IIS INTERNATIONAL INSTITUTE FOR SUSTAINABILITY AUSTRALIA

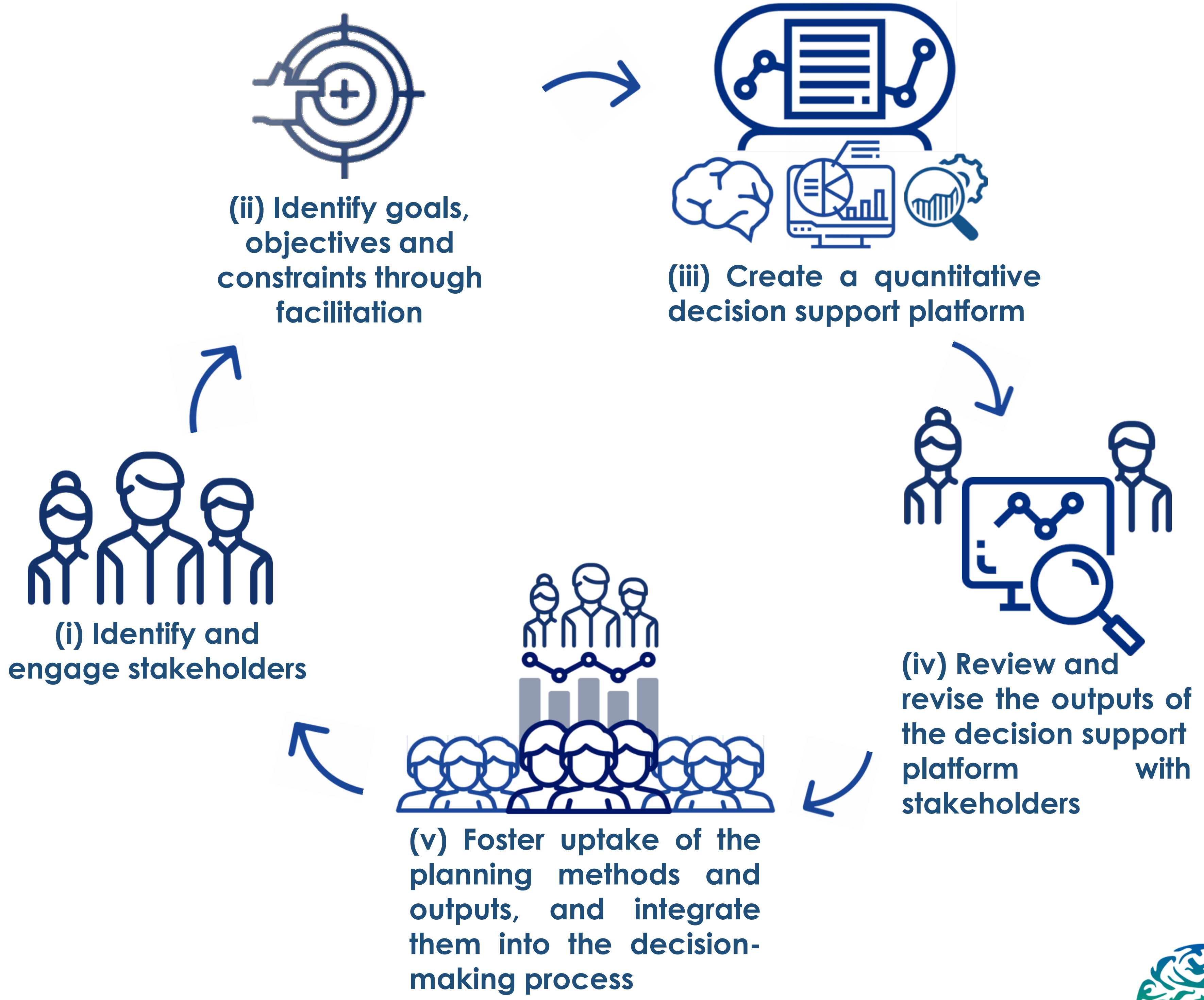
Best practice guidelines for developing quantitative approaches to spatial planning, optimisation, and decision support

Best practice guidelines

1. The planning process **must involve** and **engage** a **broad range of stakeholders**.

Decision support platforms inform but do not prescribe decisions.

In our approach the judgment of decision-makers remains an essential part of the planning and decision process.

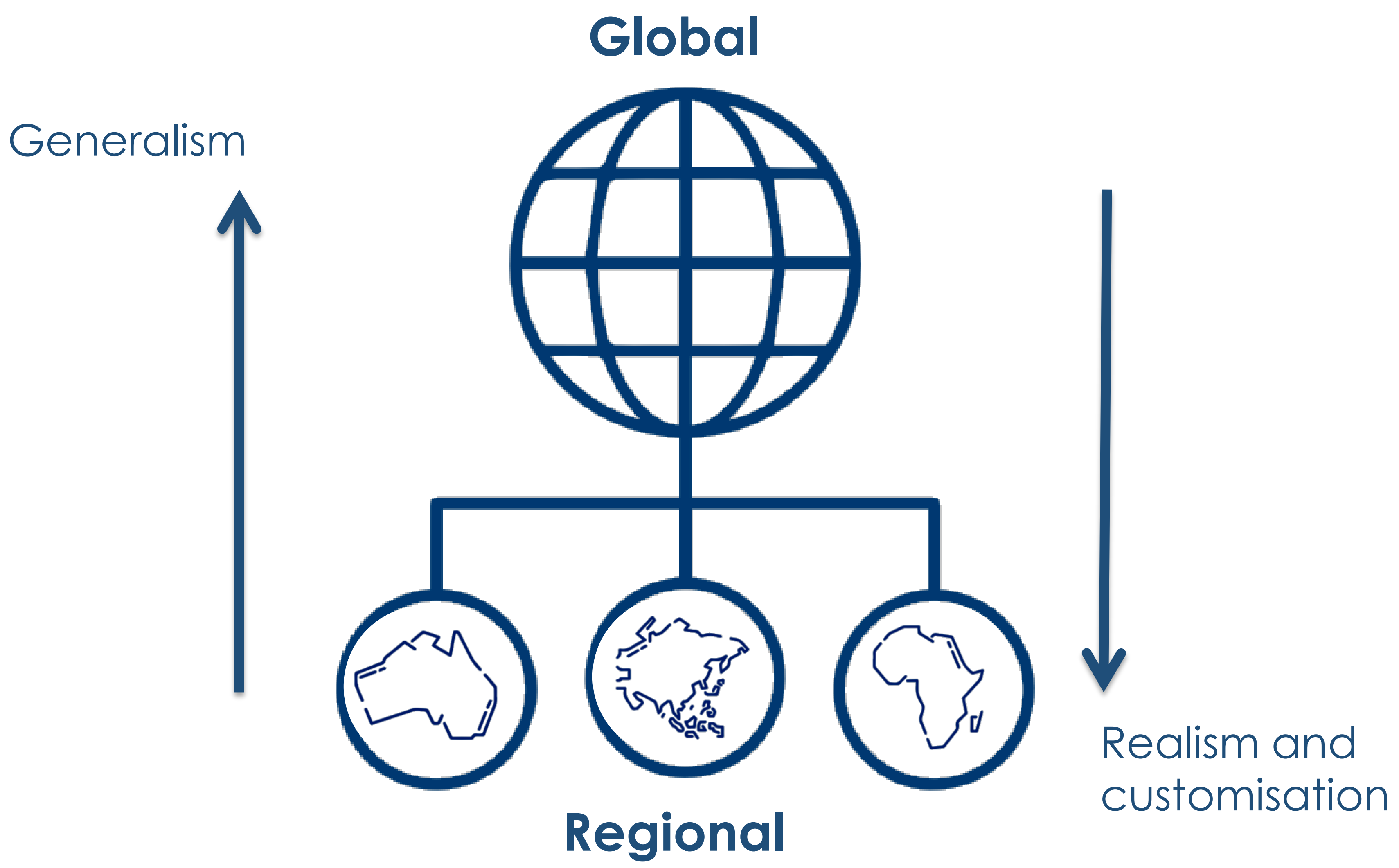


Best practice guidelines

2. Decision support strategies are **designed** to **inform both top-down policy** and **bottom-up conservation initiatives**.

Transferable and scalable.

Our approach can be applied across a range of scales (local to global) and customised to suit a wide range of stakeholder interests and planning contexts.

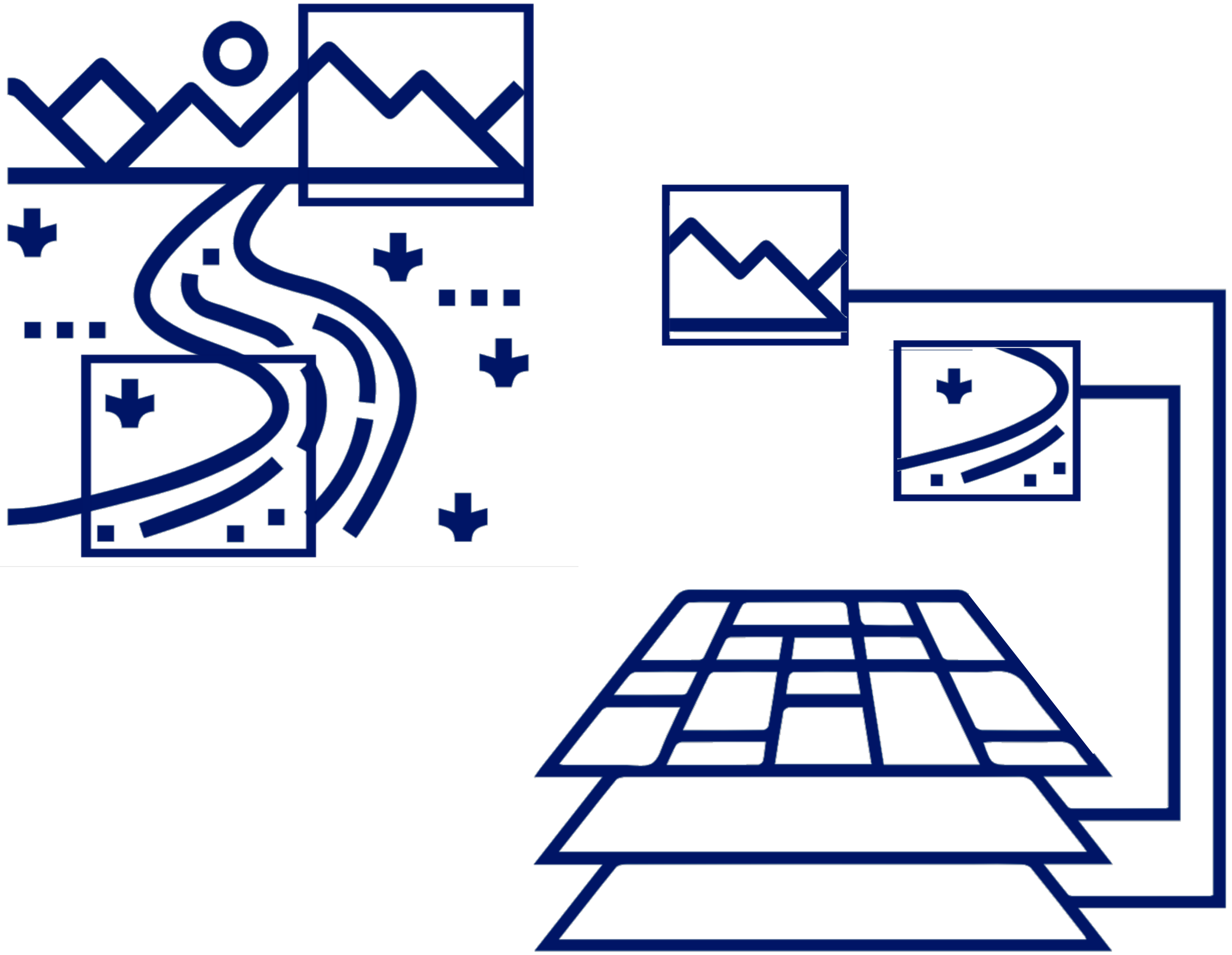


Best practice guidelines

3. Planning strategies that do not consider **objectives explicitly** and **quantitatively** often perform **sub-optimally**.

Evidence-based planning.

Our approach uses formal mathematical optimisation that can identify exact solutions to high-dimensional problems (multiple objectives and many planning units).

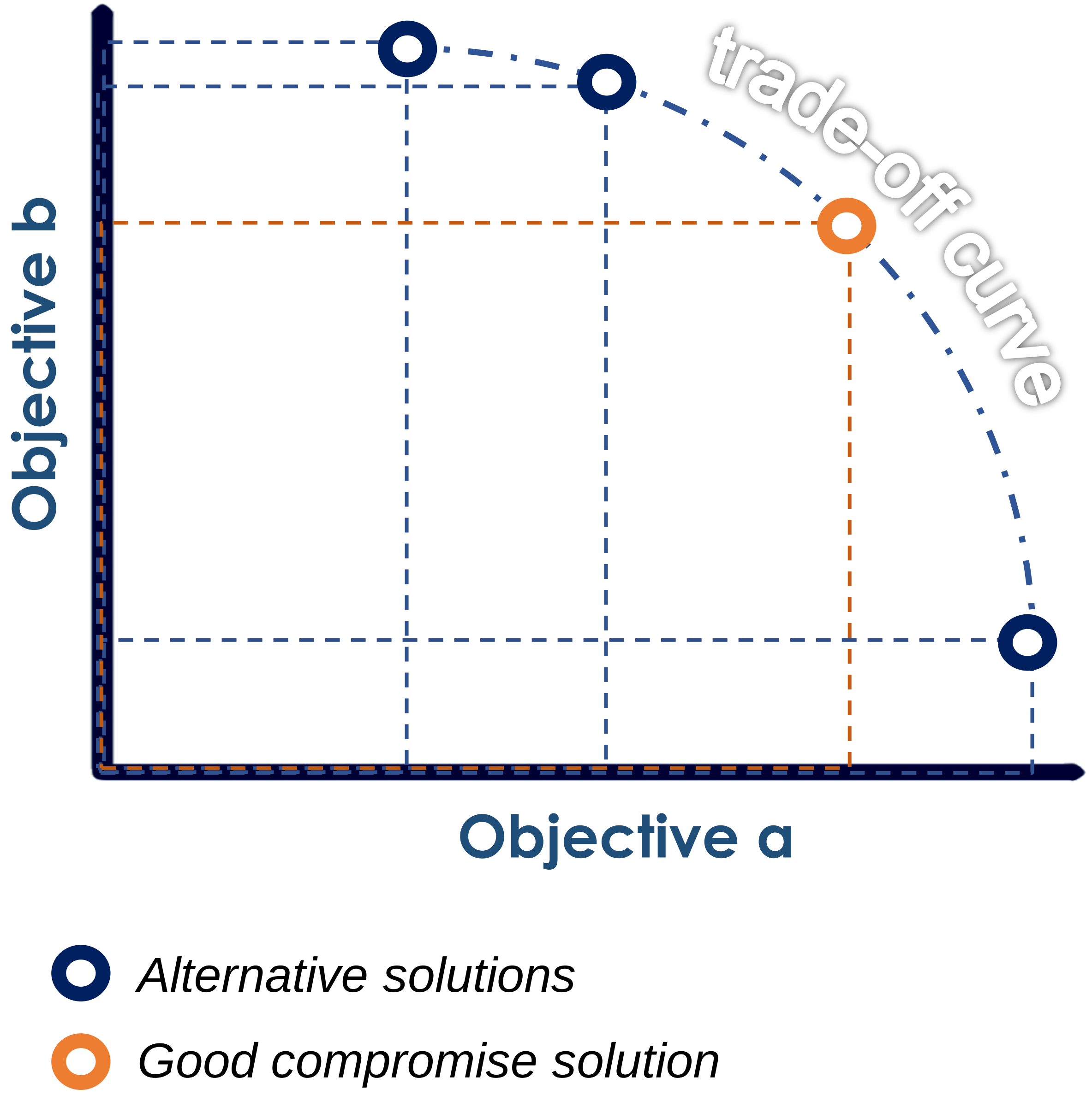


Best practice guidelines

4. It is usually not possible to **maximise multiple objectives** simultaneously as there are trade-offs among them.

Good compromise solutions.

Our approach describes trade-offs among objectives to foster more informed decisions, and is key for identifying balanced, 'good compromise'. That is, it allows to identify solutions that perform well against multiple objectives.



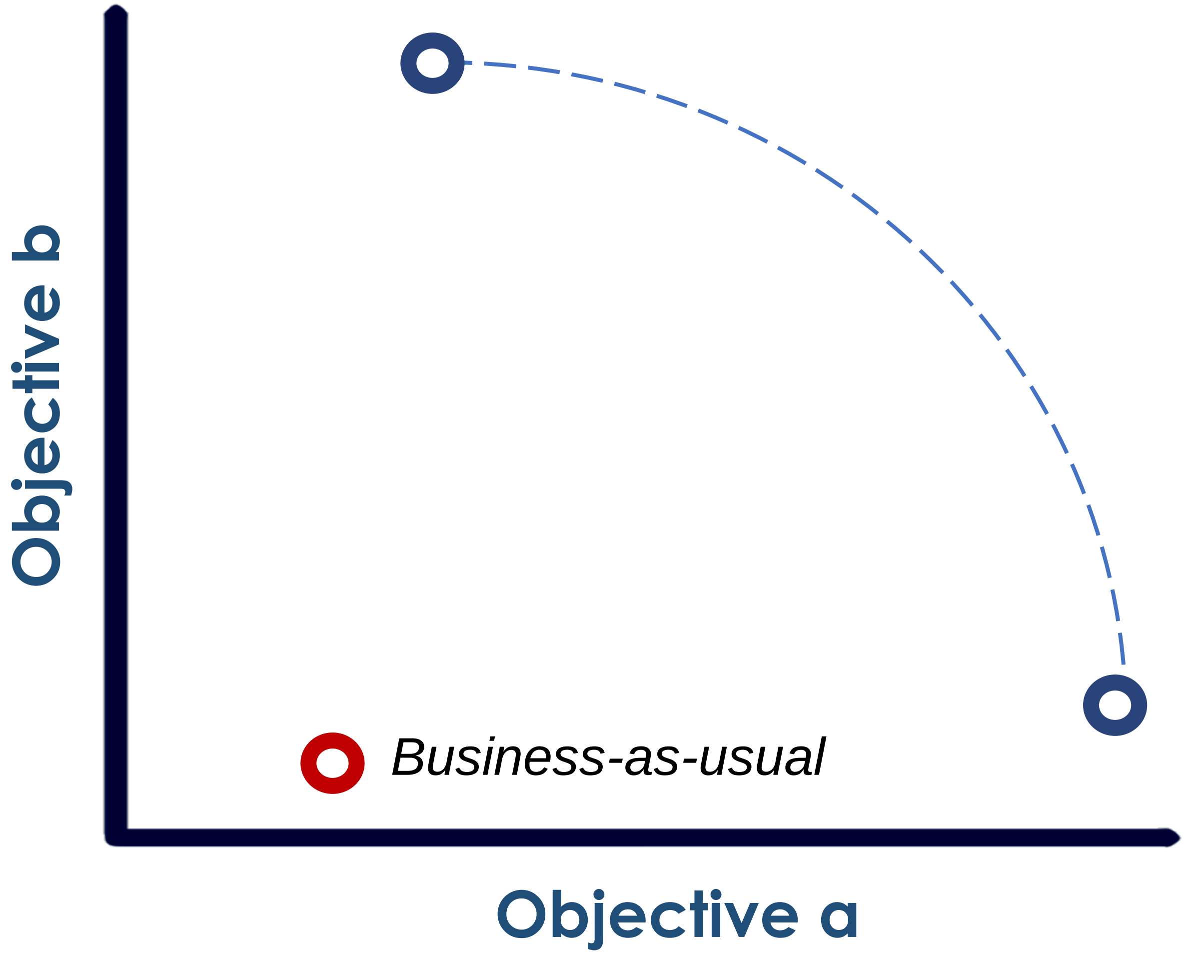
Best practice guidelines

5. Spatial planning can be used to compare the **performance** of **alternative scenarios** and **policies**.

Facilitating scenario analysis.

Our approach evaluates the expected benefits and returns of other management strategies, including "business-as-usual" approaches.

It provides a quantitative basis for evaluating the expected improvements in performance relative to existing alternatives.

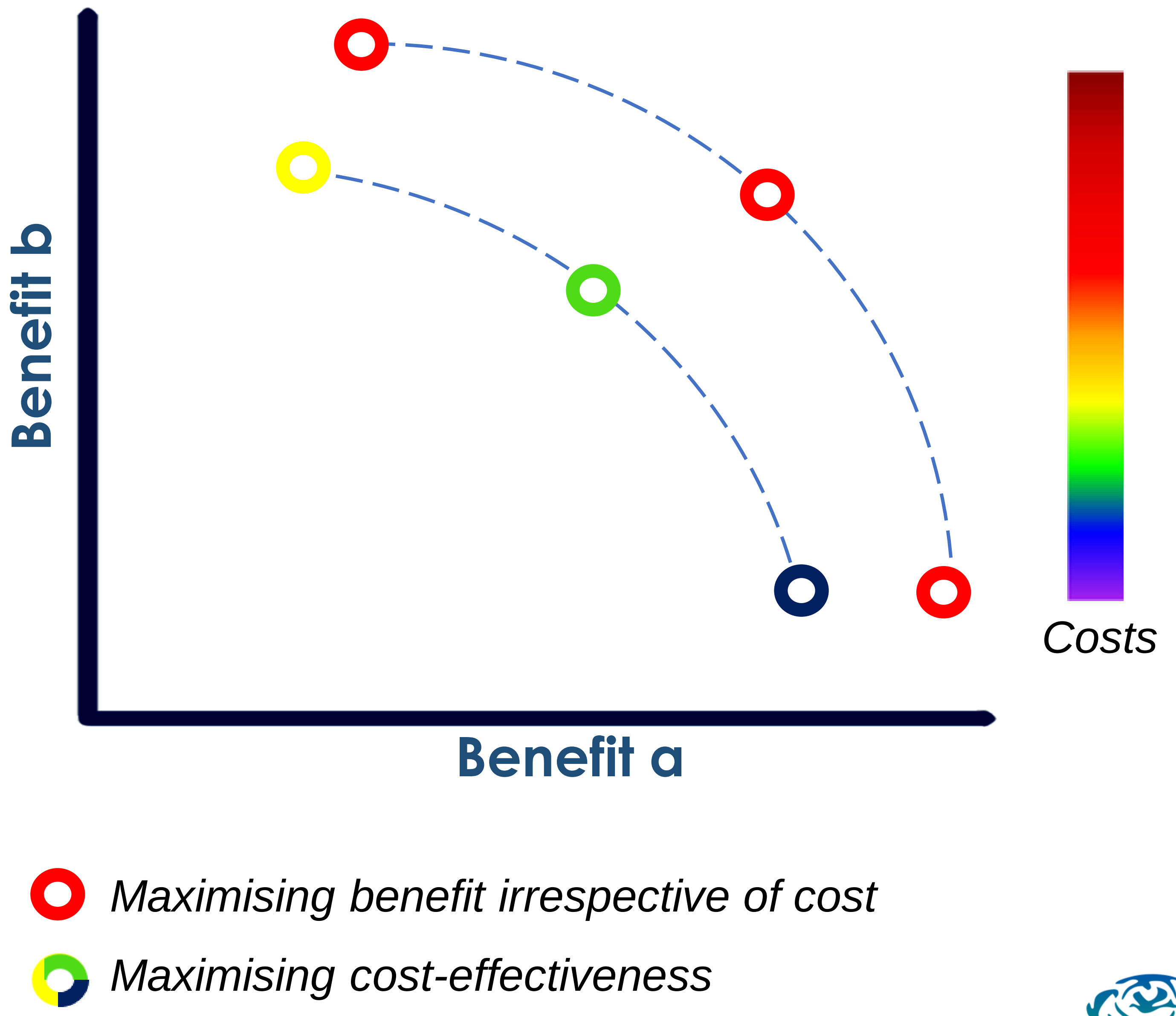


Best practice guidelines

6. Spatial planning often **maximize benefits** and **minimize costs** in a resource-limited problem (arguably, all real-world problems).

Maximising cost-effectiveness.

Our approach improves return-on-investment by maximising cost-effectiveness (benefit/cost), implying that more can be achieved with existing funds, and evaluate how budget changes can affect performance.



Best practice guidelines

7. Complex real problems needs to be informed by **spatial optimizations** that are **precise** to identify **exactly solutions.**

Algorithms.

Our approach uses a powerful mathematical optimisation method called linear programming that performs substantially better than "heuristic" (approximate) alternatives, and account for uncertainty in the objectives, fostering more robust, risk-sensitive planning.

Advantages of linear programming

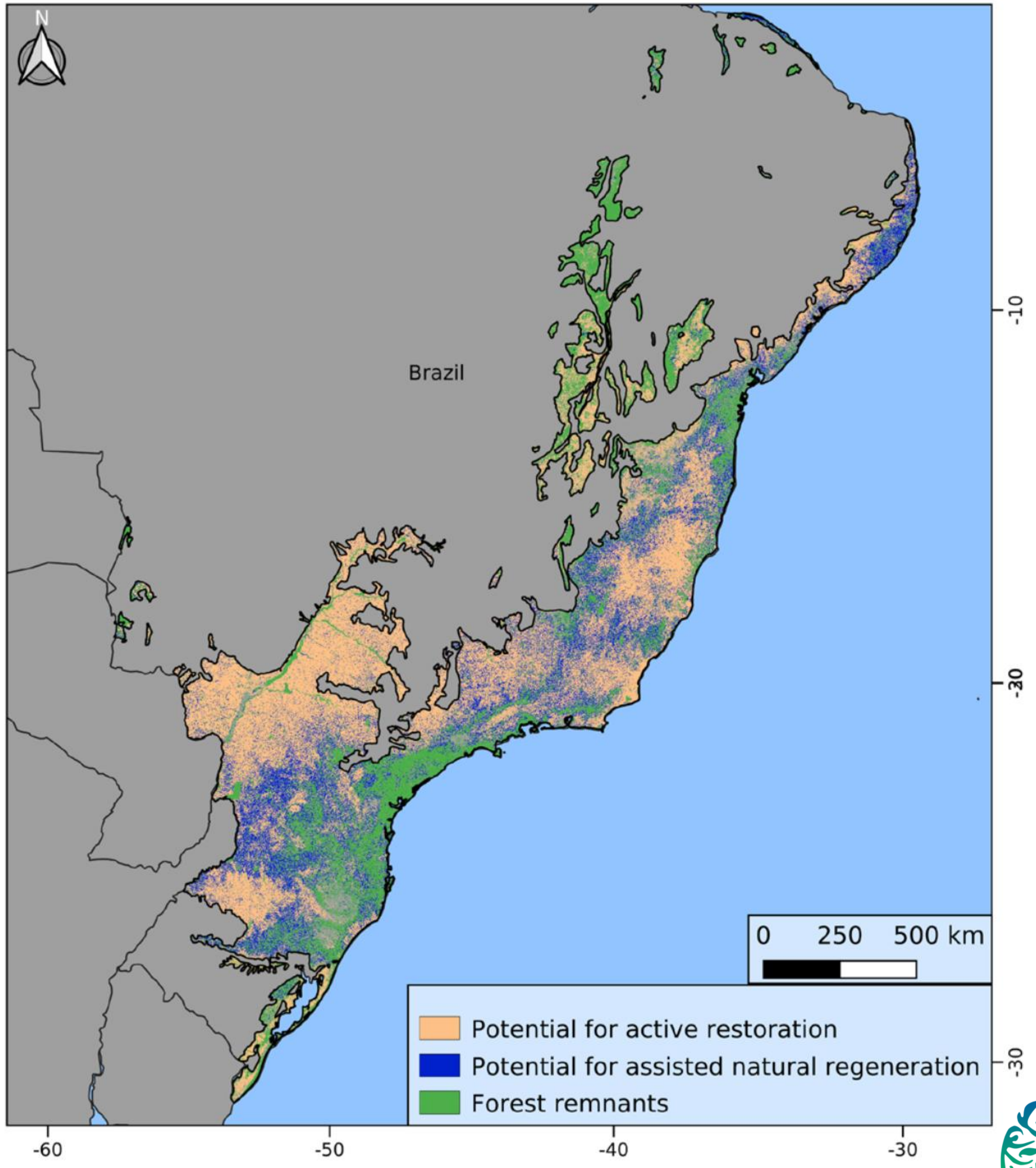
1. Capable of finding exact solutions to optimisation problems
2. Accommodates multiple objectives, and large numbers of spatial units
3. Highly flexible and customisable framework
4. Fast, facilitating more rapid decision-support
5. Include a wide range of constraints, such as budget targets, representation targets, spatial restrictions

Best practice guidelines

8. Identify suitable areas for different forest ecosystem and landscape restoration interventions is vital.

Predictive models.

Our approach can integrate systems modelling to improve planning for some actions (e.g. predictive models of the potential for natural regeneration can be used to greatly improve the cost-effectiveness of forest restoration).



Our approach can help to explore five key questions:

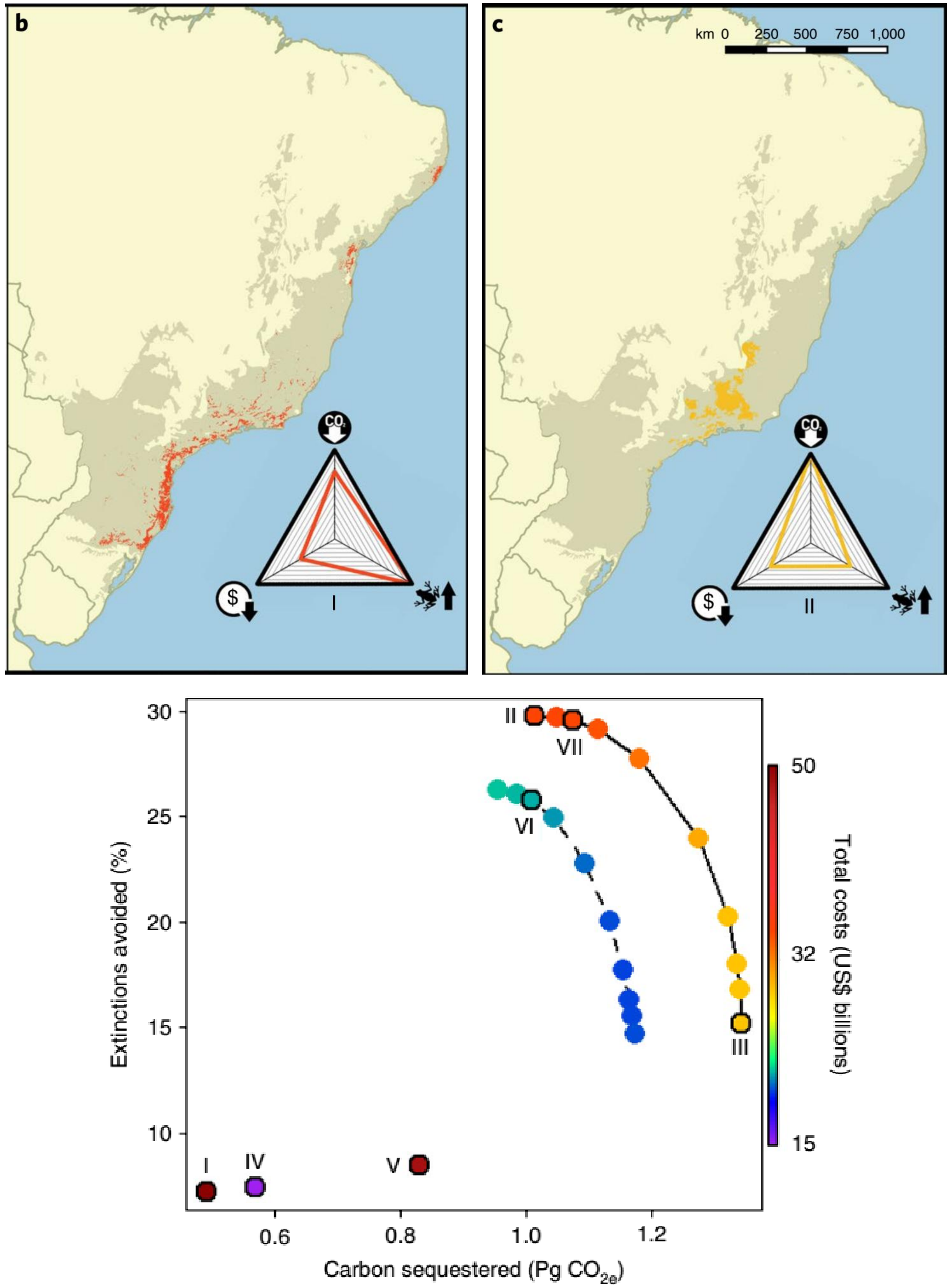
1. Where are the priority areas for restoration that maximise multiple benefits, while minimising costs?
2. What benefits are likely to be achieved over a range of total restoration area (or limited budget) targets and what are the costs?
3. How do trade-offs between benefits and costs affect priorities for restoration?
4. Where and when should actions be scheduled in space?
5. Where and how intensively restoration actions should be implemented?

Outputs

Our approach is designed to be easy to use without expert knowledge.

We:

- fully prepare all datasets and models
- fully automate data processing, optimisation and report generation
- provide an interface for exploring spatial solutions, trade-off curves, and expected benefits and costs
- deliver outputs in a variety of formats to provide more opportunities for integration and uptake
- and, it is web-accessible, and can be shared with other people.



Key publications in the area:

Beyer HL, Dujardin Y, Watts ME & HP Possingham, 2016. **Solving conservation planning problems with integer linear programming**. Ecological Modelling, 328,14-22.

Crouzeilles R, Alexandre N, Bodin B *et al*. 2020. **How to deliver forest restoration at scale: Recommendations for unlocking the potential of the most cost-effective way to restore forests in the fight against climate change and biodiversity loss**. CI, IIS and CIFOR.

Crouzeilles R, Beyer HL, Monteiro LM *et al*. 2020. **Achieving cost-effective landscape-scale forest restoration through targeted natural regeneration**. Conservation Letters, e12709.

Strassburg BBN, Beyer HL, Crouzeilles R *et al*. 2019. **Strategic approaches to restoring ecosystems can triple conservation gains and halve costs**. Nature Ecology & Evolution, 3, 62–70.

IIS INTERNATIONAL INSTITUTE FOR SUSTAINABILITY

IIS INTERNATIONAL INSTITUTE FOR SUSTAINABILITY AUSTRALIA

Authors

Renato Crouzeilles
Hawthorne Beyer
Mariana Silva Ferreira
Carlos Alberto de Matos Scaramuzza
Bernardo Strassburg

Contact Information

Renato Crouzeilles

r.crouzeilles@iis-au.org
International Institute for Sustainability Australia