

# Assessment of environmental, social, and economic co-benefits of climate change policies and actions

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## EXPERTS FROM FUTURE EARTH'S NETWORKS

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## 1 INTRODUCTION

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Evaluating climate change policies and actions and understanding the impacts of implementing response measures are important for learning and decision-making. The primary objective of providing real-time evaluation is to provide feedback in a participatory way in real-time as during the evaluation process to those executing and managing the humanitarian but scientific response.

There are a variety of forms of assessments, they range from informal reviews, simple reviews, and real-time evaluations even to evaluative exercises or strategic assessments to introduce interventions. However, all forms of assessments must produce learning. The assessments could be short feedback loops showing a spectrum of evaluative exercises from informal reviews on one side it's a more formal traditional evaluation on the other side.

A spectrum of policies mentioned below is analysed in response to the call from KCI for the assessment of climate change policies and actions:

*Table 1: A spectrum of policies analysed in this paper*

<b>Policies</b>	<b>Methods</b>	<b>Approaches</b>
The Paris Agreement (PA)	The Institutional Analysis and Development (IAD) framework and the Institutional Grammar Tool (IGT)	Country level
Climate Change Policy	Qualitative analysis	Global and nature-based
<b>Actions</b>	<b>Methods</b>	<b>Approaches</b>

The nature-based solution to climate change in central Vietnam	A cost-benefit analysis	Climate change mitigation, place-based, academic-NGO (community) partnerships
Decentralized production of green hydrogen	Qualitative analysis	Climate change adaptation, local, multistakeholder engagement and multi-lateral governance
Climate Change adaptation – nature-based solution to store water locally	Qualitative analysis	Local, multi-sectoral stakeholder engagement, including community

There are various ways in which the policy responses are evaluated. The traditional evaluation could be too institutionalized and inflexible and can generate resistance in a highly pressurized context. The innovative evaluation must allow practitioners and program people to look for something lighter and more flexible to meet immediate action planning and learning needs. Also, at the global scale, the challenge is on both fronts, the response itself and the designing of assessment methods that could be appropriate across an organization, countries, regions, and individuals. The utilization of assessment must be focused as possible. Importantly the assessment requires thinking outside the box, and the consequence could be across the sector.

## **2 POLICIES/ACTIONS ASSESSED FOR ENVIRONMENTAL, SOCIAL AND ECONOMIC CO-BENEFITS**

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### **2.1 POLICIES**

#### **2.1.1 The Paris Agreement**

The Paris Agreement (PA) is a framework for the action agreed by the international community for the global net reductions of greenhouse gas (GHG) emissions under the internationally binding regulations on emissions. However, no binding targets are set for the international community. Carbon reductions must maintain global warming within the 1.5° C or 2° C target. Therefore, coordinated efforts at all levels of governance and from all countries are required. Consequently, many least developed countries (LDCs) have prepared their nationally determined contributions (NDCs). The level of implementation varies in LDCs.

The scope of PA is broad. It influences local, national, and international policies and actions; and all sectors. It has an equal stake in mitigation and adaptation. However, when it comes to least developed countries (LDCs), the emphasis must be on mitigation. Many market-based instruments have been developed alongside regulatory instruments. Many voluntary programmes have been designed at all levels, individual, organisational and inter-organisational levels. The collective and individual leadership roles and actions are equally significant in implementing PA and achieving desired outcomes.

An NDC should communicate the commitment of the country to protect carbon sinks and to use national resources efficiently. An NDC should identify actors with clear roles and responsibilities in implementing the plan. Additionally, it should state the entity that makes the political decisions and

that they are based on the best available science. Thus, an NDC must shape action situations in LDCs. However, the action situations have a high cost of the impacts of climate change.

### 2.1.2 Climate Change Policy

In 2015, the United Nations agreed on 17 Sustainable Development Goals as the central normative framework for sustainable development worldwide. The effectiveness of governing by such broad global goals, however, remains highly uncertain since we lack comprehensive meta-studies that assess the political impact of these goals across countries and globally. The effect has been largely discursive, given how actors understand and communicate about sustainable development; scientific evidence suggests only limited transformative political impact thus far, and more profound normative and institutional impact, from legislative action to changing resource allocation, remains rare (Biermann, F. and others). Development programs often embed ideas of nature domination into the scientific management of species and landscapes and explore this for supposed social values and a distorted concept of growth that benefits most those who already have a privileged political and economic status than those who need food, clean water, proper dwellings, secure and pollution free environments<sup>1</sup>.

Climate change is one of the most complex issues facing us today. It involves many dimensions – science, economics, society, politics, and moral and ethical questions – and is a global problem felt on local scales that will be around for thousands of years. So, there can be two approaches to reducing emissions and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere or adapting to the climate change already in the pipeline. So, mitigation is either by reducing sources of these gases (for example, the burning of fossil fuels for electricity, heat, or transport) or enhancing the “sinks” that accumulate and store these gases (such as the oceans, forests, and soil). The adaptation is to reduce our risks from the harmful effects of climate change (like sea-level rise, more intense extreme weather events, or food insecurity). It also includes making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions). Improving energy efficiency and opting for renewable energy over fossil fuels. The following are some of the steps that we can take adopt in climate change mitigation in terms of implementing policies and actions:

- i. Promoting public transport and sustainable mobility by increasing the number of journeys in towns by bicycle, reducing the number of flights and taking more trips by train or in shared cars.
- ii. Promoting ecological industry, agriculture, fishing and livestock farming, food sustainability, responsible consumption and the 3Rs rule (reduce, reuse, recycle).
- iii. By taxing the use of fossil fuels and CO<sub>2</sub> emissions markets.
- iv. Erecting buildings and infrastructure that are safer and more sustainable.
- v. Replanting forests and restoring damaged ecosystems.
- vi. Diversifying crops so that they can better adapt to changing climates.
- vii. Investigating and developing innovative solutions to prevent and manage natural catastrophes like adopting nature-based solutions by planting trees on coastlines or banks of rivers and proper greenbelt planning in urban cities to prevent floods.

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<sup>1</sup> PILON, A. F., Desertification, a Condition that Involves People, Soil and the Ways of Being in the World, Humanities Commons [online]: <https://hcommons.org/deposits/item/hc:45579/>

## **2.2 ACTIONS**

### **2.2.1 Nature-based solution to climate change in central Vietnam**

The first case is a nature-based solution to climate change in central Vietnam as a proof-of-concept example of a wider possible nature-based solution policy. The project was based around mangrove restoration in a rural area and urban canal and pond restoration in the provincial capital. The work involved the inclusion of the local community in the development and implementation of the project as an avenue for inclusive disaster risk reduction and increasing sensitisation of local policymakers to such needs. The project was initiated as a joint academic-NGO initiative when it was funded by the Global Resilience Partnership (GRP)'s water window. Therefore, the project was local with a primary adaptation focus (e.g., limiting climate impacts from coastal and pluvial flooding while boosting livelihood potential). It was a voluntary program that tried to develop and support community-level action through inclusive disaster risk reduction sensitisation<sup>2</sup>.

### **2.2.2 Decentralized production of green hydrogen in the Netherlands**

The second case regards the decentralized production of green hydrogen. Making green hydrogen part of storing clean energy, the main strategy in the Netherlands is to build large factories for electrolysis connected by an infrastructure for transport to a few very large industrial sites. An important disadvantage is that these factories will produce such an amount of residual heat that the built environment in the vicinity won't be able to make good use of that; this heat will be discharged. The assessment regards the alternative of decentralized production. Although decentralized production is local, and the evaluation was made locally, the scope is national since the aim of the assessment is to change national policy. Decentralized electrolysis has several co-benefits, but the main co-benefit is a good use of residual heat, a measure to mitigate climate change as it is a clean alternative for fossil fuels. To get to this way of producing hydrogen, the market, regulation and cooperation within a community are involved.

### **2.2.3 An area to store water for climate change adaptation in the Netherlands**

The third case concerns Kristalbad, an area to store water for climate change adaptation. It is situated between the two easternmost cities in the Netherlands, Enschede and Hengelo. In case of heavy rainfall, water runs from Enschede to Hengelo. Kristalbad is a water storage area to prevent flooding of Hengelo. The assessment regards the distinction between four co-benefits: yields from positive externalities, less harm from negative externalities, community, and future value.

## **3 THE ENVIRONMENTAL, SOCIAL AND ECONOMIC CO-BENEFITS OF THE POLICIES AND ACTIONS ARE ACCORDING TO THE ASSESSMENT**

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### **3.1 ENVIRONMENTAL, SOCIAL AND ECONOMIC CO-BENEFITS OF THE POLICIES**

The scope of the Paris agreement to bring policy reforms is enormous if implemented in areas with economic development, limited natural resources<sup>3</sup>, high vulnerability<sup>4</sup> and inequality. Population

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<sup>2</sup> There is currently a second way of the ongoing project that involves the monitoring of the restoration activities (with a focus on the rural).

<sup>3</sup> Vachon, S., Menz, F.C., 2006. The role of social, political, and economic interests in promoting state green electricity policies. *Environ. Sci. Policy* 9, 652–662.

<sup>4</sup> Sapat, A., 2004. Devolution and innovation: the adoption of state environmental policy innovations by administrative agencies. *Public Adm. Rev.* 64 (2), 141–151.

growth, economic activity and prosperity, culture<sup>5</sup> and inequality drive environmental degradation and climate impacts. These factors influence development goals and national mitigation strategies. Education increases environmental awareness and support for ecological actions<sup>6</sup> by expanding the capabilities of implementing climate policy reforms<sup>7</sup>.

Looking at the SDGs, earth's and mankind's regeneration are the faces of the same coin: they are complementary aspects; they should be addressed simultaneously, in space and time, for their mutual support. Institutional capacity, judicial neutrality, transparent information, and new social spaces for enlightened participation are considered fundamental aspects of transformative actions, implying public scrutiny, accountability and independent clearance bodies. Instead of trying to solve isolated and localized issues (segmented public policies, reduced academic formats, mass media headlines), without addressing the general phenomenon, problems should be defined and dealt with deep inside the "boiling pot", encompassing the current "world system" with its boundaries, structures, techno-economic paradigms, support groups, rules of legitimation, and coherence, where the problems emerge.<sup>8</sup>

The following are some of the environmental, social and economic co-benefits of the climate change policies and actions:

- i) To simulate new green economies and green jobs. They are increasingly promoted across funding schemes and projects.
- ii) Proper greenbelt development planning in urban cities can reduce air pollution and cool urban areas during heat waves.
- iii) flood peak reduction that is likely to have co-benefits for not only coastal resilience but also for the quality of life by improving urban living conditions.
- iv) Erosion protection due to green cover planting.
- v) Species richness due to the planting of trees.
- vi) Accessibility to public green space due to the building of green urban parks, artificial lakes or wetlands.

## **3.2 ENVIRONMENTAL, SOCIAL AND ECONOMIC CO-BENEFITS OF THE ACTIONS**

### **3.2.1 A cost-benefit analysis applied to the Vietnam case to assess co-benefits**

1. Flood protection (both urban and rural sites)
2. Recreation and aesthetics (urban only)
3. Foreign tourism
4. Domestic Tourism
5. Carbon sequestration
6. Improved Fisheries (rural only)

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<sup>5</sup> Vachon, S., Menz, F.C., 2006. The role of social, political, and economic interests in promoting state green electricity policies. *Environ. Sci. Policy* 9, 652–662.

<sup>6</sup> Van Liere, K.D., Dunlap, R.E., 1981. Environmental concern: does it make a difference how it's measured? *Environ. Behav.* 13 (6), 651–676.

<sup>7</sup> Vachon, S., Menz, F.C., 2006. The role of social, political, and economic interests in promoting state green electricity policies. *Environ. Sci. Policy* 9, 652–662.

<sup>8</sup> PILON, A. F., Science, Freedom, Public Spaces and Specialized Bureaucracies: Where is the Truth? Researchgate, 2021 [online]:

[https://www.researchgate.net/publication/357662474\\_Science\\_Freedom\\_Public\\_Spaces\\_and\\_Specialized\\_Bureaucracies\\_Where\\_is\\_the\\_Truth](https://www.researchgate.net/publication/357662474_Science_Freedom_Public_Spaces_and_Specialized_Bureaucracies_Where_is_the_Truth)

These six co-benefits have been examined separately across income groups and genders. These co-benefits are a known subset of the possible benefits of investment in nature-based solutions. However, they were collectively the most tangible and important sets of co-benefits to the local communities. Therefore, they were selected because they represented a locus of co-benefits that could be directly experienced and advocated for.

### **3.2.2 Co-benefits of decentralized production of green hydrogen**

- a) Less use of fossil fuels for 1) heating within the built environment and 2) industrial processes.
- b) Less heat pollution of the environment, with surface water as an important element.
- c) Less need for electricity for heating resulting in less pressure on the busy network.
- d) More chances for the systems integration of means to produce, transport and store clean energy. For instance, in times of surplus electricity from local windmills and solar panels, this electricity can be put to good use in producing hydrogen. Besides health, oxygen and utility water are the two other residual electrolysis products. In the case of local electrolysis near a water treatment plant, all three can be put to good use.

### **3.2.3 Content and Thematic analysis to identify environmental, social and economic impacts**

The co-benefits under a) and b) are environmental because they mean less pollution from fossil fuels and the discharge of heat. The co-benefits under c) and d) are economical. Furthermore, all these co-benefits have an important social effect since the involved parties cooperate on an optimum wherein each co-benefit can be maximized. This cooperation is permanent and emerges a community of parties that help each other to reach each maximum.

The project to build and maintain an area for water storage is aimed at climate change adaptation. The scope is local with importance for both cities. Both public and private actors profit from the various co-benefits, so the arrangement to build and maintain Kristalbad involves the market and regulation, and it involves governance from the community of public and private parties that cooperate. An important lesson from Kristalbad is the distinction between four kinds of co-benefits:

#### ***3.2.3.1 Yields from positive externalities***

The water storage area Kristalbad is a nature reserve also. More quality of nature and therefore more biodiversity helps to store more water, especially since the soil is healthy and can better work as a sponge to keep water. This soil is also the basis for using the area to purify water, helping the water company to save money. Furthermore, the area is fit for recreation. As a result, there's a tearoom, and the lease brings in extra money for the area's management.

#### ***3.2.3.2 Less harm from negative externalities***

Foremost water storage helps to diminish the harm of flooding. Also, an area with water and nature cools the nearby parts of both cities. Furthermore, pressure on the livability in these city parts goes down when a nearby area with nature and recreation helps to increase wellbeing.

#### ***3.2.3.3 Community***

The water manager, nature manager, water company and owner of the tearoom cooperate to enhance the results of each and make sure no one suffers from another. Each learns to understand the needs of the other and how to serve those. From that, a community emerges wherein all understand how to serve each other and thus serve themselves best. Within this community, they also discover future values.

#### ***3.2.3.4 Future Value***

More nature was a future value of the development of the water storage area. Water purification and better cooling of parts of the two cities were future values of more nature within the water storage area. Recreation and less pressure on livability were future values thereof. These future

values were realized, so they've ceased to be future values. The community, however, has future values in the store. One is agriculture within the area, and the other is harvesting heat from the water during the summer and storing that to use in the winter. This measure results simultaneously in a lower water temperature, making it less vulnerable to plagues like blue algae and botulism.

## 4 THE TOOLS AND METHODS USED FOR THE ASSESSMENT

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Both surveys and models are sustainable tools and methods for climate policies and mitigation plans. From the output of surveys, we can get the database of a number of scientific ideas from the scientific community and can come up with a practical and sustainable policy plan. Models are also equally important as if we talk about nature-based solutions, then we can use the i-TREE model for green infrastructures and urban planning in terms of air pollution and climate change mitigation. So, the models can give a technical approach towards implementing the NbS at ground level and they can also predict the future benefit of implementing NbS in urban areas in a more sustainable and economical way<sup>9</sup>.

The Vietnam case concerned an extensive survey of about 1000 people, focused around a Choice Experiment to value the various restoration activities attributes. This survey was also used to look at intangible benefits, as well as a deeper understanding of the community so the results had a suitable context. The researchers used common flood risk modelling approaches to look at the impacts of the restoration activities in how they prevent flood damage from occurring. The data on the exposure and vulnerability in the area is "mixed" so, while there is a model, validating it is difficult simply as suitable data records do not readily exist. The case-study also consisted of an extensive set of community (and women) focused workshops to try and make sure the project remained inclusive as possible, as well as ongoing consultation with local policymakers and decision-makers.

## 5 ASSESSMENT BASED ON THE BEST AVAILABLE SCIENCE

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### 5.1 ASSESSMENT OF POLICIES

The best available science has adequately informed the evaluation. The Institutional Analysis and Development (IAD) framework and the Institutional Grammar Tool (IGT) are highly expected to be essential for policymakers to clearly articulate the purpose of regulations and laws, including interpreting and enforcing them, identifying, and reducing conflicts of interest, and recognizing differences in the knowledge base and values of scientists, managers, and other stakeholders. The Institutional Analysis and Development (IAD) framework and the Institutional Grammar Tool (IGT) were widely reviewed and criticised. IAD has been applied in 20 papers since 2010, addressing a wide range of governance institutions<sup>10</sup>.

Current technologies alone are not sufficient to limit climate change problems. Thus, it is important that all actors in society, including governments, private organizations, and citizens, will need change. These changes concern activities directly influencing greenhouse gas emissions (GHG) and ones affecting contexts, such as the governance processes of the energy system and other activities, such

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<sup>9</sup> Biermann, F., Hickmann, T., Sénit, CA. et al. Scientific evidence on the political impact of the Sustainable Development Goals. *Nat Sustain* (2022). <https://doi.org/10.1038/s41893-022-00909-5>  
<https://www.nature.com/articles/s41893-022-00909-5>

<sup>10</sup> Siddiki S, Heikkila T, Weible CM, Pacheco-Vega R, Carter D, Curley C, Deslatte A, Bennett A: Institutional analysis with the institutional grammar. *Policy Stud J* 2019 <http://dx.doi.org/10.1111/psj.12361>

as agriculture and forestry. There can be possible ways such as i) reductions in the drivers of climate change that would, for example, if all conventional vehicles are replaced, then we can achieve this target, and this can only be done when there is cooperation from citizens and governments. Moreover, it can be achieved from manufacturers' cooperation also, that is, private companies or owners like can promote the sale of electric vehicles rather than gasoline fuel based, particularly in developing countries and also provide charging stations for their employees and customers. Similarly, the implementation of nature-based solutions for reducing air pollution and combating climate change can only be achieved when citizens and governments join hands together, and that may be achieved through public awareness, implementation of strict policies and community-based participation programs.

## **5.2 ASSESSMENT OF ACTIONS**

In the Vietnam case, the "best available science" did inform the assessment. Methods of flood risk modelling were used, tried, and tested (e.g., assuming mangroves slowed water flows, cleaners' canals aided water flow), and a choice of experiments to work out what the separate attributes of the restoration projects were valued at. The point was not to be scientifically innovative but merely scientifically competent and rigorous so that the case for arguing how these strategies were socially effective and desirable could be made (if the results did in fact show this). The purpose was to use the scientific activities of the academic staff as a way of supporting and enhancing the advocacy work of the local communities and NGOs. This required to try and use these methods in a way that would allow folks to understand how the benefits materialised across different groups in the target areas.

Looking at production of green hydrogen the best available science comes from both Denmark and Austria where scientists have studied for several years now decentralized electrolysis. Many studies regard the business case thereof since it's important to prove that this way of electrolysis can compete with large scale production of hydrogen. In the Kristalbad case the best available science comes from literature on the integrative approach. Most important is literature on the integration of grey, blue, and green infrastructures. Many publications on this subject are inspired by work of the IPCC or written as studies to help the IPCC to report.

## **6 THE FACTORS CONSIDERED IN SELECTING THE ASSESSMENT APPROACH AND DATA COLLECTION**

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There are some factors which need to be considered in selecting the assessment approach and data collection i.e., survey based, by application of statistical tools to filter out those ideas from surveys which are significant for implementing climate change policies and plans. In terms of data collection, the site selection, investigating its research problem, working on methodology as how to collect the data of per se air pollutants which plays an important role in climate change either remotely i.e., satellite-based or measurement by sensitive instruments. Moreover, data quality is also very important, so data analysis tools should be very much active so that we can work on authentic or real data. Only then, we can plan about the policies/plans for climate change mitigation.

In the Vietnam case the researchers focused on what could be achieved given the skill set they had as a team and the skill set that they saw as that which best answered the particular questions that they had and the needs of the community. The largest factor the researchers kept in mind was that they wanted to use this project to address gender power imbalances in the society, and so this inclusive focus was baked into all stages of the project and the researchers always considered how they could use a method to show these social differences.



The case of green hydrogen presented itself to the researchers, so they stepped in without too many considerations of selecting the assessment approach and data collection. Stepping in, the researchers have used desk study and interviews to check the assessments of the involved parties and collect data. In the Kristalbad case the method is empirical to begin with; take a good look at the case, trying to grasp what's going on really. Next step is to use current ideas from economics and legal studies to make more sense of the case.

## **7 THE CHALLENGES AND OPPORTUNITIES, AND LESSONS LEARNED**

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### **7.1 POLICY ASSESSMENTS**

The assessment approach as per the surveys done should be more qualitative rather than quantitative. The qualitative approach can give us the best choice to select the most authentic and ground-based approach from a high-scientific mindset. It can be used in the climate change framework of policies or plans or climate change mitigation plans.

Given the overwhelming political and economic pressures on the global environment and the need to disrupt the systems that drive them, enduring and consistent results would not be achieved by trying to integrate different competitor parts; integration depends on a new conceptual level, on the non-partition of scientific knowledge, encompassing human sciences and exact and natural sciences; all areas must be considered and validated as important; excellence will not be obtained by the agglutination of parts, by the sum of isolated efforts, but by the construction of new concepts and practices to live better in a better world.

### **7.2 ACTIONS ASSESSMENTS**

In the Vietnam case, the assessment was mixed. A quantitative approach was used to estimate all the benefits that were presented on the previous page. However, there was a qualitative element as well to make sure that the relevant information was captured in the first place and that each of the co-benefits could be traced back to a specific community need and narrative. Having the data itself was not enough to spur action so the mixed methods approach was used to make sure that everyone was grounded.

In the green hydrogen case, the assessment follows from an actual local case where public and private actors cooperate to realize a local production site near a water treatment plant. The involved public parties are the municipality, the province and the water board that owns the treatment plant. The private parties are the owners of local windmills and solar fields, a large network manager, and a developer that wants to build and run the elektrolyser. Working on public plans and permits, and on the business plan, all these parties together have made the assessment, that is qualitative and certainly quantitatively.

In the Kristalbad case the assessment approach is qualitative in the first place, meant to describe the case. The theoretical background is a combination of economical and juridical thought. Economical is to follow ideas on externalities, and define co-benefits as yields from positive externalities, and less harm from negative externalities. A next step in working with these ideas is to also distinguish internalities from externalities, bringing more nuance in the assessment. More nuance also follows from juridical thoughts on the harm of negative externalities. Less harm is of importance legally, and it can mean less money for compensation, and that again has economical meaning. Expressing both yields and less harm in terms of money finally gives the assessment a quantitative character also.

Instead of taking current prospects for granted and project them into the future, the definition of desirable goals and the exploration of new paths to reach them contemplate a set of values, norms and policies that prioritizes socio-ecological objectives, human well-being, natural and built environments, the aesthetic, ethical and cultural meaning of the existence, encompassing all dimensions of being in the world (intimate, interactive, social and biophysical), as they interact to elicit the events and activate change. In this ecosystem approach, spaces are opened for new allocation of meanings, instead of being trapped into pre-established problem-definitions; heuristic-hermeneutic processes develop in the sociocultural learning niches a capacity to ask wider questions, reframing the problems, unveiling their dynamic and complex configurations, altering definitions and ways to deal with them, encompassing public policies, advocacy, communication, research and teaching programs. The proposal combines agent-based modelling (capable of capturing heterogeneous attributes, behaviours, and interactions of individuals) and system dynamics modelling (which captures population-level, ecological influences, and whole system dynamics). Special attention is given to production and consumption, local communities, indigenous areas, forest cover, soil and water quality, exposed nowadays by mining, pesticides, monocultures, desertification and loss of biodiversity.<sup>11</sup>

To get equal participation from government sector and citizens is pretty very much difficult and yes, of course a challenge especially in developing countries if we want to implement policy for climate change mitigation, there is challenge whether people will accept and follow practically or not...if we talk about implementing NbS in urban areas, then deforestation, land degradation and water pollution are big challenges due to urbanisation and industrialization. On the other side, opportunities are there, though they are dim, like, NbS can be a cost-effective solution, it can be adopted and adapted easily at community level, socio-economic benefits are there and above all eco-friendly in nature and can promote healthy living in future.

Finding the green hydrogen case was an opportunity not to be missed. A challenge was and is to translate all public and business plans into material that can convince others. These others are not only a scientific public, but also policy makers on a national level that have to be convinced to consider decentralized production of green hydrogen as an alternative for centralized production. Especially the whole concept of co-benefits, and accounting with these, is new to many. Most challenging is translating these co-benefits into quantities like less emission of pollutants and money in order to really convince others to believe in the alternative.

The factors considered in selecting the assessment approach and data collection are positive and negative externalities and internalities also. Finding these depends on knowledge of water, soil, climate and many more elements of the physical and social environment; most important is to know of their integration, how the one element causes the next.

## **8 ACTIONS AND SPECIFIC MEASURES WERE/ARE/WILL BE TAKEN BASED ON THE CO-BENEFIT ASSESSMENT TO MAXIMISE THE CO-BENEFITS**

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Common roadside ornamental plant species can mitigate air pollutants like ozone and benzene from the atmosphere of Delhi, India (Saxena and Sonwani, 2020). They can be further used in nature-based solutions like green roofs, green buildings, green spaces etc in urban areas. Such results are being considered and will soon be applied in NbS implementation in India. Such results can be

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<sup>11</sup> PILON, A. F., What changes are needed to face the global crisis? The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES): <https://onet.ipbes.net/node/48>

used in the policymaking process and as a sustainable approach to mitigate air pollution and climate change.

We have mangroves in the rural site, we have the local commune government wanting to include nature-based solutions in its plan, same with the local disaster risk management committee. We have also created the start of a relationship between the disaster management committee and the women's union so that DRM activities are becoming at least more gender inclusive.

The assessment results of decentralized production of green hydrogen have informed policymakers of the Dutch Ministry of Economic Affairs and Climate. Part of this process is the involvement of representatives of large industries, large network managers and of Dutch provinces; in other words, the assessment is backed up by some lobby.

The challenge is to work with a new idea of cause and effect. Old is to select an intended effect and use all necessary means to get this effect. New is to know each means and how it can have more effects and co-benefits. Old is to neglect these benefits and work only on the benefit of the intended effect. New is to make this intended effect part of a range of effects and harvest all benefits. In most cases, however, people are accountable only for the benefit of the intended effect; getting past that, looking at all benefits, can be quite a challenge.

## **9 INCENTIVIZED FURTHER ACTIONS DUE TO THE ASSESSMENT RESULT TO MAXIMIZE THE CO-BENEFITS**

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The assessment turns implicit knowledge into explicit knowledge. It provides a space for collective reflection and learning, making certain that findings are kind of sense-checked and validated. The findings can become organizational knowledge by ensuring the explicit organizational knowledge is internalized by staff along the journey. Some of the success factors in assessment exercises are seizing learning opportunities as they arise.

The results of the assessment have been instrumental in informing the policymaking process. It identifies the gaps between the data and its interpretation for decision-making. The main co-benefit of acting on climate change policies is economic benefit. This will have a co-benefit of capacity development, green jobs, gender equality, enhanced biodiversity, and many more. Though the policies are mainly made for mitigation, the synergies will provide opportunities for adaptation and sustainable development goals. Mitigations will give access to the carbon market. Significantly, taking action and capacity building would go hand-in-hand. The countries that volunteer and show commitment would increase institutional arrangements and diversity for global learning and resilience.

The recovery of the Earth and the recovery of mankind are complementary aspects and must be addressed simultaneously, in space and time, for their mutual support. Problems should be identified and dealt with considering the "general phenomenon", not reduced to particularities, fragmented issues, academic formats, and segmented public policies. Changing the paradigms of development, growth, power, wealth, and freedom embedded in political, technological, economic and educational institutions is imperative, given an inclusive ecosystem and transformative action, in terms of accountability, transparency, Impact and results. Institutional capacity, judicial impartiality, information transparency, and social spaces for citizen participation and enlightened political decisions depend on the development of new social and cultural niches of learning, both in academia and in society at large. Public pressure is of paramount importance, given the design, formation,

maintenance, and failure of institutions. Ethical aspects should be considered, but the main point is that changes depend on adopting of new ways of being in the world. This means the mutual support of four dimensions: the intimate (personal world); interactive (group allegiances); social (politics and economics); and biophysical (environmental conditions). There is a synergy between all of these dimensions: they can amalgamate around common goals (ecosystems), or they can antagonize each other (disorder and chaos).<sup>12</sup>

To maximize co-benefit, community participation and a scientific approach are very important. NbS is a very new area, especially in developing countries, so to aware the people, public awareness programs, more funding opportunities to work in this area for researchers, increasing job opportunities in this area and for youth awareness, nature-based solutions at the basic and advanced level is very much important to include them in the syllabus of intermediate, undergraduate and postgraduate level. Such small but important steps can be useful in future to implement and execute NbS policies and implementation on a more systematic and wider scale.

In the Vietnam case, the assessment itself was not the point. The actual act of collecting the data and working with the folks to determine what data were needed and how it should be presented was far more important than using the results of the assessment. The assessment itself would not change the mind of anybody who wasn't a fan of nature-based solutions. More successful was the narrative built up towards the assessment. For example, the act of building the "business case" got a collective of women's union members to create their own "what to do during a typhoon" musical to help create awareness and emergency preparedness. This only came out because while doing the assessment, the capacity and confidence in the women were created to enable them to be so.

Important results of the assessment of the green hydrogen case show how co-benefits pay off even more under the circumstances of systems integration. In this case, this is the integration with the water treatment plant that can use all three residual products of electrolysis: heat, oxygen, and utility water. This has incentivized further action to maximise the co-benefits.

Working with the idea of future value incentives further action and can maximize co-benefits. An illustration thereof is harvesting heat from the water in the water storage area Kristalbad. This is a form of aqua thermal energy, and it has pest control as an extra effect and co-benefit. This pest control against blue algae and botulism, is important for the quality of nature and water. That quality is important to be able to store and purify water, so harvesting energy and pest control help to incentivize action and maximize co-benefits. It's possible to assess upfront a range of co-benefits, but not all. In other words, front-loading is important, but also important is to be ready to use future values. Therefore, the policy-making process doesn't stop but is an ongoing job of the community of all parties involved, public and private.

To change the paradigms of growth, power, wealth, work and freedom embedded into the political, technological, economic and educational institutions, we must develop institutional capacity, judicial neutrality, informational transparency and social spaces for civic engagement. An "ecological civilization" includes environments, health, education, equity, ethics, safety, justice and beauty. Recovery of natural and built environments depends on the recovery of men, as the recovery of men depends on the recovery of natural and built environments. This goes beyond "social inclusion". It requires ethically interpreted experiences, a capacity to develop morally relevant interests as the

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<sup>12</sup> PILON, A. F., Restoring the Relationship between People and the Earth: Environment, Politics and Governance / Restaurer les Relations entre les Hommes et la Terre: Environnement, Politique et Gouvernance [online]: [https://www.researchgate.net/publication/353130658\\_Restoring\\_the\\_Relationship\\_between\\_People\\_and\\_the\\_Earth\\_Environment\\_Politics\\_and\\_Governance](https://www.researchgate.net/publication/353130658_Restoring_the_Relationship_between_People_and_the_Earth_Environment_Politics_and_Governance)

bases of rights-bearing, and a broad cultural knowledge. “Development policies” and “technological solutions” often ignore social, cultural and environmental impacts, binding nature to financial domains; demanding even more resources, and increasing pollution and waste without changing the irrational system of production, transport and consumption that plagues the world.<sup>13</sup>

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<sup>13</sup> PILON, A. F. Thinking and Acting in a Disrupted World: Governance, Environment, People, Inequality and Disease, EuroScientist Journal, 14 May, 2020 [on line]: <https://www.euroscientist.com/thinking-and-acting-in-a-disrupted-world-governance-environment-people-inequality-and-disease/>