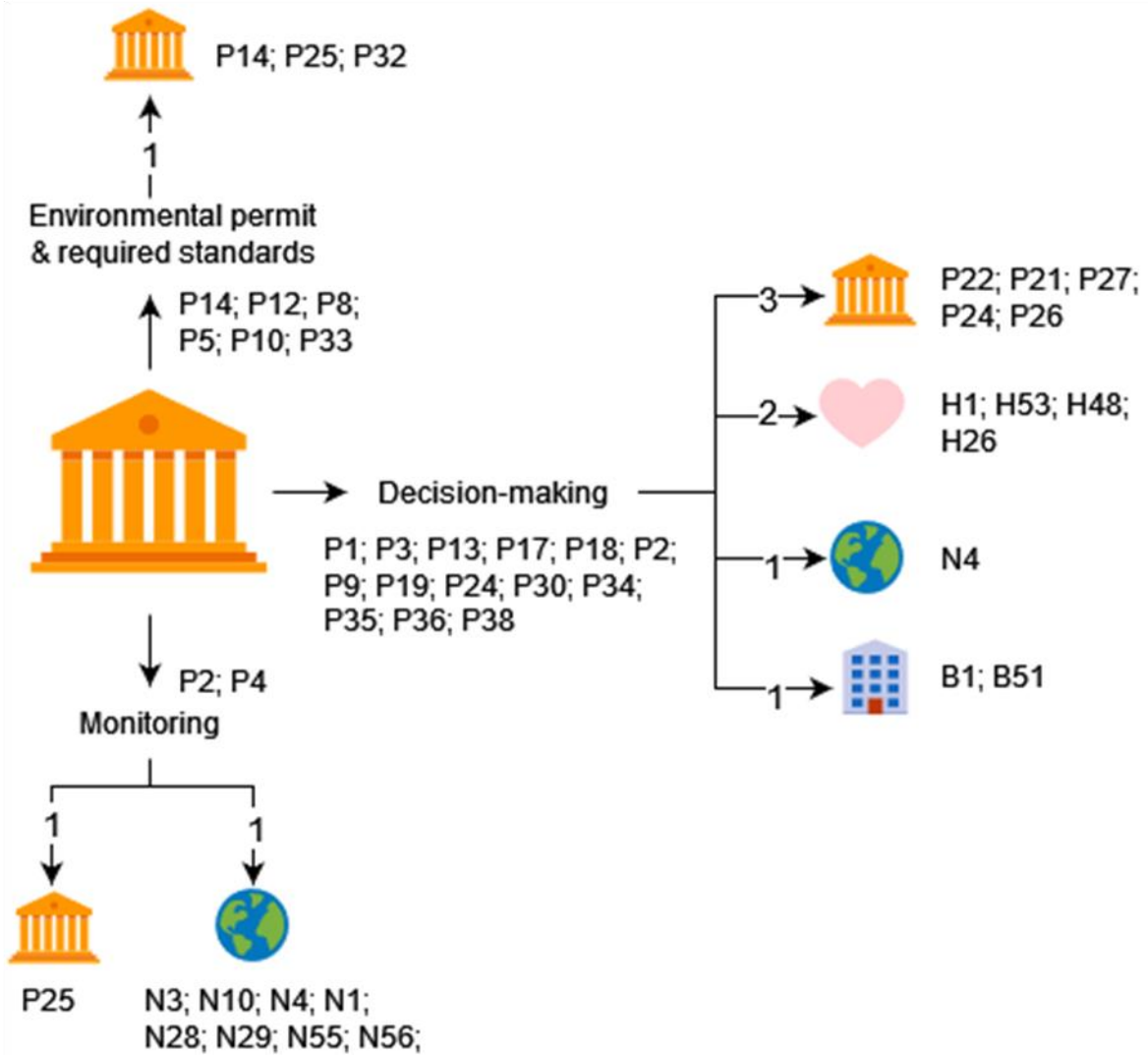
Human


Experts' advice
H3; H5; H16; H46; H10; H47; H7; H48; H50; H18; H51; H44
3
H15; H44; H26; H4; H45
3
N8; N5; N13; N61
4
F1; F7; F5; F2, F3; F4; F18
Remediation technique
H16; H18; H46; H47; H48; H50; H51
1
B51
1
H16; H1; H7; H35
1
N4; N9; N1; N15; N28; N54; N58
2
F19
Aspirations & goals
H13; H23; H46; H49; H2
1
F1; F7
1
N3; N6; N7; N9; N13;N1; N28; N29; N38; N39; N49; N6
1
H3; H9; H25; H26
1
P8; P10; P14; P12; P11, P5
Demographics
H14; H15; H3; H2; H23; H39
1
N3; N7; N10; N1; N15; N28; N30; N56
4
N13; N24; N26; N38; N36; N45; N59; N60; N63
4
H14; H15; H4; H6; H12; H2; H23; H40; H49

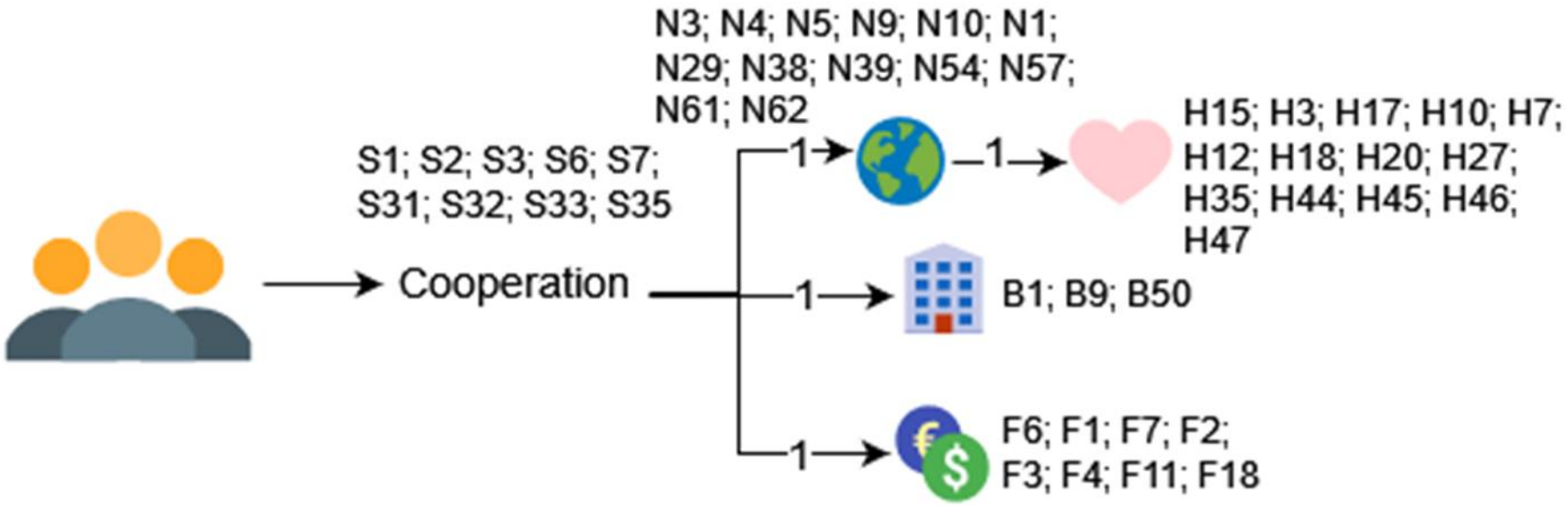
Financial


Remediation costs
F1; F2; F3; F5; F11
3
H14, H15; H16; H4; H2; H27; H35; H39; H44
3
N8; N5; N29; N53; N61; N55; N62
4
F1; F2; F3; F7; F18
P30; P32; P6; P26; P18; P4; P1; P17; P7; P16; P15
Funds
F6; F1; F7; F5; F2; F3; F4; F11
2
H3; H16; H17; H12; H20; H2
1
N2; N9; N10; N12; N1; N15; N11; N19; N20; N56; N63

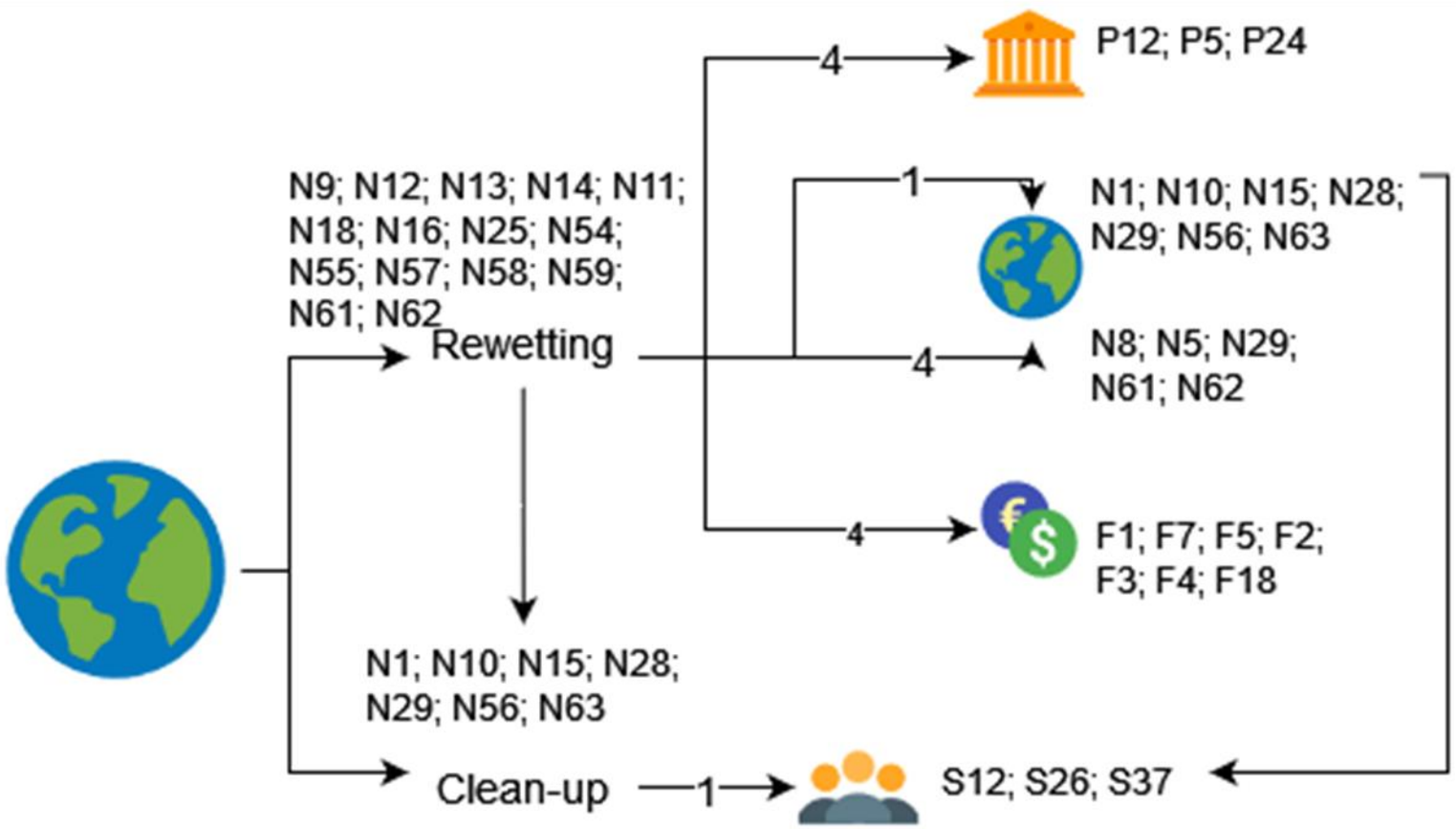
Political


P14; P25; P32
1
Environmental permit
& required standards
P14; P12; P8;
P5; P10; P33
Decision-making
P1; P3; P13; P17; P18; P2;
P9; P19; P24; P30; P34;
P35; P36; P38
3
P22; P21; P27;
P24; P26
2
H1; H53; H48;
H26
1
N4
1
B1; B51
P2; P4
Monitoring
1
1
P25
N3; N10; N4; N1;
N28; N29; N55; N56;

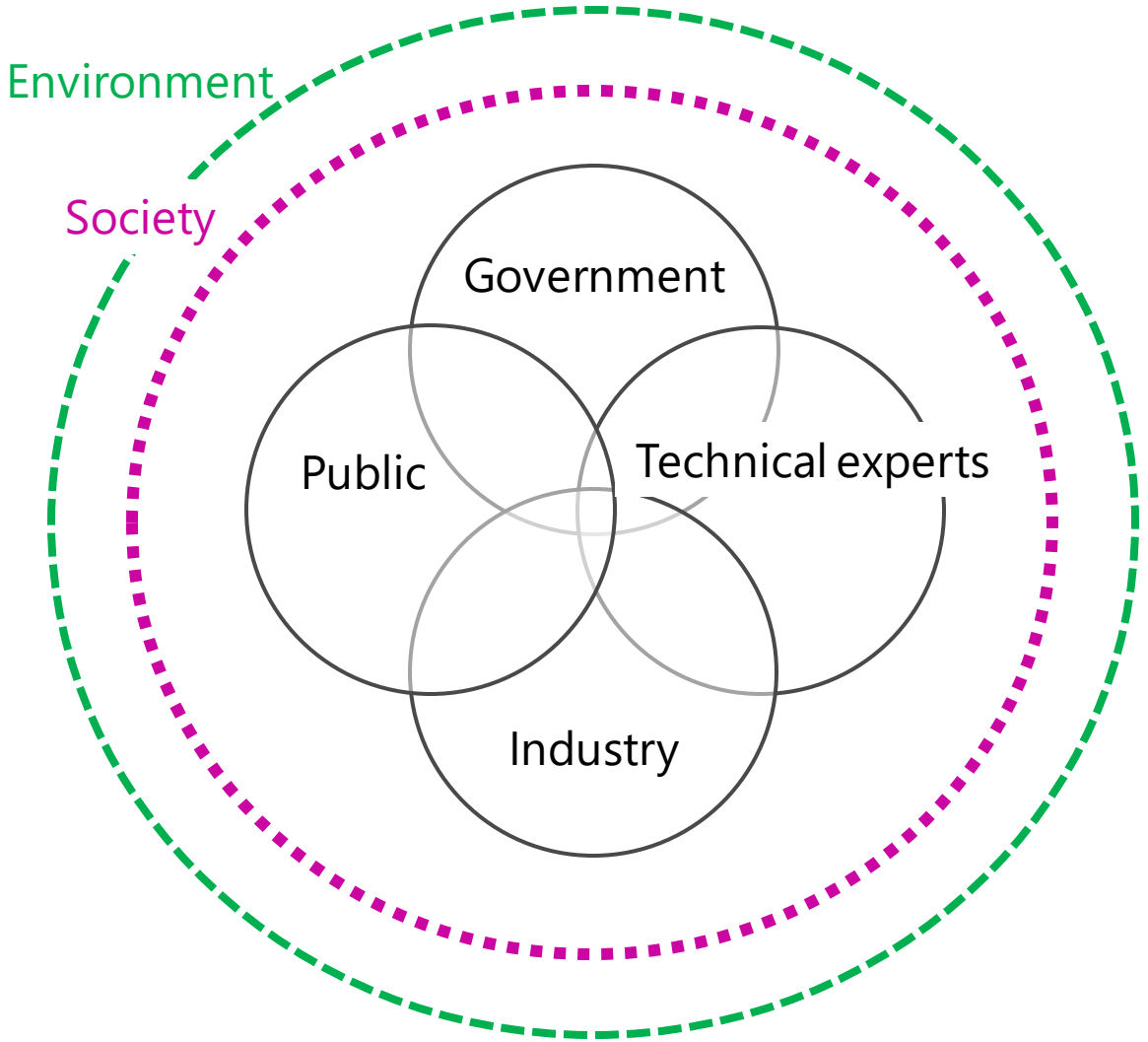
Social


N3; N4; N5; N9; N10; N1;
N29; N38; N39; N54; N57;
N61; N62
S1; S2; S3; S6; S7;
S31; S32; S33; S35
Cooperation
1
1
H15; H3; H17; H10; H7;
H12; H18; H20; H27;
H35; H44; H45; H46;
H47
1
B1; B9; B50
1
F6; F1; F7; F2;
F3; F4; F11; F18

Natural


4
P12; P5; P24
1
N1; N10; N15; N28;
N29; N56; N63
N9; N12; N13; N14; N11;
N18; N16; N25; N54;
N55; N57; N58; N59;
N61; N62
Rewetting
4
N8; N5; N29;
N61; N62
4
F1; F7; F5; F2;
F3; F4; F18
N1; N10; N15; N28;
N29; N56; N63
Clean-up
1
S12; S26; S37

Sampling framework - Quintuple Helix Approach



Adapted from: Carayannis, E. G. & Campbell, D. F. J. (2010).