NATURE-BASED INFRASTRUCTURE
GLOBAL RESOURCE CENTRE

Introduction to Sustainable Asset Valuation for Nature-Based Infrastructure

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Agenda

1. **Introductions** (5 minutes)

2. Overview of the International Institute for Sustainable Development (IISD) and the **Sustainable Asset Valuation (SAVi)** (5 minutes, Andrea)

3. Why investing in **nature-based infrastructure** matters (15 minutes with Q&A, Ronja)

4. Case studies:
    - The use of **Causal Loop Diagrams** for an assessment of dunes for coastal protection (10 minutes, Andrea)
    - The use of **spatial analysis** for an assessment of tree planting in Ethiopia (10 minutes, Marco)
    - The use of **system dynamics and project finance modeling** for an assessment of nature-based stormwater solutions in South Africa (10 minutes, Andrea)
5. Discussion and Q&A

About IISD

The International Institute for Sustainable Development (IISD)

is an award-winning independent think tank working to accelerate solutions for a stable climate, sustainable resource management, and fair economies.

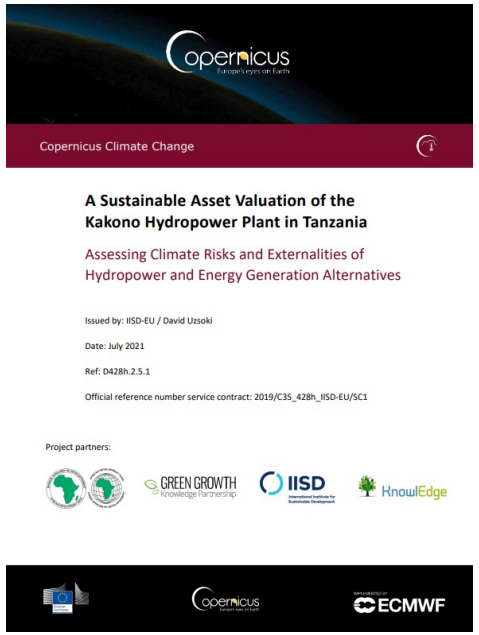
Our work inspires better decisions and sparks meaningful action to help people and the planet thrive. We shine a light on what can be achieved when governments, businesses, non-profits, and communities come together.

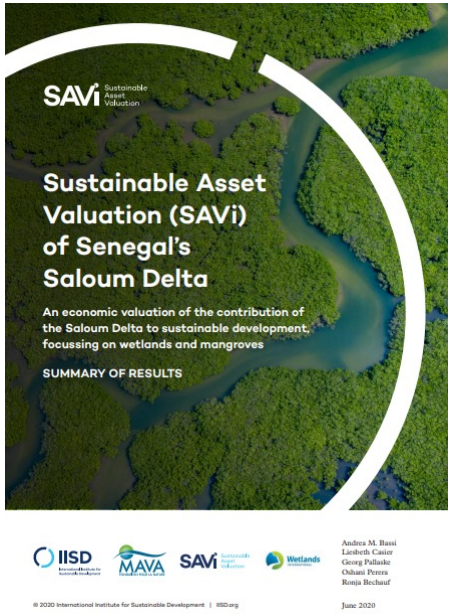
IISD's staff of more than 120 people, plus over 150 associates and consultants, come from across the globe and from many disciplines. With offices in Winnipeg, Geneva, Ottawa, and Toronto, our work affects lives in nearly 100 countries.

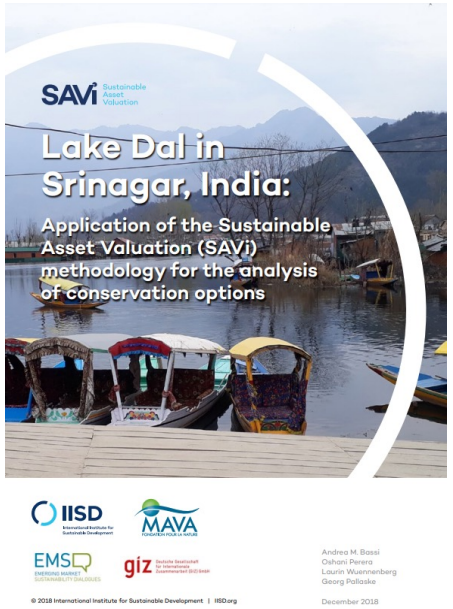
Sustainable Asset Valuation (SAVi)

SAVi Sustainable Asset Valuation

The SAVi methodology quantifies and values the environmental, social, and economic externalities of infrastructure projects.







Infrastructure is an enabler, and hence it has to be **sustainable.**

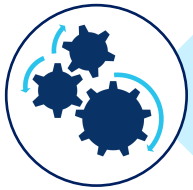
The Sustainable Asset Valuation (SAVi) tool assesses:

- Environmental, social and economic risks and externalities.
- Socio-economic benefits, such as employment, income generation and contributions to GDP.

Infrastructure projects must consider their environmental footprint, social cohesion and stewardship of natural ecosystems.

Valuation of infrastructure

Sustainable Asset Valuation (SAVi) methodology:



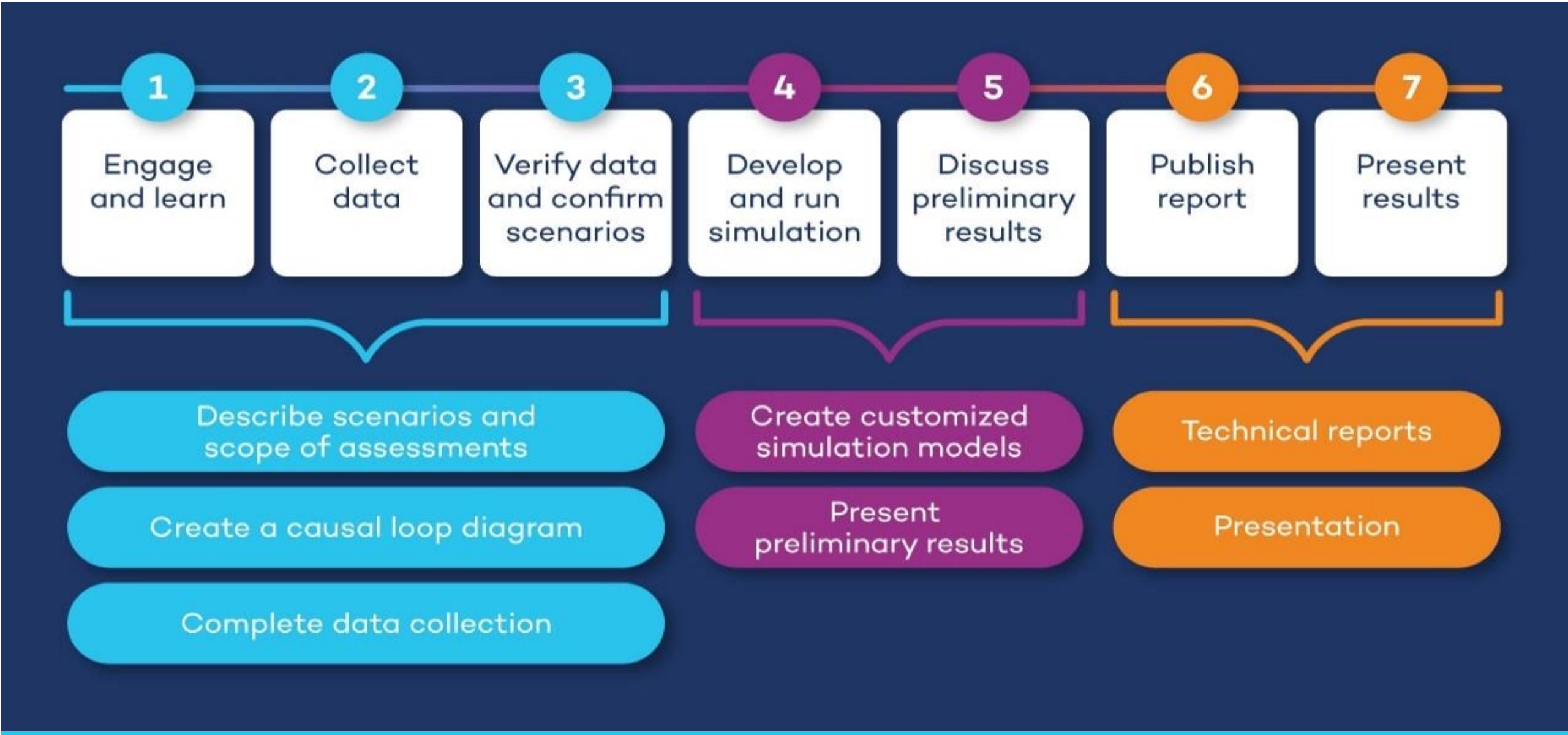
Based on systems thinking, system dynamics simulation, and project finance modelling.

Customized to each individual infrastructure project or policy.

Co-created through a multi-stakeholder approach that enables the identification of material risks and opportunities that are unique to the project.

Incorporate best-in-class climate data from the EU Copernicus Climate Data Store.

Process flow SAVi assessments



Main infrastructure types covered by SAVi

Energy infrastructure

Water and irrigation infrastructure

Transport infrastructure

Waste infrastructure

Buildings

Nature-based infrastructure

Why Investing In Nature-based Infrastructure Matters

Nature-based Infrastructure (NBI)

Natural ecosystems or working landscapes that can be conserved, rehabilitated and maintained to enhance capabilities and reduce the necessity for grey infrastructure.

Examples:

Sand dunes to protect coastal areas

Forests and wetlands to improve water quality and quantity

Urban green spaces to mitigate stormwater runoff and urban heat islands

How Can Investment in Nature Close the Infrastructure Gap?

An estimate how much nature-based infrastructure can save costs and create value relative to traditional grey infrastructure

What is the infrastructure investment required to meet development goals across sectors?

How much of this need can be filled by NBI?

What would it cost if we chose to build with nature instead of using traditional methods?

How much additional value does NBI create for our economy, society, and the environment?

Infrastructure Investment Needs

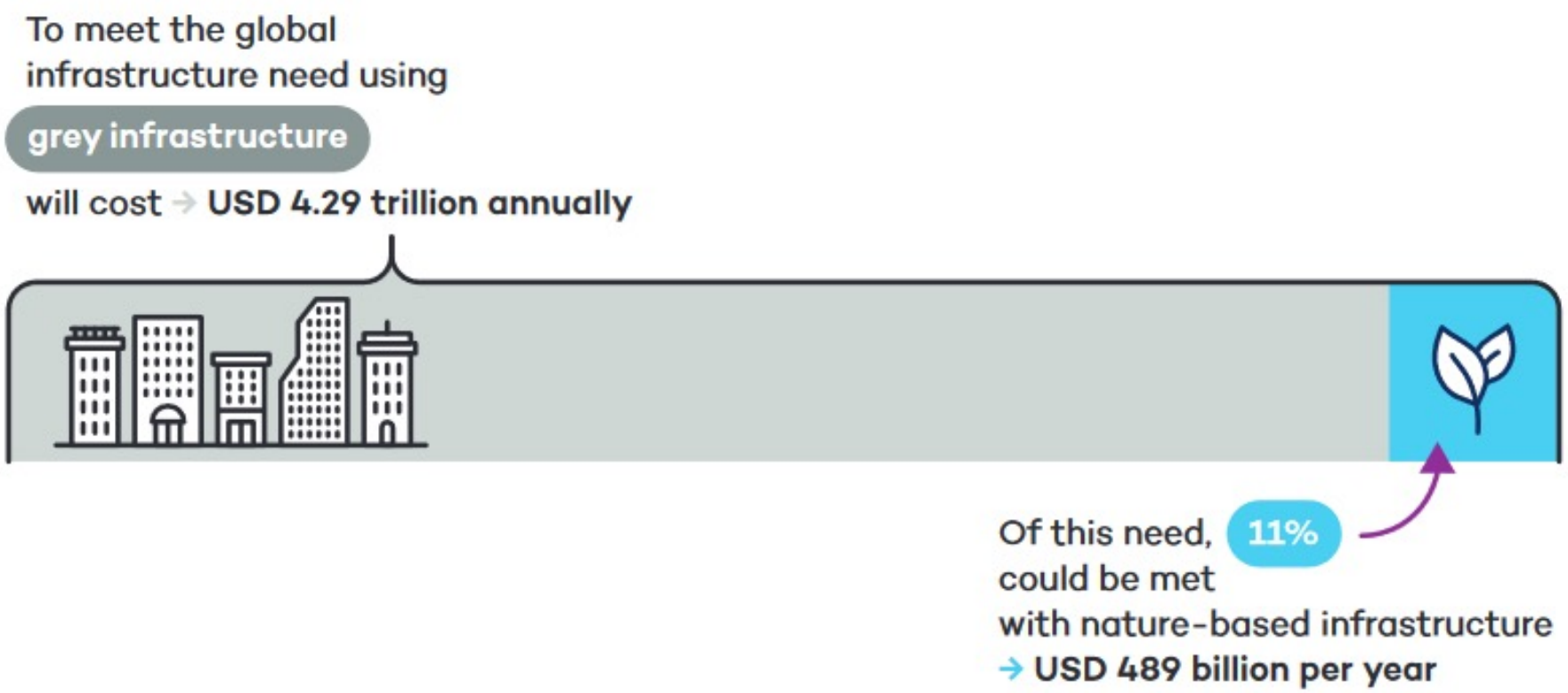
- Water and sanitation
- Energy supply and energy efficiency
- Transport
- Agriculture and irrigation
- Climate resilience

Climate

Biodiversity

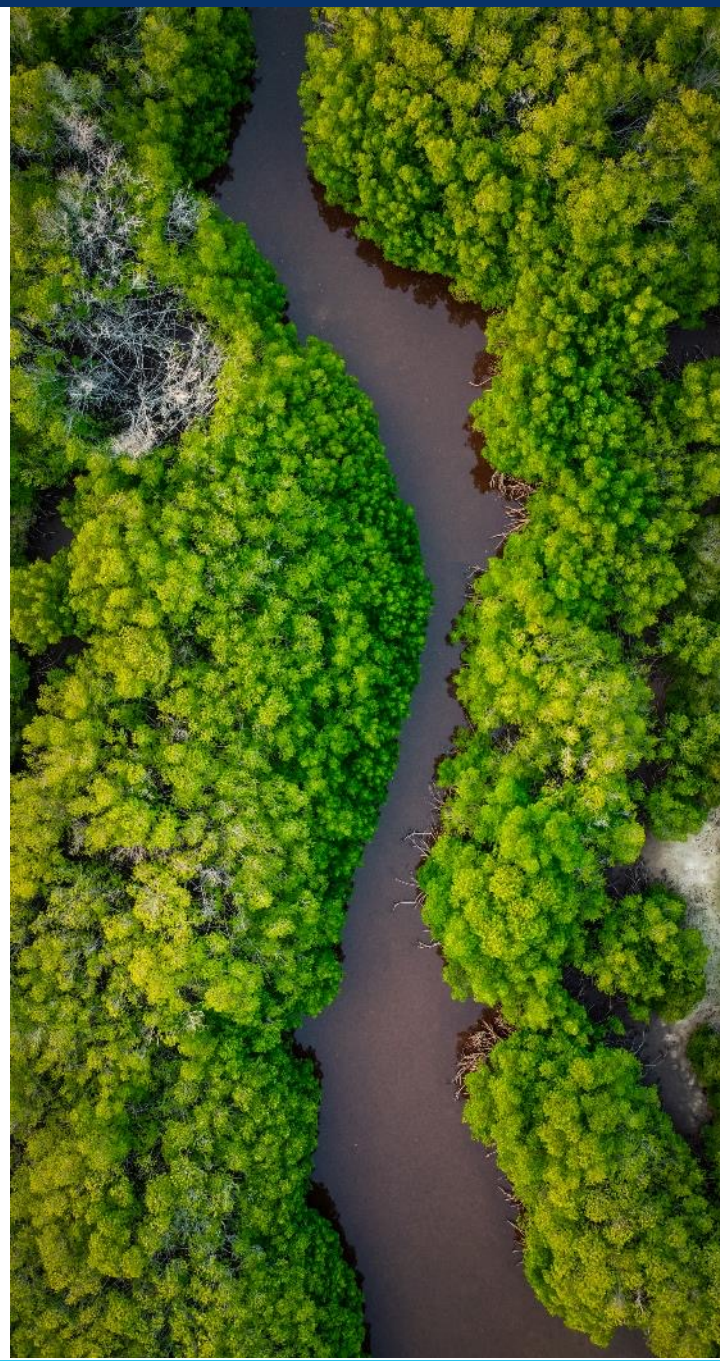
Health

Possible share of NBI investment in the global infrastructure need



Sectoral opportunities for NBI

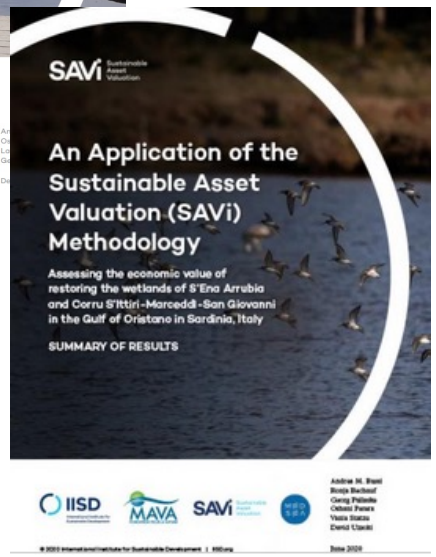
Sector	Average investment per year (USD billion)	NBI share	Corresponding potential NBI investment per year (USD billion)
Water and sanitation	448.43	25%	112.11
Energy supply	1,382.18	5%	69.11
Energy efficiency	592.36	10%	59.24
Transport	1,709.46	10%	170.95
Agriculture	125.16	50%	62.58
Irrigation	3.33	20%	0.67
Climate resilience	28.62	50%	14.31
All sectors	**4,289.54**	**11.40%**	**488.95**

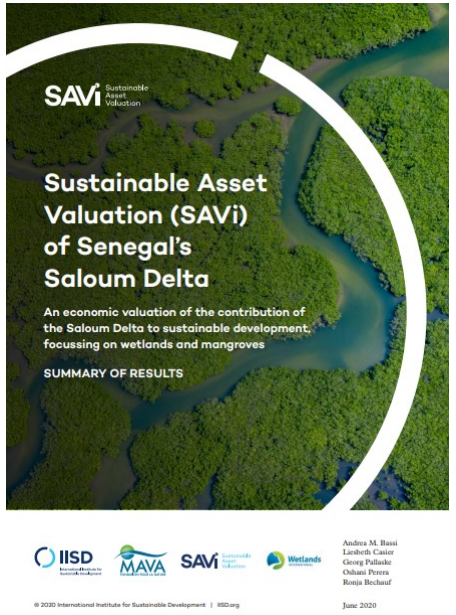


What if we invest in NBI where possible?

Calculations based on SAVi valuations

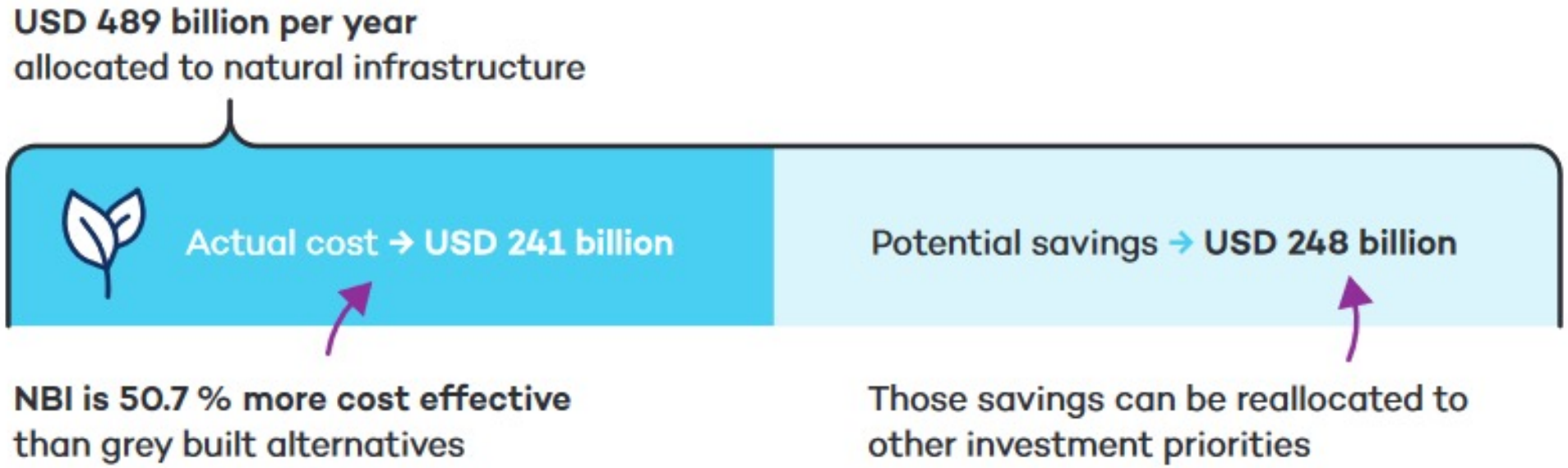
- 10 NBI projects considered
- Comparison of grey infrastructure and NBI
  - Costs, value generated, cost savings from using NBI, benefit-to-cost-ratios





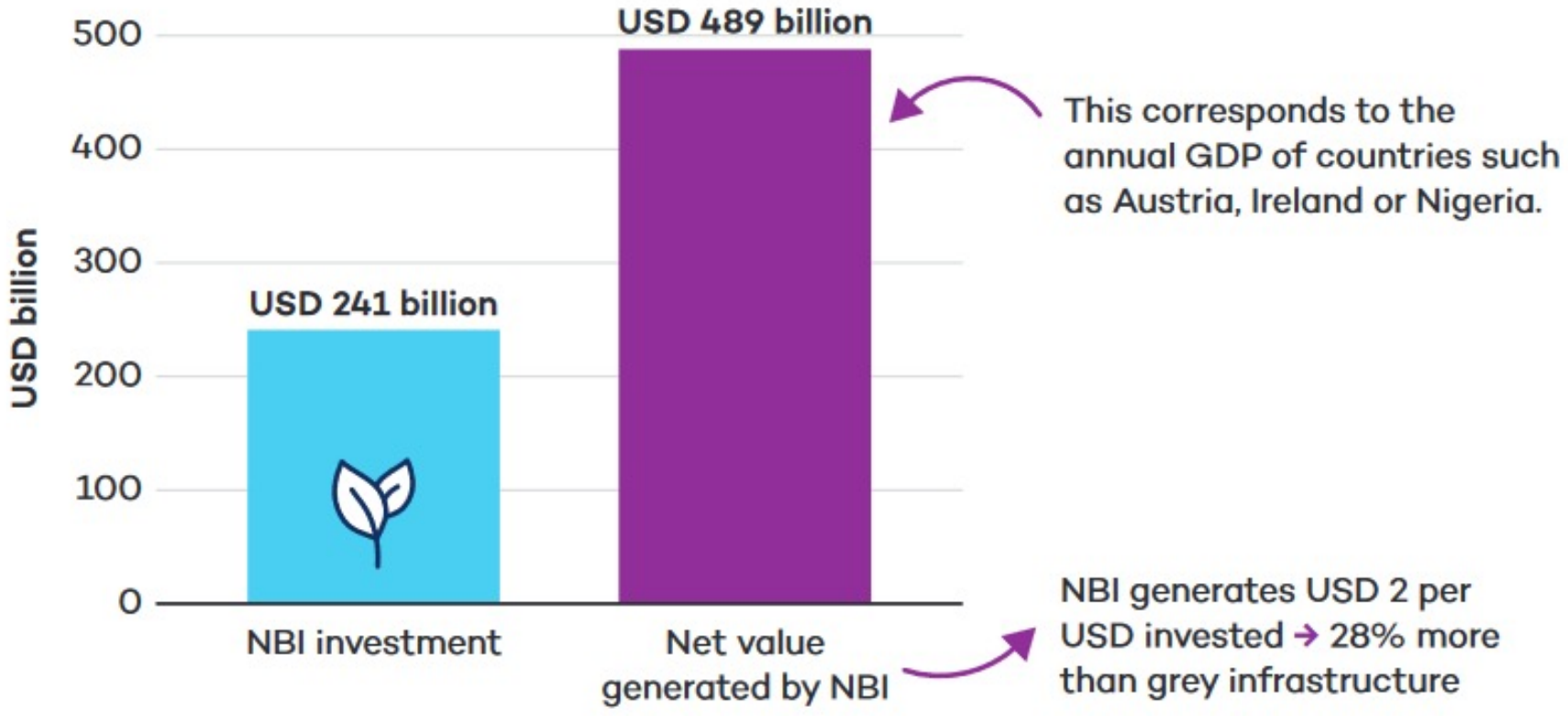
What if we invest in NBI where possible?

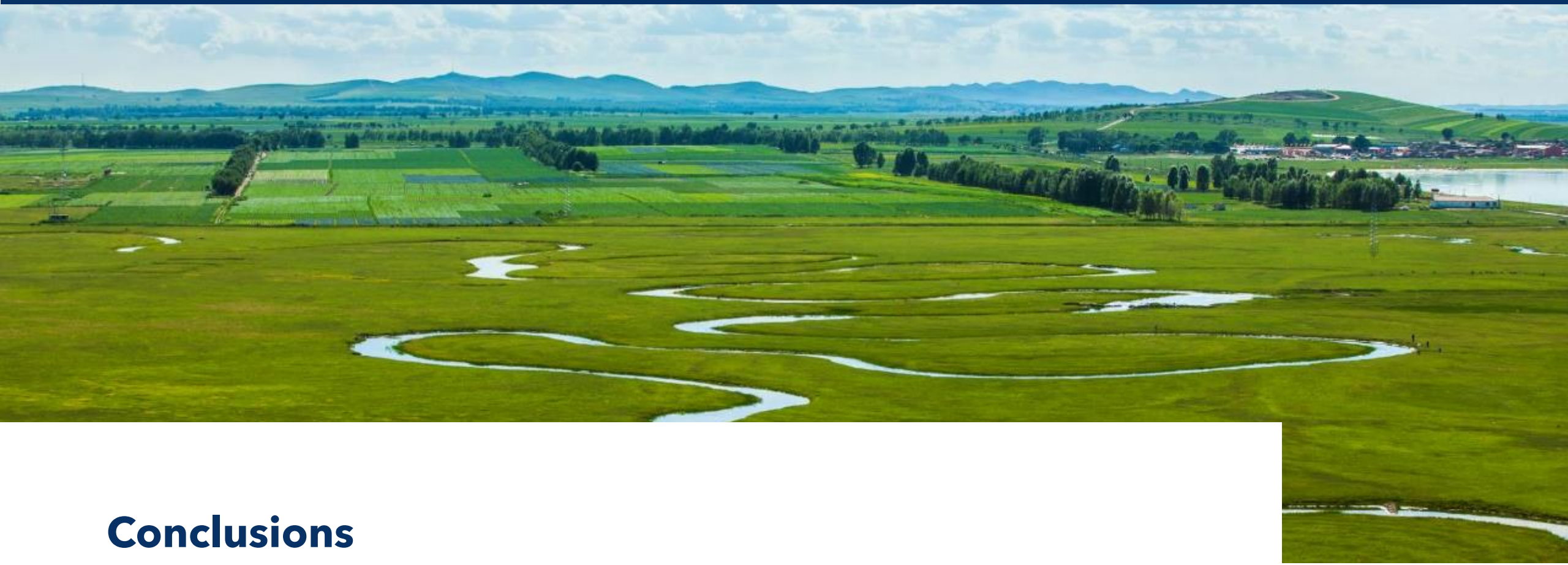
The cost saving of NBI compared to grey infrastructure



What if we invest in NBI where possible?

Net additional value generated by NBI





Conclusions

- Huge infrastructure investment needs to help people thrive (about USD 4.29 trillion annually over 20 years)
- NBI can effectively provide about 11% of the needed infrastructure services
- NBI costs about 50% less than NBI, while providing great additional benefits

Questions

Coastal protection in the Netherlands

Photo by Carrie de Wilde

About the Hondsbossche Dunes

Large-scale sand dune development for coastal protection

Construction completed in 2015

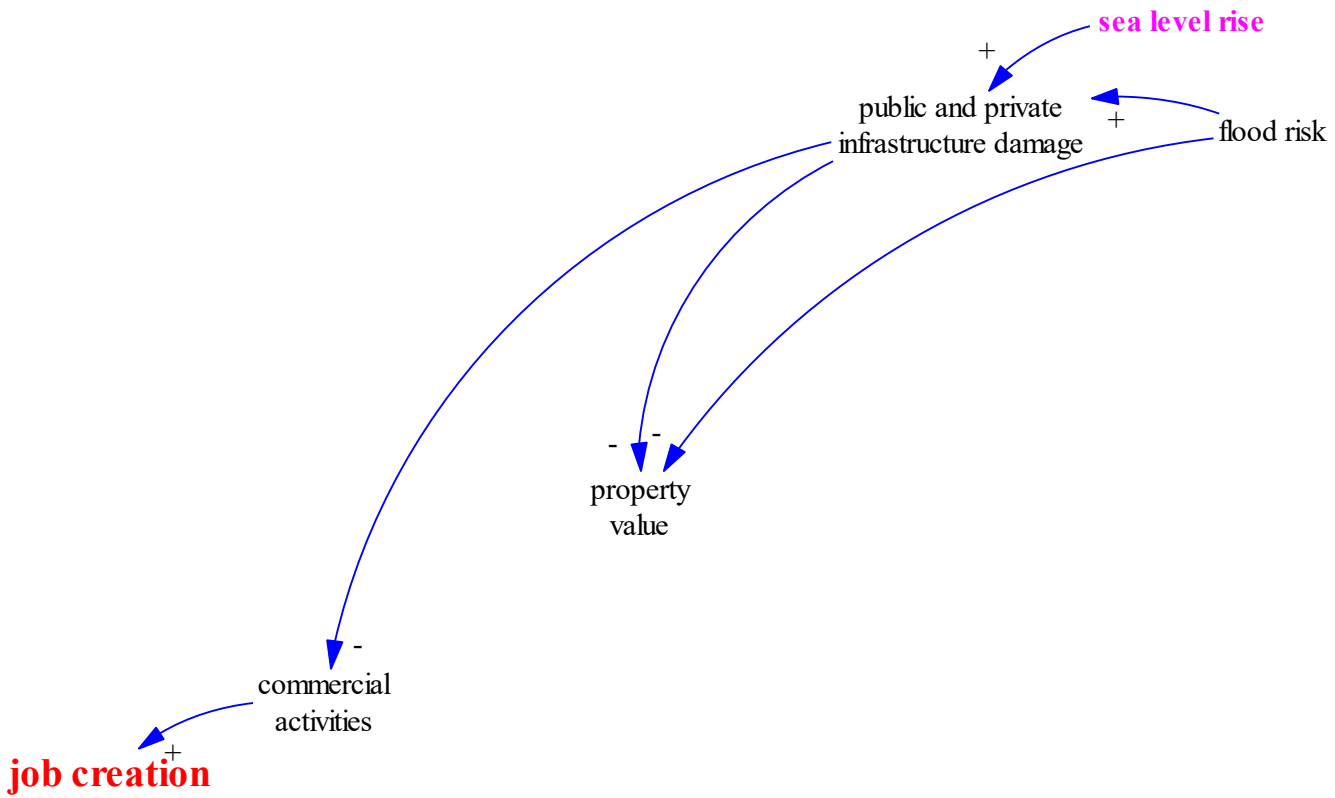
Construction costs of EUR 190 million

8 km of foreshore and 6 km dunes reinforce existing sea dike

Protection against 1 in 10,000-years storm conditions

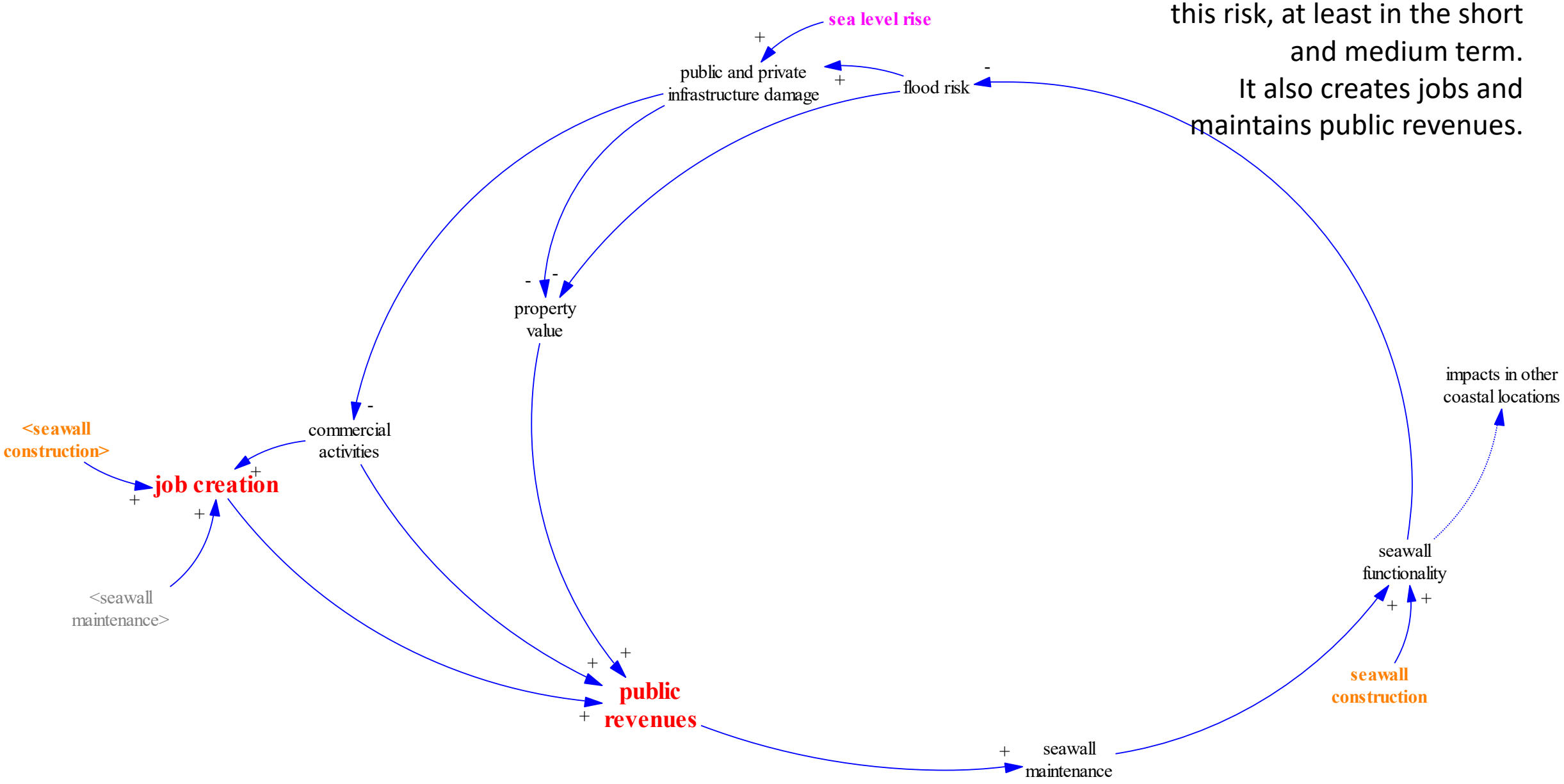
Added benefits for biodiversity and local tourism sector

Photo: Van Oord Boskalis

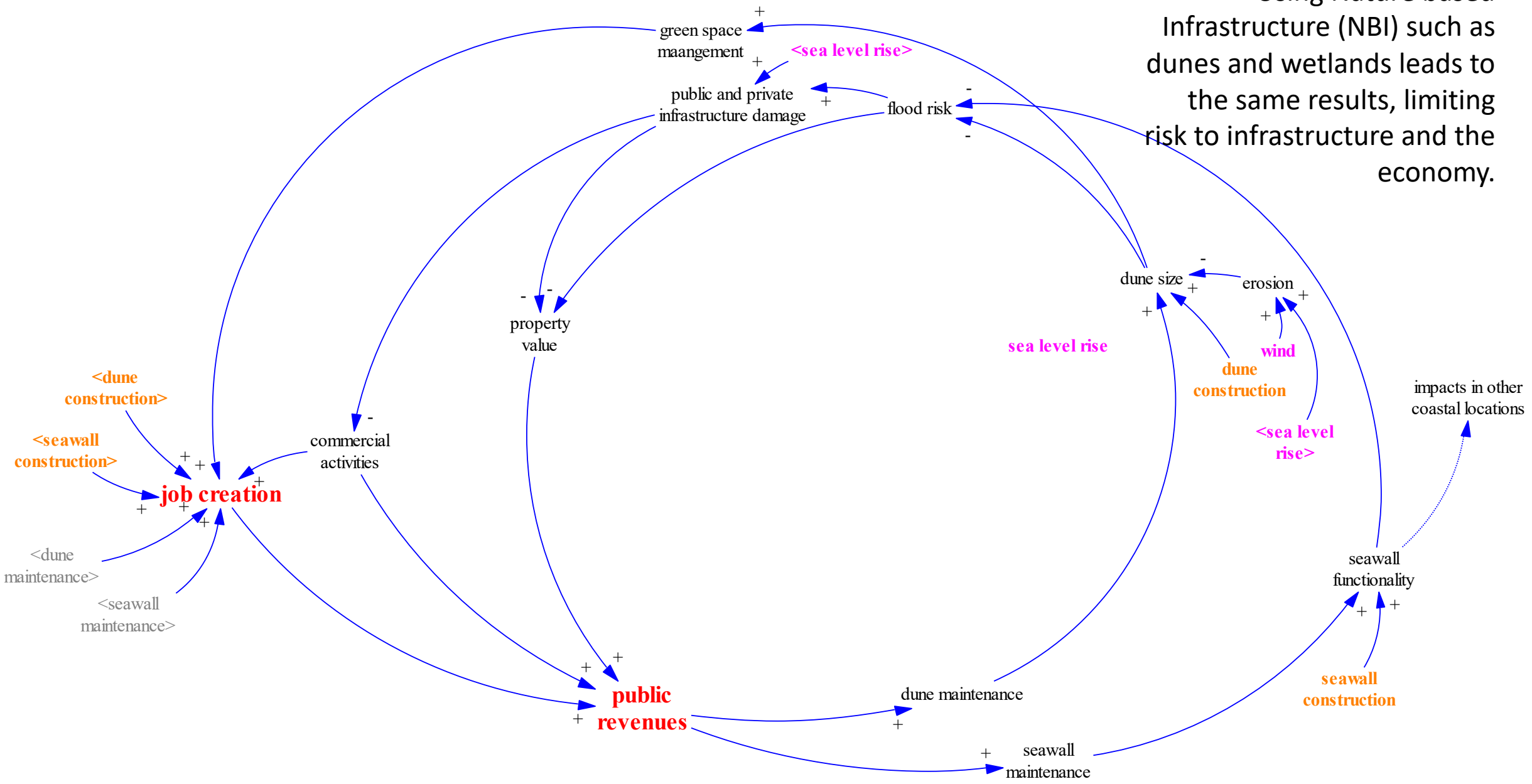


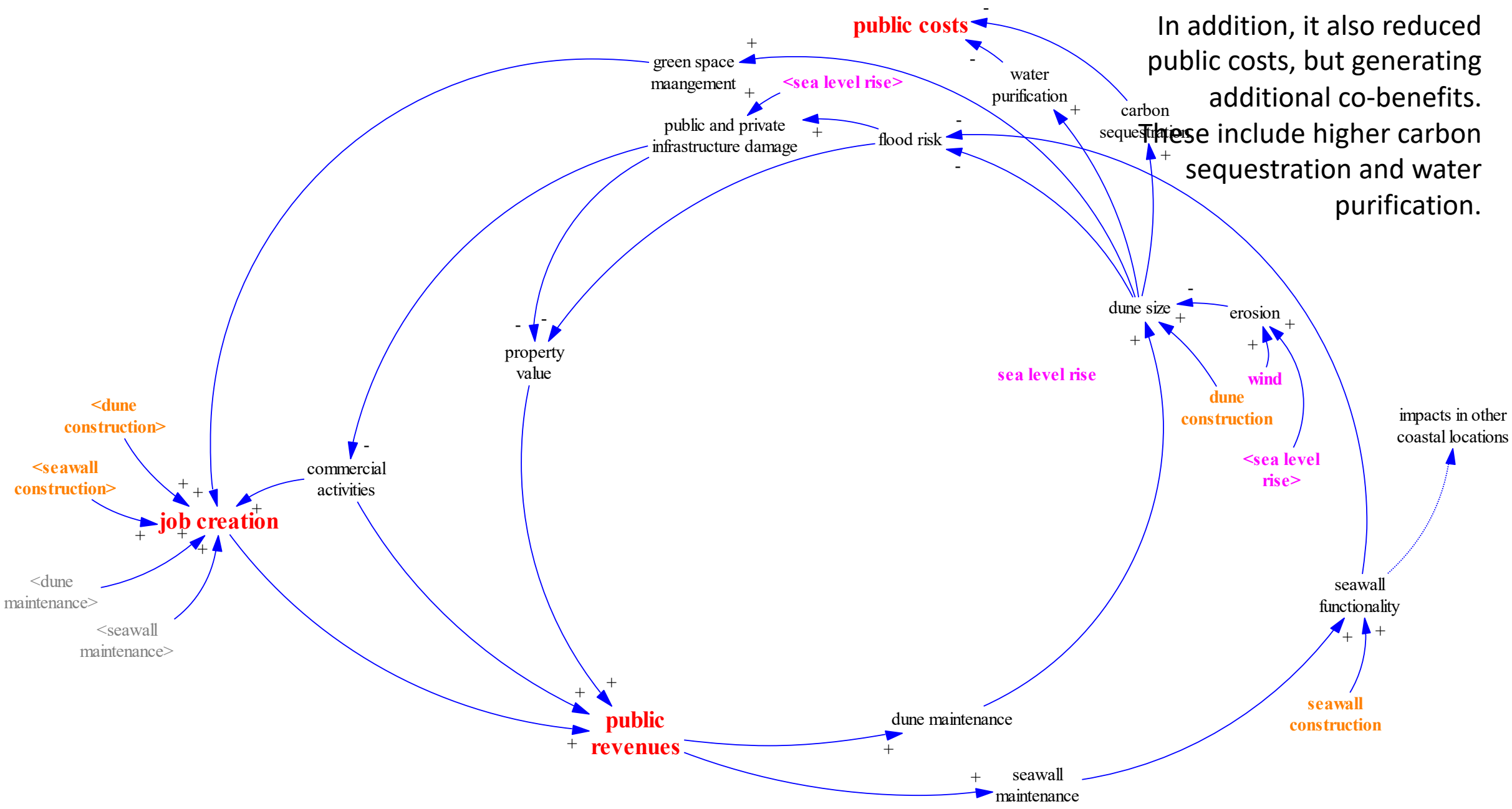
The issue at stake is that an increase in flood risk will lead to infrastructure damage, loss of property value and commercial activities.

Building a seawall mitigates this risk, at least in the short and medium term.
It also creates jobs and maintains public revenues.



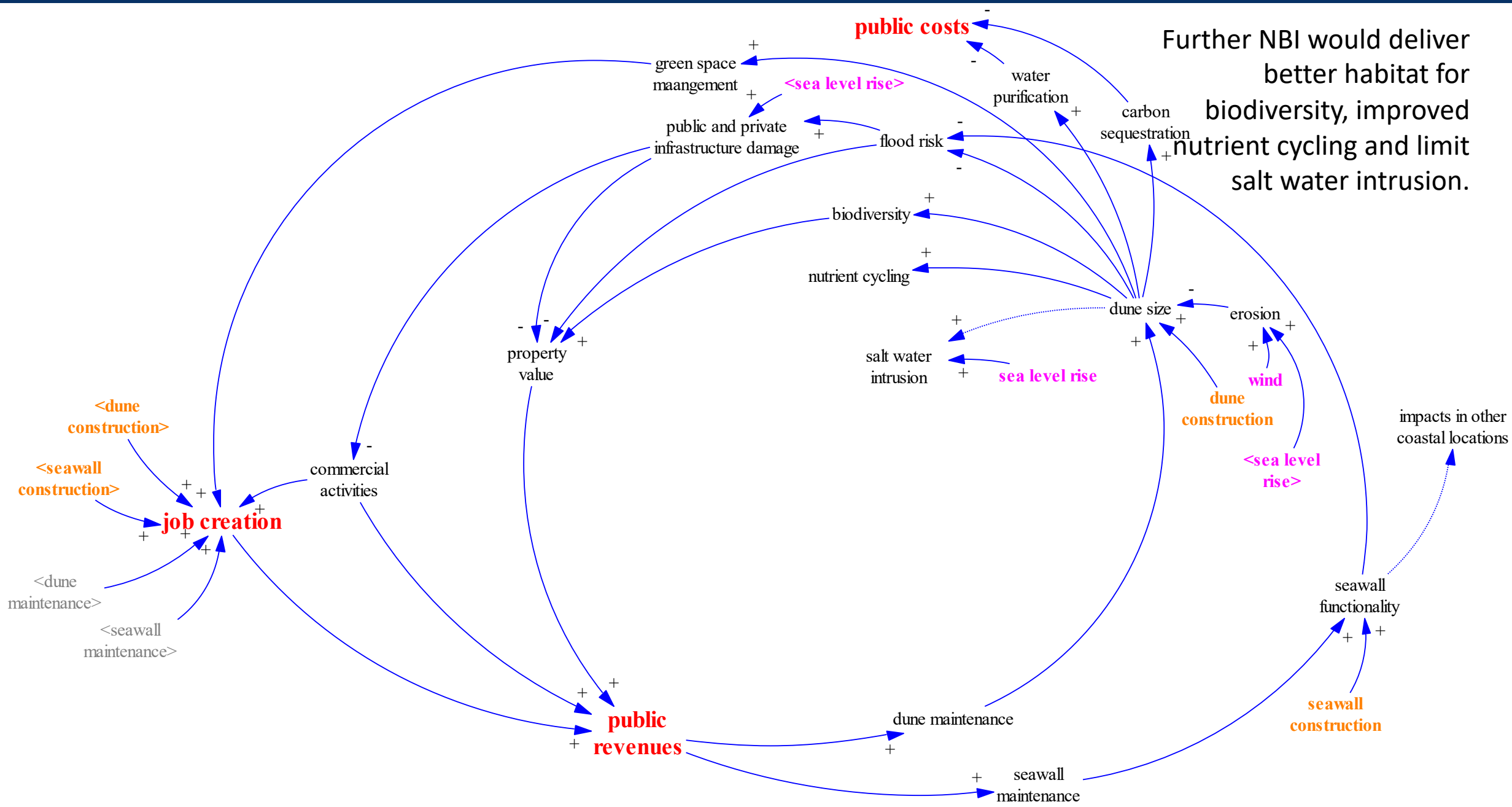
Using Nature based Infrastructure (NBI) such as dunes and wetlands leads to the same results, limiting risk to infrastructure and the economy.



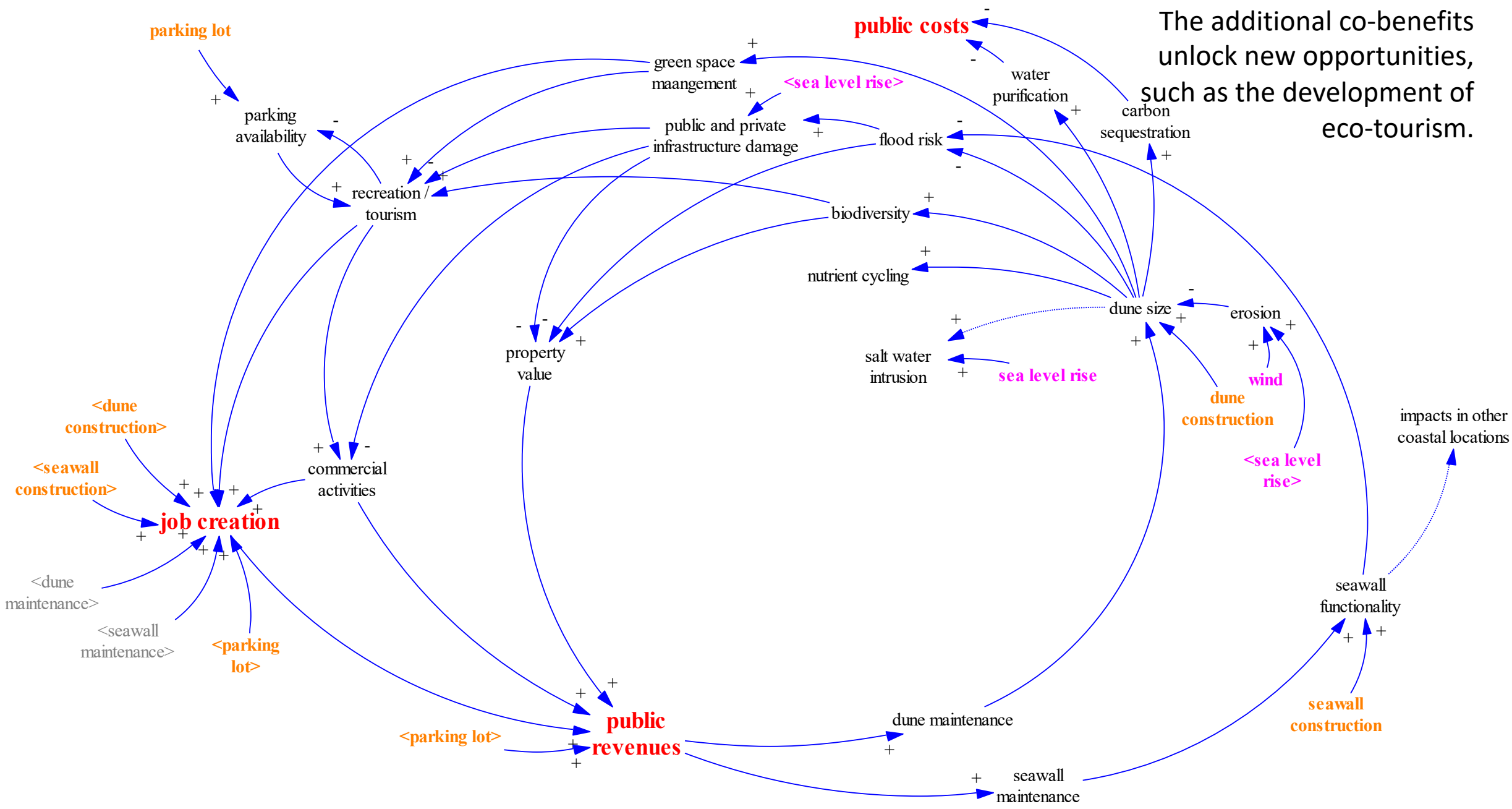


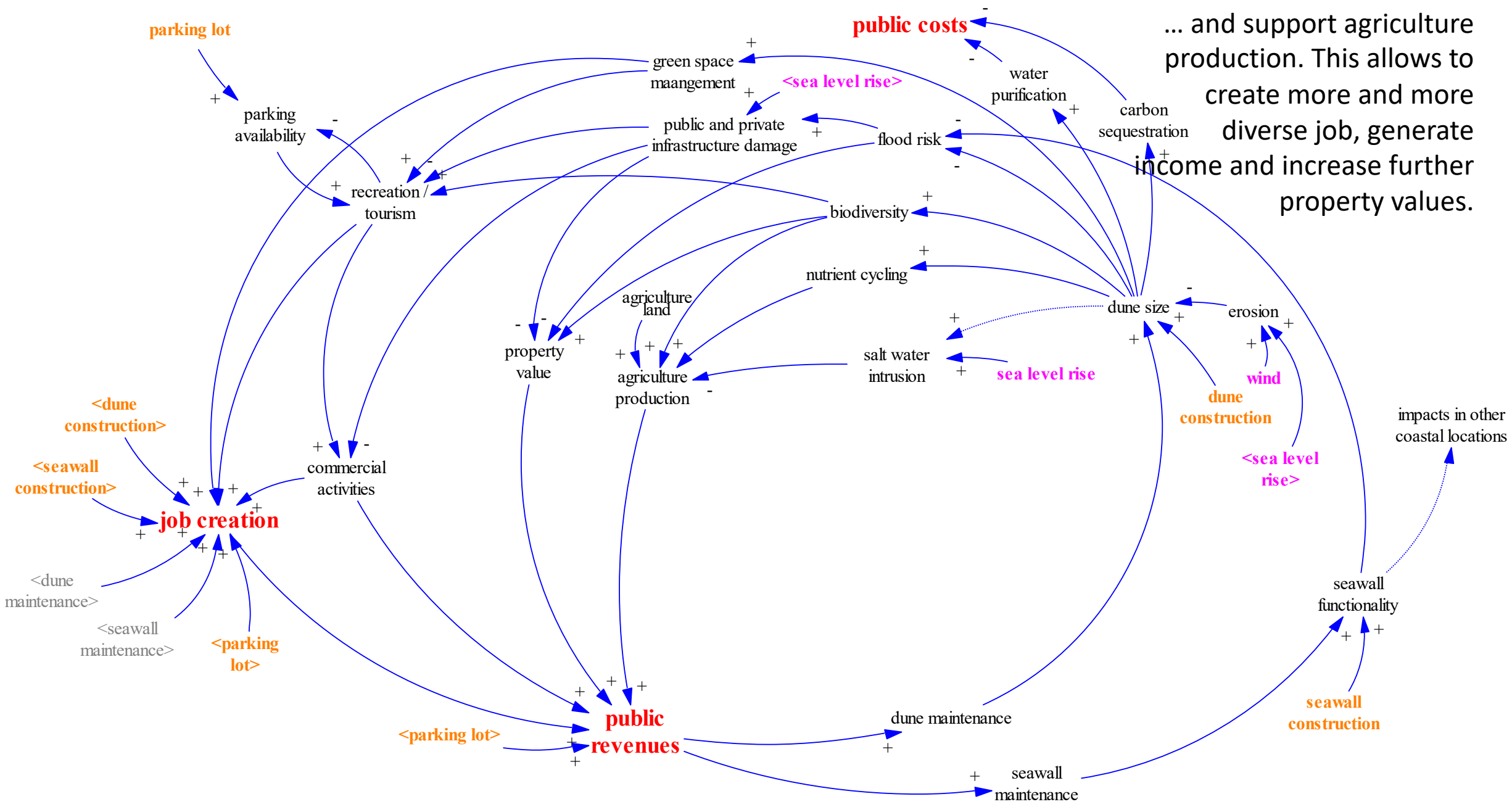
In addition, it also reduced public costs, but generating additional co-benefits. These include higher carbon sequestration and water purification.

Further NBI would deliver better habitat for biodiversity, improved nutrient cycling and limit salt water intrusion.



The additional co-benefits unlock new opportunities, such as the development of eco-tourism.

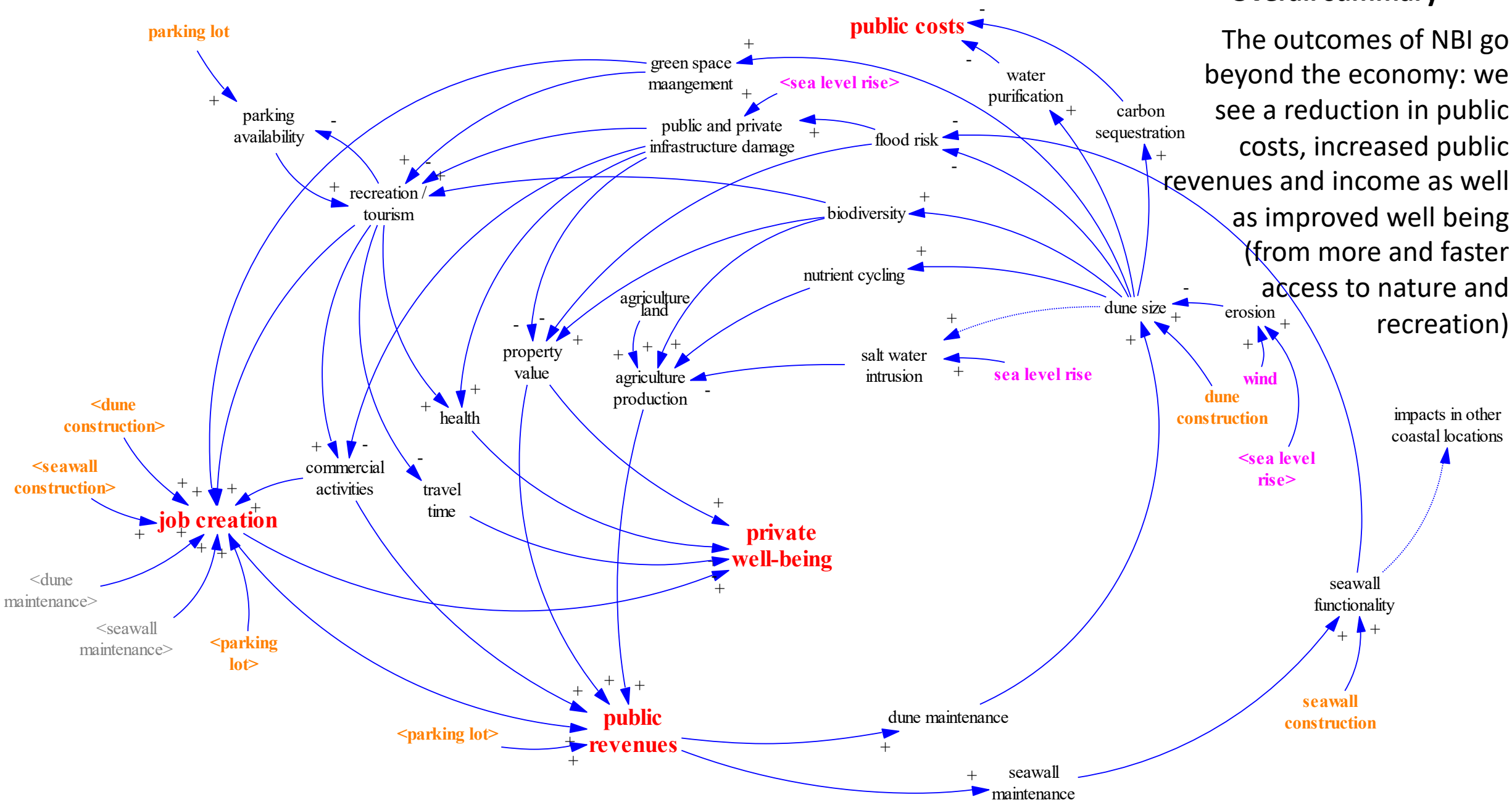




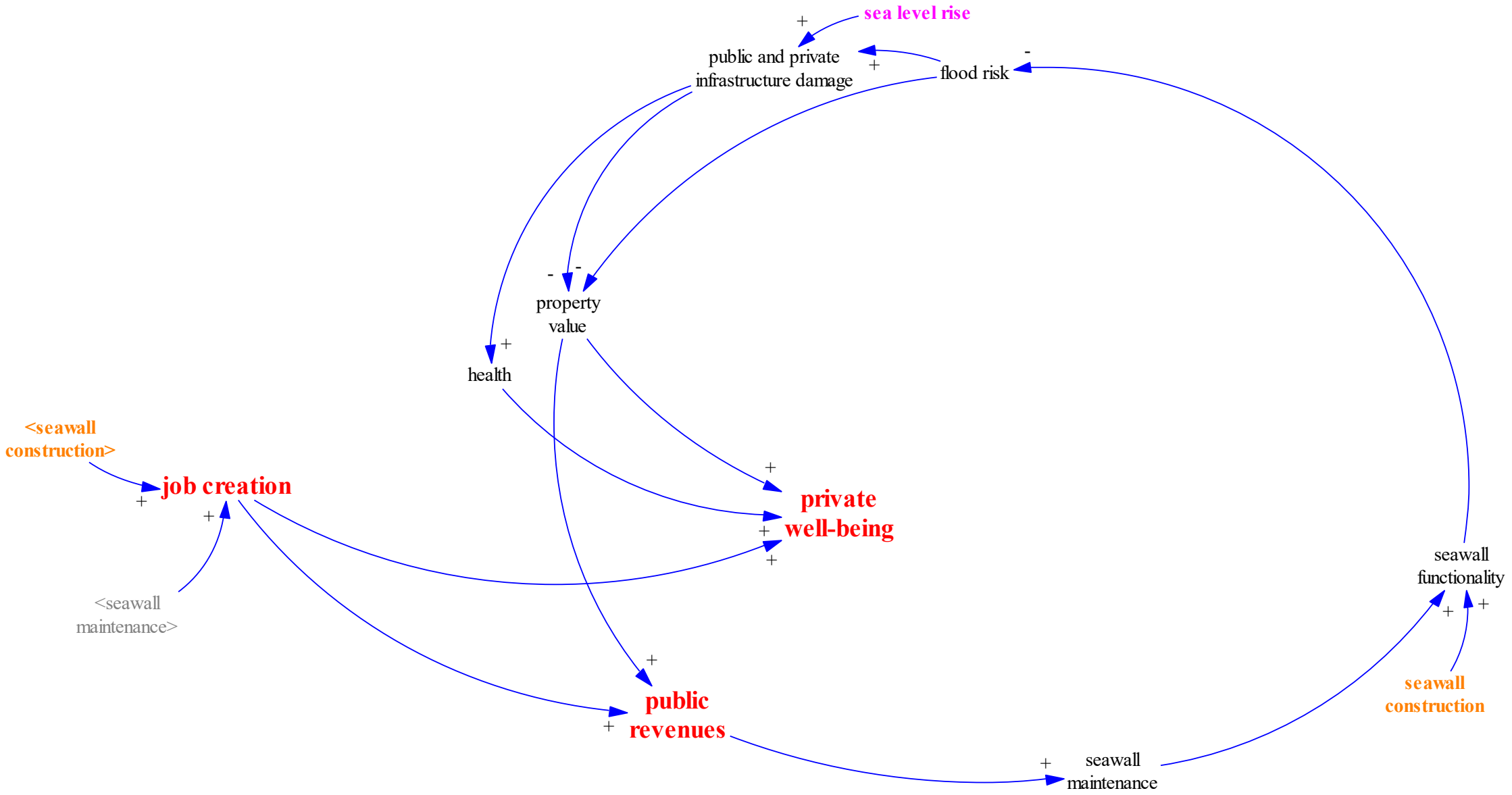
… and support agriculture production. This allows to create more and more diverse job, generate income and increase further property values.

Overall summary

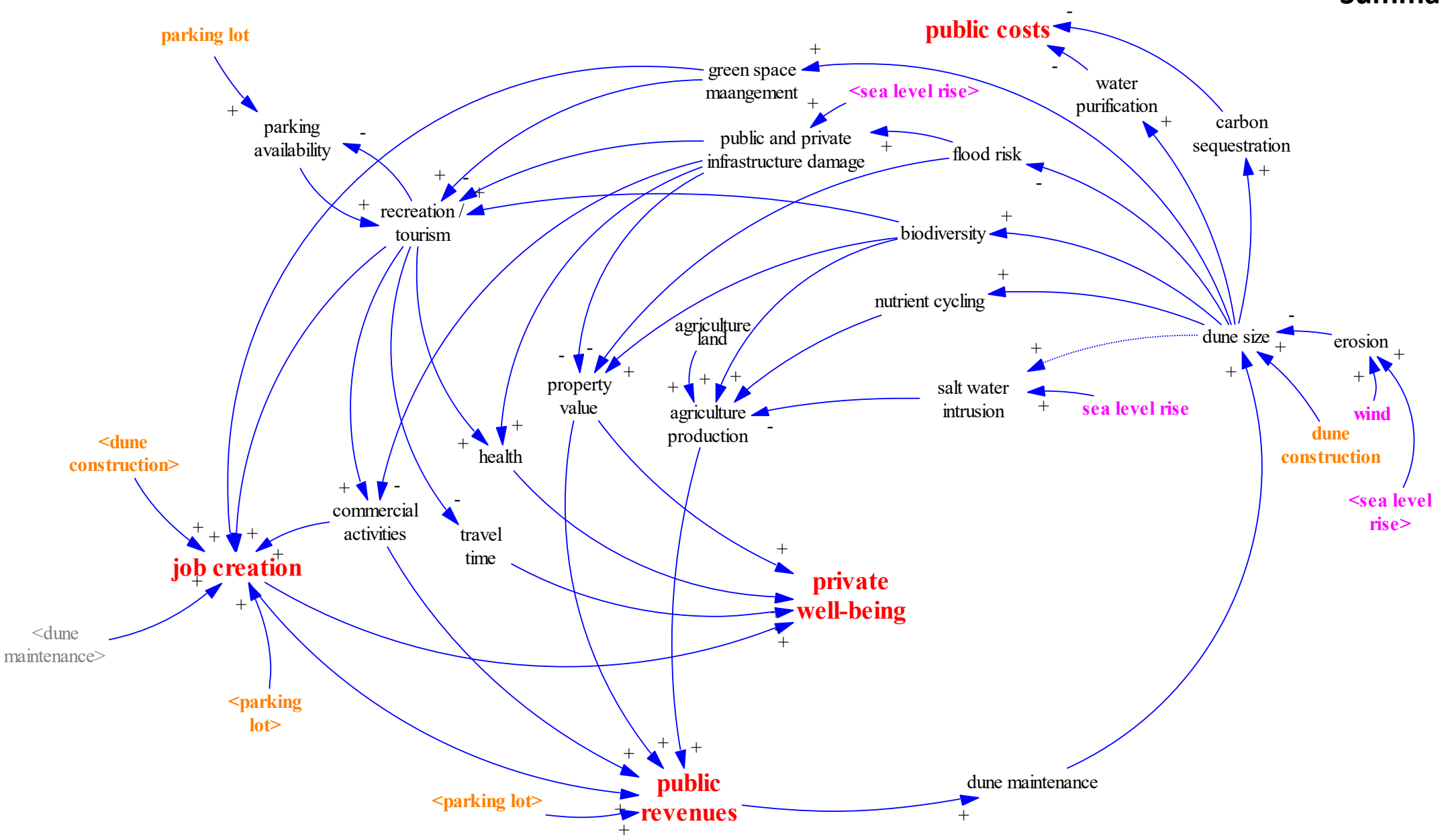
The outcomes of NBI go beyond the economy: we see a reduction in public costs, increased public revenues and income as well as improved well being (from more and faster access to nature and recreation)



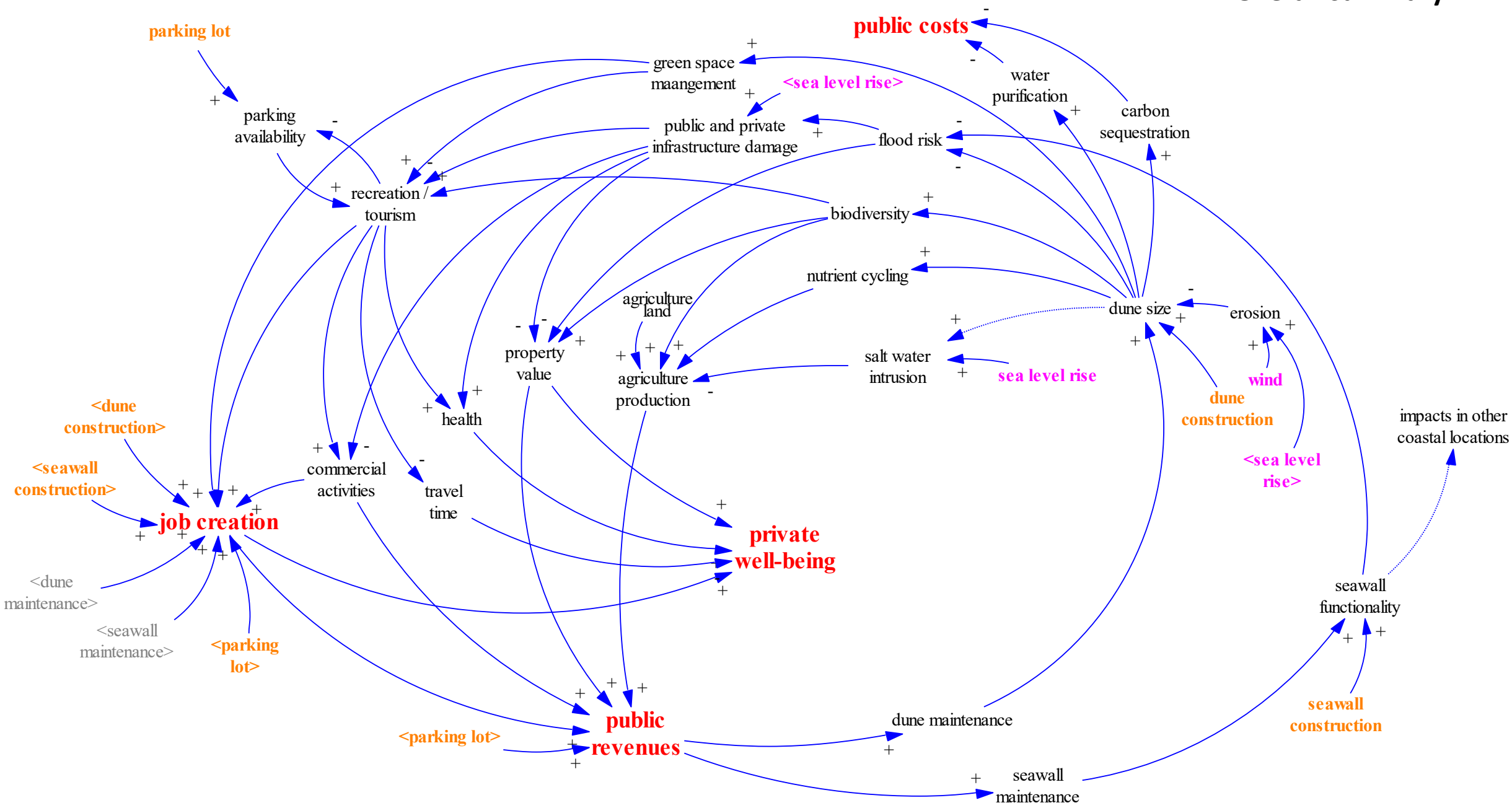
Summary seawall



Summary sand dunes



Overall summary



Questions

Urban green spaces: Addis Ababa

Tree Planting in Addis Ababa

On-going assessment that includes additional modelling approaches

- City plans to plant 25 million trees over 5 years
- We are assessing the system-wide costs and benefits
- Results will be used by local stakeholders to inform tree planting plans

Addis Ababa: Tree Planting Scenarios

All scenarios compared to business-as-usual (no trees planted)

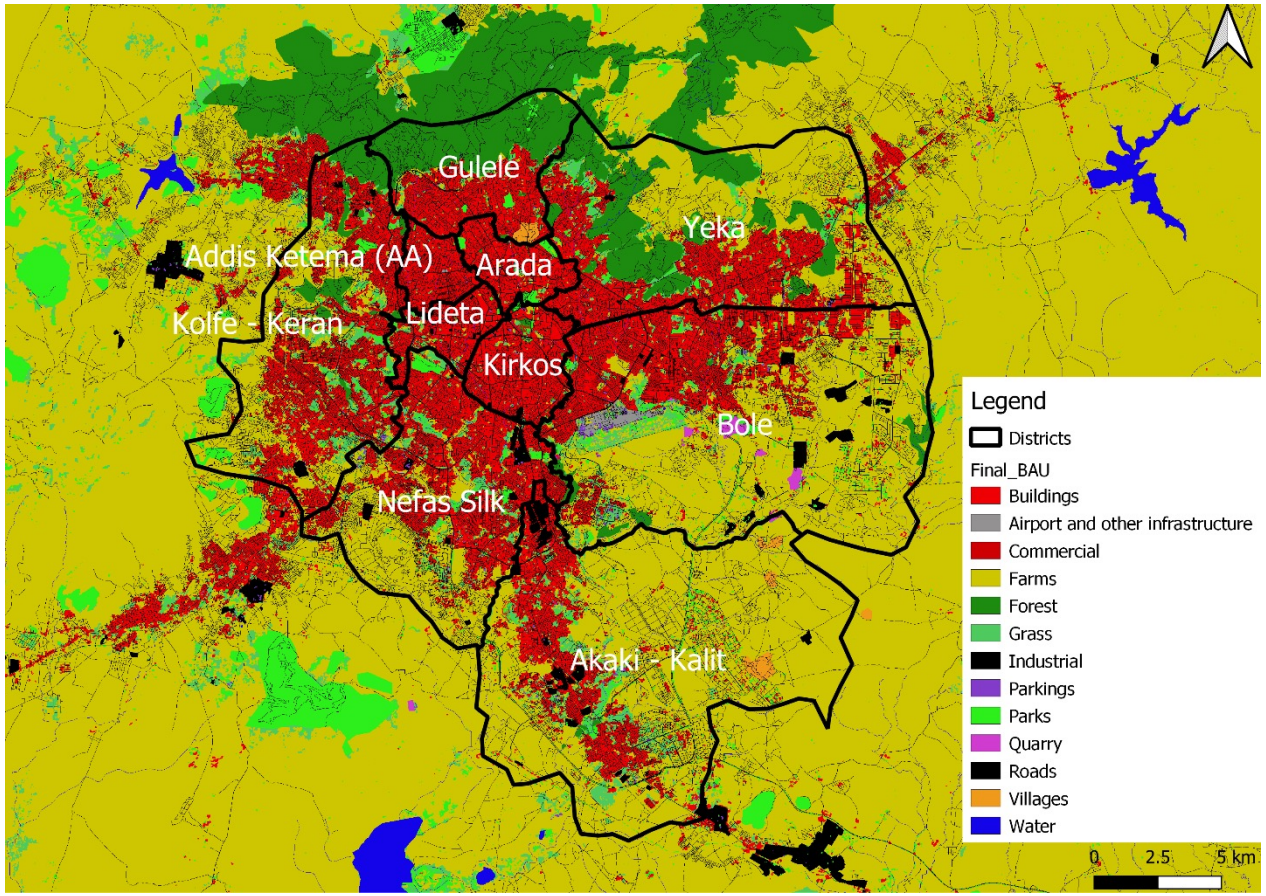
	Number planted (millions)	Survival rate	Number surviving (millions)	Percent maintained	Number maintained (millions)
High trees planted, high maintenance/survival	25	84%	21	50%	12.5
High trees planted, low maintenance/survival	25	30%	7.5	25%	6.25
Low trees planted, high maintenance/survival	11	84%	9.24	50%	5.5
Low trees planted, low maintenance/survival	11	30%	3.3	25%	2.75

Spatial Analysis

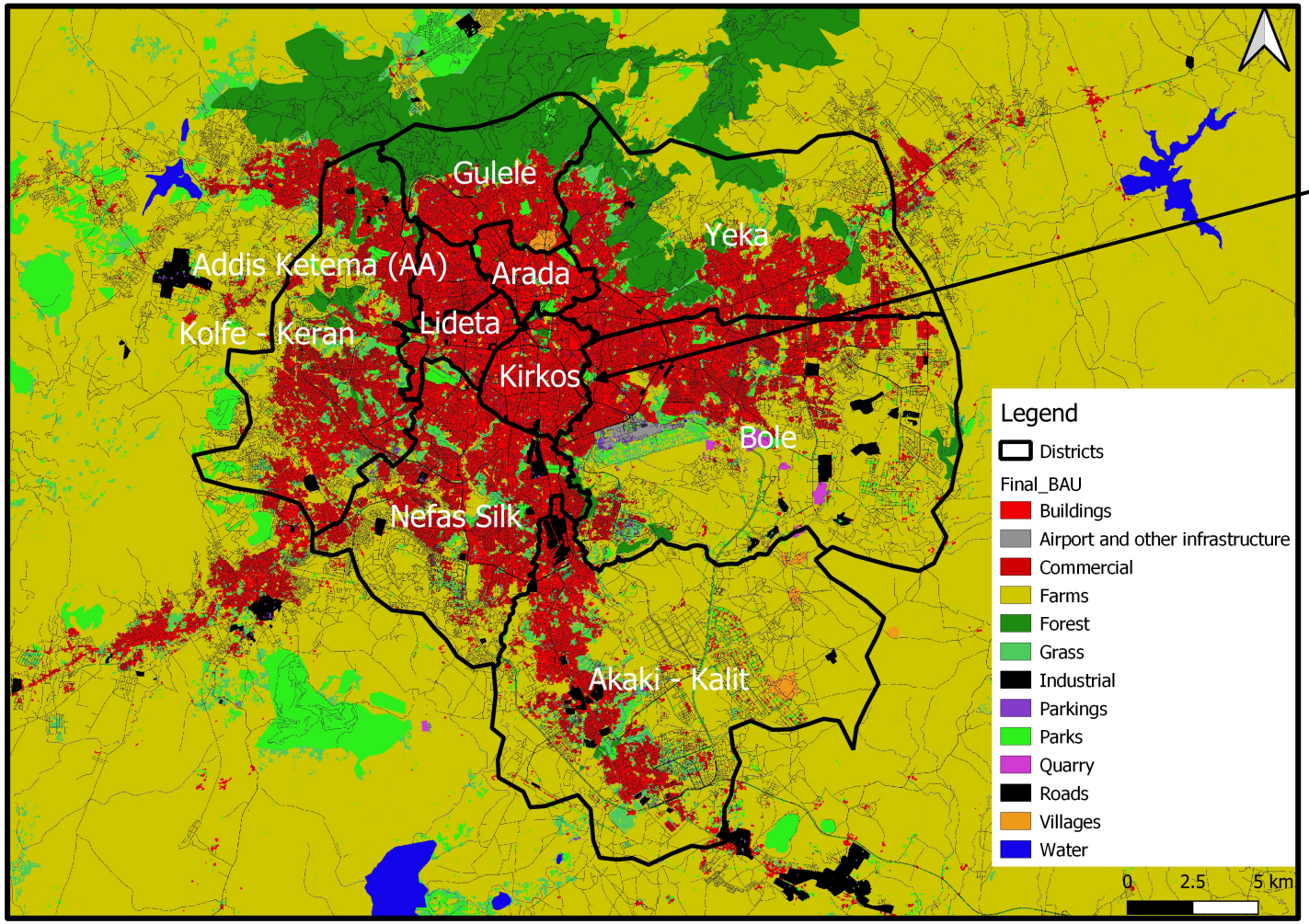
One landcover map for each tree planting scenario is used to quantify:

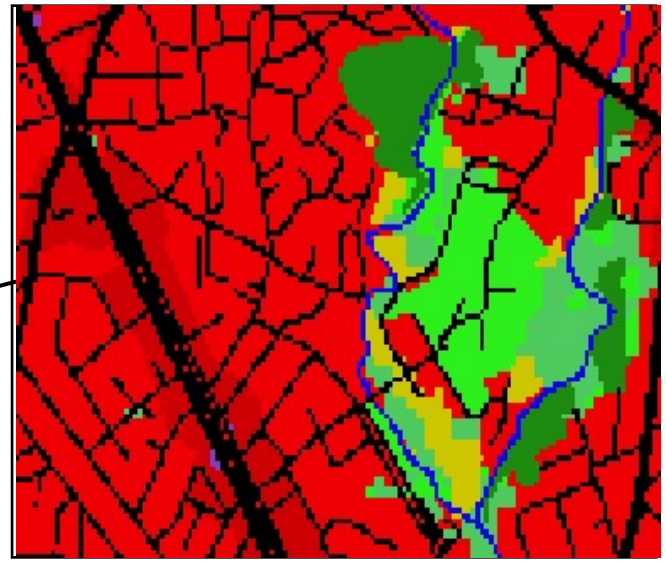
- Carbon storage
- Runoff retention
- Heat mitigation potential

Results are compared to a business-as-usual scenario with no trees planted.



LC - BAU



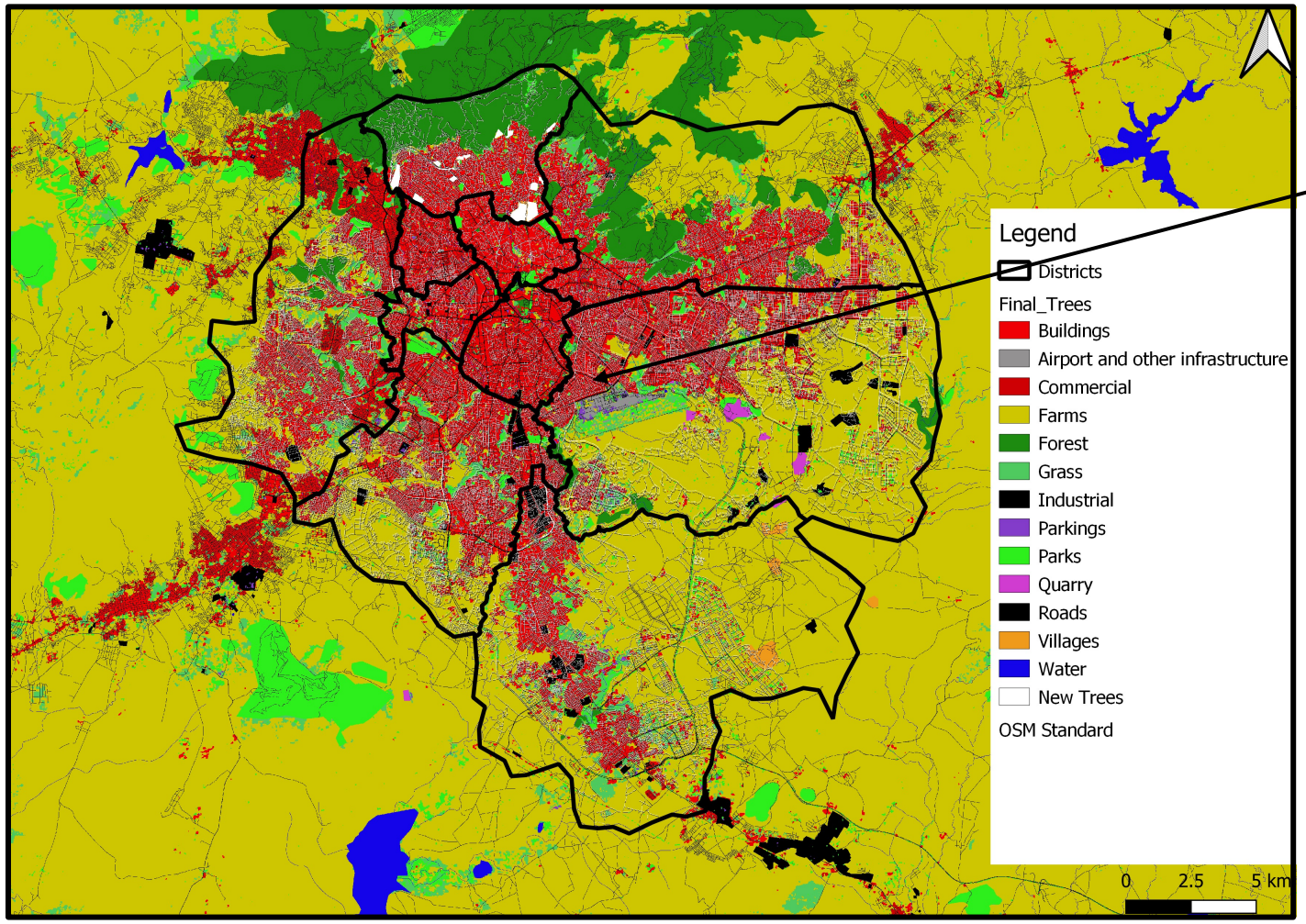


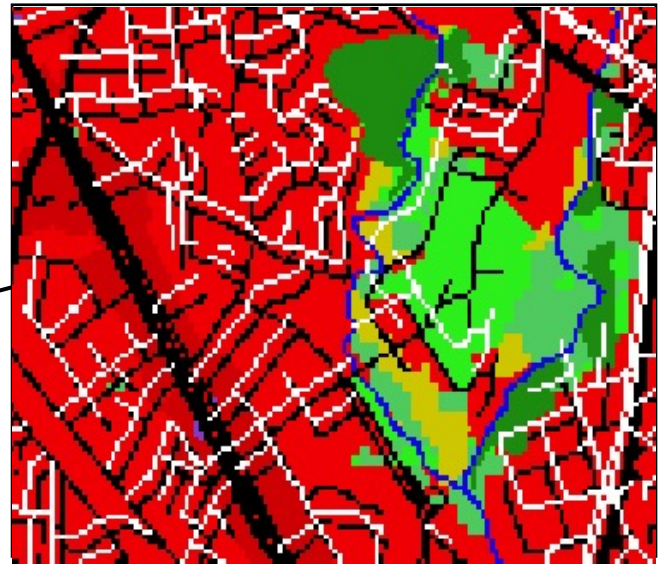
Resolution: 10m

Three data sources:

- OpenStreetMap
- Geofabrik
- CCI Land Cover (LC) team

LC - Trees

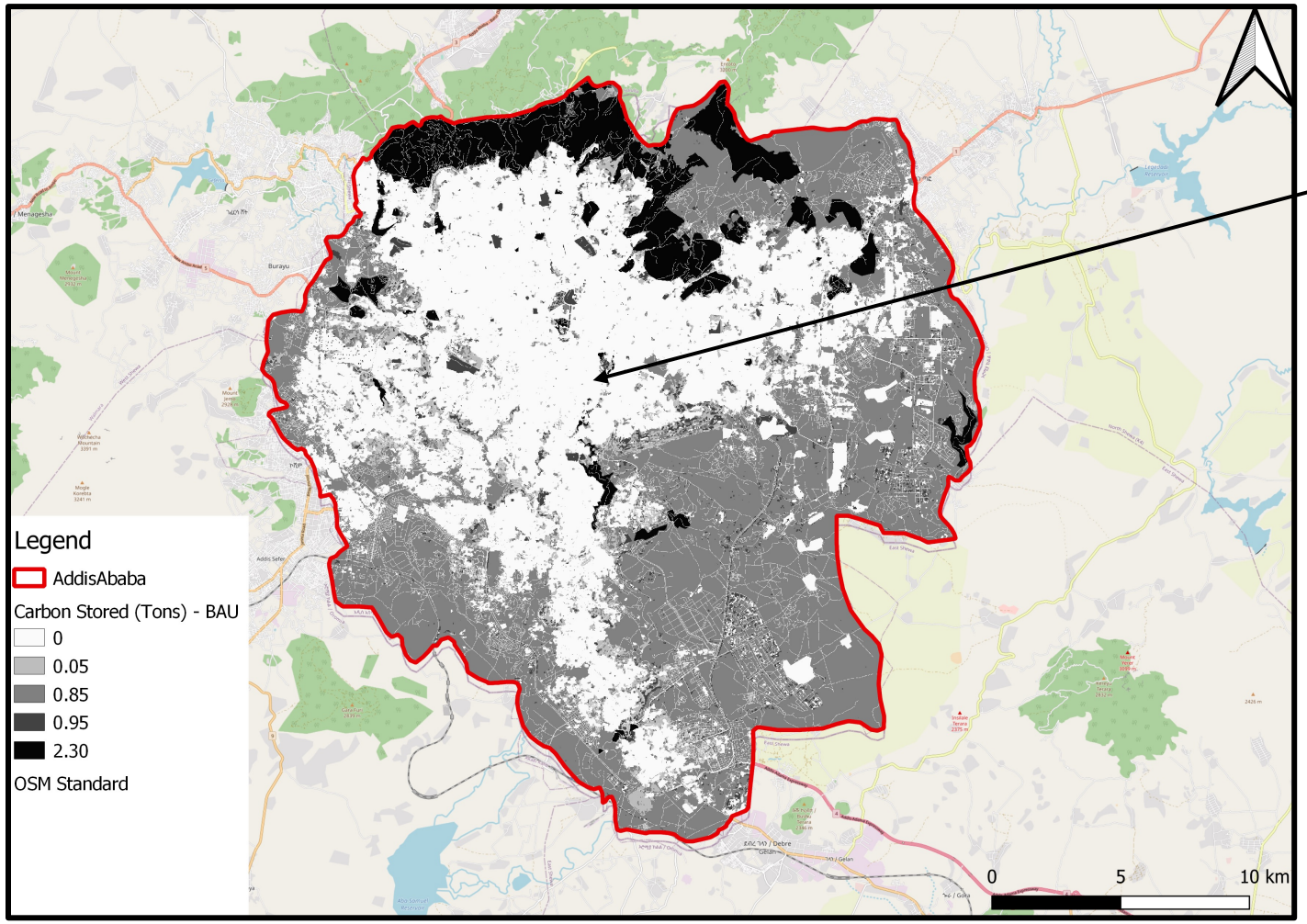




Difference with LC BAU:

- 7.5 million trees along the main roads

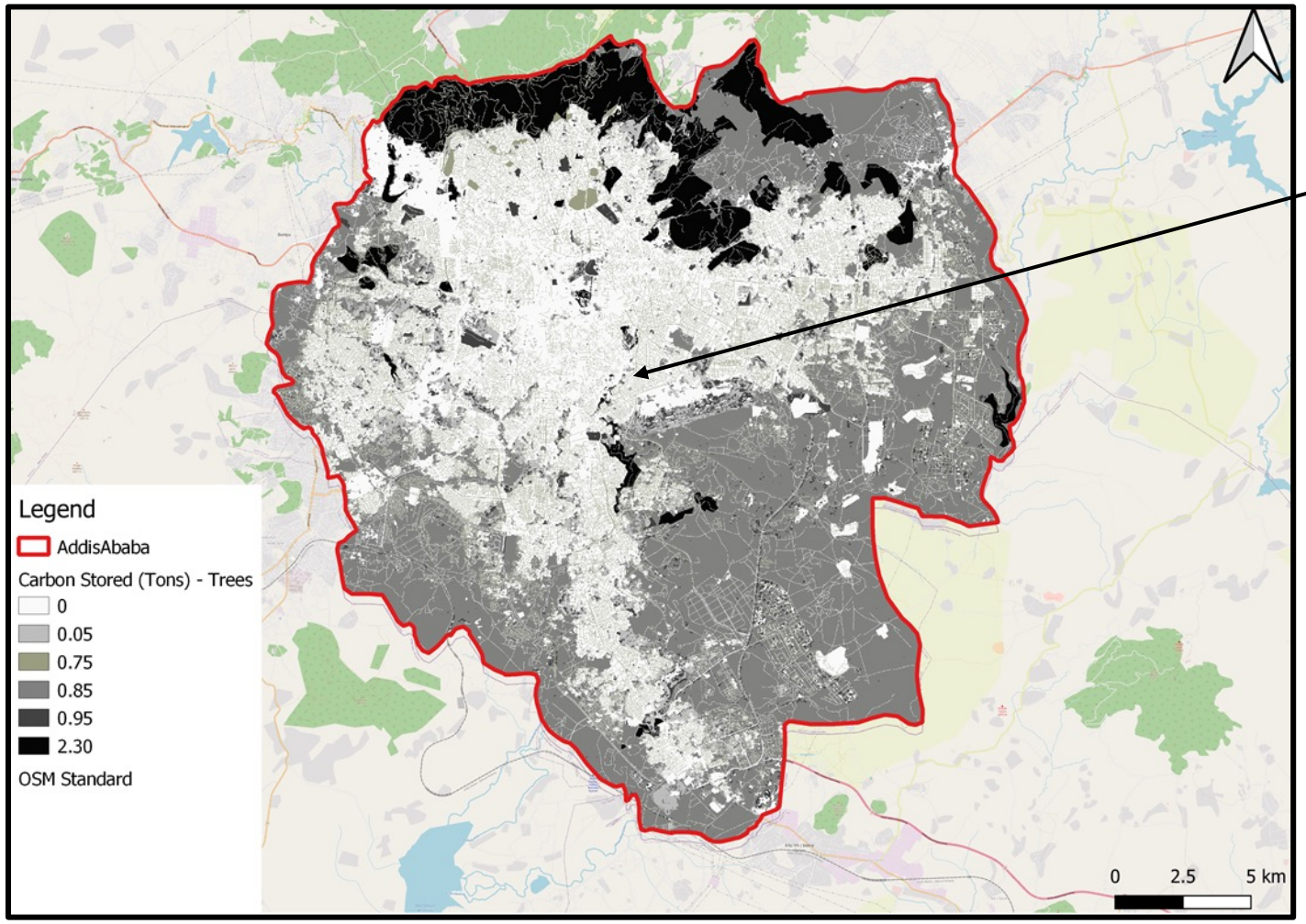
Carbon Storage - BAU



Total Carbon Stored (Tons)

3,260,839

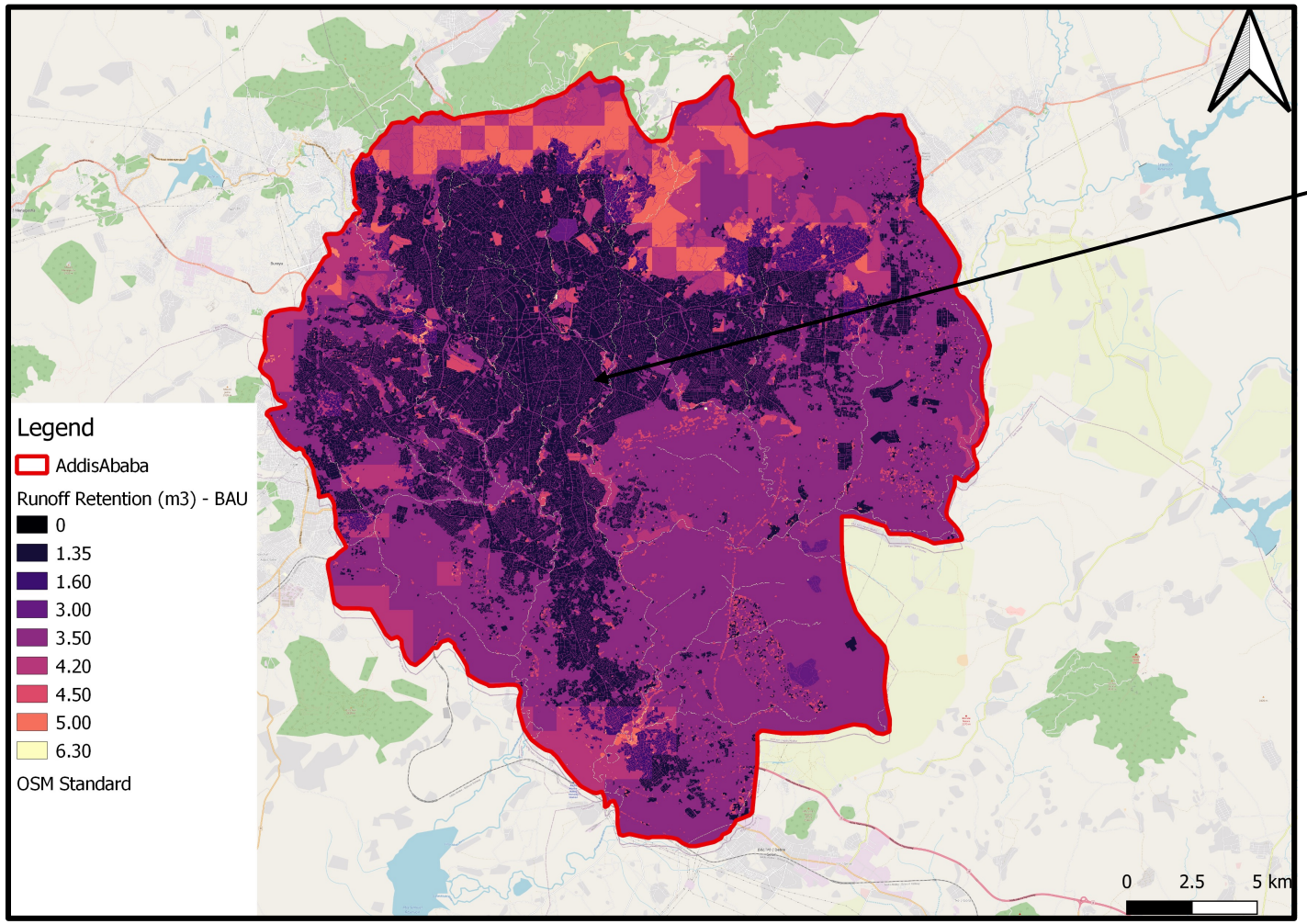
Carbon Storage - Trees

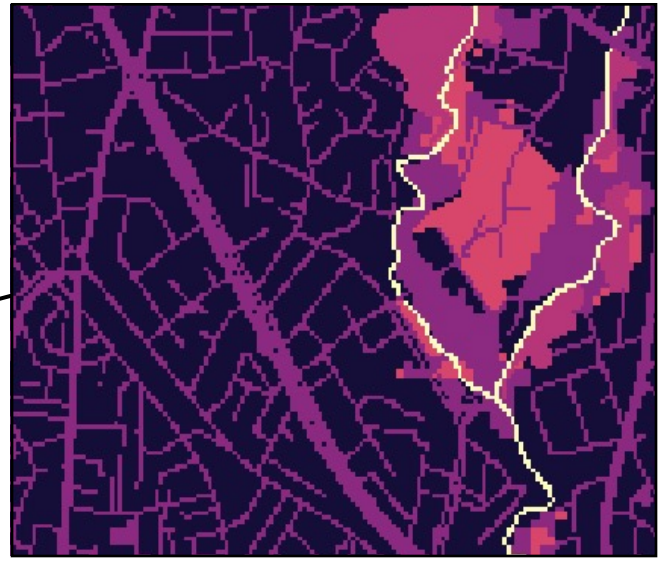


Total Carbon Stored (Tons)

3,497,002

Runoff Retention - BAU

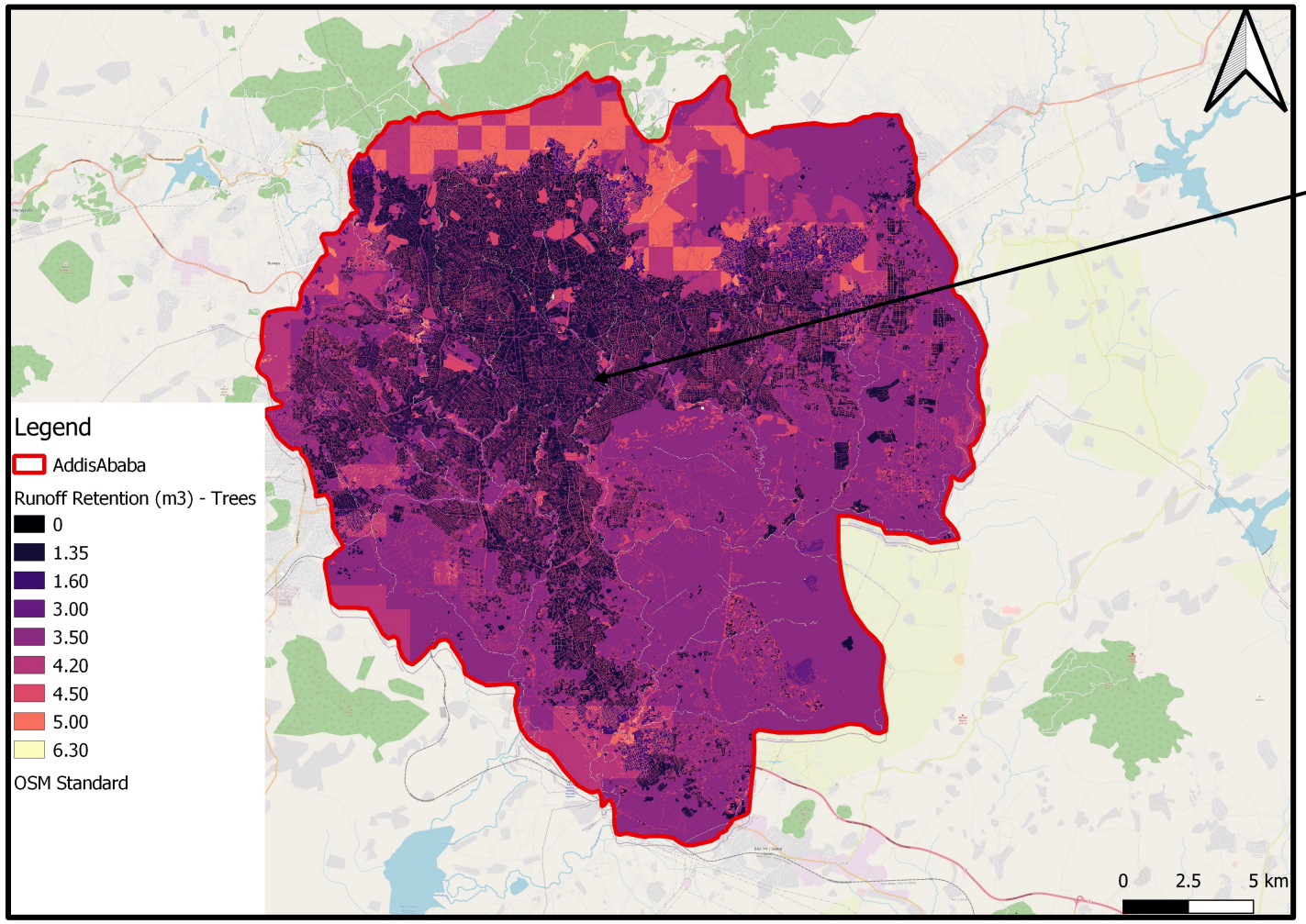




Total Runoff Retention Volume(m3)

17,631,633

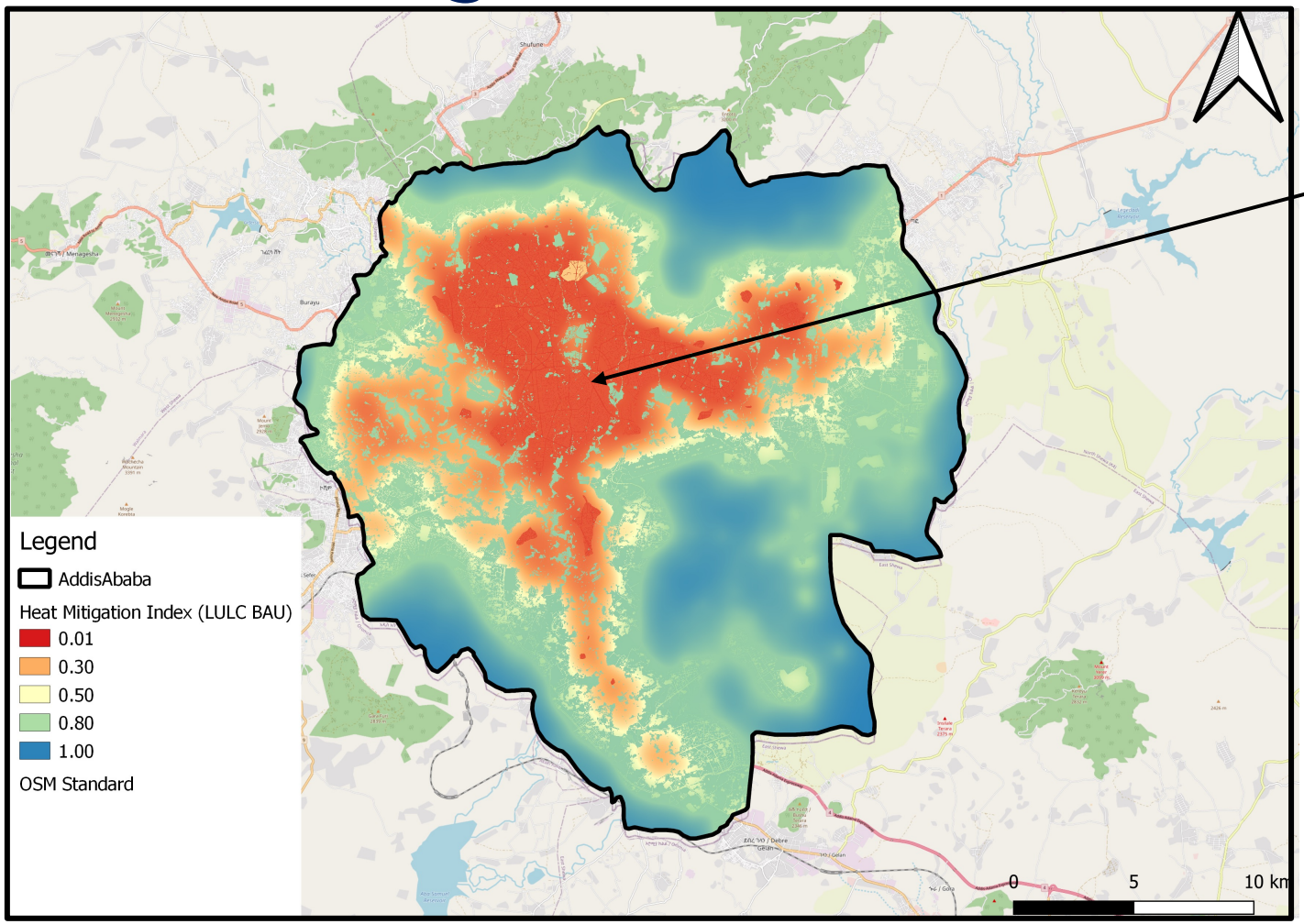
Runoff Retention - Trees



Total Runoff Retention Volume(m3)

18,550,981

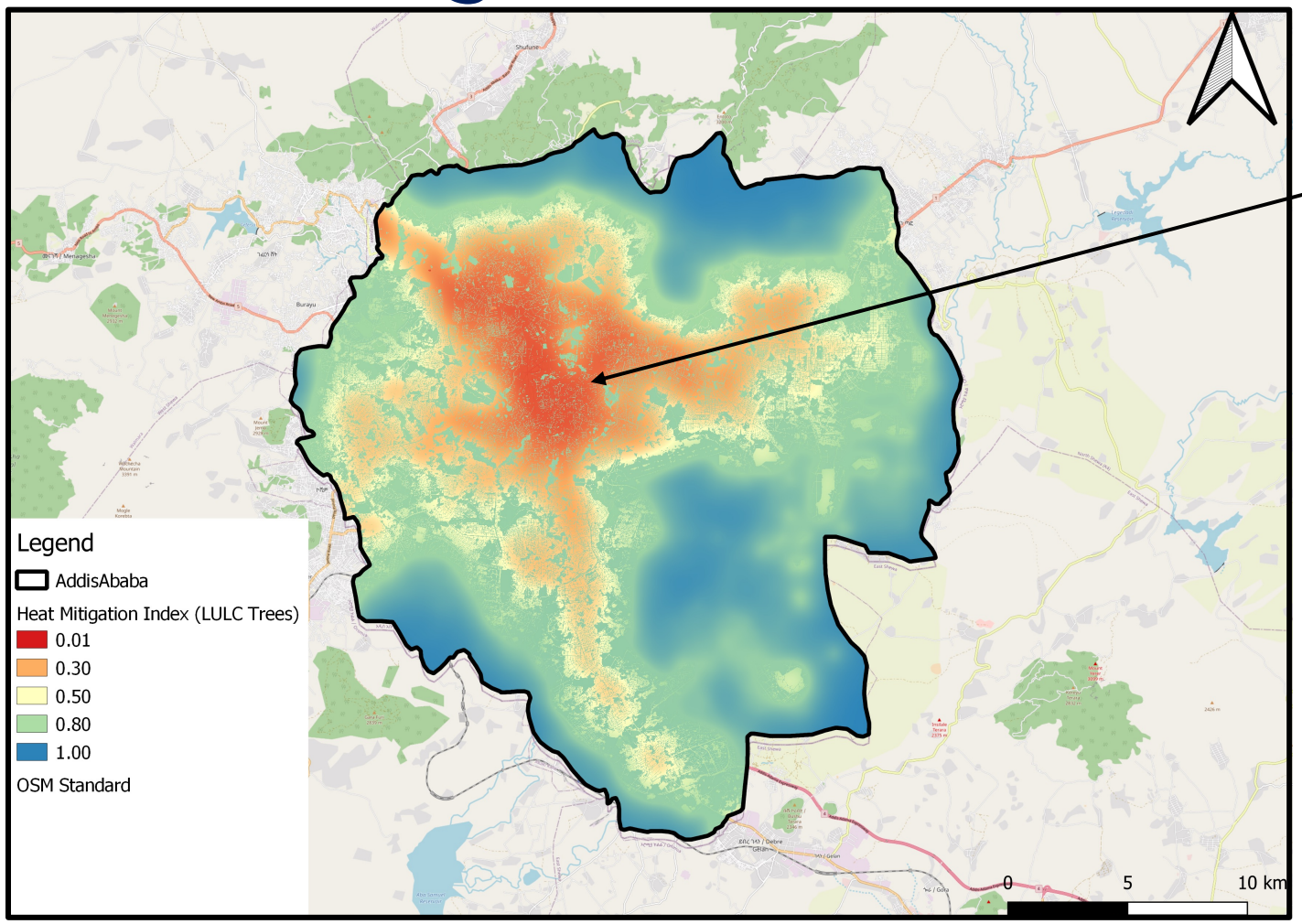
Heat mitigation - BAU

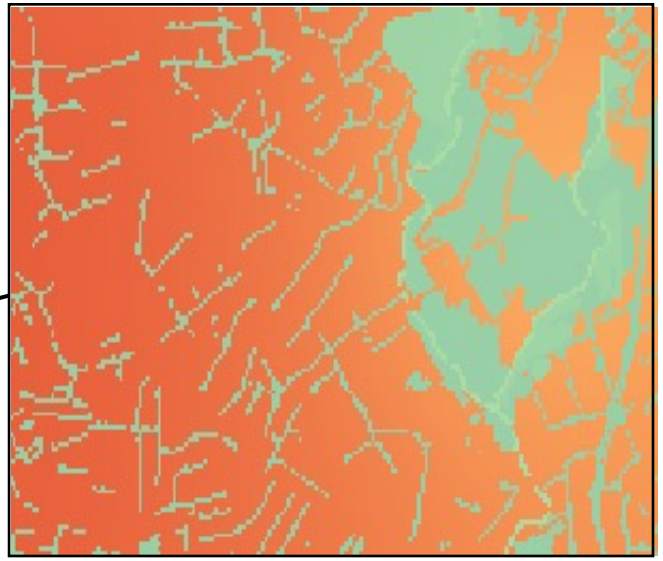


Average temperature (degC)

32.09

Heat mitigation - Trees





Average temperature (degC)

31.06

Summary

Results of multiple modelling approaches provide deeper insight

- Spatial models quantify ecosystem services for multiple landcover scenarios
- Including climate projections quantifies the impact of climate change on nature-based infrastructure and the ability for urban green spaces to increase resilience
- Comparisons with grey infrastructure show what types of services are provided by different infrastructure investments and the cost effectiveness of these investments

Questions

Stormwater management: Johannesburg

Paterson Park: Geography

Topography

Paterson Park resides between Norwood and Orange Grove, and it is a 'key open area' for enhancing social and community activity and infrastructure. It is within the Orange Grove Precinct, which is a matured and slightly undulated area. As the contour lines on the map shows, a ridge is on the southern part of the Precinct and it falls toward northwest. Thus, the park is located in a relatively lower position than its surrounding areas. All roads in the precinct are paved, hard surfaces, and there are no water bodies near the precinct. These characteristics make the park vulnerable to floods.

Urbanization & Densification

South Africa has experienced continuous urbanization, and Orange Grove has also experienced urban densification due to a town planning mechanism called Special Development Zone whereby development, densification, and rejuvenation of a specific area can be promoted, facilitated, and fast-tracked. The city of Johannesburg also implemented Paterson Park Social Housing initiative to redevelop the area, providing more than 1,400 social housing units. As a result, the area experienced both urbanization and densification.

Due to urbanization and densification, the city of Johannesburg faces environmental sustainability issues including pressures on infrastructure, climate hazards, air and water quality, and devalued natural and open spaces.

Comparative CBA – RCP 4.5 (Baseline), 20 years

Costs	Unit	Culvert	Combines	Naturalized
Renaturalize stream cost	ZAR	0	11,752,998	21,668,746
Landscaping cost	ZAR	0	2,060,265	3,798,466
Culvert construction + contingency	ZAR	74,837,981	34,246,308	0
Preliminary and general costs	ZAR	13,034,867	11,929,667	10,997,233
Maintenance costs	ZAR	9,051,038	8,283,618	7,636,163
Total cost	**ZAR**	**96,923,886**	**68,272,857**	**44,100,608**

Comparative CBA – RCP 4.5 (Baseline), 20 years

Benefits	Unit	CULVERT	COMBINED	NATURALIZED
Avoided property damages (Orange Grove, Norwood, and Orchards)	**ZAR**	**0**	**546,049,004**	**764,128,851**
Increased property values	**ZAR**	**0**	**4,246,930**	**8,493,860**
Orange Grove	ZAR	0	1,548,292	3,096,584
Norwood	ZAR	0	165,067	330,133
Orchards	ZAR	0	2,533,571	5,067,142
Increased property tax revenues	**ZAR**	**0**	**18,064**	**36,128**
Orange Grove	ZAR	0	10,080	20,160
Norwood	ZAR	0	784	1,568
Orchards	ZAR	0	7,200	14,400
Income creation	**ZAR**	**701,869**	**4,508,766**	**7,018,692**
gardener	ZAR	449,182	2,885,517	4,491,817
landscaper	ZAR	252,687	1,623,249	2,526,875
Avoided cost of carbon	**ZAR**	**12,259**	**122,587**	**226,010**
Additional water supply	**ZAR**	**0**	**13,294,061**	**26,588,122**
Total Benefits	**ZAR**	**714,128**	**568,239,411**	**806,491,664**
Net Results	**ZAR**	**-96,209,758**	**499,966,555**	**762,391,055**
Benefit over cost		**0.0**	**8.3**	**18.3**

Comparative CBA – RCP 4.5 (Baseline), 40 years

Costs	Unit	CULVERT	COMBINED	NATURALIZED
Renaturalize stream cost	ZAR	0	11,752,998	21,668,746
Landscaping cost	ZAR	0	2,060,265	3,798,466
Culvert construction + contingency	ZAR	74,837,981	34,246,308	0
Preliminary and general costs	ZAR	13,034,867	11,929,667	10,997,233
Maintenance costs	ZAR	17,671,074	16,172,778	14,908,699
Total cost	**ZAR**	**105,543,922**	**76,162,017**	**51,373,144**

Comparative CBA – RCP 4.5 (Baseline), 40 years

Benefits	Unit	CULVERT	COMBINED	NATURALIZED
Avoided property damages	**ZAR**	**0**	**1,020,855,760**	**1,440,452,428**
Increased property values	**ZAR**	**0**	**4,246,930**	**8,493,860**
Orange Grove	ZAR	0	1,548,292	3,096,584
Norwood	ZAR	0	165,067	330,133
Orchards	ZAR	0	2,533,571	5,067,142
Increased property tax revenues	**ZAR**	**0**	**18,064**	**36,128**
Orange Grove	ZAR	0	10,080	20,160
Norwood	ZAR	0	784	1,568
Orchards	ZAR	0	7,200	14,400
Income creation	**ZAR**	**1,403,738**	**9,017,532**	**14,037,384**
gardener	ZAR	898,363	5,771,033	8,983,635
landscaper	ZAR	505,375	3,246,498	5,053,749
Avoided cost of carbon	**ZAR**	**23,934**	**239,336**	**441,258**
Additional water supply	**ZAR**	**0**	**25,257,400**	**50,514,801**
Total Benefits	**ZAR**	**1,427,672**	**1,059,635,022**	**1,513,975,859**
Net Results	**ZAR**	**-104,116,250**	**983,473,005**	**1,462,602,715**
Benefit over cost		**0.0**	**13.9**	**29.5**

Discussion

NATURE-BASED INFRASTRUCTURE GLOBAL RESOURCE CENTRE

The **NBI Global Resource Centre** aims to improve the track-record of NBI by providing customized, integrated valuations that include:

- ✓ A quantification of ESG risks, costs and benefits
- ✓ A comparison with grey infrastructure
- ✓ Scenario analysis, including of project performance under different climate scenarios

https://nbi.iisd.org/

Resources and further reading

Sustainable Asset Valuation:
https://www.iisd.org/savi/

How Can Investment in Nature Close the Infrastructure Gap?
https://nbi.iisd.org/report/investment-in-nature-close-infrastructure-gap/

NBI Global Resource Centre:
https://nbi.iisd.org/

Submit your project for valuation:
https://nbi.iisd.org/submit-your-project/

Case study on stormwater management in Johannesburg:
https://www.iisd.org/publications/savi-stormwater-infrastructure-johannesburg

Case study on nature-based coastal protection in the Netherlands:
https://nbi.iisd.org/hondsbossche-dunes/

Case study on urban green spaces in Addis Ababa: forthcoming,
https://nbi.iisd.org/resources/

NATURE-BASED INFRASTRUCTURE
GLOBAL RESOURCE CENTRE

Thank You!

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