Scenarios for reduction of GHG emissions from nutrients-rich organic soils

International Conference “Climate Change Mitigation in Organic Soils in Agricultural and Forest lands”
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LIFE OrgBalt, LIFE18 CCM/LV/001158

EU LIFE Programme project
“Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland”

Mitigation scenarios evaluated in Latvia

- Farmlands:
  - transformation of arable land to grassland or pasture;
  - cultivation of legumes in crop rotation with cereals to increase soil carbon storage;
  - regulation of groundwater level in grasslands with organic soils;
  - planting tree strips along drainage systems in arable lands and grasslands.
- Land use changes:
  - afforestation of grasslands with organic soils and maintenance of drainage systems;
  - afforestation and rewetting of grasslands;
  - establishment of tree plantations in arable land.
- Forest land:
  - use of wood ash in maintenance felling;
  - selective felling in a spruce forest;
  - strip or opening felling in a pine stands with drained peat soil;
  - regeneration of black alder stands in wet organic soils by planting on mounds and making a network of furrows;
  - planting of black alder stands in riparian zones by planting on mounds and installing a network of furrows;
  - restoration of spruce stands in wet organic soils by planting on mounds and making a furrow network.

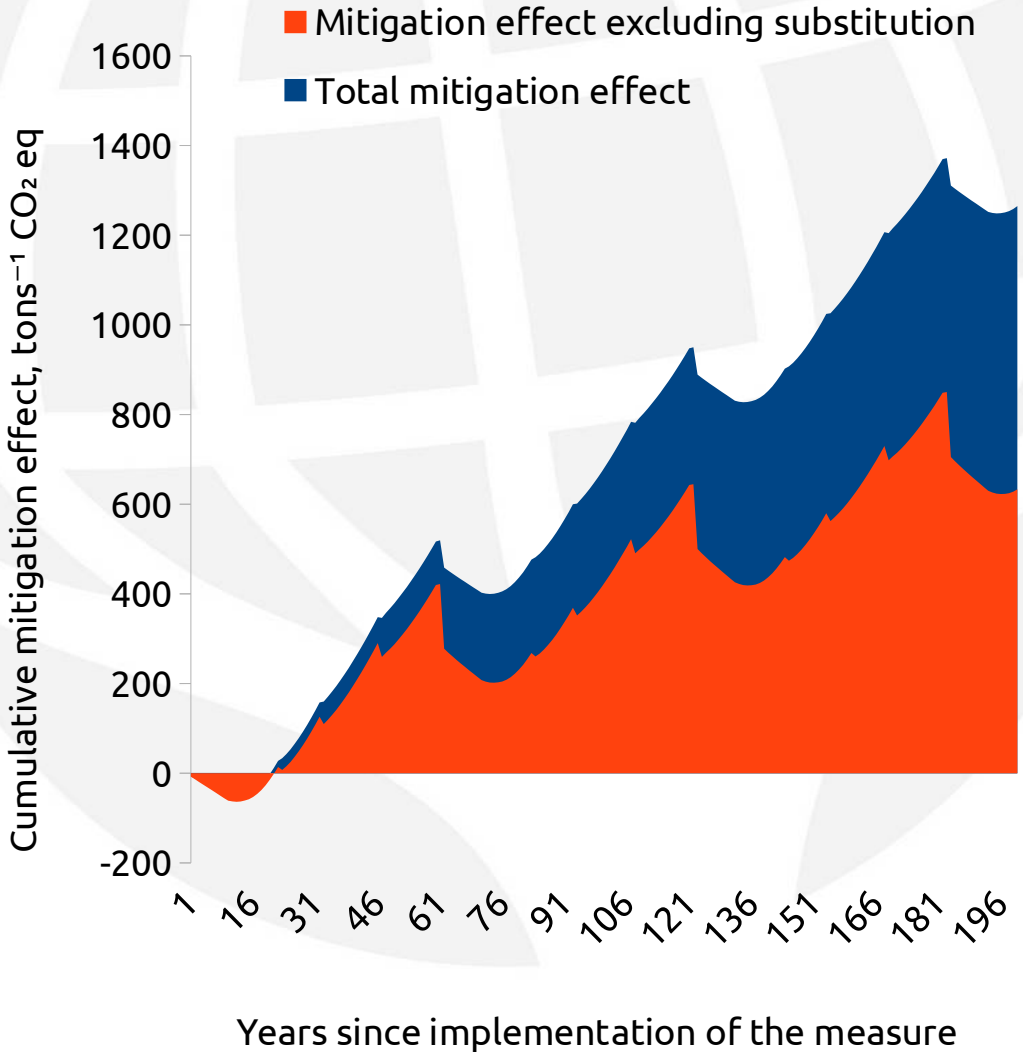
Transformation of arable land to grassland/pasture

- The aim of the measure is to ensure the reduction of GHG emissions from the soil and to increase CO_2 removals in biomass of cover plants.
- All organic soils in arable lands are suitable for this measure, a greater effect is expected in intensively cultivated areas.
- **The effect of reducing GHG emissions over 75 years (until the end of the 21st century) is 205 tons of CO_2 eq. ha^{-1} (on average 2.7 tons of CO_2 eq. ha^{-1} per year).**
- An additional positive effect is a contribution to the implementation of the goals of biodiversity and agricultural "greening".
- **The measure is unlikely to be implemented on commercial carbon trading platforms *(Verra and Gold standard)*, because it affects food production areas.**
- **The positive effect of the measure has been proven in the study, but it is small compared to other measures. One of the largest benefits – relatively small risk, drawback – transfer of emissions and potential negative effect on surrounding areas.**

Afforestation of grasslands with organic soils and maintenance of drainage systems

- The aim of the measure is to ensure the reduction of GHG emissions from the soil and to increase CO_2 removals in all carbon pools.
- All organic soils in arable lands in grasslands are suitable for the implementation of the measure, except for areas where there is a risk of flooding and there are legal restrictions for areas receiving state support as biologically valuable grasslands.
- Tree species suitable for afforestation – pine, spruce, birch, black alder. The use of selected planting material and fertilizer (wood ash, mineral fertilizer) ensures a long-term effect of reducing GHG emissions.
- **The effect of reducing GHG emissions over 75 years in a spruce forest is 381 tons of CO_2 eq. ha^{-1} (on average 7.7 tons of CO_2 eq. ha^{-1} per year). An additional effect (200 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The measure provides the best ratio of the GHG emission reduction effect and the potential impact of natural disturbances.**

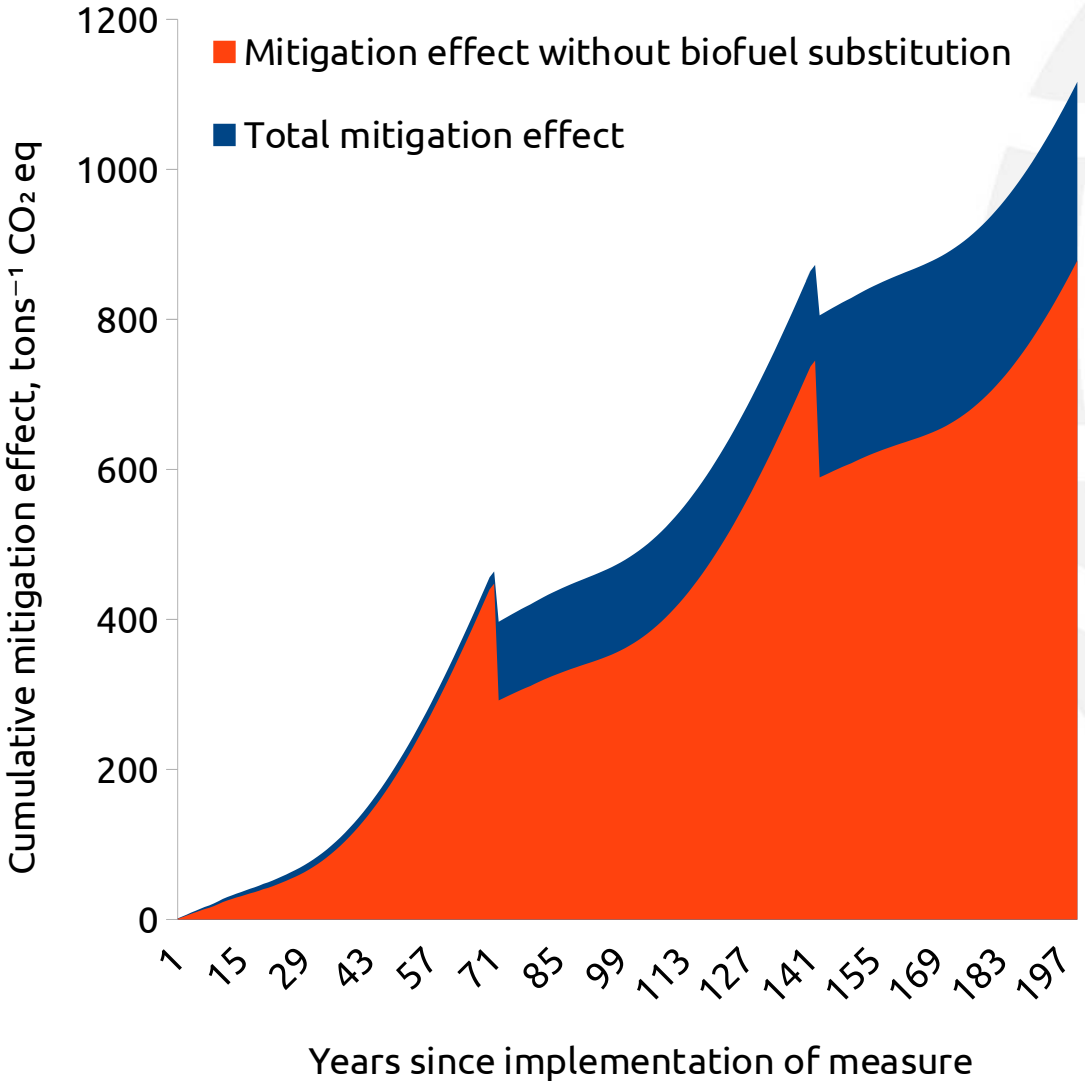
Substitution effect of forest biofuel in afforested areas



Afforestation and rewetting of grasslands

- The aim of the measure is to ensure the reduction of GHG emissions from the soil and to increase CO_2 removals in all carbon pools.
- For the implementation of the measure, organic soils in arable lands in grasslands, where there is a risk of periodic flooding, are suitable. The same limitations as for conventional afforestation persists.
- Tree species suitable for afforestation – pine, birch, black alder. The use of selected planting material and fertilizers provide a long-term effect of reducing GHG emissions, but this effect can be reduced by natural disturbances.
- **The effect of reducing GHG emissions over 75 years is 301 tons of CO_2 eq. ha^{-1} (on average 5.4 tons of CO_2 eq. ha^{-1} per year). An additional effect (107 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- **The measure can be implemented on commercial carbon unit trading platforms, but significantly higher risks must be expected and the same limitations as for afforestation (food production & biologically valuable areas) should be considered.**
- **The measure can significantly reduce GHG emissions, but it is associated with a very high risk of natural disturbances that reduce or even create a negative effect. Can be recommended for implementation together with risk management actions.**

Mitigation effect in afforested and rewetted grasslands



Cultivation of legumes in crop rotation with cereals to increase soil carbon storage

- The purpose of the measure is to ensure carbon sequestration in soil.
- Organic soils in arable land are suitable for the implementation of the measure.
- **The measure also allows to reduce N_2O emissions in the agricultural sector.**
- The effectiveness of the measure has not been proven in the study. **Carbon uptake by plant residues and the impact on N_2O emissions** needs to be studied. It is possible that a positive effect can be achieved by using legumes as cover crops.
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The measure cannot be recommended as dedicated GHG emissions mitigation measure due to insufficient data about carbon uptake by plant residues.**

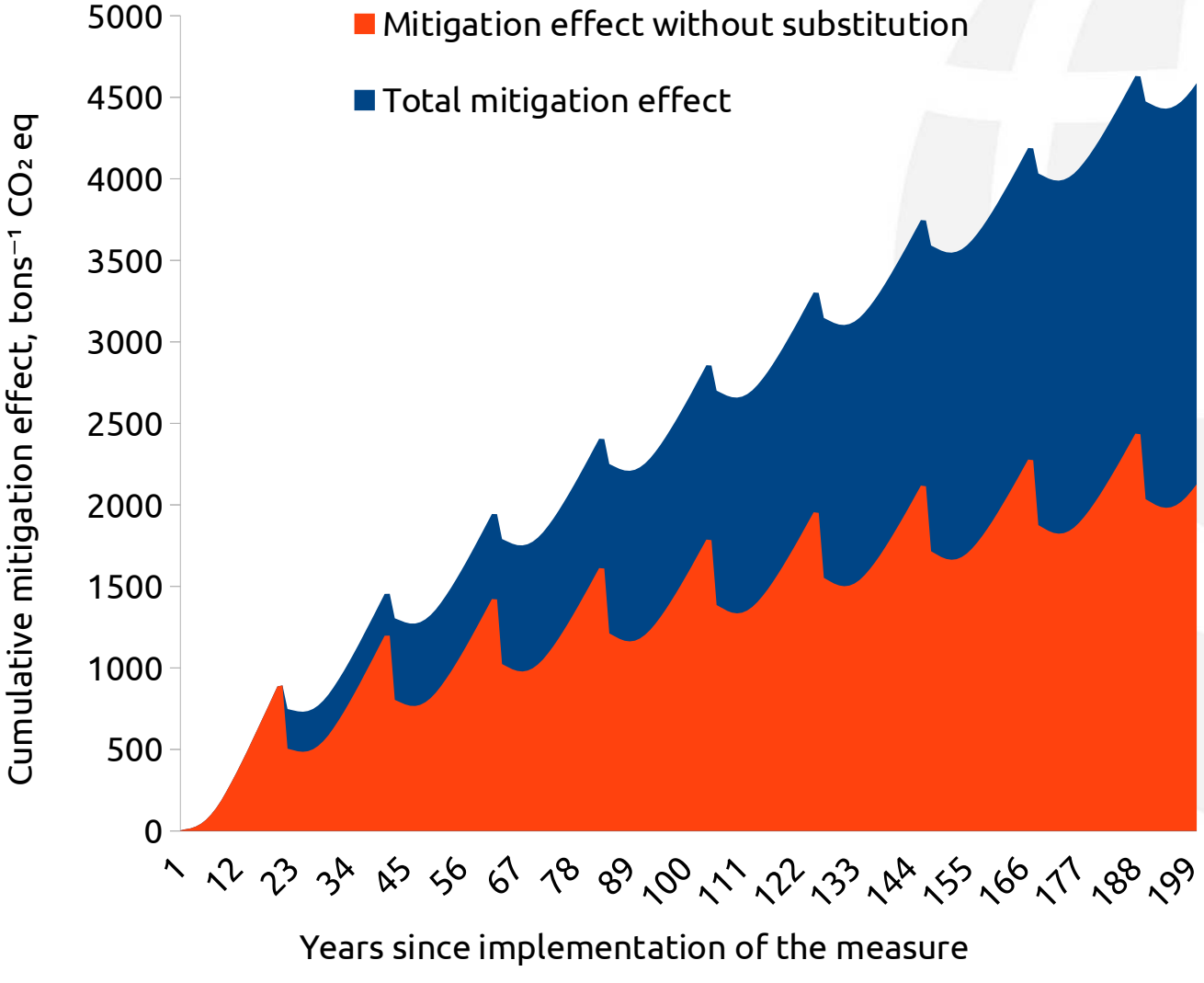
Regulation of groundwater level in grasslands with organic soils

- The purpose of the measure is to ensure the reduction of GHG emissions from soil.
- Organic soils in arable lands and grasslands are suitable for the implementation of the measure; however, terrain conditions should be favourable.
- **The GHG mitigation effect has not been proved by the study; however, conversion of arable land to grassland significantly reduced GHG emissions in the study site.**
- The measure may work over a longer period of time or can be effective in specific soils.
- The measure may be implemented on commercial carbon trading platforms.
- **The measure cannot be recommended yet. Long-term effect of this measure and the possibilities of improving its effectiveness should be studied.**

Establishment of tree plantations in arable land

- The aim of the measure is to ensure the reduction of GHG emissions from the soil and to increase CO_2 removals in in all carbon pools.
- All organic soils in arable lands and the most fertile soils in grasslands are suitable for the implementation of the measure.
- Clones of aspen, poplar, alder and other fast-growing tree species are suitable for planting. **Tree plantations must be fenced.** The plantation can also suffer from drought. An additional effect can be ensured with wood ash and mineral fertilizer.
- **The effect of reducing GHG emissions over 75 years is 1,560 tons of CO_2 eq. ha^{-1} (on average 20.8 tons of CO_2 eq. ha^{-1} per year). An additional effect (784 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The measure provides the greatest effect of reducing GHG emissions, but additional plant protection measures must be implemented. Amendments to the regulatory environment are required to increase duration of a rotation to at least 20-25 years.**

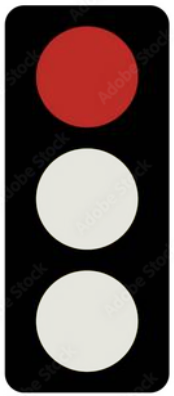
Comparison of mitigation effect



Use of wood ash after thinning

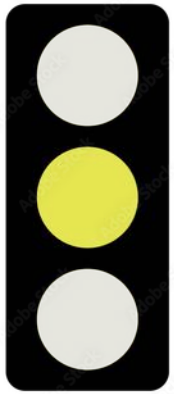
- The aim of the measure is to increase CO_2 removals in all carbon pools.
- All drained organic soils in forest lands are suitable for this measure.
- **The reducing GHG emissions over 75 years in a spruce forest is 97 tons of CO_2 eq. ha^{-1} (on average 1.3 tons of CO_2 eq. ha^{-1} per year). dditional effect (19 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- **The measure *may be* can be implemented on commercial carbon trading platforms.**
- **The measure provides the "fastest" GHG emission reduction effect with minimal risk of natural disturbances. The measure has great potential for implementation, limited only by the availability of wood ash.**

Selective felling (continued cover forestry) in a spruce forest



- The aim of the measure is to avoid the increase of GHG emissions from the soil after logging.
- Spruce groves in bogs and bogs are suitable for the implementation of the event. A greater effect is expected in areas with a greater risk of periodic flooding.
- **The effect of reducing GHG emissions over 75 years in a spruce forest is 164 tons of CO_2 eq. ha^{-1} (on average 2.1 tons of CO_2 eq. ha^{-1} per year).**
- **The measure may be implemented on commercial carbon trading platforms.**
- **The measure reduces GHG emissions from the soil in short term, but it increases the logging area by at 3-4 times, increases the risk of natural disturbances and prevents the use of the breeding effect. This measure is not recommended for implementation due to additional risks.**

Regeneration of black alder stands in wet organic soils by planting trees on mounds and by digging network of furrows



- The aim of the measure is to ensure the reduction of GHG emissions from the soil after logging and to increase CO_2 sequestration in all carbon pools in the regenerated area.
- The study do not prove positive effect of this measure; however, long term observations could demonstrate quicker restoration of a forest stand and accumulation of CO_2 in all carbon pools.
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **Research on the effectiveness of the measure should be continued, especially on the reduction of the risk of natural disturbances, tree growth and the long-term impact on emissions from soil.**

Planting tree strips along drainage systems in arable lands and grasslands

- The aim of the measure is to ensure the reduction of GHG emissions from the soil and to increase CO_2 removals in in all carbon pools.
- All organic soils in arable lands and the most fertile organic soils in grasslands are suitable for the implementation of the measure.
- Hydrid aspen, poplar, alder and other fast-growing tree species are suitable for planting, in a litter with bushy plantings. **Tree plantations must be fenced.**
- **The effect of reducing GHG emissions over 75 years is 1334 tons of CO_2 eq. ha^{-1} (on average 17.8 tons of CO_2 eq. ha^{-1} per year). An additional effect (475 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- In addition to the positive effect, the limitation of leaching of nutrients, improvement of the moisture regime and increase of biodiversity.
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The measure provides the second largest GHG emission reduction effect. The measure can be recommended for implementation, but additional plant protection measures should be implemented. Selection of "animal tolerant" species will reduce the risk, but also the mitigation effect.**

Planting of black alder stands in riparian zones on mounds and establishment a network of furrows

- The aim of the measure is to ensure an increase in CO_2 sequestration in all carbon stores in the restored area and to reduce GHG emissions from the soil.
- Implementation of the measure is possible in areas with wet peat soils along the coastal strips of natural watercourses with no restrictions on economic activity.
- The effect of reducing GHG emissions over 75 years is negative, if GHG emissions from the soil after regeneration correspond to the emissions of drained areas.
- **Research on the effectiveness of the measure must be continued. The implementation potential and the effect is significantly limited by the management restrictions in buffer zones of natural water streams.**

Regeneration of spruce stands in wet organic soils by planting on mounds and establishment a network of furrows

- The purpose of the measure is to increase CO_2 removals in all carbon pools and to reduce GHG emissions from soil.
- All mature spruce stands with naturally wet organic soils are suitable for the implementation of the measure.
- **The effect of reducing GHG emissions over 75 years in a spruce forest is 338 tons of CO_2 eq. ha^{-1} (on average 1.3 tons of CO_2 eq. ha^{-1} per year). An additional effect (19 tons of CO_2 eq. ha^{-1} per year) is provided by forest biofuel and recycled wood.**
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The measure can be recommended, but there are potential issues. The assumptions used in the calculation have yet to be tested. The effectiveness of the measure is more influenced by different soil emission factors compared to deciduous tree stands. Additional issue is considerably higher risk of natural disturbances.**

Strip or opening felling in a pine stands with drained peat soil

- The aim of the measure is to ensure the reduction of GHG emissions from the soil after logging.
- Pine and other tree species in peatland forests are suitable for this measure.
- The effect of reducing GHG emissions is negligible. Additionally, it can be negatively affected by reduced tree growth potential in openings. **However, the positive effect on groundwater level changes is clearly demonstrated.**
- **The measure is unlikely to be implemented on commercial carbon trading platforms.**
- **The effectiveness of the measure has not been proved, so the research should be continued, especially to assess the effect of the size of the openings on tree growth and soil GHG fluxes.**

What can be recommended, in short

- Conversion of cropland with organic soil to grassland. Rewetting of the converted areas can provide additional benefits in reaching biodiversity targets. Additional climate and farming benefits can be reached by planting of groups of trees in pastures.
- Afforestation of nutrient rich organic soils, considering short rotation period. Following rewetting can be considered in black alder and birch stands to contribute to the biodiversity targets. Substitution effect and harvested wood products are important part of the mitigation effect. The climate benefits can be increased by application of wood ash after thinnings.
- Fast growing trees as alternative to afforestation and shelter belts (not only around drainage systems). Higher risk, but also significantly higher mitigation potential. Fencing and other plant protection measures are crucial for successful implementation of the measure.
- Further studies are necessary on purposeful regeneration of wet and rewetted peatland forests to prove mitigation effect in comparison to natural regeneration; as well as on the eefect of regulation of groundwater level.
- Proper planning and management are crucial to reach the mitigation effect in all measures, higher potential mitigation effect is associated with higher risks.

Thank you for attention!

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