



# Twin-Regions Pilot Project Outline

**Twin-Regions - International solidarity to unlock potentials for achieving carbon neutrality**

**Explore the feasibility of the Twin-Regions concept and verify the potential to increase carbon sequestration by improving soil health in Sub-Saharan Africa**

**Countries:** Europe: Germany, France, Spain | Africa: Mali, Benin, DR Congo

**Cost:** 1.500.000 €

**Requesting party:** Members and Partners of the "4 per 1000" Initiative





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# 1 Executive Summary

This project outline is an offer for an investment of 1.5 million Euros to explore the feasibility and potential of an innovative and promising approach to drastically reduce carbon emissions and capture 5 Gt C ~ 18 Gt CO<sub>2</sub> within 10 years.

To achieve the goals of the Paris Agreement we have to work on ambitious emission reduction measures. Most global emission pathway models show that we are not doing enough to limit temperature rise. We have to think bigger. Globally billions of metric tons of carbon dioxide (CO<sub>2</sub>) per year need to be removed. Despite the goodwill, efforts on the national and international level were unable to halt the catastrophic development. The CO<sub>2</sub> concentration continues to rise exponentially. Key issues that prevent the breakthrough of established and proposed solutions continue to persist. Recurrent issues are low perception of the urgency 'Why should I care?', the questions of fairness 'How can we distribute the burdens fairly?', conflict of interest 'How will this affect our economy and welfare?' and above all a feeling of powerlessness on the part of the citizens 'What can I contribute and achieve?'. Against this background, decision-makers, who have to balance interests, are finding it difficult to provide a satisfactory response to the justified demands of initiatives such as Fridays for Future, despite all the sympathy. It seems that approaches that enable citizens to act independently and self-determined and promote international solidarity are essential for solving the climate crisis.

The concept of Twin-Regions is proposed by the "4 per 1000" Initiative as a novel mechanism that combines large-scale bottom-up climate action and international solidarity to reduce emissions and unlock untapped potential for natural carbon sequestration by improving soil health.

The Twin-Regions concept addresses the above mentioned issues and has the potential to contribute to a rapid reduction of atmospheric CO<sub>2</sub>. Additionally, it contributes to the solution of pressing societal and environmental problems. Moreover, it is expected to contribute significantly to overcoming barriers that currently hinder the acceptance and effectiveness of established climate change mitigation mechanisms such as carbon trading, carbon taxes and the implementation of NDCs.

A Twin-Regions is a pair of complementary communities in terms of emissions and carbon sequestration potential, which is essentially determined by their area and the potential to increase biomass production. The basic idea of the concept is to motivate citizens in a community of an industrialized nation with high emissions per person but low carbon sequestration potential to join forces with citizens in a community of a developing nation with low emissions but high carbon sequestration potential. Together they are pursuing the goal of being CO<sub>2</sub>-neutral by 2050 at the latest and from then on to pay off the historical CO<sub>2</sub> debts. Progress is measured by the carbon balance of the Twin-Region, which includes both communities. To achieve this, citizens in both regions will pool their social, cultural and natural resources to develop the necessary solutions that take into account their local conditions. It is anticipated that the citizens of communities in developed countries will focus on solutions to reduce emissions and to support carbon sequestration in their partner communities in developing countries in order to make their fair contribution to achieving carbon neutrality. The partnership allows the citizens in the community of the developing country to take advantage of innovative land use technologies, to combine increased carbon sequestration with sufficient food production and to increase their income. In return this might trigger a virtuous cycle that will lead to economic and societal development that ultimately benefits everybody.

The proposed pilot project will collaborate with citizens in communities in Europe and in Sub-Saharan Africa (SSA). The synergistic effects of collaboration between these two regions is expected to be particularly high since the potential of soil health improvement for enhancing C-sequestration is highest in areas that are characterized by a large yield gap. These are regions where the actual production of biomass is far below its potential and large gains are achievable with comparatively low investments. There is an untapped large potential to increase C-sequestration in SSA where biomass production can be greatly improved by reducing nitrogen, phosphorus and micro-nutrient deficiencies of soils and promoting good agricultural, forestry and other land use practices (GAFOLUP). Initial theoretical estimates suggest that up to 5 Gt C ~ 18 Gt CO<sub>2</sub> could be sequestered in addition over a 10-year period.



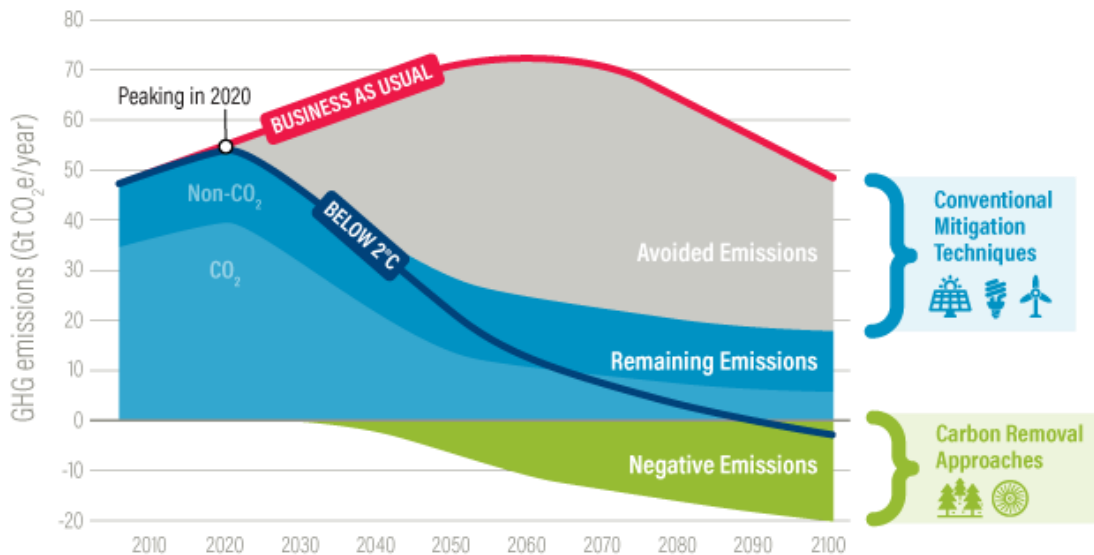
Both, the Twin-Regions concept and the idea to boost carbon sequestration by improved soil health and in particular through reducing nutrient deficiencies of soils in sub-Saharan Africa, are novel. It is obvious that at this pioneering stage there are a number of open questions that need to be clarified in order to lower the risks of investments into development and scaling. The proposed pilot project seeks to address two key issues, a) to explore the feasibility of the Twin-Regions concept in participation with stakeholders and b) to get a realistic assessment of the potential to boost carbon sequestration by reducing nutrient deficiencies in soils of SSA. Apart from that, the proposed project is expected to yield practical experience, valuable new ideas and an improved understanding of the factors determining success, barriers, co-benefits and risk that need to be considered for a large scale adoption. Other important topics such as the promotion of improved agricultural practices will be the subject of subsequent projects.

The pilot project will form 12 pilot Twin-Regions, each composed of a community in Europe and one in Africa. In total it will engage citizens of 24 communities (Germany 4, France 4, Spain 4, Benin 4, DRC 4 and Mali 4). Field activities in both regions will be organized by NGOs and Civil Society Organizations in collaboration with producer organizations and local governments. Procedures for data gathering and the analysis of results will be done by research organization in the pilot countries.

## 2 Introduction

To achieve the goals of the Paris Agreement, we must work on ambitious measures to reduce CO<sub>2</sub>. Most global emission path models show that we are not doing enough to limit the rise in temperature. Despite good will, efforts at national and international level have not been able to halt the catastrophic trend. The chart below illustrates that we need to do both: reduce emissions and start carbon sequestration immediately to prevent the catastrophe.

### Staying Below 2 Degrees of Global Warming



Source: Adapted from UNEP 2016.  
For more information, visit [wri.org/carbonremoval](http://wri.org/carbonremoval).



It seems that our existing economic and political system cannot avert the climate crisis. We continue to promote the destruction of our livelihoods to protect our immediate interests. Overcoming the crisis requires immediate technical and social innovation. This can only succeed in a systematic and result-oriented approach that is massively supported by the population.

The Twin-Regions concept starts at this point and enables the massive self-responsible and self-determined participation of the population by implementing projects. Besides the sequestration of soil carbon, it aims to encourage people in consumer societies to rethink their attitudes towards climate, emissions and waste of resources. In addition, the concept promises to make a decisive contribution to solving related urgent social and environmental problems and has considerable potential to contribute to employment, food security and the preservation of biodiversity.

### 3 The Twin-Regions concept

Twin-Regions can be described as a mechanism for transition to a new way of life that places the common good and stewardship of the natural resource base at the center of human activities.

A Twin-Regions is a pair of complementary communities in terms of emissions and carbon sequestration potential. The basic idea of the concept is to motivate citizens in a community of an industrialized nation with high emissions per person but low carbon sequestration potential to join forces with citizens in a community of a developing nation with low emissions but high carbon sequestration potential. Together they aim to achieve net zero emissions by 2050 and to eliminate its historical carbon footprint by 2100. Progress is measured by the carbon balance of both twins. To achieve this, citizens in both regions will pool their social, cultural and natural resources to develop the necessary solutions that take into account their local conditions. It is anticipated that the citizens of communities in developed countries will focus on solutions to reduce emissions and to support carbon sequestration in their partner communities in developing countries in order to make their fair contribution to achieving carbon neutrality. The partnership allows the citizens in the community of the developing country to take advantage of innovative land use technologies, to combine increased carbon sequestration with sufficient food production and to increase their income. In return this might trigger a virtuous cycle that will lead to economic and societal development that ultimately benefits everybody. Besides the clear effects of CO<sub>2</sub> reduction itself, the community in the industrialized country benefits through learning and thought-provoking processes. It is important that participating should not be seen as a license to act in an environmentally harmful way. It is about achieving an understanding of the climate change problem, minimizing one's own footprint as much as possible and giving additional support for CO<sub>2</sub> compensation in the South.

The matching of locations for the formation of Twin-Regions will be coordinated so that the average emission and sequestration potential per citizen is the same for all citizens of the earth. According to the principle of the Gaussian summation formula, all Twin-Regions ideally have the same average emissions per person of 4,8 t of CO<sub>2</sub> per year and sequestration potential. Despite all effort, a fair matching of twins and equitable distribution of burden and initial conditions will be difficult to achieve. It must also be expected that certain Twin-Regions will be disadvantaged by weather-related events and other calamities. A solidarity pact between Twin-Regions will help to compensate for remaining differences or those caused by unforeseeable events.

#### Example of a Twin-Regions

Alfter is a locality near Bonn (Germany) with 25.000 inhabitants. Annually this little town emits approximately 253,000 tons of CO<sub>2</sub> per year (Statista 2017, EnergieAgentur.NRW 2020). Its total area of 3500 ha is by far too small to sequester these emissions. Their options to compensate for emissions is mainly limited by their natural resource base. In contrast the 45,000 people living in Sinendé and Sèkèrè, two neighboring localities in Benin (West Africa), emit about 27,000 t of CO<sub>2</sub> per year (The World Bank 2014) and occupy an area of 114,000 ha. On top of that improved nutrient management has huge potential to increase biomass yields. Their options are mainly limited by poverty. It prevents them to invest into soil health for unlocking the carbon capture potential. Once these two communities unite, they can take advantage of their combined natural, social and economic resource base and collaborate to achieve carbon neutrality. Citizens in the Sinendé and Sèkèrè could provide the land required to produce biomass and to store carbon. Those in Alfter could provide the financial resources to buy fertilizer that is required to overcome nutrient deficiencies in soils in Sinendé and Sèkèrè. In return, the inhabitants in Sinendé and Sèkèrè could produce teak wood, which is needed for construction in Alfter. This would fix carbon in the long term. This is just a game of thought and it is up to the people in the Twin-Regions to develop and implement the business model that suits them best.

## 4 The C-sequestration potential in Sub-Saharan Africa (SSA)

WRI compared the different C sequestration technologies. They conclude that, although novel technical solutions bear a considerable potential, forestry and farming are presently the only option that we master sufficiently to remove large quantities of carbon from the atmosphere at reasonable costs of USD 50 per t of CO<sub>2</sub> (WRI 2018). The measures envisaged in their report consist primarily in afforestation/reforestation and in land use practices increasing soil organic carbon (SOC). Both approaches aim at an increased productivity in forestry and agriculture. In both cases, soil health is essential to achieve the required biomass gains.

Regions where the actual production of biomass is far below its potential and large gains are achievable with comparatively low investments are of particular interest. In this regard there is untapped large potential to increase C-sequestration in many tropical and subtropical regions with strongly weathered and degraded soils especially and most easily by reducing nitrogen, phosphorus and micro-nutrient deficiencies as proposed for the Twin-Regions pilot project.

There is an estimated theoretical potential to sequester 1 to 5 Gt C equal to 4 to 18 Gt CO<sub>2</sub> over a 10-year period in SSA. The estimate is calculated considering:

- the anthropologically managed areas in SSA according to land cover/land use classes (herbaceous crops, woody crops, grasslands and shrub-covered areas),
- annual biomass productivity of different land-use classes (literature) and
- estimates of additional biomass gains caused by a reduction of soil nutrient deficiencies that were derived from literature.

Reducing nutrient deficiencies improves soil health which in return leads to increased biomass production that allows to increased carbon stocks in a given area. Building up carbon stocks takes time and varies between agro-ecological regions and land use system. A change in temperature and land use induces a change of the carbon stock until a new equilibrium is reached. Land use systems dominated by plants with high biomass turnover and short C-half-life such as fast decomposing herbaceous crops, grasslands, are considered to reach the new steady state within one to few years. In contrast ecosystems dominated by plants with lower biomass turnover and comparatively longer C-half-life (slow decomposing woody plants) are considered to take 10-20 years until reaching a new steady state. These dynamics explain the comparatively low C-sequestration potential of crop- and grasslands compared to woody crops and shrub-lands.

According to the results of available studies in woodlands, a total of 300 kg/ha of commercial fertilizer are required during the first two to three years of a 10 year period to boost sequestration as indicated in Table 1. Equivalent data for grassland and shrub covered areas are difficult to find. At a current fertilizer price between 250 (World Market) and 800 US\$ / mt (Africa Fertilizer.org), this would translate into per ha fertilizer expenses of 75-240 US\$ and total expenses of 70-225 billion US\$. This would result in comparatively very low C-sequestration costs of 3.8-60 US\$ per t CO<sub>2</sub>.



**Table 1:** Estimated theoretical C-sequestration potential in SSA by reducing soil nutrient deficiencies with the application of 100 kg of NPK (14-23-14) per ha

Land use	Area in SSA (million ha)	Additional carbon yield (t of C/ha/year)		Total Annual C sequestration (Gt of C)		Time to saturation of carbon stock (years)	10 Years potential (Gt of C)	
		from	to	from	to		from	to
Herbaceous Crops	119	0,25	1,5	0,03	0,18	1	0,03	0,18
Woody Crops	17	1,25	7,5	0,02	0,13	10	0,21	1,28
Grasslands	672	0,25	1,5	0,17	1,01	1	0,17	1,01
Shrub-covered Areas	124	0,5	2	0,06	0,25	10	0,62	2,48
<b>Total</b>	<b>932</b>			<b>0,28</b>	<b>1,56</b>		<b>1,03 (1)</b>	<b>4,94 (5)</b>
<b>In Gt of CO<sub>2</sub></b>				<b>1</b>	<b>6</b>		<b>4</b>	<b>18</b>

Source : Alvarez-Clare et al. (2013); Campo und Vazquez-Yanes (2004); FAO-Modis, Feldpausch et al. (2007); Gehring et al. (1999); Nair et al. (2009); Poorter et al. (2016); Silver et al. (2000)

The figures in the table 1 highlighting the theoretical potential of improved nutrient management. However, it is important to bear in mind that the alleviation of nutrient deficiencies through mineral fertilization is just one of many measures for soil health restoration. Other measures may have an important impact on returns. To study their effect, will be the subject of subsequent studies.

## 5 Strategic fit with international climate change mitigation efforts

The "4 per 1000" Initiative was launched at the UNFCCC's Conference of the parties in Paris (COP21), where the first-ever universal, legally binding global agreement on climate change mitigation and adaptation was adopted. The so-called Paris Agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change. These efforts are defined at the national level as so called NDCs (Nationally Determined Contributions). The global goals of the Paris Agreement are to hold global warming well below 2°C on pre-industrial averages and to achieve net-zero emissions in the second half of this century. To achieve these goals, it is important to reduce greenhouse gas emissions as fast as possible and to complement emission reductions by ramping up C sequestration.

The Twin-Regions concept is proposed as civil societal engagement that is complementary to climate change mitigation efforts undertaken by the community of states under the UNFCCC. Important here: complementary does not mean additional, because the C sequestration achievements within a Twin-Regions are accountable to the NDCs of the developing country realizing the sequestration project as soon as the results are reflected in the national LULUCF (land-use, land-use change and forestry) inventories. This is especially true since most developing countries already consider LULUCF as a sector with high mitigation potential in their NDCs. It also means that realized C sequestrations cannot anymore be used to offset emissions elsewhere\*.

\*This contrasts with emission reduction and sequestration projects under both the Clean Development Mechanism (CDM) of the Kyoto Protocol. Under the CDM emission reductions in Non-Annex 1 countries (~developing countries) are financed through the sales of certified emission reductions (CERs) to Annex 1 countries and used to compensate emissions and to meet emission reduction targets in industrialized countries.

## 6 Pilot Project Description

### 6.1 Objective

To promote the development and adoption of the Twin-Regions concept is one of the three crosscutting objectives of the "4 per 1000" strategy. It seeks to engage a large number of partners from diverse stakeholder groups in a collaborative effort to achieve real impact at grass-root level. The implementation plan for this strategic objective comprises several activity areas, i) Start-up activities, ii) Pilot projects, iii) Enabling environment, iv) Operational framework, v) Out-scaling and vi) Monitoring and Evaluation. A number of partners in the pilot countries are presently carrying out startup activities with their own resources in order to raise awareness, mobilize support, build partnerships and gather feedback from stakeholders. This project proposal contributed to the second activity area 'Pilot Projects' for the clarification of fundamental open questions by surveys and safe-to-fail experiments to that allow a better understanding of complex issues and for developing ideas.

Both, the Twin-Regions concept and the idea to boost carbon sequestration by improved soil health and in particular through reducing nutrient deficiencies of soils in sub-Saharan Africa, are novel. The proposed pilot project seeks to address two key issues:

1. Exploration of the feasibility of the Twin-Regions concept in participation with stakeholders in Europe and Africa and
2. Verification of the potential to increase carbon sequestration by improving soil health in Sub-Saharan Africa by reducing nutrient deficiencies of soils

Apart from that, the proposed project is expected to yield practical experience, valuable new ideas and an improved understanding of the factors determining success, barriers, co-benefits and risk that need to be considered for a large scale adoption. Other important topics such as the promotion of improved agricultural practices will be the subject of subsequent projects.

The specific objectives of the proposed pilot project are:

Exploration of the feasibility:

- elaborate a agro-ecological and socio-economic profile of the localities
- establish a baseline (Carbon Footprint Analysis)
- the participatory evaluation of the motivation of citizens to engage
- the elaboration of alternative business models to drive carbon sequestration and emissions reduction
- clarification of governance modalities in support of transparency, accountability, inclusiveness conflict and risk management
- outline requirements of the enabling environment
- define procedures for the promotion and management of the concept
- provided an operational framework for the management of Twin-Regions
- forging strategic partnerships to assure promotion and support of the Twin-Regions concept

Verification of the potential:

- elaborate procedures for data gathering, processing and sharing
- determine the impact of mineral fertilizer on soil health and C-sequestration
- assess environmental and socio-economic co-benefits and risks
- establish scenarios for large-scale implementation
- verify MRV procedures and modalities
- formulate recommendations for further scaling
- identify research needs

## 6.2 Approach

The proposed pilot project will collaborate with citizens in communities in Europe and in Sub-Saharan Africa (SSA) and aims at exemplary establishing 12 pilot Twin-Regions. In total it will engage citizens of 24 communities in Germany, France, Spain, Benin, DRC, and Mali. This will allow covering a wide range of agro-ecological zones and socio-economic settings. The three countries were also selected due to the good and trusted relations with local partners that permit a rapid implementation and to reduce the risk of failure.

Field activities in Mali, Benin and the DRC are coordinated by national NGOs that have well established relations with the selected locations and have a solid working relationship with local authorities and extension services. They will engage young professionals from agricultural colleges and school leavers in the villages who will organize community meetings and carry out surveys and field activities. All activities will be carried out as services that are designed by experts. An innovative and proven system, the so-called RUN-Network-system, will be used for the organization and management of services (RUN 2018). It will ensure the timely provision of services, payment of service providers and seamless documentation of the entire process in near real time on the collaborative platform of the "4 per 1000" initiative for sharing. The business model is similar to franchising. Local teams of service providers offer a range of standard services to meet local demand. Service providers are hired on a freelance basis and paid on delivery. From their perspective, it is an additional economic activity that contributes to their total income. The Run-Network system has been successfully used to provide thousands of ecosystem services by several hundred service providers in 173 communities in Benin, reaching up to 50,000 producers.

Research organization in the pilot countries will be in charge of the development of the procedures for data gathering and the analysis of results.

All data is considered public good and is passed on to research institutions for analysis.

## 6.3 Activities

### Exploration of the feasibility

Proof of the Twin-Regions concept will start with some awareness raising activities for the identification of localities willing to engage in a Twin-Regions. Selected localities will be characterized to capture the agro-ecological and socio-economies conditions. This includes a participatory rapid assessment of their carbon footprint. Each location will have its own space on the collaborative platform of the "4 per 1000" Initiative for documentation and sharing of information. It will be used for the matching of locations and for the formation of 12 Twin-Regions.

The project will undertake surveys and initiate consultations to better understand the motivations, the interests that are at stake, to elaborate business models that motivate people to lower emissions and to invest into carbon sequestration and to work out proposals for improving the enabling environment. All 12 Twin-Regions will join to think about governance structures, an operational framework for the management of activities and to make suggestions for further scaling.

During the same period the secretariat of "4 per 1000" will exchange with members of the forum and consortium to forge strategic partnerships willing buy in and support the Twin-Regions action.

### Verification of potential

It is expected that the effect of fertilization on sequestration will be influenced by a variety of factors and will vary greatly depending on the type of land use and environmental conditions. With the exception of cropland, only few data are available to predict its effect on differently used areas such as grassland, shrub-land and plantations. It is therefore not possible at the present time to give concrete recommendations for the fertilization of areas used for other purposes and to reliably estimate the total sequestration potential. Against this background, the investment risk is considerable.



For this reason, the project will adopt a simple experimental design, with a large number of repetitions and put the main emphasis on the participatory discovery, observation and understanding of factors that might explain the variability of the effect on C-sequestration and on other key indicators related to the SDGs such as biodiversity. To evaluate the potential, the project will consider four different land-use types: Herbaceous Crops, Woody Crops, Grasslands and Shrub-covered areas. Experimental areas of 2 ha will be identified in agreement with producers. Half of the experimental areas will be fertilized with commercial fertilizer (N, NP, NPK) at a rate 23 kg of P<sub>2</sub>O<sub>5</sub> per ha. The formula might vary according to availability. Geo-referencing will allow the use of remote sensing. Experimental protocols, procedures and manuals for observations will be elaborated in exchange with the members and partners of the college of research and educational organizations to assure that they match international standards and can be followed by the young service providers.

## 6.4 Provisional Work-plan and budget

The total duration of the project is 24 months. The columns Start and end in the table in indicate the month since the start of the project.

#	Activity	Managers and key actors	Budget (€)	Start	End
<b>1</b>	<b>Coordination</b>				
1.1	Detailed planning with implementing partners	• 4 per 1000 Executive Secretariat	40.000	1	3
1.2	Provision of the platform for the documentation and sharing of information and management of services	• 4 per 1000 Executive Secretariat	40.000	3	4
1.3	Networking, animation and reporting	• 4 per 1000 Executive Secretariat	100.000	1	24
	<b>Sub-total</b>		<b>180.000</b>		
<b>2</b>	<b>Exploration of the feasibility</b>				
2.1	Africa	• NGOs & Civil Society Organizations	150.000	5	24
2.2	Europe	• NGOs Civil Society Organizations	120.000	5	24
2.3	Scientific backstopping, clarify role and relevance of the concept for on-going climate change strategies, data analysis and reporting	• Research organizations in Africa and Europe	100.000	1	24
2.4	Forging strategic partnerships and clarify modalities for a mechanism for the administrative and financial management of the Twin-regions action	• 4 per 1000 Executive Secretariat	50.000	1	24
	<b>Sub-total</b>		<b>420.000</b>		
<b>3</b>	<b>Verification of potential</b>				
3.1	Experimentation in 2400 fields of 2 ha	• NGOs & Civil society Organizations	720.000	3	24
3.2	Scientific backstopping for the development of procedures, data analysis and reporting	• Research organizations in Africa and Europe	180.000	3	24
	<b>Sub-total</b>		<b>900.000</b>		
	<b>Total</b>		<b>1.500.000</b>		

## 7 References

- Africa Fertilizer <https://africafertilizer.org/national/>
- Alvarez-Clare, S.; Mack, M. C.; Brooks, M. (2013): A direct test of nitrogen and phosphorus limitation to net primary productivity in a lowland tropical wet forest. In: *Ecology* 94 (7), S. 1540–1551. DOI: 10.1890/12-2128.1.
- Arnold, T., Blokland, K., Engel, A., Ifejika Speranza, C., Losch, B., Michel, B., Rampa, F., Wieck, C., Zvarimwa, M. (2019): *An Africa-Europe agenda for rural transformation* (Report by the Task Force Rural Africa). European Union [https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/report-tfra\\_mar2019\\_en.pdf](https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/report-tfra_mar2019_en.pdf)
- BMU (2017): Der Klimaschutzplan 2050 - Die deutsche Klimaschutzlangfriststrategie. <https://www.bmu.de/themen/klima-energie/klimaschutz/nationale-klimapolitik/klimaschutzplan-2050/>
- Campo, Julio; Vzquez-Yanes, Carlos (2004): Effects of Nutrient Limitation on Aboveground Carbon Dynamics during Tropical Dry Forest Regeneration in Yucatan, Mexico. In: *Ecosystems* 7 (3). DOI: 10.1007/s10021-003-0249-2.
- Climate Focus (2015): The Paris Agreement: Summary. Climate Focus Client Brief on the Paris Agreement III. <https://climatefocus.com/sites/default/files/20151228%20COP%2021%20briefing%20FIN.pdf>
- Davidson, Eric A.; Reis de Carvalho, Cláudio J.; Vieira, Ima C. G.; Figueiredo, Ricardo de O.; Moutinho, Paulo; Yoko Ishida, Françoise et al. (2004): Nitrogen and phosphorus limitation of biomass growth in a tropical secondary forest. In: *Ecological Applications* 14 (sp4), S. 150–163. DOI: 10.1890/01-6006.
- Energieagentur.NRW (2020): [https://www.energieagentur.nrw/mediathek/Grafik/co2-emissionen\\_pro-kopf\\_in\\_nrw\\_und\\_deutschland](https://www.energieagentur.nrw/mediathek/Grafik/co2-emissionen_pro-kopf_in_nrw_und_deutschland)
- Europäische Kommission (o.J.): Ein europäischer grüner Deal. Erster klimaneutraler Kontinent werden. [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_de](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de)
- FAO-MODIS: <http://www.fao.org/faostat/en/#data/LC>
- Feldpausch T.R.E.D.; Prates-Clark, Cassia da Conceicao; Fernandes, Eick C.M.; Riha, Susan J. (2007): Secondary forest growth deviation from chronosequence predictions in central Amazonia. In: *Global Change Biol* 13 (5), S. 967–979. DOI: 10.1111/j.1365-2486.2007.01344.x.
- Gehring, Christoph; Denich, Manfred; Kanashiro, Milton; Vlek, Paul L. G. (1999): Response of secondary vegetation in Eastern Amazonia to relaxed nutrient availability constraints. In: *Biogeochemistry* 45 (3), S. 223–241. DOI: 10.1007/BF00993001.
- Nair, P. Ramachandran K.; Nair, Vimala D.; Kumar, B. Mohan; Haile, Solomon G. (2009): Soil carbon sequestration in tropical agroforestry systems: a feasibility appraisal. In: *Environmental Science & Policy* 12 (8), S. 1099–1111. DOI: 10.1016/j.envsci.2009.01.010.
- Pellegrini, Adam F. A. (2016): Nutrient limitation in tropical savannas across multiple scales and mechanisms. In: *Ecology* 97 (2), S. 313–324. DOI: 10.1890/15-0869.1.
- Poorter, Lourens; Bongers, Frans; Aide, T. Mitchell; Almeyda Zambrano, Angélica M.; Balvanera, Patricia; Becknell, Justin M. et al. (2016): Biomass resilience of Neotropical secondary forests. In: *Nature* 530 (7589), S. 211–214. DOI: 10.1038/nature16512.
- RUN 2018: [An Operational Framework for Innovation and Youth Employment at Large Scale](#)
- Silva, Lucas C. R.; Hoffmann, William A.; Rossatto, Davi R.; Haridasan, Mundayatan; Franco, Augusto C.; Horwath, William R. (2013): Can savannas become forests? A coupled analysis of nutrient stocks and fire thresholds in central Brazil. In: *Plant Soil* 373 (1-2), S. 829–842. DOI: 10.1007/s11104-013-1822-x.
- Silver, W. L.; Ostertag, R.; Lugo, A. E. (2000): The Potential for Carbon Sequestration Through Reforestation of Abandoned Tropical Agricultural and Pasture Lands. In: *Restor Ecology* 8 (4), S. 394–407. DOI:10.1046/j.1526-100x.2000.80054.x.



Statista (2017): <https://de.statista.com/statistik/daten/studie/167877/umfrage/co-emissionen-nach-laendern-je-einwohner/#professional>

The World Bank 2018: CO2 emissions (metric tons per capita) <https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>

WRI (2018): 6 Ways to Remove Carbon Pollution from the Sky:  
<https://www.wri.org/blog/2018/09/6-ways-remove-carbon-pollution-sky>