Confluence of Danube and Morava Rivers by young shanahan 2019 licensed under CC by 2.0

Ecosystem-based Adaptation for Climate-proofing Water Infrastructure – Conceptual Overview

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April 30, 2021

ESSA

PROBLEM

With projected climate hazards, standard approaches to **water infrastructure** will not be able to sustain the same service provision as in the past

Dams

Sennar Dam, Blue Nile, Sudan. 2021, Google Earth

Irrigation Pipes

Water injected at tail end of canal by Francois Molle 2013.

Irrigation Canals

Irrigation Canals

Wells

Well in Nubaria area by Francois Molle, 2011. Licensed under CC by 2.0

Pumps

Saqia in fish farm, Nile Delta by Francois Molle 2013. Licensed under CC by 2.0

Pumps

Downstream of head pumping station in Tiba area, New Lands, Egypt by Francois Molle 2015. Licensed under CC by 2.0

Pump Stations

IIP Pump Station, Nile Delta by Francois Molle 2013. Licensed under CC by 2.0

Cisterns

Elevated rainfed cistern for irrigating farmland by IFPRI/, 2008.

Mine Tailings Ponds

North Mara Gold Mine, Tarim District, Tanzania, 2021. Google Earth

Waste Water Treatment

New Cairo waste treatment plant, 2021. Google Earth

WATER INFRASTRUCTURE EXAMPLES

- Dams & spillways
- Irrigation Canals
- Wells
- Pumps & Pump Stations
- Cisterns
- Mine Tailings Ponds
- Wastewater Treatment
- Water pipes (domestic supply)
- Water pipes (irrigation)
- Desalination plants
- Hydroelectric facilities
- Docks & moorages
- Reservoirs
- Access roads & camps
- Culverts
- Debris screens
- Barrages & dikes

CLIMATE HAZARDS AFFECTING WATER INFRASTRUCTURE

- **Floods (rainstorms)**
- **Droughts**
- **Seasonal shifts**
- **Storm surges (coast)**
- **Sea level rise**
- **Erosion & landslides**
- **High temperatures (slow onset)**
- **Wind**

EXPOSURE 

IMPACTS OF CLIMATE HAZARDS

- **Direct damages**
- **Supply/demand shifts (spatial)**
- **Supply/demand shifts (temporal)**
- **Capacity exceedance**
- **Full infrastructure failure**
- **Well contamination**
- **Increased weathering**
- **More 'brittle' infrastructure (slow onset)**

ADAPTIVE CAPACITY 

SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABLE DEVELOPMENT GOALS

Using EbA to climate-proof water infrastructure is the focus

SOLUTION?

Harness the power of nature by integrating **ecosystem-based adaptation** into water infrastructure project cycles

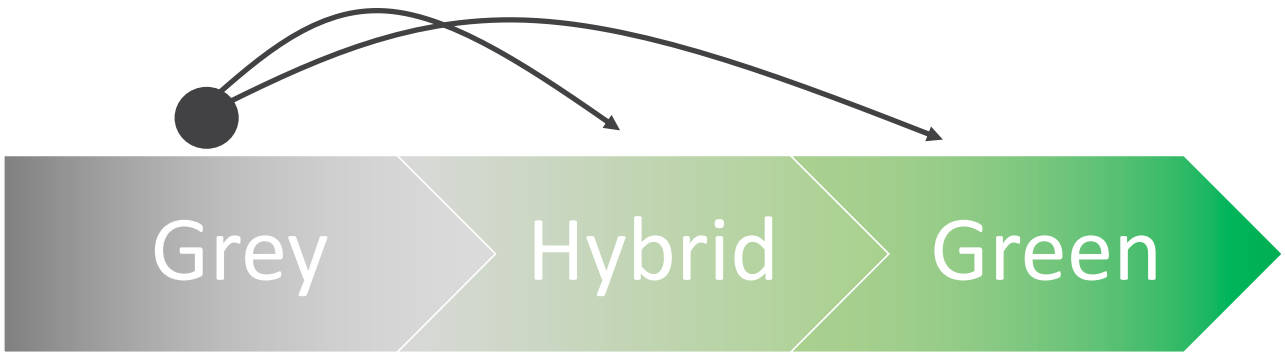
ECOSYSTEM-BASED ADAPTATION (EbA)

"The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change"

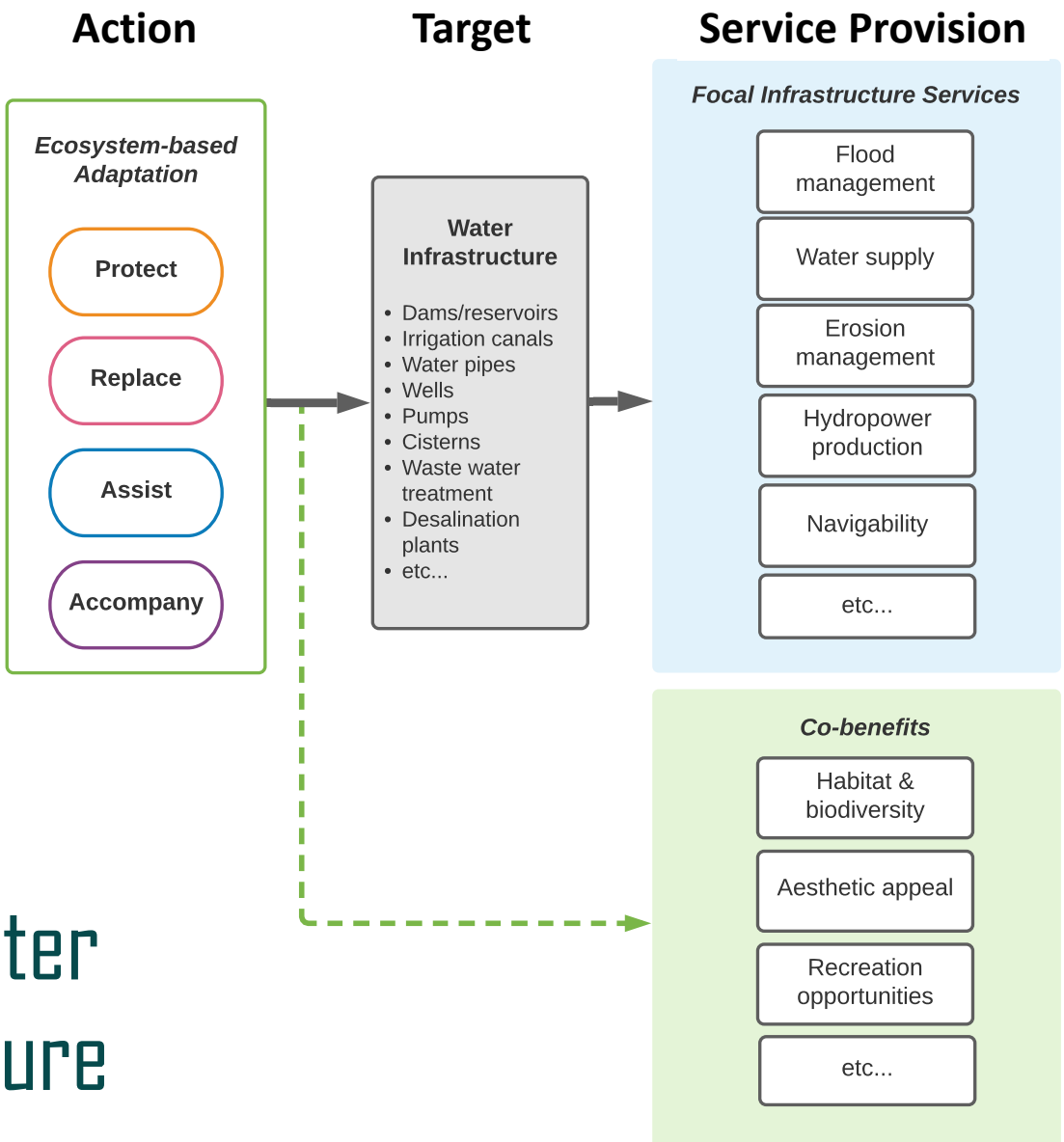
-Convention on Biological Diversity, 2009

[Also referred to as "**nature-based solutions** for climate change adaptation"]

GREY-TO-GREEN CONTINUUM



EbA for Water Infrastructure



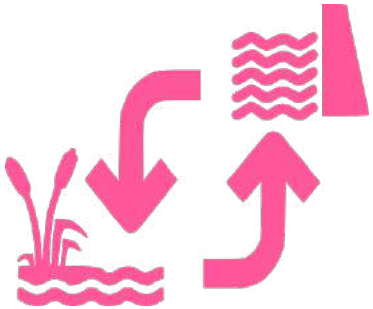
Protect

- Directly **protects** a hard/grey infrastructure project from climate hazards
- Increases its lifespan and reduces operating/maintenance costs
- Also provides co-benefits

✓

Grey | Hybrid | Green

Replace



- Completely **replaces** the need for a hard/grey infrastructure project
- Potentially more resilient to climate hazards
- Also provides co-benefits

✓

Grey | Hybrid | Green

Assist

- Increases focal service provision beyond what could be provided by the hard/grey infrastructure project alone
- Improves capacity to continue service provision when impacted by climate hazards
- Also provides co-benefits

✓

Grey | Hybrid | Green

Accompany

- No direct benefit to the hard/grey infrastructure project or its focal services

- Can be implemented as part of the project to provide co-benefits that increase a community's overall adaptive capacity to climate hazards

✓

Grey | Hybrid | Green

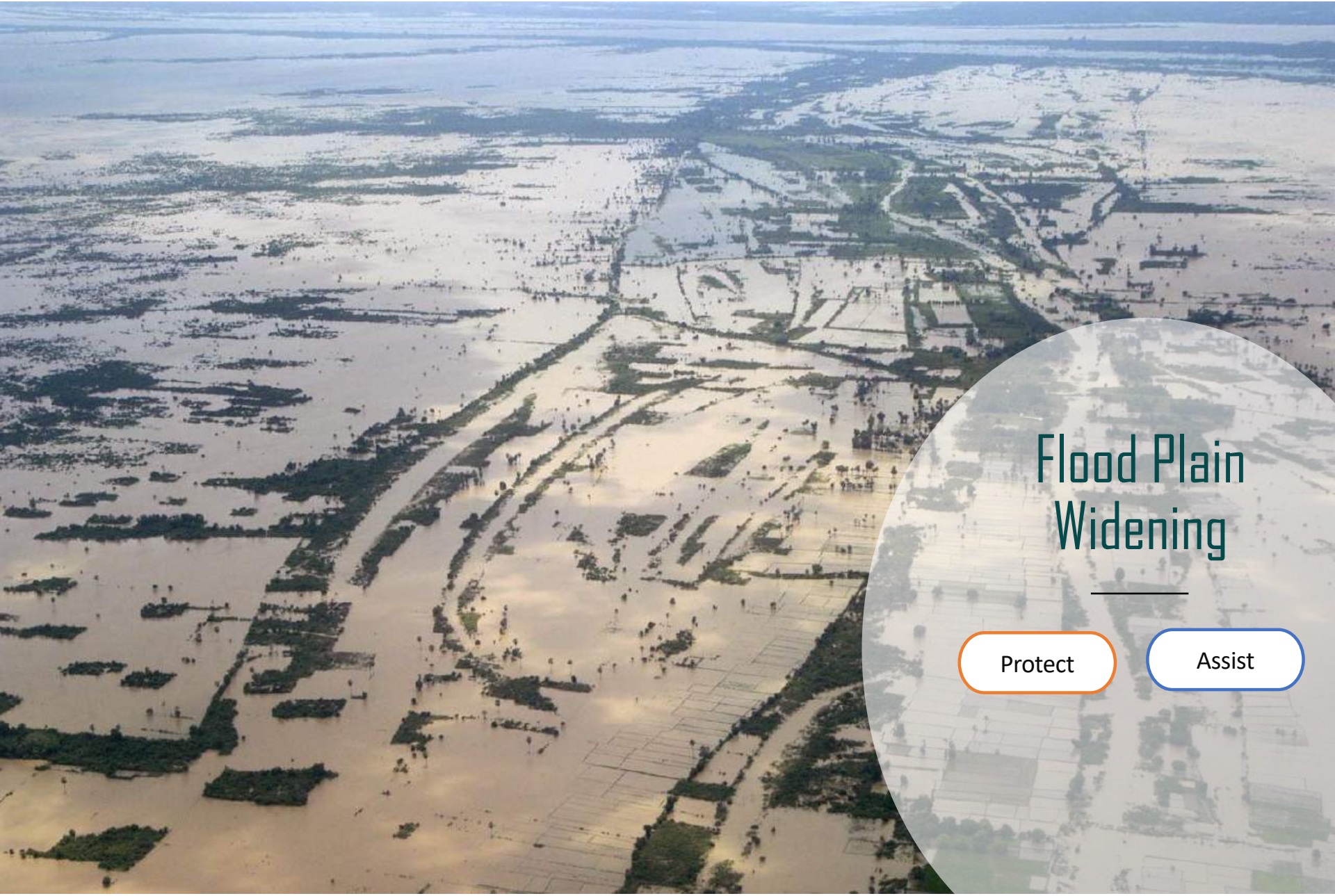
Re-Meandering

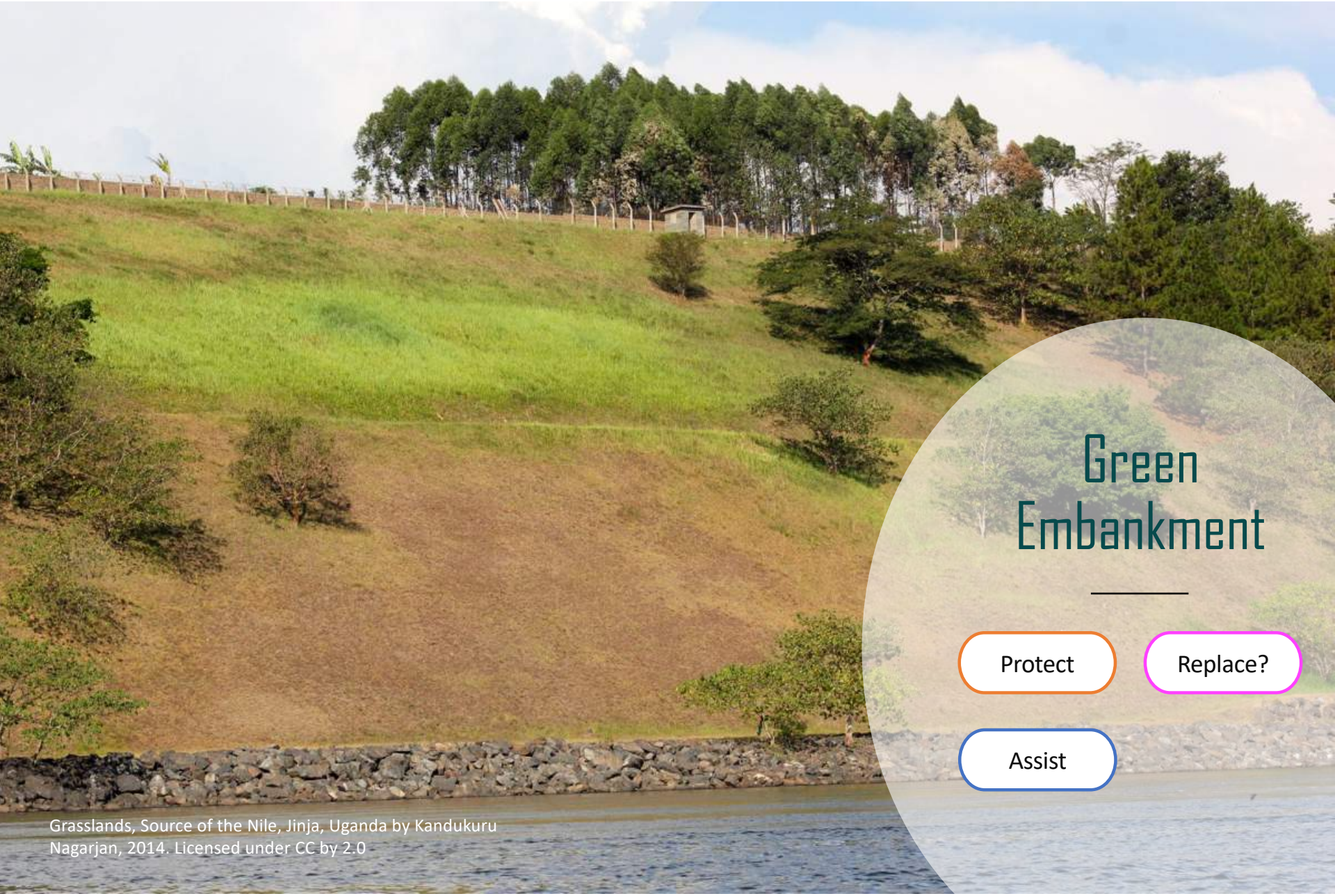
Protect

Assist

Meandering through the flat fields of northwest Scotland by ben-benjamin 2008. Licensed under CC by 2.0


Side Channels
Protect
Assist


Flood Plain
Widening
Protect
Assist

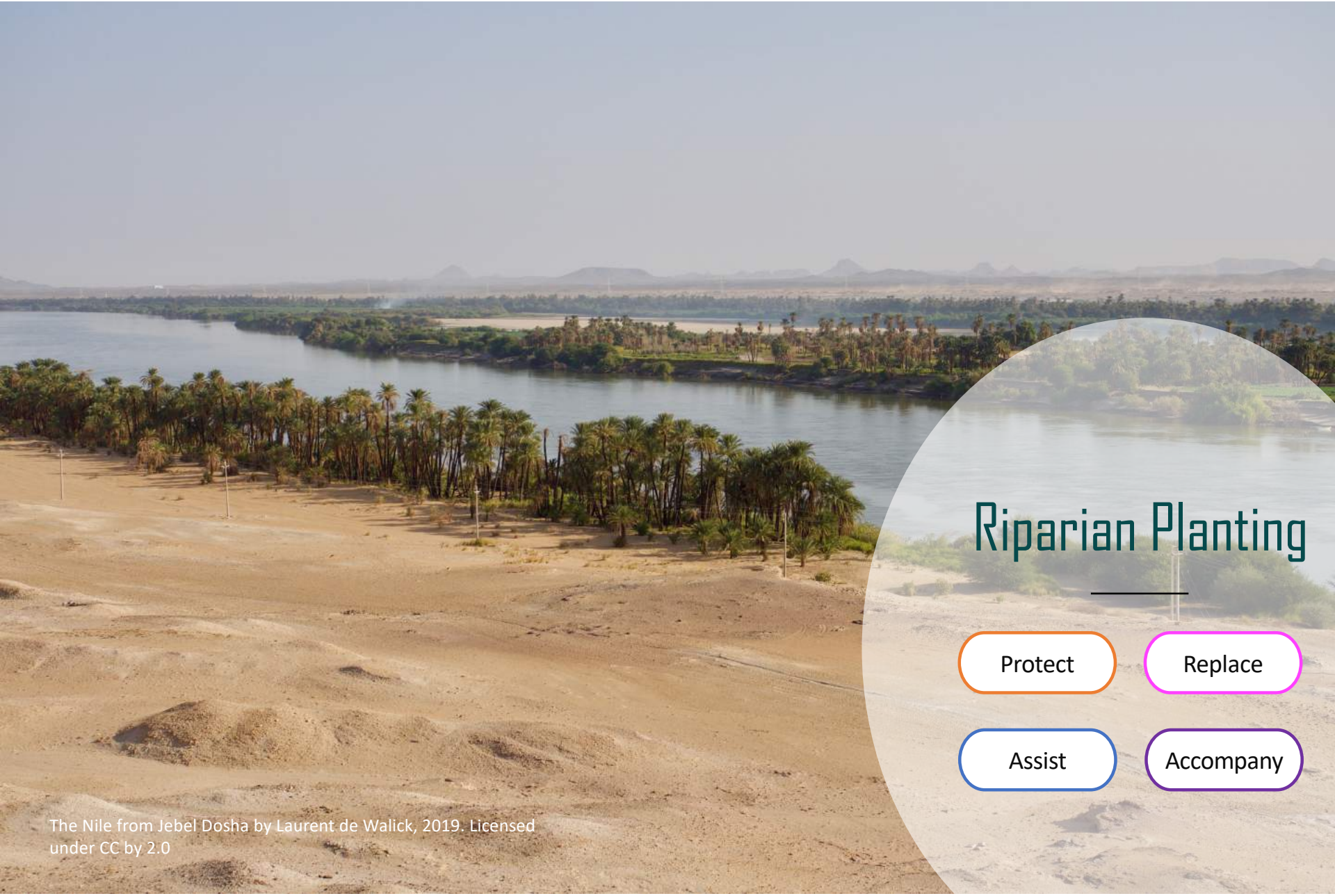


Green Embankment

Protect

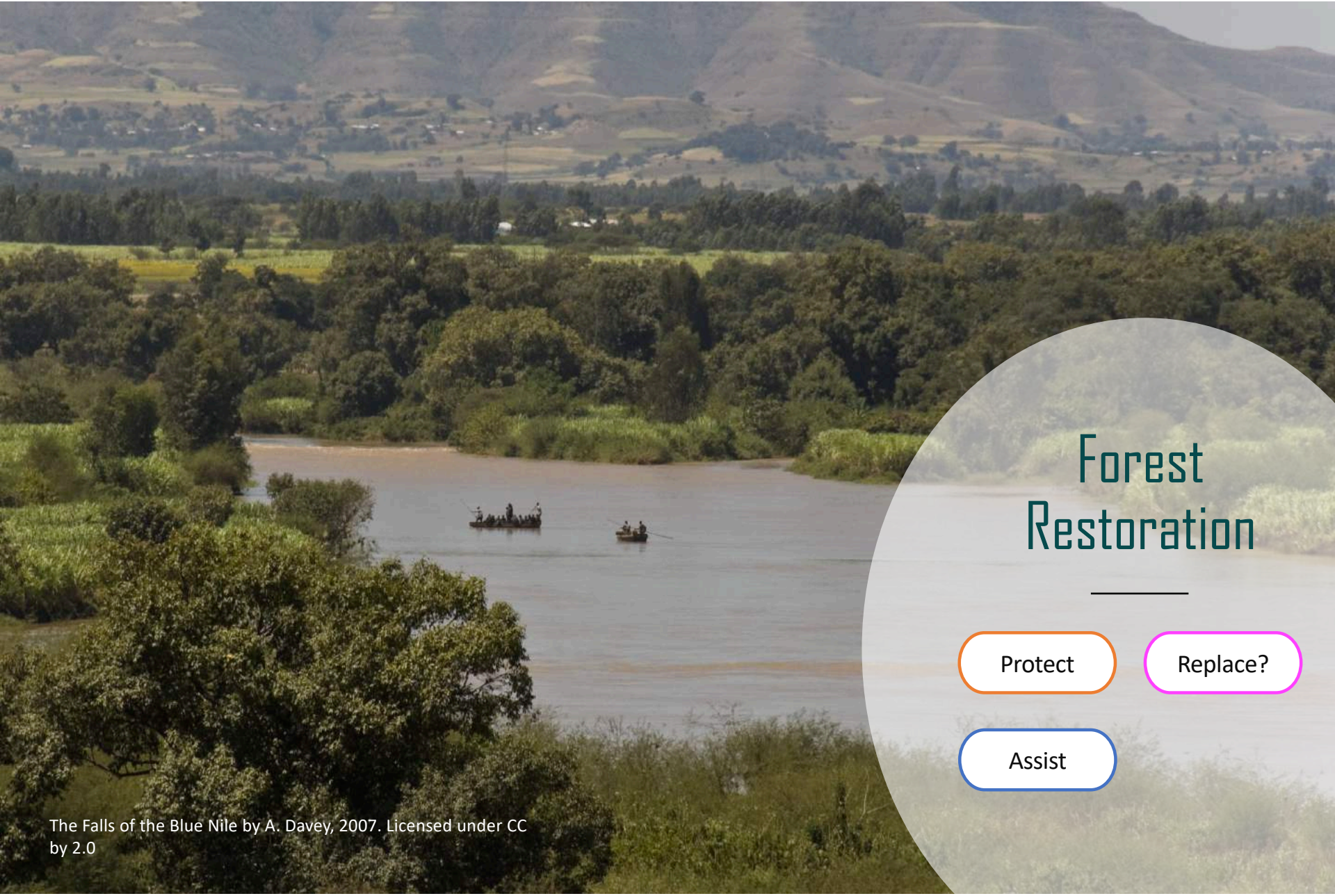
Replace?

Assist



Riparian Planting

- Protect
- Replace
- Assist
- Accompany



Forest Restoration

Protect

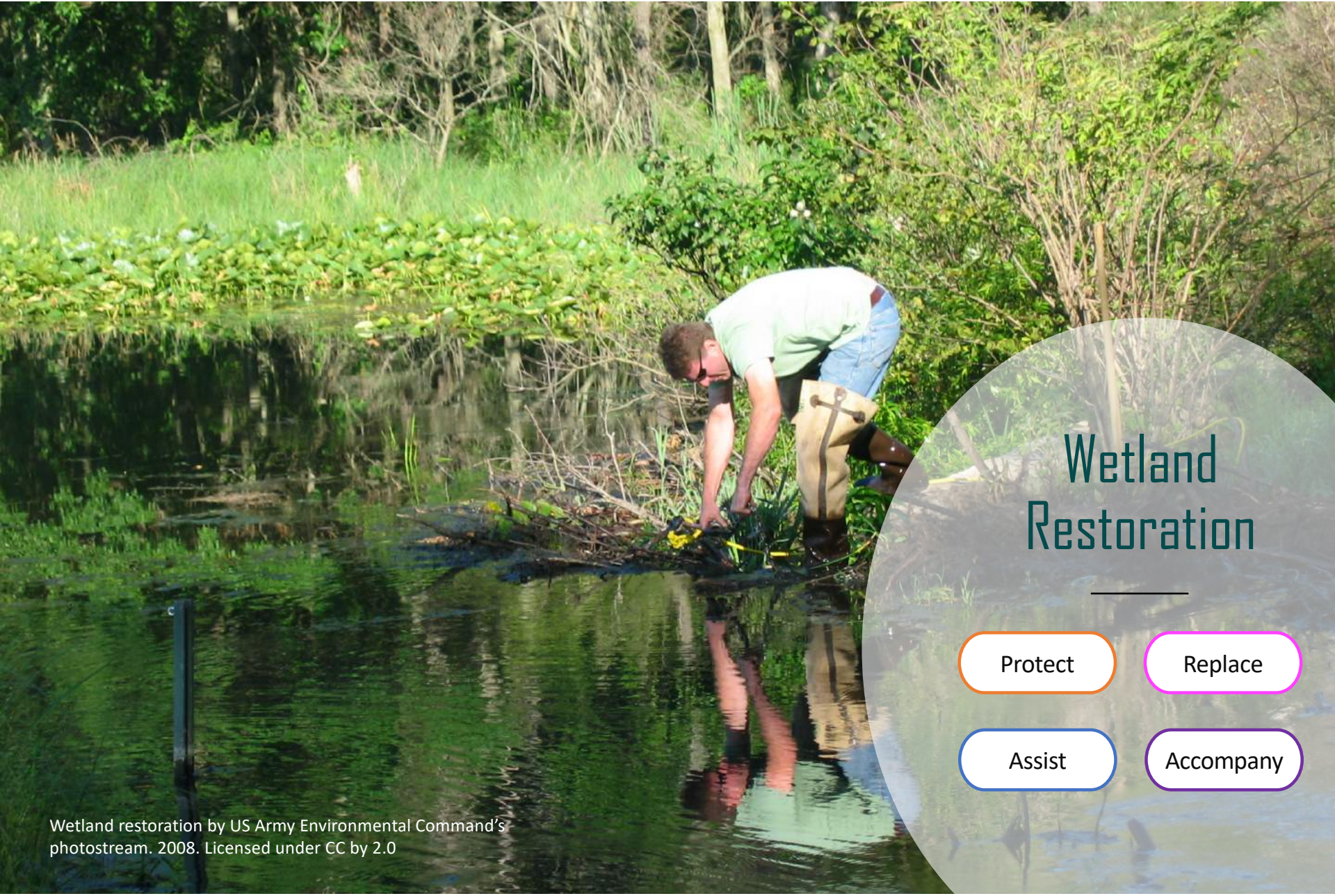
Replace?

Assist

Land Use Management

Protect

Assist



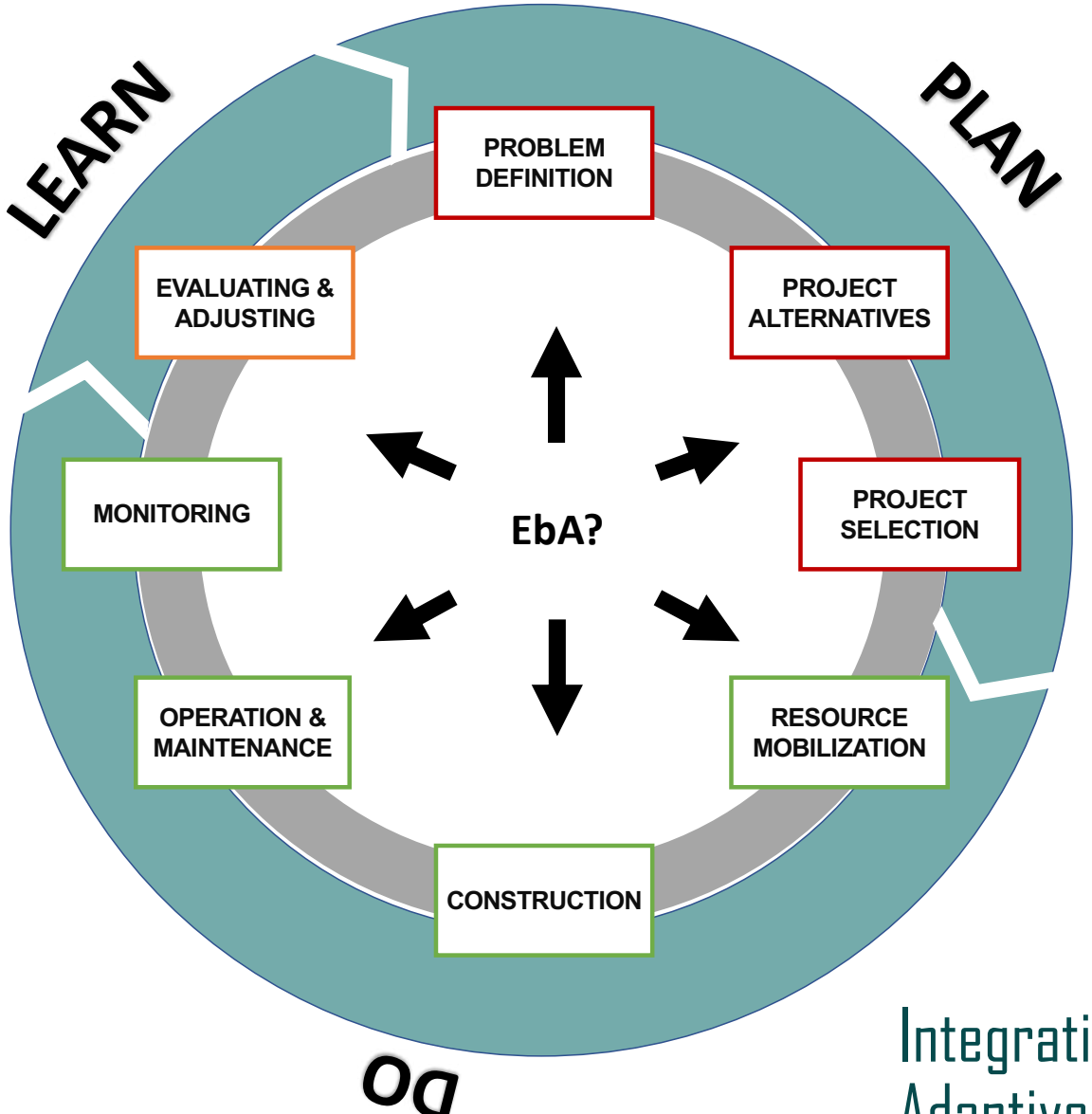
Wetland Restoration

- Protect
- Replace
- Assist
- Accompany

Wetland restoration by US Army Environmental Command's photostream. 2008. Licensed under CC by 2.0

EBA OPTIONS FOR CLIMATE-PROOFING WATER INFRASTRUCTURE

- **Land use management**
- **Mimic natural hydrograph**
- **Re-meandering**
- **Side channels**
- **Floodplain widening/restoration**
- **Embankments (green)**
- **Embankment removal (grey)**
- **Wetland restoration**
- **Urban drainage (green)**
- **Bioswales**
- **Retention areas**
- **Dam removal**
- **Removal of conveyance obstacles**
- **Riparian planting**
- **Forest restoration**



Integration of **EbA** into an Adaptive Project Cycle

PROBLEM DEFINITION

New Spatial & Temporal Scope
New Jurisdictions and Affected Groups

PROJECT ALTERNATIVES

PROJECT SELECTION

Natural Asset Inventory

Co-benefits in Cost-benefit Analysis

New Types of Risk for Project-level Risk Assessment

More Complex Indicator Development

Additional Sensitivity Analyses

CONSTRUCTION

Different Materials and Activities
Personnel with Different Expertise

OPERATION &
MAINTENANCE

Different Deterioration Rates/Lifespans

MONITORING

Complex Long-term Changes w/Multiple System Drivers
Difficult to Define Causal Pathways
Unique Indicators at Every Site
Longer Time Horizons to Observe EbA Benefits
Portfolio of Ecosystem Services

Library of EbA Guidance Documents with the "Enhancing Climate Services for Infrastructure (CSI)" Product Series by GIZ and Collaborators


Thank You!
ESSA