NATURE-BASED SOLUTIONS TO SUPPORT EQUITABLE CLIMATE RESILIENCE

Desk-based Review Synthesis Report

ABSTRACT

This set of reports presents findings from international, and regional, desk-based reviews designed to identify research needs, opportunities, challenges, and gaps related to nature-based solutions and equitable climate resilience.

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Table of Contents

Introduction

Introduction and Aim:
This desk-based review is the result of Workstream 1, of the broader UKRI-led consultative process on *'Nature-based Solutions to Support Equitable Climate Resilience*'. The aim of this first workstream was to identify international needs and opportunities for research on NbS and to help narrow the scope for Workstream 2 (workshops).

Definitions:
NbS = Nature-based solutions
SUDS = Sustainable urban drainage systems
EA = Environment agency
ESS = Ecosystem services
GBM = Ganges Brahmaputra Meghna
GCRI = Global Climate Risk Index
GESI = Gender Equity and Social Inclusion
HMH = Hydrometeorological hazard
IPLC = Indigenous peoples and local communities
ISPF = International Science Partnership Fund
IWRM = Integrated Water Resources Management
LMRB = Lower Mekong River Basin
LWD = Leaky Wooden Dam
ODA = Official Development Assistance
PeS = Payment for ecosystem services

Preliminary scoping searches undertaken:
A preliminary search was undertaken to identify key search terms, potential regions, and initial research gaps. This was using key terms such as "Nature-based solutions" AND "Climate adaptation". Furthermore, key grey literature sources were identified such as IUCN, WRI, and the NbS Initiative.

Eligibility criteria:
In order to make literature eligible for review it must be in English (or translatable to English). Documents had to be accessible through institutional log-ins; if unavailable they were discarded. Documents pertaining to solely NbS and their impact on carbon sequestration or greenhouse gas emissions were also not included as the review was focussed towards NbS for equitable climate adaption not climate mitigation. Finally, news articles and informative bulletins were included as often these reported on key changes in policy or highlighted key contacts and case studies.

Timeline:
The review was conducted between 07/11/2022 and 16/12/2022. Initial scoping was conducted between 10/11/2022 and 18/11/2022. The full international and regional review was conducted between 18/11/2022 and 16/12/2022, including the write up of this report.

Caveats:
- ***Timeframe:*** Due to the limited timeframe, we were unable to review all documents identified and so smaller samples of literature were selected for review. Despite the short timeframe this report attempts to follow a condensed version of known systematic review protocols, in order to follow best practice. This does mean that this review is likely to miss some smaller key research themes, evidence gaps, and key literature but will likely pick up more general widespread literature.

- ***Bias:*** The review is able to capture NbS work which has been reported and published in English. Therefore, the review is likely to represent internationally important themes, but may miss data from more regional/local contexts. In order to minimise this, where possible, in-country contacts were used to provide additional regional information (particularly grey literature) that may be missed within the international literature
- ***GESI and IPLC dimensions:*** Although GESI and IPLC related challenges are raised in the literature, the specific challenges in regions or contexts are not captured. The high-level generalisation of these challenges misses the nuance of social issues. Workshops in Workstream 2 will be better able to capture these specific challenges and will be used to supplement this report.

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Methods:
A literature search was conducted between 21/11/22 – 25/11/22 for international literature on NbS and climate change adaptation. This involved a search of both academic and grey literature sources including: Google, Google Scholar, SCOPUS, and many grey literature websites. The details of the methods, results, and recommendations are provided in this section of the report.

Search Strategy:
To ensure a systematic and scientific approach was taken towards the expedited literature review process an adapted version of the Joanna Briggs Institute protocol was adopted (JBI, 2022). The approach involved many searches including; 1) a search of SCOPUS to identify the amount of general literature around specific regions, as well as NbS and climate adaptation; 2) a search of Google Scholar using a robust approach for searching for literature adapted from Haddaway et al., (2015), and 3) a Google search for literature, mainly grey, that involved using search terms that were likely to come up, as well as exploring governmental and organisations websites.

The exact search terms used are detailed in the Appendix.

Results:
From the international literature search on SCOPUS a total of n = 8,851 research items were identified on 23/11/2022. Due to the expedited nature of this review a smaller sample of this was selected for review alongside Google and Scholar search results. These were selected by sorting for more recent, and highly cited literature. A total of n = 89 key pieces of both grey and academic literature were identified, with a total of n = 40 of these making the final reviewed research items. This was due to many reasons including: appropriateness of source, access challenges, and time constraints.

These 40 items were then thoroughly reviewed to identify key gaps/needs in international literature on NbS and climate adaptation. This identified key research gaps, areas, and questions that could be answered by future research calls.

Key research gap areas:
International research gaps were combined into nine themes, as shown in Figure 1. Further context and explanation of the themes is given in Table 1. The themes are categorised into core NERC and other council themes to (i) help identification of world-leading environmental science needs and (ii) identify opportunities for approaching other councils to co-fund the programme to make sure important non-technical research gaps are addressed in tandem with the technical research questions.

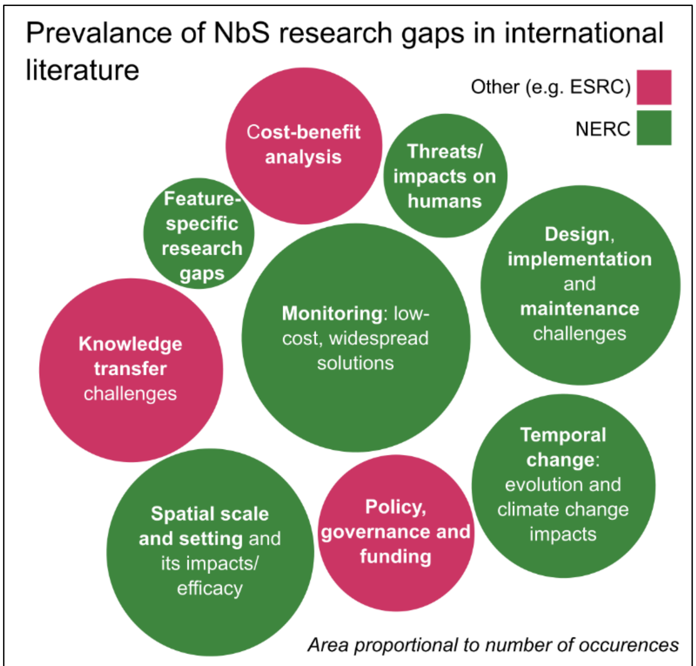


Figure 1: International NbS research gaps

Table 1: Explanation of research gap themes, the number of papers that mentioned them (#), and corresponding references

Gap/Need	Summary/notes	#	References
Scale and Setting of NbS and its impacts/efficacy	Internationally, it is well documented that due to the ad-hoc approach of NbS implementation there has been a lack of investigation into the large-scale impacts of NbS interventions. This lack of research of large-scale impacts of NbS is also reflected in the global South, even if large-scale interventions may have already been implemented in some regions, such as India and China's large land use change programs or wetland restorations. This is compounded by a lack of large-scale monitoring evidence or modelling of the efficacy of these at scale. Research Questions: What is the efficacy of NbS at different scales; micro, meso, large, and between interventions? How does the efficacy of different NbS features change across different settings, and what is the impact of scale on this?	14	Seddon et al., 2020b, Chausson et al., 2020, Kabisch et al., 2017, Seddon et al., 2022b, Frantzeskaki et al., 2019, Faivre et al., 2017, Seddon, 2022c, Austin et al., 2021, Johnson et al., 2022, Martin et al., 2021, Lafortezza et al., 2018, UNEP, 2022, EA, 2017, Heidari et al., 2022
Temporal change of NbS: evolution of efficacy and climate change adaptation	While the concept of NbS is traditional in essence, as it uses natural processes, the understanding of how constructed sites develop over time is relatively new. With temporal change often being linked to wider scale change of landscapes it is important to note that many recently built sites may not show the true extent of their benefits till many years into the future, and their efficacy may be impacted either positively or negatively under future climate scenarios. Research Questions: How will the efficacy of certain NbS features change under future climate scenarios? How will the development and evolution of certain NbS features impact their efficacy for managing different HMHs?	11	Kabisch et al., 2016, Seddon et al., 2020b, Kabisch et al., 2017, Seddon, 2022c, Turner et al., 2022, Martin et al., 2021, Hobbie and Grimm, 2020, Ossola and Lin, 2021, EA, 2017, Kabisch et al., 2016, Heidari et al., 2022
Monitoring NbS: low-cost, wide-spread indicators and solutions	Monitoring NbS came up as the most mentioned research need/gap, due to the lack of guidance on monitoring, as well as lack of monitoring of NbS for multi-benefits, large-scale impacts, or temporal change. This area may be under researched due to; the high cost of large-scale monitoring plans, the limited funding typically given toward monitoring programs, or the challenge of monitoring the multi-benefits of a site that means monitoring plans tend to focus on one or two key environmental indicators to monitor. Research Questions: How to develop methods and guidance for monitoring multiple environmental indicators/benefits provided by NbS sites? What low-cost, modern-tech monitoring methods can be used to monitor large-scale NbS interventions for efficacy at scale? (Internet of things, citizen science, drone data, Lowaran networks, etc.)	17	Seddon et al., 2020a, Chausson et al., 2020, Kabisch et al., 2017, Seddon et al., 2022b, Frantzeskaki et al., 2019, Seddon, 2022c, Frantzeskaki and McPhearson, 2022, Austin et al., 2021, Ossola and Lin, 2021, Parker et al., 2020, Lafortezza et al., 2018, DelosRios-White et al., 2020, CISL, 2022, FEBA-IUCN, 2022, Matthews and Dela Cruz, 2022, EA, 2017, Heidari et al., 2022

Knowledge transfer challenges: Western and IPLC	Knowledge transfer refers to challenges at varying levels of NbS research. In some cases, the challenge of transferring knowledge around NbS, and its benefits, is quite local, such as building capacity and knowledge transfer between IPLC and engineers implementing features. However, in other cases this can also be all the way up to the international level of IPLC knowledge integration with established NbS research. There are, however, major issues with heavily Western dominated literature (at least in English, that was used to perform the literature search) and a lack of the involvement of community and indigenous voices in planning NbS, in particular with the change of land-use practices or conservation and restoration of native forests. Research Questions: How can the integration of IPLC knowledge and support on projects improve current understanding of the efficacy of NbS, as well as improve current global North and South NbS design? How can knowledge transfer contribute to the evidence base globally, as well as improve equitable approaches to NbS climate adaptation?	11	Kabisch et al., 2016, Chausson et al., 2020, Kabisch et al., 2017, Osaka et al., 2021, Wamsler et al., 2020b, Wamsley et al., 2020a, Seddon et al., 2022b, Faivre et al., 2017, Rivzi et al., 2015. UNEP, 2022, Heidari et al., 2022
Design, Maintenance, and Implementation challenges	Internationally, the design of sites was identified as a major challenge to NbS implementation. This came in three forms; 1) optimal design of NbS (location of features and order at an NbS site, or the addition of other elements to improve efficacy for managing multiple hazards), 2) complex scenarios (while the IUCN provide design criteria for sites and practitioners are trained on optimal situations this is often not the case or far more complex in real-world situations), 3) integration of local or other flora-fauna (often sites are designed with one type of vegetation intervention and does not always integrate multiple or native species). Maintenance falls under this category as although it overarches many different challenges, this is generally a major barrier to implementation as engineers are generally reluctant to create features that will not be maintained. Research Questions: How can existing NbS be enhanced to fit complex scenarios using alternative configurations of features or multiple features at one site? How can integrating IPLC knowledge improve new NbS site design through use of traditional techniques, as well as local flora-fauna? From a community perspective: what factors influence adoption of NbS? And how can IPLC knowledge enhance these features?	13	Kabisch et al., 2016, Kabisch et al., 2017, Osaka et al., 2021, Wamsler et al., 2020b, Frantzeskaki et al., 2019, Seddon, 2022c, Hobbie and Grimm, 2020, Frantzeskaki and McPhearson, 2022, Ossola and Lin, 2021, CISL, 2022, Matthews and Dela Cruz, 2022. EA, 2017, Kabisch et al., 2016,
Cost-Benefit analysis of NbS	Cost-benefit analysis is defined here as the analysis of NbS' costs and benefits when compared to traditional engineered solutions. While some advocate that we should move away from this approach as they are not comparable and should be considered separately, it is also widely recognised that to create a shift in the paradigm of thinking in practitioners for NbS implementation, there is a need for clear evidence of its effectiveness relative to its cost. This cost effectiveness assessment should consider the capital cost of the feature itself, the expected maintenance costs, and the potential hazard risk reduction savings they provide.	8	(Seddon et al., 2020a, Chausson et al., 2020, Faivre et al., 2017, Seddon, 2022c, Risvi et al., 2015, Hobbie and Grimm, 2020, Matthews and Dela Cruz, 2022, Kabisch et al., 2016,

	Research Questions: How can we accurately perform a cost-benefit analysis of NbS for its efficacy in the short and long term? How can we quantify the multi-benefits of Nbs and the ESS that they provide?		
Challenges of policy, governance, and funding for projects	Policy and governance challenges are a barrier to implementation in nearly every setting. Sometimes these barriers can come from a lack of legal instruments for implementation but can also be related to poor administrative or funding services for NbS. Overall, sharing of knowledge on funding methods for NbS implementation, maintenance, and PeS would likely help to increase international NbS representation in key national policy and governance. Research Questions: How can international sharing of policy and governance approaches to NbS implementation improve regional policy? What are examples of best practice for NbS policy, and how can international policy and lessons learnt inform regional policies? And how can environmental agencies aim to reflect this locally? What are the roles of socio-economic-cultural factors in policy and governance to encourage wider adoption?	8	Kabisch et al., 2016, Seddon et al., 2022b, Woroniecki et al., 2022, Seddon, 2022c, Frantzeskaki and McPhearson, 2022, Lafortezza et al., 2018, CISL, 2022, FEBA-IUCN, 2022
Threats/Impacts on humans from NbS	While threats and unintended consequences of NbS were not mentioned frequently, it is certainly becoming an area of interest. With not only climate change increasing the threats of HMHs, and therefore increased pressure on NbS to adapt and potentially fail, but also an increased risk of waterborne vector diseases such as malaria, the threats from NbS are becoming a serious challenge for practitioners to consider. Cascade failures from the combination of multiple NbS features, increased risk of disease from large water bodies, and increased drowning risk are just some of the potential threats from NbS to be considered. Research Questions: What are the threats of NbS and to whom? How can they be identified? How can threats be better incorporated into the planning and scoping process of NbS delivery? How can threats to human health and wellbeing be minimised through improved design of NbS in-context, and how can these threats be quantified in terms of economic damages?	5	(Calliari et al., 2019, Kabisch et al., 2017, Parker et al., 2020, CISL, 2022, Kabisch et al., 2016,
Feature Specific Lack of Research (Mangroves, Grassland, Hybrid, etc…)	Internationally, mangroves, grasslands, and drylands remain settings with a lack of research into their impact on climate adaptation. Furthermore, there is lack of research on hybrid NbS solutions with few examples existing globally. These specific environments come with different contextual challenges that are yet to be quantified, monitored, or studied. Research Questions: How do hybrid solutions compare to purely NbS or purely infrastructural solutions for climate adaptation? How can NbS be implemented in under-represented settings to adapt to climate forced HMHs?	4	(YaleE360, 2022, Chausson et al., 2020, Kabisch et al., 2017, Turner et al., 2022,

NbS vs Hazard Matrix
Using the literature identified above and the regional literature we mapped different common NbS types to different contexts/hazards (Table 2). This allows examination of multi-hazard solutions and identifies the range of potential NbS for a given hazard.

Table 2: Mapping of NbS types against contexts/hazards, with examples from the literature. Each reference can be found by going to the Appendix and looking for the appropriate letter and number. (I = India, SSA = Sub Saharan Africa, M = Mekong, B = Brazil)

Context / NbS type	Urban Pluvial	Catchment Fluvial	Coastal	Landslides	Heatwaves/ Urban heat	Drought
Tree planting	SSA 8,10,17	SSA 35 B 22		I 7	B 23 M 6	
Wetlands	I 9	SSA 29-32	I 11		I 9	SSA 14
Run-off attenuation/ storage	M 8	M 5				I 7
Coastal vegetation			I 11			
SUDS/LID/GI	SSA 1,8 B 13				SSA 23	SSA 1 B 11
Land use/soil management		SSA 13,14,16 B 15	I 15	I 6		

Summary of findings and key points:
The international review highlighted nine themes (Fig. 1) within which current research gaps were grouped. This may be simplified further into three higher level NERC-facing challenges and one non-NERC challenge:
1. Spatial scale and setting
2. Temporal scale (system evolution, climate change mitigation, monitoring, maintenance)
3. Technical (design, implementation, feature-specific science)
4. Societal (Policy, governance, funding, knowledge exchange)

Future research recommendations:
1) There have been major reviews of NbS internationally but typically wetlands, SUDS/LID/GI, and tree planting tend to be best represented. Despite this representation there is a lack of empirical evidence of their effectiveness at scale and temporally, particularly in the Global South. We therefore recommend that investigation into low-cost large-scale monitoring should be conducted to quantify the benefits and threats of these features in a range of contexts.
2) Monitoring that has been conducted has built a large evidence base that is challenging to synthesise using a single or even multiple reviews. However, there appears to be a lack of multi-environmental indicator monitoring for sites, with a trend to focus towards specific benefits of NbS features, such as flood risk or water quality. We recommend that the development of monitoring plans that account for multiple hazards, and environmental indicators be developed and implemented to quantify the multi-benefits that NbS allegedly brings.
3) While NbS has been represented widely in literature there is a lack of "hybrid" solutions implemented which is likely due to technical gaps in knowledge for how to implement them, as well as a need to build trust in NbS as an effective solution. Furthermore, "hybrid" features tend to require more complex work that may not fit with high-level IUCN guidelines on NbS. We recommend that greater focus on "hybrid" solutions and their effectiveness at tackling medium – large scale HMHs be taken, alongside building capacity for local practitioners to implement these sorts of projects.

4) An important consideration for implementing NbS in Global South settings is the trade-off between local communities needs and implementing effective NbS measures. Often IPLC voices can be lost in the early stages of project delivery as projects are typically implemented from a “top-down” approach but managed and maintained by local communities from a “bottom-up” way. We recommend that any research conducted should aim to integrate IPLC in the decision-making process from the beginning and should aim to share knowledge not only down the chain to IPLCs but also upwards to international policy to improve best practice and understand the importance of context when implementing NbS.
5) Finally, internationally literature highlights that catchment-based approaches for managing HMHs are best practice, but this becomes more complex when transboundary management comes into play. The challenges of transboundary IWRM must be accounted for and managed when considering NbS solutions. We recommend that future research aims to take a systems approach to NbS siting in order to capture all of the complex political dynamics of catchment management, and furthermore that modelling, and monitoring be conducted to quantify the impacts of large-scale NbS across-boundaries both benefits and disadvantages.

Justification of approach
To ensure feasibility within the limited timeframe it was necessary to constrain the regions covered within the regional review to a maximum of four geographic regions from 29 ISPF ODA countries. To do so, we used indices related to the core themes of the proposed call (climate risk and equity) to compare the ISPF countries. The Global Climate Risk Index (GCRI) 2021 is a measure of the extent to which countries/regions have been affected by hydrometeorological hazards between 2000-2019. Therefore, it is a first-order measure of which regions may have a priority need for climate resilience that agrees broadly with other climate change vulnerability research (Byers et al, 2018). The INFORM 2023 index was inspected to further justify and consider capacity to cope and vulnerability (EC, 2022). Using the index overall score itself may not be as useful as we are looking for countries with vulnerability, middling capacity to cope, and hazards and drawing this out as a meaningful index may be challenging given the time frame. Overviews of each country can be found via the European Commission.

The Gini coefficient is a statistical measure of income inequality (De maio, 2007) that was used to identify countries where equity may be an important theme, regarding the implementation of NbS. As with GCRI, we recognise the limitations of this approach, but given the short timeframe it provides an initial method for grouping countries, and we treat the index as an approximate value rather than for precise ranking.

To narrow down countries/regions, we first restricted the scope to countries in the top 85 for CRI as there is a natural split between 85-110 (Figure 2). Second, we considered countries with a Gini score above 50 as there is a similar split in the data around this value. Selecting countries that met either or both of the above thresholds resulted in a list of 18 countries.

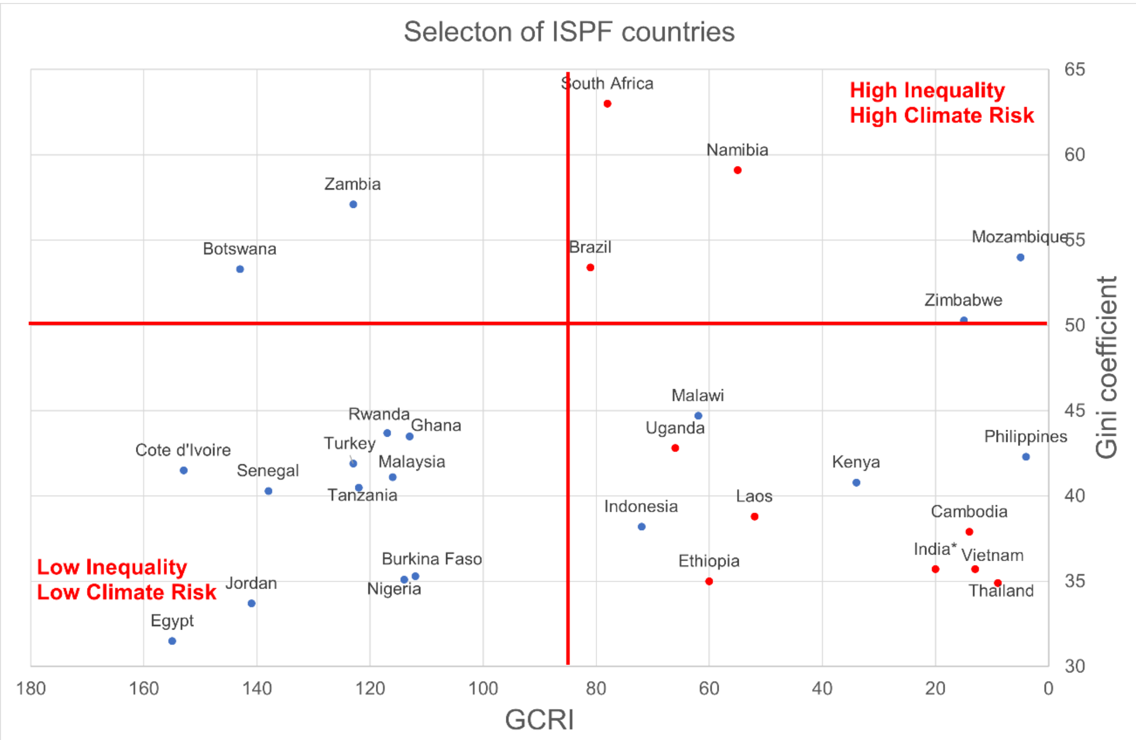


Figure 2: Plot of Gini coefficient against GCRI for all 29 ODA ISPF countries. The horizontal red line shows the identified lower threshold Gini coefficient (50). The vertical red line shows the upper threshold identified for GCRI (85). Thus, countries not in the lower left quadrant were considered. Red dots show countries included within the final regional analysis. Blue dots indicate excluded countries (see below for rationale).

The final step in narrowing the scope was based on (i) evidence of existing NbS activity and capacity and (ii) a pragmatic approach to group countries into no more than four geographic regions for further analysis. The first criterion is a requirement for the desk-based review, to ensure adequate material for review and also reflects the balance between selecting countries with too little evidence and capacity, where the programme may fail, and selecting countries where there is already a wealth of knowledge and experience and thus fewer needs (Figure 3).

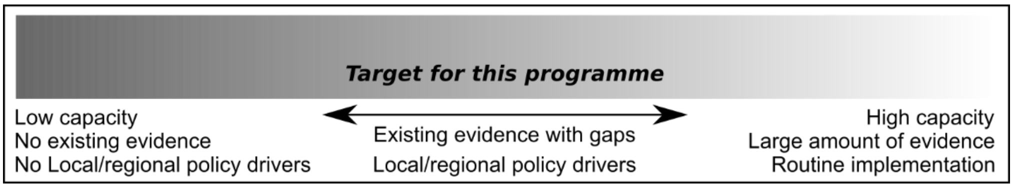


Figure 3: Schematic of the intended scope of the programme

Of the 18 countries not in the lower left quadrant in Figure 2, six Sub-Saharan African countries were excluded based on initial review of NbS evidence across Africa due to lack of existing evidence/capacity. Cilliers et al., (2019) identified key publications and case studies of NbS in Africa which led to Botswana (n = 6), Zambia (n = 37), Mozambique (n = 0), Zimbabwe (n = 16), Malawi (n = 20), Kenya (n = 15) being excluded either due to the lack of NbS examples, or if there were examples some of the literature being >20 years old, or not specifically NbS. By comparison, South Africa (n = 70), Uganda (n = 48), and Ethiopia (n = 82) were clear candidates for having enough evidence and case studies to investigate, while still having enough researchable gaps.

In addition to existing literature, we examined past and present UKRI funding. A number of recent/ongoing UK research programmes have focused on regions within the ISPF ODA list. In particular, Future Climate for Africa (FCFA), Science for Humanitarian Emergencies and Resilience (SHEAR), and understanding the impacts of hydrometeorological hazards in Southeast Asia (Newton Hydromet) have funded numerous projects in this space (Table 3). Furthermore, some large GCRF projects have also covered these countries.

The FCFA programme was mainly focused on regional climate prediction and incorporating this understanding in decision-making processes. For two FCFA projects, we identified overlap with the broad topic of NbS; drivers of urban flooding (Burkina Faso) and agricultural adaptation (Senegal). Similarly for the SHEAR programme, only one project clearly mapped to themes of NbS; pluvial flooding (Uganda). For Newton Hydromet, most projects focussed on understanding impacts of hydrometeorological hazards and prediction/warning systems rather than resilience/adaptation. However, some did consider the impact of land-use, including deforestation and urbanisation (Indonesia), basin-scale flood management (Indonesia), adaptation strategies (Thailand) and BGI for flood resilience (Vietnam).

The GCRF Living Deltas project includes research on coastal NbS across the Mekong (Vietnam, Cambodia, Laos, Thailand) and Ganges Brahmaputra Meghna (India) rivers. Another large GCRF project, Blue Communities, (NE/P021107/1) focused on coastal NbS in Indonesia, Philippines, Vietnam and Malaysia. Finally, African Research Universities Alliance (ARUA), in partnership with UKRI, are developing capacity within centres of excellence in ‘Water’ and ‘Climate and Development’ that both map to the themes of NbS and climate adaptation.

In addition to large programmes and directed calls, country-specific searches on UKRI Gateway were used to identify relevant existing projects. For countries with >300 search results, additional search terms (“NbS”, “climate”, “adaptation”, “ecosystem”) were used to narrow the search. The results show some disparity with existing NbS occurrence (e.g., some African countries with more funded projects than the literature above suggests).

However, the classification of relevant projects was broad, and the precise focus/outputs of the projects was often not clear, which may explain the disparity.

To maintain a global focus at this stage, it was decided to focus the regional reviews on five catchments or regions covering 10 countries. A ‘catchment’ approach was selected, not to limit the types of NbS or contexts considered, but to identify regions with similar climate, geology and potentially management frameworks/stakeholders that could provide the focus for a coherent research programme. Within each region/catchment, multiple NbS contexts or hazards were considered (catchment, coastal, drought, heat, landslides, urban). In adopting this catchment approach, the pragmatic decision was made to disregard two further countries (Indonesia, Philippines). Both have received substantial funding and research and so are arguably towards the right-hand side of Figure 3; but are also similar in context to countries included in the list (Cambodia, Thailand, Vietnam) such that relevant issues may still be picked up by the regional review.

The final catchments/regions selected were:

- Lower Mekong River Basin (Cambodia, Laos, Thailand, Vietnam + *China*)
- Ganges Brahmaputra Meghna (GBM) river basin (India + *Bangladesh*, *Nepal*)
- Orange River Basin (Namibia, South Africa)
- Nile River Upper Basin (Ethiopia, Uganda)
- Brazil

To simplify the review, the Orange River and Nile River contexts were combined into a single Sub-Saharan Africa region. A similar approach to that of the international review was taken for regional reviews with search terms adapted for more regional specific NbS or countries.

Summary of Findings and Key Points

Individual region-specific findings are included in the following pages. Here we present the broader findings that emerged across and between regions.

1. Internationally, Wetlands, Afforestation, and Urban NbS solutions tend to be the most common across all contexts.
2. While NbS may have been implemented in the Global South a lack of monitoring has made it hard to empirically show the efficacy of NbS. This is particularly important when assessing the impacts of NbS at varying scales, or multi-benefits of NbS monitoring as sites tend to be monitored for one particular purpose with a tagline of having multi-benefits.
3. There is a need for a “multi hazard, multi method” approach to NbS design. This comes from the complexity of climatic settings in the Global South, as well as a need for more hybrid approaches to tackle multi-faceted problems.
4. Between the 4 regions we have 2 key groups of setting. Group 1 (GBM and LMRB), where there has been widespread NbS developed, but there is a need for further monitoring and upscaling of solutions. They have a need to move towards developed NbS networks, catchment-scale management and monitoring, and more complex hybrid solutions. Group 2 (Brazil and Sub-Saharan Africa) have more limited NbS implementation, showing some capacity, but we are yet to see this made widespread or cemented in policy. These regions are slowly developing pilot-sites for NbS, but still lack some technical capacity or policy to implement these features. Group 2’s need is to move towards building further evidence base and case studies to improve practitioners trust in its efficacy and build on local knowledge and capacity through working closely with IPLC.

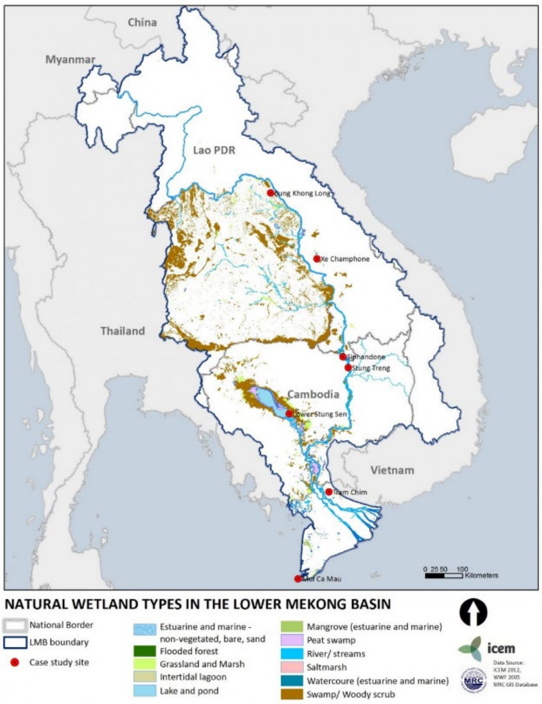
Table 3: ISPF ODA countries with corresponding CRI ranks and Gini coefficients as well as details of existing or recent UKRI funded projects. Cells coloured red indicate countries above the threshold for consideration for GCRI/Gini. Countries in bold are those included in the final review

ISPF Country	GCRI	Gini	Existing UKRI-funded and related projects
Botswana	143	53.3	FCFA, SHEAR (x3) ESRC project (ES/P006701/1) on ecosystem degradation
Brazil	***81***	***53.4***	***NERC studentship (2607180) on tree planting*** ***NERC project (NE/S000011/1) on restoration of forests*** ***BBSRC project (BB/R016429/1) on sustainable agriculture***
Burkina Faso	112	35.3	FCFA (including urban flooding)
Cambodia	***14***	***37.9***	***ESRC project (ES/R009279/1) on ESS access/use*** ***NERC project (NE/L001411/1) on ESS availability/use for wellbeing and justice***
Cote d'Ivoire	153	41.5	
Egypt	155	31.5	
Ethiopia	***60***	***35***	***SHEAR (x2)*** ***ESRC project (ES/T003073/1) on combatting land degradation considering equity and justice*** ***EPSRC studentship (2598942) on urban resilience to climate hazards*** ***ESRC Grant (ES/T015330/1) including landscape restoration outcomes*** ***EPSRC studentship (2597525) addressing dryland degradation***
Ghana	113	43.5	NERC KE fellowship (NE/V018590/1) on reforestation ESRC studentship (2398935) on community-based land/resource management ESRC project (ES/T015446/1) on climate action to reduce poverty/inequality (inc. adaptation)
India*	***20***	***35.7***	***SHEAR (x2)*** ***COP26A&R NERC Call (with particular focus on India)*** ***BBSRC project (BB/T018755/1) including nature-based water quality management*** ***NERC project (NE/I003282/1) on just ecosystem management*** ***NERC project (NE/S012850/1) on contribution of nature/ESS to poverty alleviation*** ***NERC projects (NE/I004661/1, NE/I003924/1) on multiple benefits/trade-offs of forest ESS***
Indonesia	72	38.2	3x Newton Hydromet, (including flooding/drought) SHEAR Newton project (GA261682033) on Blue-Green infrastructure NERC studentship (2271813) on ESS of restored mangroves NERC project (NE/T005092/1) on forest restoration NERC project (NE/S007059/1) on forest natural capital value NERC project (NE/P014127/1) on mangrove restoration and ESS
Jordan	141	33.7	
Kenya	34	40.8	FCFA, SHEAR (x3) ESRC project (ES/T015446/1) on climate action to reduce poverty/inequality (including adaptation) NERC grant (NE/X001679/1) on regenerative agriculture adoption BBSRC grant (BB/S014934/1) on restoring grasslands NERC projects (NE/K010484/1, NE/L001535/1, NE/I00324X/1, NE/G008078/1) on coastal ESS (mangroves, seagrasses & forests) & wellbeing/poverty alleviation EPSRC studentship (2597525) addressing dryland degradation
Laos	***52***	***38.8***	
Malawi	62	44.7	FCFA (x2), SHEAR (x2) AHRC Studentship (2748340) on agriculture and reforestation

			NERC project (NE/P02095X/1) on conservation agriculture
Malaysia	116	41.1	4 x Newton Hydromet NERC projects (NE/V005758/2, NE/P020925/1) on mangrove restoration partnerships and tension/trade-offs with fisheries NERC project (NE/P020917/1) on land-use terrestrial/coastal trade-offs NERC project (NE/T005092/1) on forest restoration
Mozambique	5	54	FCFA, SHEAR (x3) ESRC studentship (2434509) on PeS in forests.
Namibia	***55***	***59.1***	***FCFA***
Nigeria	114	35.1	SHEAR ESRC project (ES/P006701/1) on ecosystem degradation
Philippines	4	42.3	4 x Newton Hydromet, SHEAR NERC project (NE/P020917/1) on land-use terrestrial/coastal trade-offs
Rwanda	117	43.7	
Senegal	138	40.3	FCFA (including agricultural adaptation) SHEAR (x2) ESRC Grant (ES/T015330/1) including landscape restoration outcomes
South Africa	***78***	***63***	***FCFA, SHEAR (x2)*** ***ESRC project (ES/T015446/1) on climate action to reduce poverty/inequality (inc. adaptation)*** ***ESRC Grant (ES/T015330/1) including landscape restoration outcomes*** ***NERC project (NE/P008127/1) on ESS, poverty and policy***
Tanzania	122	40.5	FCFA NERC studentship (2449770) on tree planting restoration potential NERC project (NE/L001616/1) on urban poor access to ESS NERC project (NE/L00139X/1) on PeS for wildlife conservation NERC project (NE/L001535/1) on coastal ESS NERC project (NE/X002276/1) on value of conservation woodlands
Thailand	***9***	***34.9***	***3 x Newton Hydromet (including agricultural drought, drought, coastal)*** ***NERC project (NE/T005092/1) on forest restoration and resilience***
Turkey	123	41.9	
Uganda	***66***	***42.8***	***FCFA, SHEAR (x3, including pluvial flooding)*** ***ESRC project (ES/P006701/1) on ecosystem degradation*** ***NERC project (NE/V008714/1) on forest restoration***
Vietnam	***13***	***35.7***	***4 x Newton Hydromet, (including flood mapping, flood/drought, compound flooding, BGI);*** ***NERC KE fellowship (NE/V018590/1) on reforestation*** ***NERC project (NE/P014127/1) on mangrove restoration and ESS***
Zambia	123	57.1	FCFA, SHEAR NERC project (NE/P02095X/1) on conservation agriculture
Zimbabwe	15	50.3	FCFA, SHEAR (x2) NERC project (NE/P02095X/1) on conservation agriculture

Lower Mekong (Vietnam, Laos, Thailand, China)

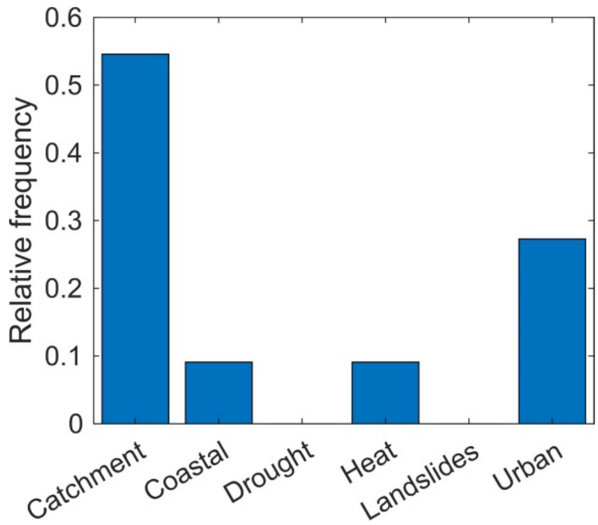
Introduction:
The total length of the Mekong River is approximately 4,900 km, and crosses from the Tibetan plateau in China all the way to its delta in Vietnam.

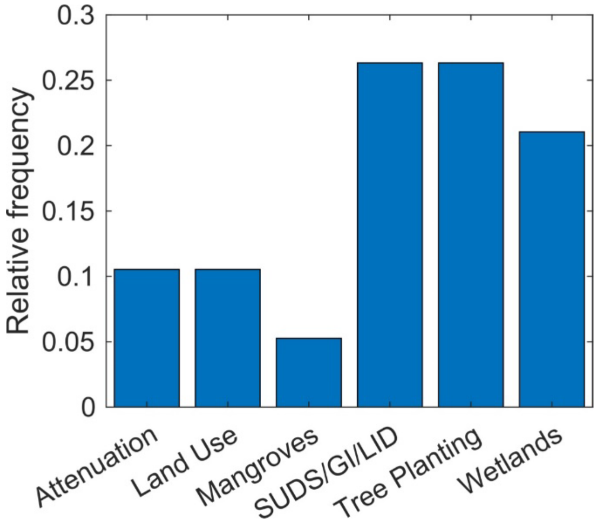


Source: (MRC, 2022)

Key landscapes/contexts:
The LMRB comprises of a range of biodiverse environments from tropical rainforest environments to wetlands. A key feature of the LMRB is the Tonle Sap Lake which is the largest freshwater lake in Southeast Asia. In recent years, the LMRB has suffered from massive amounts of soil erosion from damming and deforestation for agriculture. The delta itself is also under threat from increased salinisation, sea-level rise, and pluvial flood risk from climate change.

Literature search overview:
Initially, SCOPUS identified a total of n = 283 papers on 30/11/2022. This was then narrowed down to a total of n = 29 key pieces of literature that were most relevant to the setting. While the REDD+ initiative has been referenced as a method for tackling erosion challenges there have been many local challenges to implementing this.





Prevalence of Hazards:
- The LMRB literature reflected a range of potential hazards with catchment fluvial hazards appearing the most.
- Catchment hazards coming up the most is again reflective of the major challenges of soil erosion and deforestation.
- A majority of coastal literature referred to the protection of mangroves and wetlands within the Vietnam deltaic environment. (While not mentioned here fish stock decline is also a major threat to this ecosystem and livelihoods). The topic of coastal NbS also features heavily in research projects across the wider region (Table 3)
- A majority of literature came from Thailand, Cambodia, and Vietnam. This may be why we see a lack of landslide NbS as the south part of China and Laos is generally the most high-risk zones for this type of hazard.

Prevalence of NbS:
- A range of NbS was represented in the literature which is reflective of the range of hazards impacting the LMRB.
- Wetlands, tree planting, and SUDS appeared the most in the most which was expected from the hazards in the region. As above, with a wider geographic we expect mangroves would be more prominent.

Key Case Studies:

Case study	Source
Ho Chi Minh City, Vietnam (Green Buildings/ Infrastructure)	President Place, located at 93 Nguyen Du in District 1 (ADB, 2016).
Building Climate Change Resilience in Battambang, Cambodia	https://www.adb.org/sites/default/files/publication/215721/nature-based-solutions.pdf
Four major NbS opportunities highlighted by IUFM in Thailand and Vietnam	IUFM Summary – (https://watersensitivecities.org.au/wp-content/uploads/2022/02/IUFM-Summary-Guide_ENG.pdf)

Key Regional Actors:

Key regional actor(s)	Website/Contact Details
Mekong River Commission	https://www.mrcmekong.org/
Asian Development Bank	https://www.adb.org/
Association of Southeast Asian Nations	https://asean.org/
Water, Land, and Ecosystems Mekong Partnership	https://wle-mekong.cgiar.org/
CRC for Water Sensitive Cities	https://watersensitivecities.org.au/nature-based-solutions-in-the-mekong-region/

Regional drivers for NbS research:
The Mekong River Commission has been integral in the assessment and implementation of climate change adaptation and policy across Laos, Thailand, Vietnam, and Cambodia. The MRC (2017) published a document detailing all the key regional policies in place for climate change adaptation in the LMRB. The Mekong itself has seen an extensive amount of interest in NbS with numerous sources of outside funding such as the ASEAN, through means such as the Smart Cities Network that strives for modernisation through sustainable urban development. A wide range of actors are also involved in NbS implementation in the region who are now looking to up-scale these numerous smaller sites, as well as consider how to adapt existing NbS to be more effective.

Key regional research needs/gaps: *[mapped to identified international research themes]*

- Adapting existing afforestation projects to enhance soil conservation *[Feature-specific, Spatial scale]*

Existing afforestation projects typically focus on the use of one species of tree and do not consider how cover crops or shrubbery can aid in reducing the erosion of soils in high-rainfall events. Even the combination of cross-slope barriers or no-till policy has not been explored.

- Impact of future climate change on flood risk (coastal, pluvial, fluvial) *[Temporal/ Monitoring/ Threats]*

The deltaic Mekong region is at particular risk as it is a hazard hotspot for many different HMHs. Finding methods for predicting and monitoring change in this area would be beneficial for deltaic environments globally.

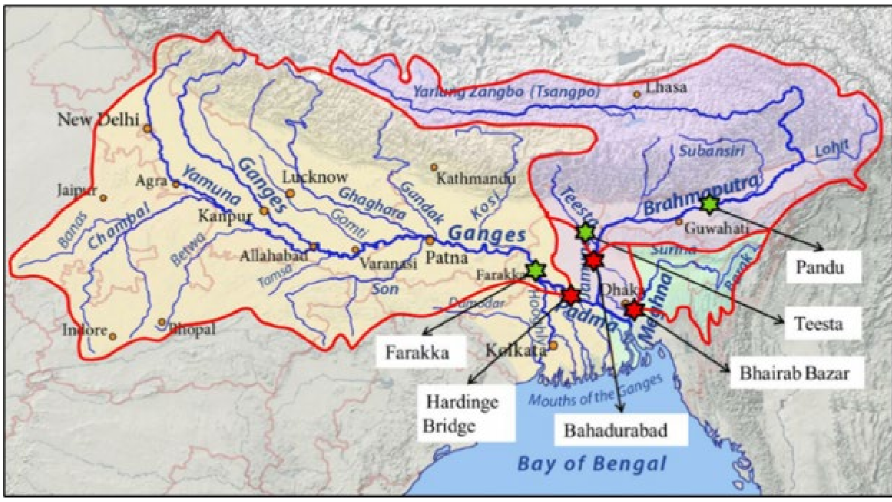
- Human comfort in urban heat spots *[Threats/ Monitoring/ Feature-Specific]*

In the urban cities in the Mekong region there has been an increase of urban heat islands. To combat this, urban tree planting has been used in pilot schemes and shown to be effective, yet a lack of extensive intervention, monitoring of both social and physical parameters means its full impacts are not yet realised.

Ganges Brahmaputra Meghna river basin (India)

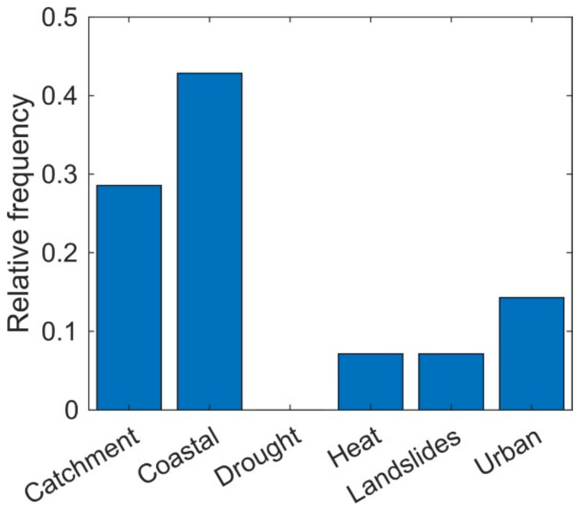
Introduction:
The GBM is the third largest freshwater outlet in the world with over 630 million people living within its boundaries.

Key landscapes/contexts:
The GBM is a transboundary river network crossing through five countries: Bangladesh, Bhutan, China, India, and Nepal. The GBM has many challenges both social and physical, from pollution to high flood risk, with its delta being one of the most threated internationally due to sea-level rise, growing populations, and climate change.



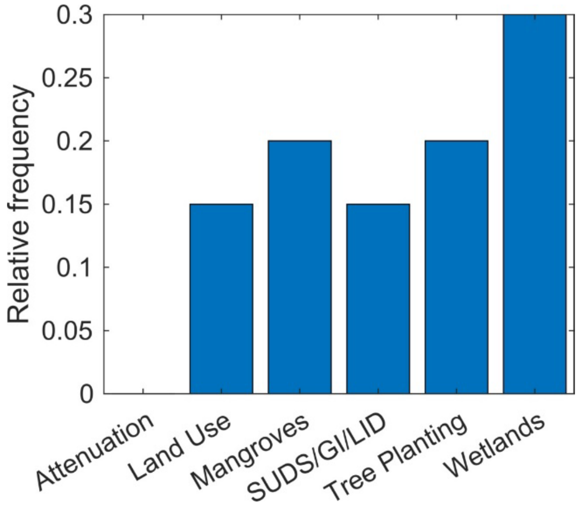
Source: (Masood et al., 2015)

Literature search overview:
Initially, SCOPUS identified a total of n = 1,088 papers on 30/11/2022. This was then narrowed down to a total of n = 19 key pieces of literature, which did include 2 books, as well as large reviews of NbS in the GBM. Hence why fewer literature sources were required to gain a broad overview of the topic in this region.



Prevalence of Hazards:

- Nearly all types of hazards were being tackled through a range of NbS measures with coastal NbS being represented most.
- Large reviews of NbS in the GBM have been conducted that highlight many case studies, gaps, and ways NbS have been used to tackle HMHs.
- The Bangladesh delta is a hazard hotspot where many different NbS have been used. (Mangroves for coastal; reservoirs, land use change, and agroforestry for inland flooding and landslides, and SUDS for water security)



Prevalence of NbS:

- A UK GOV (2021) review of NbS and key issues in India highlighted 134 NbS and hybrid solutions that reflect the widespread and high frequency of NbS in other literature.
- The concept of Eco-DRR is a prevalent in literature and policy, with “Jal Shakti” (India’s EA equivalent) reflecting this through schemes such as “Catch the Rain”.
- Some alternative NbS solutions that were picked up from the literature include: check dams, nala bunds, and bandals which are similar to Western styles of NbS such as LWDs.

Key Case Studies:

Case study	Source
134 NbS and Hybrid approaches all documented in the UK GOV – India NbS Review	https://ioraecological.com/wp-content/uploads/2021/06/Nature-based-Solutions.-A-review-of-key-issues-in-India.pdf
NbS case studies specific to the GBM captured by IUCN	https://programme.worldwaterweek.org/Content/ProposalResources/PDF/2022/pdf-2022-10379-1nbs_in_the_gbm_river_basin_case_studies_and_lessons_learned_iucn_final_2.pdfNature-based Solutions in the Ganges Brahmaputra Meghna (GBM) river basin (IUCN, 2021)
Jal Shakti: Catch the Rain project	https://jsactr.mowr.gov.in/public_dash/dashboard.aspx

Key Regional Actors:

Key regional actor(s)	Website/Contact Details
International Union for Conservation of Nature and Natural Resources (IUCN)	https://www.iucn.org/
Transboundary Rivers of South Asia (TROSA)	https://www.cnr.edu.bt/?page_id=720
Ministry of Jal Shakti (Indian Environment Agency)	http://jalshakti-dowr.gov.in/
Vast range of key NbS experts highlighted in Annexures 9.1,	https://ioraecological.com/wp-content/uploads/2021/06/Nature-based-Solutions.-A-review-of-key-issues-in-India.pdf

Regional drivers for NbS research:
There has been a large amount of investment from both government and outside actors such as the UK government (e.g. Smart Cities Mission, Centre for Wetland Conservation & Management). Further to this, an ongoing project titled "Building River Dialogue and Governance for civil society organisations in the Ganges-Brahmaputra-Meghna River basins" or (BRIDGE GBM) is aiming to spark better regional level basin management. There is lots of interest in supporting NbS, as well as cross-boundary projects and monitoring but more investment and technical knowledge development is required.

Key research needs/gaps: (mapped on to bubble themes)

- Low-cost monitoring of existing large-scale NbS interventions *[Temporal/ Monitoring/ Spatial]*

With the large amount of NbS projects implemented there is a need for the development of monitoring plans cross-boundaries. This will require the cooperation of many different stakeholders across regions and will help to improve the evidence base around the large-scale impacts of NbS.

- Cross-boundary/scale related impacts of NbS *[Spatial/ Monitoring/ Policy]*

This area builds on the last to not only monitor but use this data to model the potential impacts at scale both negative and positive. This will be particularly important for the flood risk aspect of DRR but modelling pollutant transport and erosion will be key for protecting habitats also.

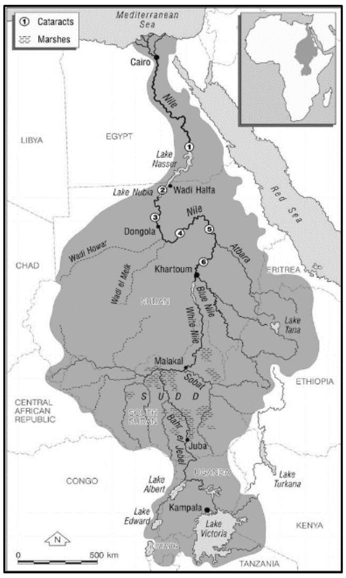
- Improving existing NbS through IPLC knowledge *[Knowledge Transfer/ Policy]*

Similar to that of the Mekong but by integrating IPLC into NbS monitoring plans or by working with communities to further up-scale NbS will be key for the longevity of NbS. Furthermore, by re-visiting existing NbS communities this may help to share knowledge up the chain on the evolution of NbS under different climatic conditions.

Sub-Saharan Africa (Nile and Orange River)

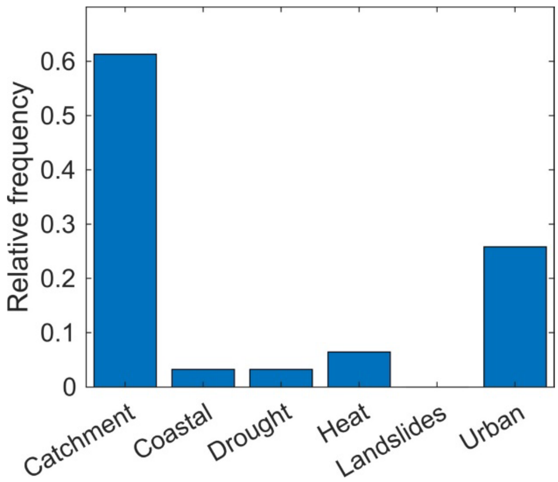
Introduction:
The upper blue and white Niles both start in in both Ethiopia, and Uganda, and the Orange River-Karoo begins in South Africa and ends at the border of Namibia and South Africa.

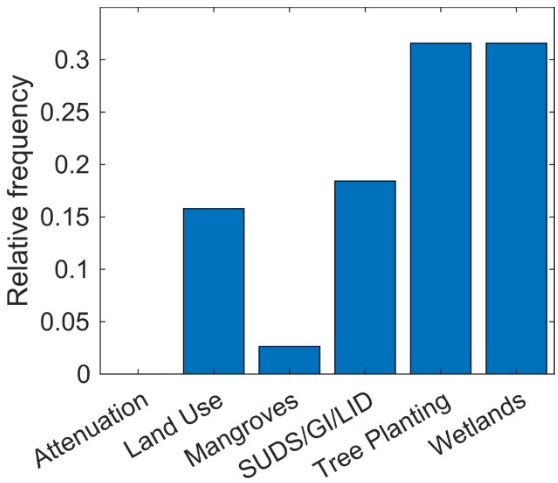
Key landscapes/contexts:
These two basins cover different areas of sub-Saharan Africa, however both basins struggle with degradation of native habitats through farming practice, successive droughts, and deforestation.



Source: (Lange et al., 2007) (Macklin et al., 2015)

Literature search overview:
Initially, SCOPUS identified a total of n = 432 papers on 28/11/2022. This was then narrowed down to a total of n = 37 key pieces of literature, which is more than other regions. These extra papers were used as the lack of widespread NbS in sub-Saharan Africa, meant there weren't as many major review documents of key evidence gaps in the region. Furthermore, Cilliers et al., (2019) identified that NbS as a term was not used in the academic space, in a Sub-Saharan context.





Prevalence of Hazards:

- Catchment scale NbS was the most frequent, with a majority of these aiming to tackle soil erosion, particularly in Ethiopia with grass strips, and afforestation.
- Surprisingly, drought and heat management did not feature in the literature review as much as expected, but this is likely due to the general lack of NbS prevalence in Sub-Saharan Africa.
- For coastal this appeared only once from mangrove restoration in Kenya (from a regional-level paper) and so other coastal areas of Africa may better represent this hazard

Prevalence of NbS:

- A majority of the NbS solutions, highlighted focus on wetlands and afforestation schemes.
- Wetlands and Forests tend to be under monitored and have many threats against them. (Typically, private wetlands are better maintained than public wetlands).
- IPLC are quite heavily involved in management and maintenance of existing NbS, yet their local knowledge is not always involved in the process of design.

Key Case Studies:

Case study	Source
Working for Wetlands in South Africa	https://www.iucn-uk-peatlandprogramme.org/projects/working-wetlands-south-africa
Highlights 492 NbS related case studies from across Africa (A supplementary word document contains links to every single case study)	https://iopscience.iop.org/article/10.1088/1748-9326/ac0210#erlac0210s9

Key Regional Actors:

Key regional actor(s)	Website/Contact Details
Orange River-Karoo Conservation Area (NGO)	https://orkca.org/
Working for Wetlands	https://www.dffe.gov.za/projectsprogrammes/workingfowetlands
IUCN (South and East Africa)	https://www.iucn.org/our-work/region/eastern-and-southern-africa
Eden Reforestation Projects	https://www.edenprojects.org/our-work/ethiopia
ICLEI (Contains key contacts for NbS in Africa)	https://africa.iclei.org/workstreams_cat/biodiversity-and-nature-based-solutions/

Regional drivers for NbS research:
NbS as a term is not often referred to in literature with most cases of NbS occurring in South Africa. Instead, a focus on ecosystem restoration and recovery through tree planting and wetland protection tends to be the main focus of NbS work in the Sub-Saharan context. While a majority of the projects focus on WASH and agricultural needs this does show that there is opportunity for monitoring and scaling up. Within South Africa the Natural Resources Governance Framework highlights key actors in natural resource management, as well as the need for integrating IPLC into the decision-making process. When implementing future NbS, close consideration of the trade-offs and needs of local people is key especially in low-income or highly unequal settings.

Key research needs/gaps: (mapped on to bubble themes)

- Indigenous vs exotic species *[Feature-specific/Technical]*

Typically, "exotic" trees that have been used as NbS in Ethiopia have been monitored for their impact on hazards, while "indigenous" species have not. Further investigation of the drought-flood resilience of "native" species could be a way of integrating IPLC knowledge, locally sourced HMH protection, and outside technical knowledge.

- Drivers of wetland degradation *[Feature-specific/Monitoring]*

Internationally, wetlands are key biodiversity hotspots that are under threat from many different human-induced hazards. In South Africa, a majority of these wetlands are not protected or monitored, and so the benefits and threats of wetlands are not fully realised. Furthermore, the degradation of these wetlands has not been measured and so a quantification exercise of data around wetlands will be required.

- Need for hybrid solutions *[Design/Spatial scale/Knowledge Transfer]*

While NbS has been implemented at the small-scale there has not been any documented use of hybrid solutions. Hybrid solutions are better suited for dealing with larger scale hazards and some solutions such as urban agriculture have not been upscaled or monitored. Implementation of wider scale urban agriculture or pilots of hybrid sites could offer insights into their effectiveness in a Sub-Saharan context.

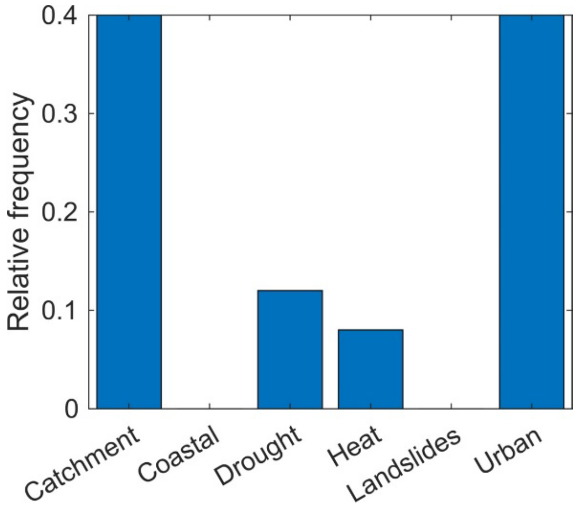
Brazil (Amazon and Atlantic catchments)

Introduction:
Brazil is the owner of nearly 20% of the world's fresh water supply (World Bank, 2016), yet a lot of the country struggle with water access and are affected by a range of hazards that can be regionally specific. One potential reason for this lack of water is the drought cycles and the fact that irrigation consumes over 70% of its water supply.

Key landscapes/contexts:
Brazil contains the 2[nd] largest river basin in the world (Amazon), yet large areas of Brazil outside of this suffer from intense rainfall-runoff and long drought periods. The El Nino cycle tends to exacerbate the issues leading to longer droughts and more intense rains, and in turn: flash floods, massive soil erosion, and unpredictable water supply.

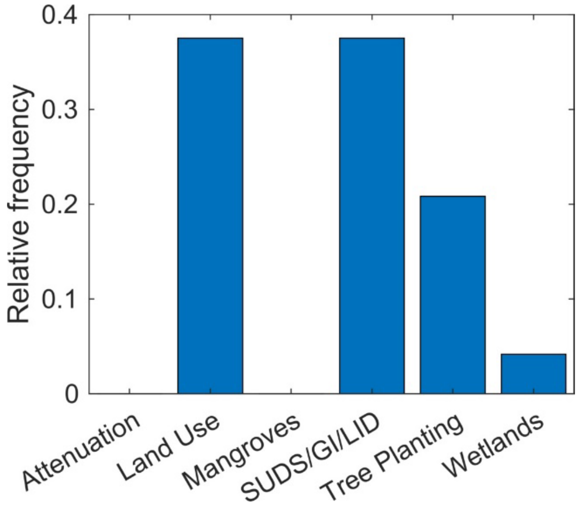
Literature search overview:
Initially, SCOPUS identified a total of n = 590 papers on 30/11/2022. This was then narrowed down to a total of n = 30 key pieces of literature. A large amount of literature spoke of opportunities for Brazil to take advantage of NbS, yet the uptake of this seems to be localised to specific regions rather than a more national approach.

Source: (Hermes-Silva et al., 2021)



Prevalence of Hazards:

- Brazil suffers from high-rainfall events and droughts and, accordingly, catchment, drought, and heat come up as key targets for NbS. There tends to be drought issues in the Eastern regions and high rainfall in the Western rain forested areas.
- A lot of literature discusses changing land use practice for managing soil erosion and its impact on urban areas.
- Urban solutions such as SUDS or GI tend to be localised and not monitored. (Potentially due to lack of local technical knowledge)



Prevalence of NbS:

- Brazil has received a lot of interest in NbS but is yet to implement these features widely. (They tend to be localised to specific areas, and focus more on erosion management)
- Wetlands and Mangroves are prevalent except the focus tends to be more towards carbon sequestration and nutrient removal than climate adaptation.
- Land use and urban solutions tend to be the most prevalent, but these are ad-hoc and tend to focus on solving one specific challenge such as pluvial flooding, erosion, or drought.

- One key area for protection and research is the Pantanal wetland, the largest on the planet, which is threatened by fire and droughts.

Key Case Studies:

Case study	Source
Multiple urban case studies from Brazil. (Largely based in the South or East)	https://oppla.eu/sites/default/files/docs/EU-Brazil-NBS-dialogue-1610.pdf

Key Regional Actors:

Key regional actor(s)	Website/Contact Details
INTERACT-Bio	https://interactbio.iclei.org/
RECONECTA RMC	https://reconectarmc.wixsite.com/meusite-2
Tema Favela (A group working on favela remediation)	http://www.temafavela.com.br/site/
NbS Brazil Alliance	https://nbsbrazilalliance.org/

Regional drivers for NbS research:
Brazil has a history of ecological fiscal transfer schemes where municipals can receive money for hosting protected areas (Santos et al., 2012). More recently the Floresta+ program and National Policy for Ecosystem Services Payment (PNPSA) have come into play with aims to restore and monitor the Amazon, as well as compensate private and public authorities for preserving natural resources. Other key documentation, policies, and programs are outline in the UK pact document (CDP, 2022). Despite this we are yet to see widespread NbS implementation, but this will likely change in the near future.

Key research needs/gaps: (mapped on to bubble themes)

- Lots of discussion of potential for NbS, fewer examples of implementation *[Policy etc, Design/Implementation]*

Brazil sits in a powerful position to implement NbS features due to its policy around the preservation of biomes and environments that are key to Brazil's economy. While they are yet to implement widespread NbS an opportunity to co-produce from the start and share international experiences in to design and implementation awaits.

- Integration of urban and peri-urban, with particular focus on erosion *[Spatial]*

While NbS is in its infancy in Brazil it tends to focus on managing problems at the site scale. A consideration for the linkages between peri-urban and urban areas needs to be explored as this is where a large amount of NbS has already been conducted. Erosion is a major challenge for Brazil due to the agricultural "slash and burn" tactics, using native plants and cacti in peri-urban areas, combined with sediment capture and more sustainable agricultural practices may help to combat this challenge.

- Designing NbS to tackle multiple complex scenarios *[Design, Spatial]*

Brazil's climate means that it suffers from short high intensity rainfall, as well as prolonged drought periods. This makes it challenging to implement NbS as they tend to provide multiple benefits but are not always designed to tackle multiple hazards. An integration of multiple features at a site level, as well as including native plant species and IPLC could provide a method for tackling drought-flood risk scenarios in Brazil.

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Appendix

International Literature (Table 1)

1. Seddon et al. (2020a) https://doi.org/10.1098/rstb.2019.0120
2. Kabisch et al. (2016) http://dx.doi.org/10.5751/ES-08373-210239
3. Seddon et al. (2020b) https://doi.org/10.1111/gcb.15513
4. Chausson et al. (2020) https://doi.org/10.1111/gcb.15310
5. Kabisch et al. (2017) https://library.oapen.org/bitstream/handle/20.500.12657/27761/1002244.pdf?sequence=1
6. Osaka et al. (2021) https://doi.org/10.1002/wcc.729
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Search Terms: (International)

Scholar:
- Nature Based Solutions AND Climate Change
- Nature Based Solutions AND Climate Resilience

SCOPUS:
TITLE-ABS-KEY ("Hazard*" OR "Climat*" OR "Resili*" OR "Challenge*" OR "Research Gap*") AND TITLE-ABS-KEY ("Natural Flood Management" OR "NFM" OR "Nature Based Solutions" OR "Low Impact Development" OR "Catchment Based Flood Management" OR "Low Impact Development" OR "Soft Engineering" OR "Green Infrastructure" OR "Sustainable Urban Drainage" OR "SUDS" OR "Working with Natural Processes" OR "Runoff Attenuation" OR "Storage Ponds" OR "Leaky Barriers" OR "Offline Storage Areas" OR "Soil and Land Management" OR "Floodplain Woodland" OR "Riparian Woodland" OR "Woodland Restoration" OR "Runoff Pathway" OR "Managed Retreat" OR "Enhanced Hillslope" OR "Deculvert" OR "Slow the Flow" OR "Wetland" OR "Afforestation" OR "Tree Planting") AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020))

Google:
- Nature Based Solutions AND Climate Change
- Nature Based Solutions AND Climate Resilience
- Nature Based Solutions Research Gaps

Sites Searched:
IWA (Nature Based Solutions)
IUCN (Nature Based Solutions)
EU Commission (Nature Based Solutions)
EA (WWNP)
NBS for Climate Change (General Search)
UNDRR (Nature Based Solutions)
British Ecological Society (Nature Based Solutions)
NBS Initiative
Catchment Based Approach

Search Terms: (Brazil)

Scholar:
- Nature Based Solutions AND Brazil

SCOPUS:
TITLE-ABS-KEY ("Brazil") AND TITLE-ABS-KEY ("Natural Flood Management" OR "NFM" OR "Nature Based Solutions" OR "Low Impact Development" OR "Catchment Based Flood Management" OR "Low Impact Development" OR "Soft Engineering" OR "Green Infrastructure" OR "Sustainable Urban Drainage" OR "SUDS" OR "Working with Natural Processes" OR "Runoff Attenuation" OR "Storage Ponds" OR "Leaky Barriers" OR "Offline Storage Areas" OR "Soil and Land Management" OR "Floodplain Woodland" OR "Riparian Woodland" OR "Woodland Restoration" OR "Runoff Pathway" OR "Managed Retreat" OR "Enhanced Hillslope" OR "Deculvert" OR "Slow the Flow" OR "Wetland" OR "Afforestation" OR "Tree Planting") AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020))

Google:
- Nature Based Solutions AND Brazil

Search Terms: (Ganges Brahmaputra Meghna)

Scholar:
- Nature Based Solutions AND Ganges Brahmaputra Meghna
- Low Impact Development AND Ganges Brahmaputra Meghna
- Nature Based Solutions AND Community Led Ecosystem Adaptation AND India

SCOPUS:
TITLE-ABS-KEY ("Ganges" OR "Brahmaputra" OR "Meghna" OR "India" OR "Bangladesh" OR "Nepal" or "Bhutan") AND TITLE-ABS-KEY ("Natural Flood Management" OR "NFM" OR "Nature Based Solutions" OR "Low Impact Development" OR "Catchment Based Flood Management" OR "Low Impact Development" OR "Soft Engineering" OR "Green Infrastructure" OR "Sustainable Urban Drainage" OR "SUDS" OR "Working with Natural Processes" OR "Runoff Attenuation" OR "Storage Ponds" OR "Leaky Barriers" OR "Offline Storage Areas" OR "Soil and Land Management" OR "Floodplain Woodland" OR "Riparian Woodland" OR "Woodland Restoration" OR "Runoff Pathway" OR "Managed Retreat" OR "Enhanced Hillslope" OR "Deculvert" OR "Slow the Flow" OR "Wetland" OR "Afforestation" OR "Tree Planting" OR "Integrated Watershed Management" OR “Check Dams” OR “Bandal”) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020))

Google:
- Nature Based Solutions AND India
- Nature Based Solutions AND Ganges Brahmaputra Meghna

Search Terms: (Lower Mekong River Basin)

Scholar:
- Nature Based Solutions AND Lower Mekong River Basin
- Wetlands AND Lower Mekong River AND Climate Change

- Mekong and Community Led Ecosystem Adaptation

SCOPUS:
TITLE-ABS-KEY ("Mekong" OR "Lao*" OR "Cambodia" OR "Thailand" OR "Vietnam") AND TITLE-ABS-KEY ("Natural Flood Management" OR "NFM" OR "Nature Based Solutions" OR "Low Impact Development" OR "Catchment Based Flood Management" OR "Low Impact Development" OR "Soft Engineering" OR "Green Infrastructure" OR "Sustainable Urban Drainage" OR "SUDS" OR "Working with Natural Processes" OR "Runoff Attenuation" OR "Storage Ponds" OR "Leaky Barriers" OR "Offline Storage Areas" OR "Soil and Land Management" OR "Floodplain Woodland" OR "Riparian Woodland" OR "Woodland Restoration" OR "Runoff Pathway" OR "Managed Retreat" OR "Enhanced Hillslope" OR "Deculvert" OR "Slow the Flow" OR "Wetland" OR "Afforestation" OR "Tree Planting") AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020))
Google:
- Nature Based Solutions AND Lower Mekong River Basin

Search Terms: (Sub-Saharan Africa)

Scholar:
- Nature Based Solutions AND South Africa
- Nature Based Solutions AND Ethiopia
- Wetlands AND Orange River
- Wetlands AND Ethiopia
- Forest AND Orange River
- Forests AND Orange River

SCOPUS:
TITLE-ABS-KEY ("Ethiopia" OR "Orange River" OR "South Africa") AND TITLE-ABS-KEY ("Natural Flood Management" OR "NFM" OR "Nature Based Solutions" OR "Low Impact Development" OR "Catchment Based Flood Management" OR "Low Impact Development" OR "Soft Engineering" OR "Green Infrastructure" OR "Sustainable Urban Drainage" OR "SUDS" OR "Working with Natural Processes" OR "Runoff Attenuation" OR "Storage Ponds" OR "Leaky Barriers" OR "Offline Storage Areas" OR "Soil and Land Management" OR "Floodplain Woodland" OR "Riparian Woodland" OR "Woodland Restoration" OR "Runoff Pathway" OR "Managed Retreat" OR "Enhanced Hillslope" OR "Deculvert" OR "Slow the Flow" OR "Wetland" OR "Afforestation" OR "Tree Planting") AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020))

Google:
Orange River AND Nature Based Solutions
Ethiopia AND Nature Based Solutions

Search Terms (Ctrl-F) to aid in finding Evidence Gaps:

Gap
Future
Need
Oppurtunit