CLIMATE CHANGE
19/2017

Synergies and Conflicts between Climate Protection and Adaptation Measures in Countries of Different Development Levels

Summary

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Synergies and Conflicts between Climate Protection and Adaptation Measures in Countries of Different Development Levels

Summary

by

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1 Foreword

As global warming is accelerating it is essential for developing countries to figure out how they can at the same time maintain development targets, cope with unavoidable consequences of climate change and contribute to climate protection. These questions call for the derivation of climate resilient pathways for developing countries, i.e. for a systematic analysis of trade-offs and synergies between adaptation, greenhouse gas mitigation and development measures. Such an undertaking needs to review scientific and governmental literature, employ data from different sources, and develop a semi-empirical approach to analyze major processes on the country level. Seeking the relevant documents, investigating different data sources and deriving the right conclusions from these sources was a tremendous undertaking, but it led to fundamental insights for the investigated countries. Apart from this huge amount of material investigated, the present report has still room for improvements. During the course of the project it was not feasible to develop a comprehensive model approach, which enables to make projections into the future. Moreover, in this study the countries were investigated independently, i.e. it was assumed that a country system and all its internal activities will evolve without any influence from other countries. This assumption, of course, is a simplification, but it was necessary for a structuring of the overwhelming amount of information the project needed to review. The outcome is a matrix that comprises economic, societal, and financial indicators. This matrix can be used to assess coping capacity in certain sectors and it can serve as a starting point for more detailed investigations. Indeed, this also holds true for the underlying methodological framework, which can be further developed into a model that combines environmental, societal, and financial challenges, and enables projections and systematic trade-off analyses.

Summing up, the full report and the present short version provide a good entry point for further investigations and may provide a blueprint for such undertakings. The current short version provides only a first glance about potential trade-offs and synergies. For more details and deeper insights the respected reader has to look into the full report. The framework developed enables the evaluation of the development of the country system. It offers an opportunity to assess the determinants of adaptive capacity and, therefore, ideas for future action can be derived i.e. in the field of adaptation, mitigation and sustainable development.

Due to the fact that various countries, regions and sectors were investigated, a lot of colleagues supported the preparation of this report. In particular, the authors are indebted to thank various colleagues for supporting this report, i.e. by figures, text pieces, and data. Furthermore, we generally encountered open ears for more in-depth - sometimes controversial - discussions. In particular, the authors are indebted to acknowledge the following colleagues for their help and support: in alphabetical order, Luis Costa, Thomas Day, Camila Flórez Bossio, Fatima Ghaffarian, Cornelius Grupp, Ramana Guddipudi, Steffen Kriewald, Jürgen Kropp, Linda Krummenauer, David Landholm, Mariana Morena Lemos da Conceição, Stefanie Lyn Becker, Prajal Pradhan, Theresa Rauch, Katja Voigt, Hibba Waheed, and Carsten Walther.

2 Introduction

The Earth is warming. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2013). However, even small changes in the average temperature of the planet can translate to large and potentially dangerous shifts, affecting regional climate and weather regimes that will subsequently influence human livelihoods, the economic basis of countries and the natural environment. These effects and increasing risks could limit, or even reduce, the options for human development and, consequently, also limit opportunities for societal transformations which are needed to cope with the upcoming challenges. Therefore, this project analyzes synergies between potential adaptation measures to climate change and mitigation of GHG in sixteen countries under parallel consideration of development needs. Namely, these countries are: Brazil, Cambodia, Colombia, Ethiopia, Grenada, India, Indonesia, Kenya, Mali, Mexico, Nicaragua, Pakistan, Peru, Philippines, South Africa and Vietnam. The project identifies the country institutions required to address crucial adaptation needs in order to exploit the highest mitigation potential, i.e. the institutions for maximizing climate resilience.

3 Methodological Aspects

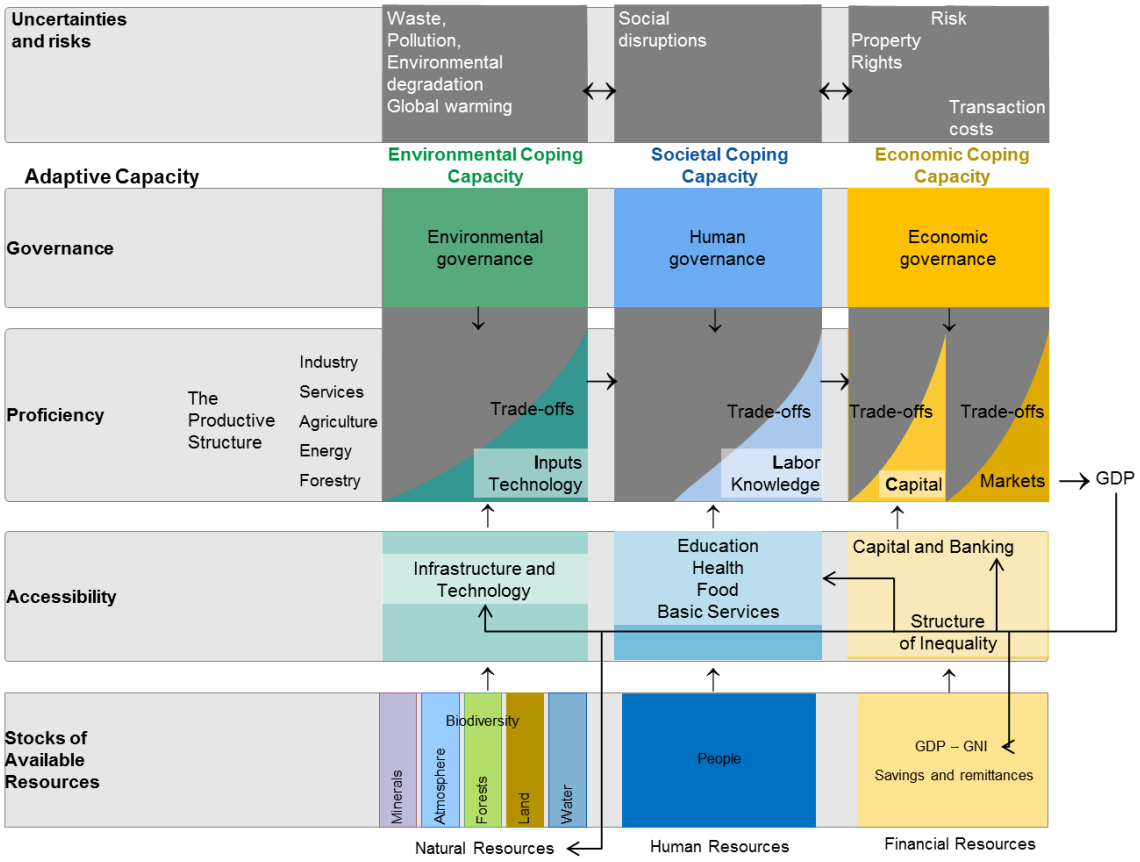
The main goal of this report is to identify potentials for synergies between adaptation needs and mitigation opportunities at a country level under parallel consideration of sustainable development. Consequently, this report tries to pave the road towards a more integrated vision. From a scientific point of view, the identification of adaptation needs in the context of climate change has mainly been investigated through vulnerability assessments. In general, current approaches can be categorized into two groups: i) concepts within a biophysical tradition (cf. Klein et al. 2007) and ii) approaches dealing with a human-ecology perspective (O'Keefe, Westgate, and Wisner 1976). The biophysical tradition focuses on the analysis of interactions between natural hazards and their impacts on certain sectors like agriculture, human health, or forestry. The human ecology perspective emerged in the 1970s from the inclusion of political and economic causes of vulnerability, and how micro- and macroeconomic conditions may affect human vulnerability. As these conditions related to e.g. income inequality, the provision of health and basic services are unequally distributed within societies, vulnerability also becomes a matter of justice and political economy and social justice. The present report makes an attempt to integrate these two traditions, because the analysis of synergies between adaptation action, mitigation needs, and sustainable development goals affects all dimensions of the above traditions. To achieve this, the report analyses synergies (positive multiplier) and trade-offs (negative multiplier) between adaptation and mitigation measures in countries of different and similar development levels. For the integrated analysis, the concept of *country system* was introduced (cf. Figure 1). A country system is defined by a set of structural components and its dynamic relationships. These components were identified from the determinants of adaptive capacity (Adger et al. 2007). Countries develop from the strengthening of these structures, i.e. the country system defines the relationships that create the adaptive capacity (cf. Moss et al. 2001, William & Baumert 2003, Nelson et al. 2007). Hence, development and adaptive capacity, required for institutionalizing synergies, co-evolve. (For further readings regarding the methodological background, please refer to the main report). Thus, the synergies project developed a comprehensive, partly qualitative heuristic approach that enables a ranking

of countries with different development levels (common metric), based on a set of common indicators (Figure 2).

In summary, the work provided in this report is based on the following rationale:

- The unsuitable utilization of natural resources in economic activities causes environmental disruptions, social unrest and conflicts, economic losses and risks.
- Pursuing climate resilient pathways implies the transformation of countries towards more efficient economies in terms of natural resources use, development of infrastructure, social conditions and governance. The transformation of tradeoffs into synergies sets countries on track of climate resilient pathways.

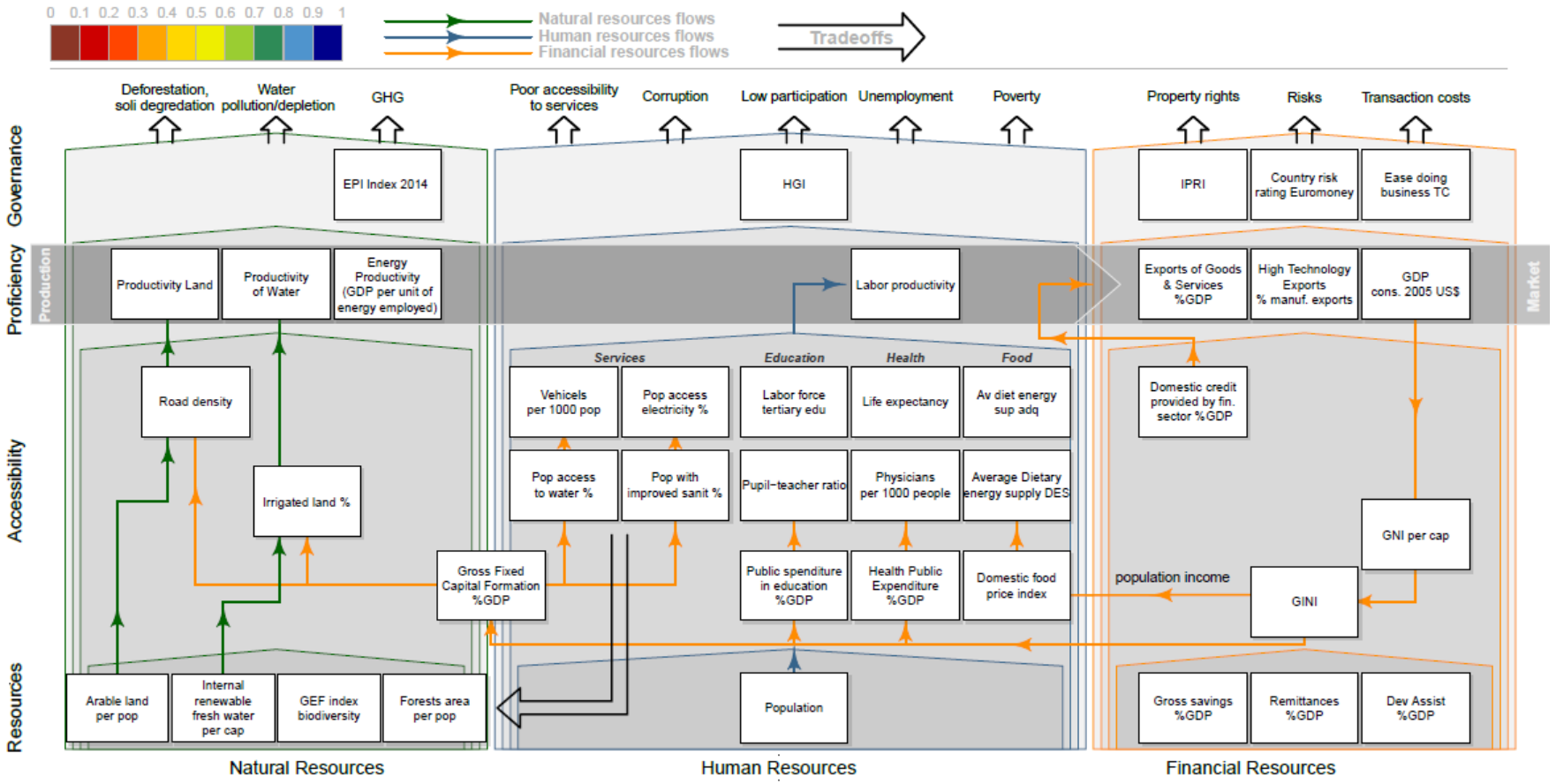
Figure 1: Country systems and adaptive capacity, structural components and relationships.



Structural components of country systems include the productive structure, markets, the frameworks that create the accessibility to resources, and governance. These components not only define the conditions to control flows (arrows), e.g. roads may improve accessibility to natural resources, but also define conditions for the flows of resources needed by economic activities. Economic activities perform according to the conditions of the structures of accessibility, and according to the rules and conditions imposed by governance structures. The accessibility to natural resources is determined by infrastructure and technologies, e.g. dams, technological development, etc.. Economic activities require human knowledge. To create the accessibility to knowledge countries have to improve livelihood conditions, education systems, and infrastructure. In turn, the accessibility to financial resources is determined by capital and banking, and by the structure of income inequality of the country. A country with large disparities in terms of income inequality will allocate more of its GDP output in the capital and banking sector, which is a disadvantage for societal capacities. A country is characterized by a high adaptive capacity if the accessibility to resources, the capable use of the resources in economic activities and governance institutions are highly developed. Accessibility, proficiency, and governance are postulated as relevant capacity factors. Adequately developed, these may reduce uncertainties and allow planning for risks. For example, mitigation of GHG emissions are

initiated by the reduction of environmental tradeoffs produced by the low-proficient usage of natural resources in energy production.

Figure 2: Framework of indicators used to assess the adaptive capacity and the stage of development of a country.



Each indicator is used as a proxy for a component of the country system (for a detailed discussion of the data, components and their relationships, refer to appendix 3 of the full report). The value of each indicator is normalized, and a colored scale indicates the ranking of the relative values, i.e. brown for very low and blue for very high values. Colored arrows indicate the flows of resources being transformed by the structures of accessibility to make them available as inputs in economic activities. For some elements the assessment is based only on one indicator, e.g. road density informs adequately of the accessibility to land and other natural resources. Other elements such as those shaping social conditions (food security, health and education) require more than one indicator. Proficiency was assessed in terms of the productivity of the resource - for natural and human resources. Void arrows indicate potential sources of tradeoffs.

4 Country Reports

The assessment of the adaptive capacity was integrated into the assessment of sensitivity and vulnerability, and consists of the following components:

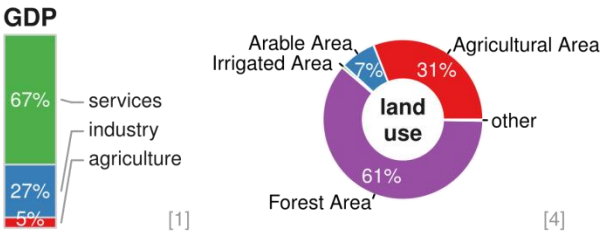
- Assessment of sensitivity, including trends and projected changes on water, precipitation and rainfall, land use and forests, crop yields and atmosphere;
- Analysis of the economic vulnerability, based (if possible) on the results of models that calculate the projected economic damages, the current development of productive factors, the contribution of agriculture, the structure of exports and their contribution to GDP. This assessment included recent trends on capital formation, on investments in gross fixed capital formation, on the provision of domestic credit by the financial institutions and inflation. It also included indicators assessing the performance of institutions to cope with uncertainties (in regard of property rights and transaction costs) and risk.
- Assessment of social vulnerability, reporting the trends on inequality, income distribution and poverty, projected impacts (when studies were available) and the situation of food security, health, education and the provision of basic services. It also reports the trends of the indicators of human governance.
- Complementary analysis of the development of GHG emissions: analysis of GHG emissions from the combustion of fossil fuels coupled to the development of the indices composing the Human Development Index, based on the research of Costa et al., (2011).
- Analysis of GHG emissions from agriculture and trends of food patterns: the report dived into the analysis of trends of food diets, the potential for food self-sufficiency (Pradhan et al. 2015) and trends on GHG emissions from agriculture (Pradhan et al., 2013), and the potential of peri-urban agriculture for self-sufficiency and mitigation of GHG emissions (Kriewald 2012a; Kriewald et al., 2015).

The analysis of synergies in the country reports starts with the identification of the most relevant tradeoffs (based on the analysis of vulnerability and sensitivity) and integrates the assessment of the adaptive capacity.

For sake of readability it is worth to know that most ranking statements made in this report relate to the situation of the other investigated countries only. For the discussion of potential emission trends it was important to appraise country values in regard to emissions limits, i.e. 2 tCO_2/capita yr on average up to 2050 (WBGU, 2009) which may keep global warming below 2 °C. Due to globally increasing emissions a 2 to/cap yr emission budget is a matter of debate. Nevertheless, the IPCC-TAR (2001) stated that a world population of about 10 billion people may emit an average of carbon of about 0.3-0.6 to carbon/capita (equals to 1.1-2.2 to CO_2) compatible with 450-550ppm limits, respectively by 2100. Therefore 2 to/cap yr was taken as a reference value.

4.1 Brazil

Country size	8,514,877 sq km	[1]
Coastline	7,491 km	[1]
Population	202.03 millions	[2]
Rural population (%)	14.6	[2]
Human Development Index	0.74 (79 of 187 – High)	[3]
Life expectancy at birth	73.94	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: A high mitigation potential exists in agriculture, energy production and forestry. CO_2 emissions per capita from fossil fuel combustion are higher than 2 to CO_2/capita year (cf. IPCC 2001, WBGU 2009). Emissions from agriculture grow steadily, mainly forced by changes in dietary styles and increasing meat consumption.

Vulnerability, Adaptive Capacity and Development: GDP growth is mainly driven by domestic consumption. Economic factors affecting the adaptive capacity comprise an unsuitable infrastructure and less low human capital. The banking system has large capacities to invest, but investments in infrastructure are still quite low. Economic inefficiencies cause high transaction costs. The legal embedding of property rights is insufficient. Inequality has been decreasing in recent decades, but still high. Income of lower income shares is growing and mainly spent for consumption, but not being invested in the improvement of education and health.

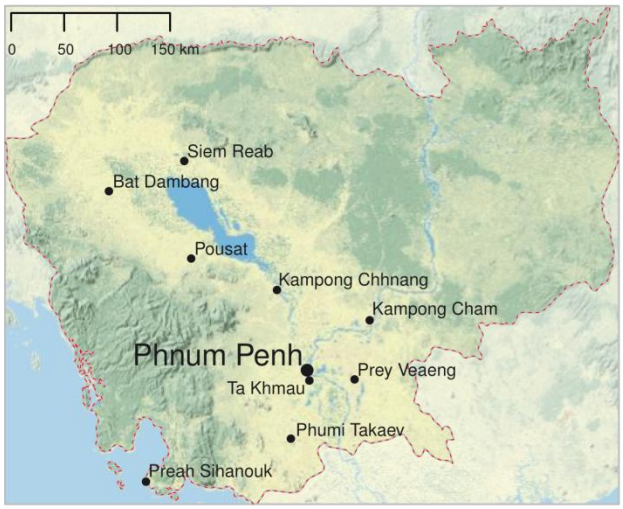
Current Tradeoffs: Carbon dioxide emissions grow at a quicker pace than human development. In particular, emissions from agriculture are in comparison to other countries too high. This is further worsened by the expansion of agriculture at the cost of forest areas.

Action for the Potential Creation of Synergies:

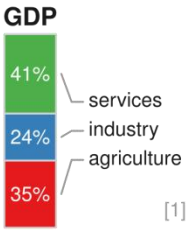
- A taxing system that creates incentives to invest in education and health care systems may be complemented by taxes on superfluous consumption (luxury goods).
- An institutional set-up drawing upon the successful (best practice) management experiences.
- Further technological development and increased human capacity for monitoring deforestation on a daily basis.
- The creation of incentives so that poor residents can become forests guardians.
- Adequate policies for the expansion of soybean and other profitable crops in savannahs and pastures.

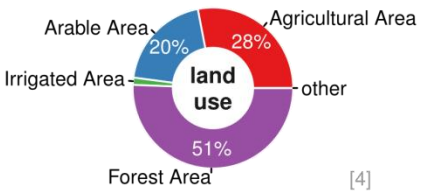
- Long-term programs to improve the productivity of land.
- Policies for the development of industry and services that create incentives for rural population to safely migrate to urban or semi-urban areas.
- Surveillance institutions and more suitable management practices that reduce emissions from agriculture.

4.2 Cambodia



Country size	181,035 sq km	[1]
Coastline	443 km	[1]
Population	15.41 millions	[2]
Rural population (%)	79.5	[2]
Human Development Index	0.58 (136 of 187 – Medium)	[3]
Life expectancy at birth	71.92	[1]





[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: REDD+ measures and the agricultural sector offer the highest mitigation potential. Economic growth in industry and services fed by a further regional integration with Thailand, Vietnam and China would lead to increasing emissions from the energy sector. Emissions per capita (0.3 to CO_2/cap yr in 2010) are still low (cf. IPCC 2001, WBGU 2009). Rice production offers the highest reduction potential in agriculture.

Vulnerability, Adaptive Capacity and Development: Floods in 2011 caused damages equivalent to 4.8% of GDP. Climate change will exacerbate flood risk in the Mekong watershed, which may cause damages to road infrastructure and rice and textile production (main source of revenues). Deforestation is high and mainly driven by poverty and industrial agriculture. Agriculture will remain the main sector for growth and development for the next decades. The economy is highly dependent on exports –mainly textiles (70% of GDP by 2012) and rice. Electricity shortages are quite frequent. Uncontrolled inflation has affected food price levels in the past. 15.4% of the population is still undernourished (FAO 2015). Current accomplishments in poverty reduction are still very fragile.

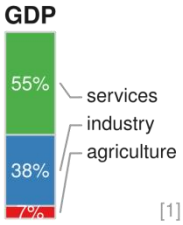
Current Tradeoffs: The expansion of agriculture at the cost of forest areas. Unsustainable rice production is causing GHG emissions. Inadequate capacity in Disaster Risk Management mechanisms, which are crucial for guaranteeing adaptation, growth and development.

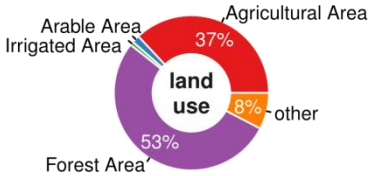
Action for the Potential Creation of Synergies:

- Huge investments in the road network are needed to foster further regional integration. Moreover, the infrastructure needs to be designed in a risk-resilient manner in order to take into account increased exposure to floods in the Mekong's watershed.
- Monitoring, Reporting and Verification for REDD+ measure needs further support.
- Cambodia needs to develop institutions that promote further improvement of agricultural productivity, agricultural diversification, the adoption of modern technologies for small and middle size farms, and the implementation of technologies and practices for low emissions in crop production, mainly in rice production.

4.3 Colombia

Country size	1,138,910 sq km	[1]
Coastline	3,208 km	[1]
Population	48.93 millions	[2]
Rural population (%)	23.8	[2]
Human Development Index	0.71 (98 of 187 – High)	[3]
Life expectancy at birth	74.04	[1]





[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: The sectors of energy, agriculture –mostly enteric fermentation- and forestry (deforestation) provide the largest potential for mitigation. CO_2 emissions per capita increased from ≈1.3 to ≈1.8 tCO_2/yr between 2004 and 2013 (cf. WBGU 2001). The country has good potential for renewable energy production.

Vulnerability, Adaptive Capacity and Development: Changes of rainfall patterns forced land use changes. Deforestation rates in Caquetá are the highest in South America. Labor productivity, poor road infrastructure and the social conflicts have negative effects on adaptive capacity formation. The domestic economy is highly dependent on mining. Overall the economy is poorly diversified. Actual exports are concentrated on a few (mostly raw) commodities. Domestic loans have steadily grown since 2003, but inequality and poverty headcount ratio are still high (WorldBank 2015a). The country is vulnerable to natural and human disasters. Despite recurrent impacts from landslides, floods, droughts and fires, the country has not developed preventive capacities for Disaster Risk Management.

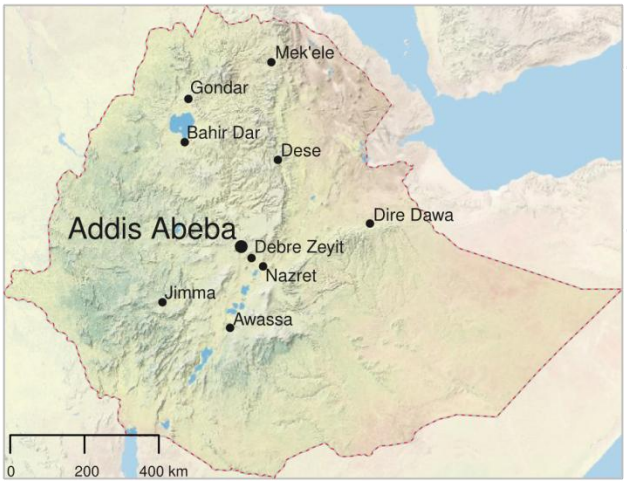
Current Tradeoffs: The expansion of agriculture into forest areas mobilizes greenhouse gases and degrades the sink function of forests. Cattle growing –mainly enteric fermentation–

fosters further emissions. The development of the capacity in Disaster Risk Management is currently unsuitable and limits adaptation, growth and development.

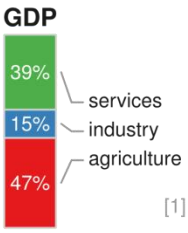
Action for the Potential Creation of Synergies:

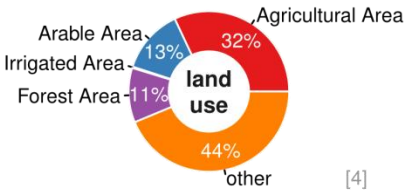
- Large investments are needed in education, promotion of small and middle enterprises, as well as an economic diversification.
- Enhancing environmental governance and further implementation of REDD+ measures.
- Improvement of the productivity of agriculture und parallel reduction of emissions.
- Enhancement of peasant-based agriculture to develop capacities that control deforestation.
- Improvement of inefficient livestock production is essential; in parallel, the expansion of cattle ranching needs to be reversed.
- Institutional coordination and performance of public bodies should be improved in order to decrease corruption.

4.4 Ethiopia



Country size	1,104,300 sq km	[1]
Coastline	0 km (landlocked)	[1]
Population	96.51 millions	[2]
Rural population (%)	81	[2]
Human Development Index	0.44 (173 of 187 – Low)	[3]
Life expectancy at birth	63.63	[1]





[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: The highest mitigation potential exists in agriculture and forestry. Expected growth in the energy production and transport sectors creates a high potential for GHG mitigation if adequate measures are applied. CO_2 emissions from fossil fuel combustion per capita are still low, i.e. approx, 0.1 tCO_2/cap yr (cf. WBGU 2001). The potential of emission reduction in agriculture is largely ignored in policy.

Vulnerability, Adaptive Capacity and Development: The economy, in particular agriculture, is highly vulnerable in regard to changing precipitation patterns and long-term impacts of climate change on crop yields. The country has developed a long-term strategy for a climate resilient growth (FDRE 2011). The kebeles (rural community associations) are one key asset to sustain such a growth. Infrastructure, productivity, markets, financial capacity, social

conditions and governance are underdeveloped and need improvements. Financial capital is mainly spent for infrastructure development. Existing property rights on land need to be enforced more adequately to improve economic efficiency.

Tradeoffs: Expansion of agriculture at the cost of forest areas and agricultural production styles increase greenhouse gas emissions.

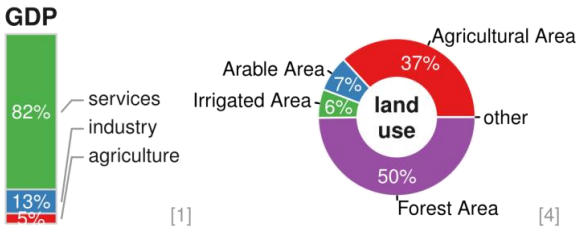
Action for the Potential Creation of Synergies:

- Agricultural markets need to be enhanced, and increasing the productivity and diversification in agriculture are required, since agriculture is still the backbone of the Ethiopian economy.
- Kebeles[1] are the key institutions to develop a strategy for deforestation control, agricultural development and the provision of social services in rural areas.
- Community identification with the kebeles requires transparency, control of corruption and justice.
- Strategies for growth and development in rural areas require the creation of national institutions for research and development that can support agricultural development (cf. above).
- The implementation of technologies and practices for emission reductions in agriculture and forestry as well as capacity development for monitoring, reporting and verification of carbon sinks will further improve a climate friendly development.
- The further support of REDD+ measure can foster capacity development.

[1] Kebeles are the smallest administrative entity in Ethopia and composed by village councils. More than 10.000 kebeles exist in Ethopia

4.5 Grenada

Country size	344 sq km	[1]
Coastline	121 km	[1]
Population	0.11 millions	[2]
Rural population (%)	64.4	[2]
Human Development Index	0.74 (79 of 187 – High)	[3]
Life expectancy at birth	72.77	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: In terms of emission reduction (mitigation potential) Grenada's global contribution is insignificant. In regard to future climate resilient pathways Grenada needs to focus on the development of an advanced institutional architecture that can cope with weather-related disasters.

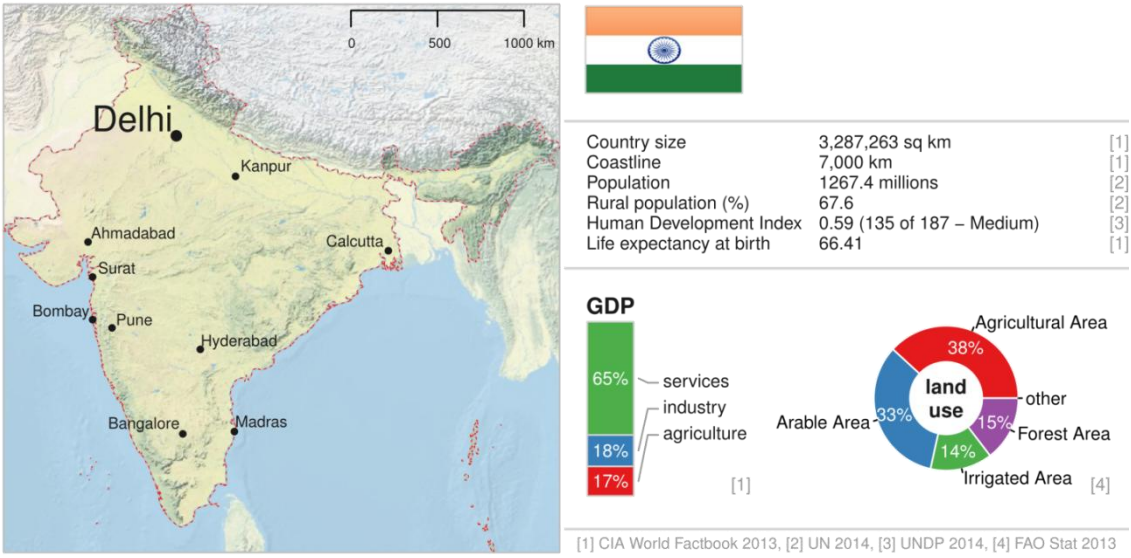
Vulnerability, Adaptive Capacity and Development: The country is highly exposed to weather-related disasters. In the recent past, hurricanes have been major sources of damages. In addition, the country is still burdened by a high external debt, caused by the recovery needs induced by the hurricanes in 2005 and 2006. Flood flashes are common and relevant for permanent risk of damages in agriculture and infrastructure. The current adaptive capacity is low due to an unsuitable institutional architecture. The country is suffering from the lack of highly qualified human capital in governmental institutions that can develop and implement suitable response plans. However, the governmental situation is stable and credible, i.e. indicators of human governance rank Grenada on the top position amongst the countries studied (WorldBank 2015a).

Tradeoffs: The waste management sector has a high share in GHG emissions. Due to the inadequacy of institutional settings the country has difficulties to cope with disaster risk management, in particular in regard to water-related threats.

Action for the Potential Creation of Synergies:

Given the scarcity of human capital and financial resources, an obvious option for Grenada to cope with weather-related impacts is to improve its institutional architecture. The development of plans and projects could be more effectively tackled if water governance will be institutionalized at a higher priority. Water-related threats could be managed more efficiently if district borders would coincide with watersheds. Such an institutional design would facilitate the integration of the community in contingency plans and the responsive action during and after a hazard.

4.6 India



Mitigation Potential: Energy is the sector with the highest mitigation potential (1913 $MtCO_{2e}$ in 2011), followed by agriculture (353 $MtCO_{2e}$ in the same year) (WRI 2014). Coal-based energy generation for electricity was responsible for 963 $MtCO_{2e}$ (this number almost matches the total emissions from electricity of all the other countries in this study combined) and will continue to play an important role for energy production in the future. Although the per capita emissions are still below the reference value (cf. Sect. 4) (1.7 to/cap yr (2011), India became the third largest emitter of GHGs worldwide accounting for approx. 6% of global emissions (WRI 2014).

Vulnerability, Adaptive Capacity and Development: Climate change will force changes in land use as a consequence of increased temperatures affecting crops, higher variability in rainfall (more droughts and more floods are expected) and more pronounced seasonality in river run-off. Low labor productivity and a still relatively low share of population with higher education limits the adaptive capacity. In terms of the economic specialization India is comparable to Mexico, Brazil and South Africa. Inflation is high (10.9 in 2003) and variable. Transaction costs are high. Combating poverty and guaranteeing food security are major issues for Indian policy. The increasing demand for food from population growth and changes in dietary styles may increase the pressure on land and water resources. The population is burdened by low access to sanitation, fresh water, and electricity (WorldBank 2015a).

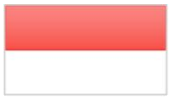
Tradeoffs: Agriculture will suffer from an increasing competition for water, but also from changing seasonality in rainfall and river run-off. The current economic growth and human development create vast GHG emissions, because large parts of energy production are based on coal fired plants. Without higher livelihood standards, the development of carbon markets or taxing systems for mitigation does not seems to be feasible, due to the low paying capacity of the large amount of the population.

Action for the Potential Creation of Synergies:

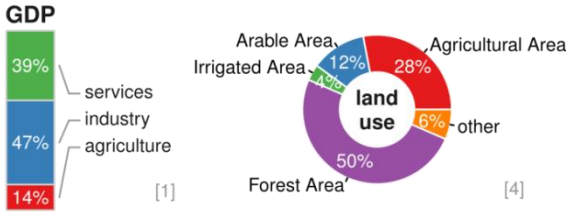
- Enhancement of agricultural productivity and improving food security.

- Development of an adequate capacity in water management including strategies for rain water harvesting.
- Enhancement of forest areas and forest density.
- Development of sustainable guidelines to cope with the increasing competition for water (human consumption, energy sector, agriculture, etc.).
- Substitution of domestic coal in energy production by renewable energy production, which either needs massive support from international assistance to make the acquisition and operation affordable or a rise in average income.
- Investments in the creation of human capital.
- Governmental incentives for the development of more sustainable industry and services.

4.7 Indonesia



Country size	1,904,569 sq km	[1]
Coastline	54,716 km	[1]
Population	252.81 millions	[2]
Rural population (%)	47	[2]
Human Development Index	0.68 (108 of 187 – Medium)	[3]
Life expectancy at birth	70.83	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Indonesia possesses the world's third largest tropical rainforest area. Approx. 60% of its landmass is covered by forests, while deforestation rates are high (ranging from 500.000 to 1.2 million ha/yr between 2005 and 2013 - UN-REDD 2014). Estimates for emissions from deforestation in Indonesia varies greatly, from ~300 up to ~2000 $MtCO_{2e}$/yr (for the period 2000-2010) depending on the source (cf. Busch et al. 2015, but they are the highest in comparison to all other countries in this study. Parallel the per capita emissions are further increasing (currently 2.3 to in 2011) (WorldBank 2015a). As of 2010, peat fires (26%) and deforestation (36%) caused 62% of total GHG emissions of the country (GIZ 2012). Additionally, total agricultural emissions of Indonesia have almost tripled from 51 $MtCO_{2e}$/yr to 160 $MtCO_{2e}$/yr in the last 50 years (WRI 2014).

Vulnerability, Adaptive Capacity and Development: Climate change will affect agriculture in Indonesia due to sea level rise and reduced crop yields. The orientation of the country's economy towards mining is one major driver of deforestation. Indonesia is characterized by the decline of the financial system in the provision of credits below 60% of GDP as of 2013 (WorldBank 2015a). The low spread of financial services constraints credit and exposes the poor population to private lenders that charge high interest rates. Thus, inequality is

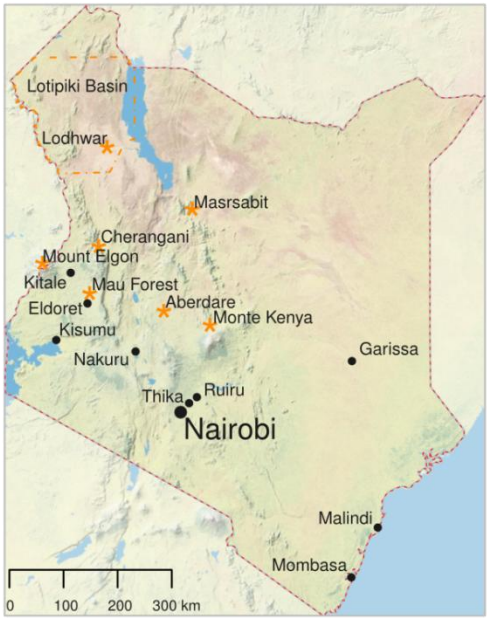
growing. The domestic food price level index has increased. Expenditure in education in 2012 was very low and further decreasing. Only 7% of the population had tertiary education.

Tradeoffs: The expansion of industrial agriculture and mining accelerates deforestation, often accompanied by peat and forest fires. Conversion of primary forests into palm oil plantations mobilizes additional GHG in Indonesia, while the advantage of emission savings from biofuel use is gained abroad. Economic growth and increased resource use causes over-proportional emissions, while pathways towards sustainable growth are missing.

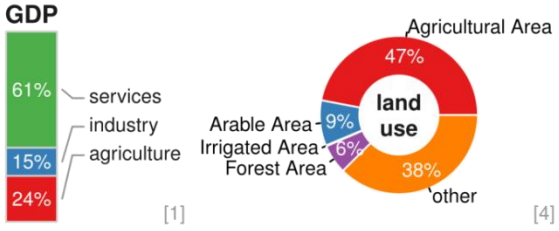
Action for the Potential Creation of Synergies:

- Development of an economic model that shifts from mining and other activities that foster deforestation.
- Advancement in agriculture productivity, which currently attained only 50% of potential yield. This would reduce the pressure on forests.
- Advanced surveillance technologies are needed to protect forests as a natural heritage and to combat fires. In this aspect, Indonesia can learn from Brazil, but international support is needed as well.
- Diversification of the Indonesian economy (current focusing on mining) towards modern industry and services sectors can relieve pressure on forests.
- Strengthening of governance, i.e. establishment of efficient institutions for fostering sustainable management.
- Bridging the gaps in the provision of basic services in order to combat poverty.

4.8 Kenya



Country size	580,367 sq km	[1]
Coastline	536 km	[1]
Population	45.55 millions	[2]
Rural population (%)	74.8	[2]
Human Development Index	0.54 (147 of 187 – Low)	[3]
Life expectancy at birth	61.72	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: The major sources of GHG emissions in Kenya originate from agriculture, energy production and deforestation. Annual emissions from the combustion of fossil fuels per capita are still low, i.e. only 0.30 to CO_2/cap yr.

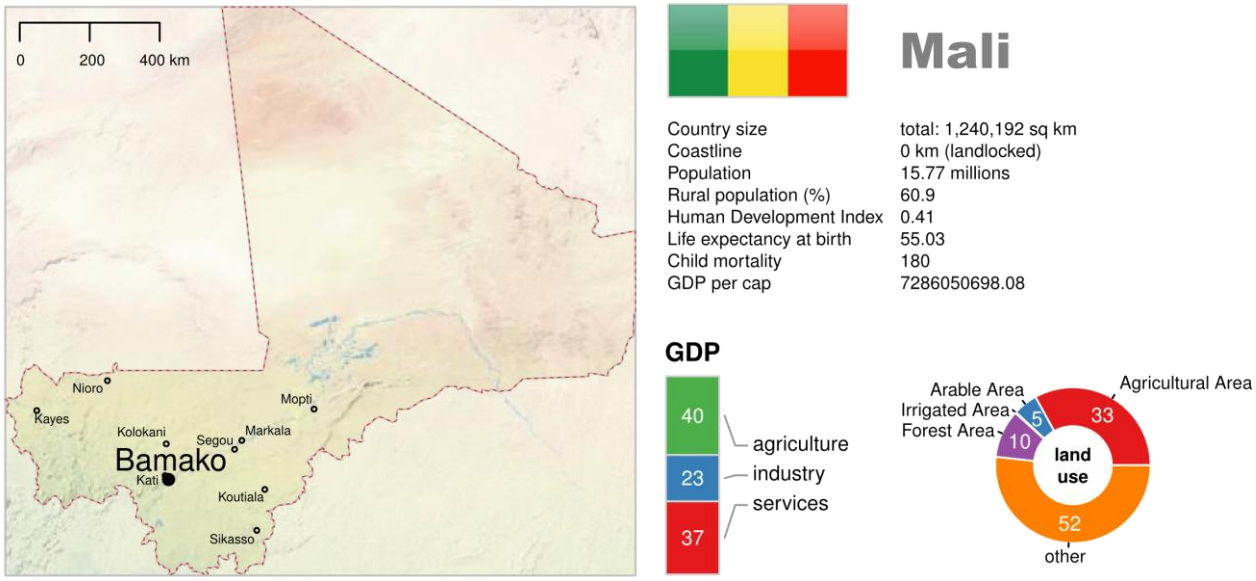
Vulnerability, Adaptive Capacity and Development: Water scarcity is the major problem for Kenya's people and its economy. The population affected by droughts has grown exponentially in the last thirty years. Five water towers provide approx. 75% of total renewable water availability (15,800 mio. m^3/yr) (Mau forests, Mont Kenya, the Aberdares, Mont Elgon, and Cherangani). Due to the logging of 50,000 ha in these areas water availability has been reduced to 62 mio. m^3/yr between 2000 and 2010. Inequality in Kenya is high and citizens are highly vulnerable to current weather variability. Food insecurity is a major issue -one quarter of the population was undernourished in 2013 (FAO 2015). Food supply is decreasing, while the income per capita is stagnant. In 2012, 17.3 million Kenyans had no access to improved water resources. As of 2012, nearly 30 million Kenyans had no access to water sanitation and 21 million Kenyans lacked access to electricity.

Tradeoffs: Deforestation causes water scarcities in several regions. Undernourishment and inadequate food security foster further expansion of agriculture at the cost of forests. The substitution of traditional biofuels by fossil fuels could foster economic growth, but also will induce more GHG emissions.

Action for the Potential Creation of Synergies:

- Agricultural productivity needs to be enhanced under parallel consideration of decreasing water availability.
- Kenya needs additional international assistance to help improve forest and agricultural management (forest and water governance)
- Combating corruption is mandatory for an efficient usage of natural heritages in Kenya
- Existing underground water resources, like in the Lotipiki basin, should be sustainably exploited under a strict consideration of groundwater recharge rates.
- Capacity development in water management. This holds for adequate technologies as well as for institutions which take care of sustainability targets.

4.9 Mali



Mitigation Potential: Mali's GHG emissions are mostly forced by agriculture and deforestation. The per capita emissions from the combustion of fossil fuels are very low and actually decreasing (0.045 tCO_2/cap yr).

Vulnerability, Adaptive Capacity and Development: The economy of Mali is highly vulnerable to impacts of climate change (e.g. decreasing rainfall), due to the high GDP share of agriculture (industrial cotton production). The current variability of rain makes it rather difficult to adapt to current changes. For the needed improvement of electrification the government continued with the installation of thermal power plants with high average prices and ignored the potential interconnection with neighbor countries. Mali's economy is lowly diversified, i.e. climatologic shocks may cause tremendous effects in agriculture. Mali is a country where climate change may cause limits for further development, causing restrictions for energy production, employment and infrastructure that may lead to political instability. Large parts of the population still suffer from chronic undernourishment.

Tradeoffs: The expansion of agriculture at the cost of forest areas can accelerate desertification. The installation of coal-fired power plants creates more energy independence, but neglects potential synergies of local cooperation and will increase fossil fuel emissions.

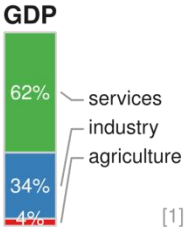
Action for the Potential Creation of Synergies:

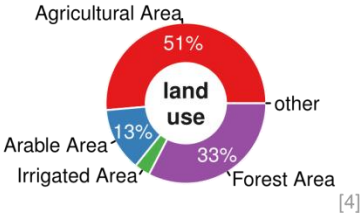
- The improvement of agricultural productivity will reduce livelihood vulnerability, because the food need can be based on safer planning scenarios.
- In parallel, this will also decrease deforestation rates, which is needed in order to combat desertification.
- Afforestation programs will help to regulate and strengthen water cycles and reduce exposure to droughts and floods.

- Agriculture is and will be the economic backbone of the country. Nevertheless, the diversification of this sector is quite low and needs to be fostered, i.e. also towards more drought-resistant species.
- Economic growth is still a challenge in the country. Better infrastructure, i.e. roads, is needed to guarantee access to markets.
- Studies exploring the size and the sustainable exploitation rates for underground water reservoirs need to be fostered and accomplished.
- Knowledge of how small-scale farming can be operated in drought-prone areas should be provided by development organizations.
- An improved capacity in monitoring, verification and reporting for afforestation, deforestation, and reforestation may create opportunities for growth and development in rural areas.

4.10 Mexico

Country size	1,964,375 sq km	[1]
Coastline	9,330 km	[1]
Population	123.8 millions	[2]
Rural population (%)	21	[2]
Human Development Index	0.76 (71 of 187 – High)	[3]
Life expectancy at birth	77.5	[1]





[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Mexico is the 12th largest GHG emitter in the world and the second largest in Latin America. Energy and transport are the sectors with the highest shares of emissions. Emissions per capita approached 4.1 to/cap yr in 2008, but decreased to 3.9 to in 2011 (WorldBank 2014a).

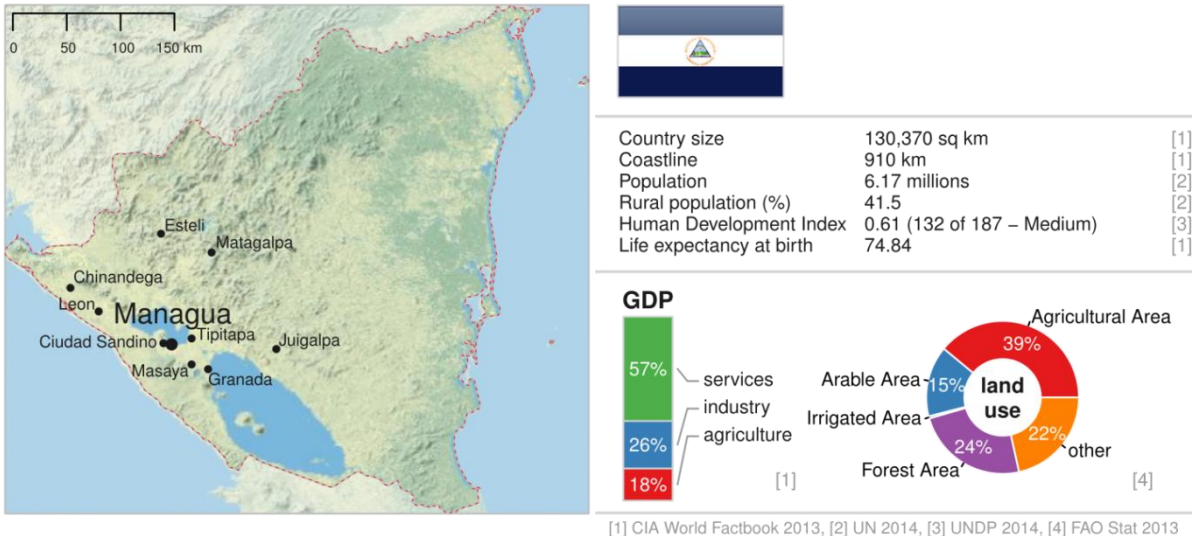
Vulnerability, Adaptive Capacity and Development: The country already experienced longer dry and hot periods in the past. To cope with increasing droughts, more intense rain, frequent hurricanes, flash floods, and mudslides is common for public administrations in Mexico. Deforestation is considered as a national security issue. Hot spots are concentrated in the southern states. Major drivers of deforestation comprise agriculture and cattle ranching, timber logging, wild fires and urbanization. The actual growth model fosters competitiveness for large companies and informal work and low productivity in medium and small size enterprises. The economy of Mexico is highly diversified. Inflation has been kept low, but inequality is high and constant, while poverty is increasing.

Tradeoffs: The increasing fuel based emissions and accelerated human development cause over-proportional GHG emissions. The expansion of the agricultural frontier into forest areas creates further trade-offs in regard to future emissions.

Action for the Potential Creation of Synergies:

- Shifting the actual fossil fuel-based energy production to sustainable power production could create social trade-offs, due to high poverty and inequality of income. A progressive tax system is needed to change this.
- A structure of incentives that might create an economic situation in which small and medium enterprises can grow would further support such a strategy.
- Although Mexico can be food self-sufficient it is a net food importer. The enhancement of production technologies and the implementation of advanced practices for small farm agriculture would push Mexico into the direction of food self-sufficiency. This would at the same time reduce transportation requirements in agriculture.
- The country needs to develop strategies to enhance and optimize the use of water, e.g. by rainwater harvesting.
- North Central regions, which can expect more rainfall in the future, can be utilized as future water towers. This should be supported by REDD+ instruments.

4.11 Nicaragua



Mitigation Potential: Most GHG emissions in Nicaragua are caused by deforestation (~63%), agriculture (24%), and energy production (11%). Emissions per capita (0.8 to CO_2/cap yr, 2010) are still low in comparison to other countries (cf. IPCC 2011, WBGU 2009).

Vulnerability, Adaptive Capacity and Development: Nicaragua was the third most affected country by the impacts of extreme weather events between 1991 and 2010. Mean annual rainfall has declined since 1960 by 5-6% on average per decade. 50% of forest area has been converted into crops and pastures since 1950. Deforestation is forced by an uncontrolled expansion of cattle ranching, commercial logging, mining, and intensive agriculture. The

adaptive capacity is constrained by the low development of infrastructure (e.g. for surveillance). The high dependence on agriculture, poor social conditions and weak governance structures further intensify the problems. There structural problems are related to a low diversity and specialization of Nicaragua's economy, high transaction costs, and the shrinking capacity of the financial sector. As of 2013, 25% of farming households experienced chronic or temporary food insecurity (FAO 2015).

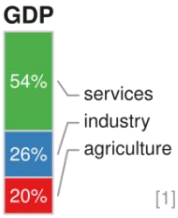
Tradeoffs: The expansion of agriculture and cattle ranching at the cost of primary forests causes GHG emissions. Furthermore, the use of fuel-wood also reduces forest areas. Nicaragua needs to pay special attention to water scarcity in order to reduce planning uncertainties in agriculture. The country is currently not food self-sufficient and its population is burdened by food insecurity and malnutrition. The country is frequently affected by weather-related disasters.

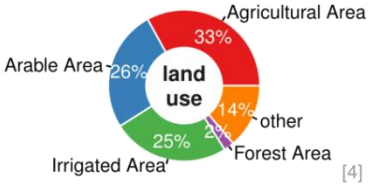
Action for the Potential Creation of Synergies:

- Forest areas and water bodies need sustainable exploitation targets, while deforestation should be halted.
- The creation of synergies in forestry should be supported by REDD+ instruments.
- For resilience the country needs to improve substantially in environmental, human and economic governance. This will result in a reduction of income inequalities.
- The country needs to enhance agricultural productivity while improving environmental governance in the forestry sector.
- Fair investment opportunities (even for the poor), improved political participation, and coordinated efforts of institutions in regard to sustainability challenges would further strengthen the country's economic and societal resilience.
- Nicaragua has excellent opportunities for renewable energy production, e.g. by possible utilization of geothermal, hydroelectric, wind, solar and biomass energy.

4.12 Pakistan

Country size	796,095 sq km	[1]
Coastline	1,046 km	[1]
Population	185.13 millions	[2]
Rural population (%)	61.7	[2]
Human Development Index	0.54 (146 of 187 – Low)	[3]
Life expectancy at birth	66.57	[1]





[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Pakistan currently emits 0.9 to/cap yr (in 2011) GHGs (cf. IPCC 2001, WorldBank 2014a). Nevertheless, the inefficient energy sector has a large potential for reducing energy demand. Moreover, adequate incentives for a sustainable energy production provided in an early phase could deploy a sector dynamic which forces the country on a sustainable pathway. Unfortunately, rapid economic growth (> 3.5% 2012) makes it likely that emissions from the energy and transport sector will grow fast in order to satisfy demand. In contrast, considerable mitigation potential exists in the forestry sector through carbon sequestration.

Vulnerability, Adaptive Capacity and Development: Pakistan is highly vulnerable to climate change. 70% of the Indus river run-off is based on snow and glacial melting. Thus, agricultural production is threatened by increasing water scarcity (if glaciers melt completely) and seasonality. The capacity to increase crop yields per hectare is constrained, due to clear limits in surface and underground water availability. Infrastructure and individual livelihoods are increasingly threatened by extreme events, like extreme floods, droughts or glacial outbursts. Moreover, the economic centers of the country are often located in risk-prone areas. The adaptive capacity is constrained by the low installed capacity of electricity, lack of infrastructure, high expenditure in defense, and low economic diversification and specialization. Financial capacity is low. Labor force in agriculture is mostly illiterate. The country is burdened by an inefficient governance structure (WorldBank 2015a,b).

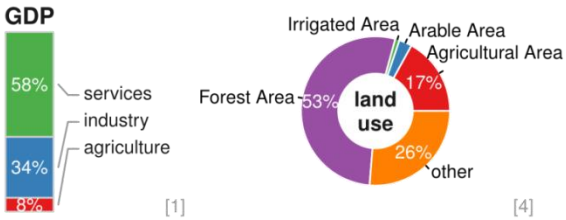
Tradeoffs: Rapid economic growth and investments in a technologically unsuitable energy infrastructure will increase emissions. The expansion of agriculture at the expense of forests destroys potential carbon sinks. The unsuitable disaster risk management is not able to protect lives and assets adequately. Thus, extreme weather hazards could always have the potential to sweep out growth gains.

Action for the Potential Creation of Synergies:

- Pakistan needs strategies for further economic diversification under a parallel implementation of sustainable energy production in order to satisfy the needs of the population.
- Investments in human development are required to enhance the adaptive capacity of institutions, regions and individuals.
- The country needs advanced concepts for an increased agricultural productivity under parallel consideration of current and future water limits.
- Advanced water management strategies with clear sustainability targets are mandatory.
- An ambitious technological readjustment in the energy sector can make energy supply more reliable, reduce losses and save additional emissions.
- Capacity building in research (climate impacts in agriculture, forestry, water, societies, etc.) and strengthening of other institutions in the field should be supported by international ODA.
- An improved capacity building is required in terms of assistance for small-scale farms to support their technological transformation.

4.13 Peru

Country size	1,285,216 sq km	[1]
Coastline	2,414 km	[1]
Population	30.77 millions	[2]
Rural population (%)	21.7	[2]
Human Development Index	0.74 (82 of 187 – High)	[3]
Life expectancy at birth	74.83	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Deforestation, energy, and agricultural production are the largest contributors to Peru's GHG emissions. The Peruvian Amazon became a net emitter of carbon dioxide in 2012 as a result of the droughts in the western Amazon in 2005 and 2010 (UNDP 2013). Power plants based on natural gas are the most cost effective technology to cover the gaps in electricity generation. The per capita emissions amount to 1.8 to. in 2011 (WorldBank 2015b).

Vulnerability, Adaptive Capacity and Development: Effects of increased temperature include more droughts, lower rainfall, and more GHG emissions from deforestation. Overall 95% of Peruvian population, particularly in the western coast, is extremely dependent on freshwater (fed by glaciers) from the Andes. The major causes of vulnerability include weather extremes, increasing water scarcity and decreasing crop yields. Over the next two decades inter-tropical glaciers are very likely to disappear with tremendous consequences for freshwater availability and hydropower generation. High deforestation rates are driven by agricultural expansion, livestock production, mining, logging and the growing of illegal coca crops. The adaptive capacity is constrained by a low economic specialization and diversification of the Peruvian economy. Income inequality and poverty are high, while income per capita is stagnant.

Tradeoffs: Agricultural activities in dry areas and the rapid growth of cities on the Pacific coast intensify fresh water scarcity. Deforestation in the Amazon catchment mobilizes further emissions. Economic growth is based on inefficient energy production.

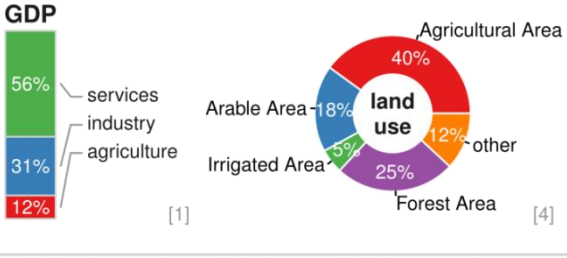
Action for the Potential Creation of Synergies:

- The country needs to develop its capacity in water management. On the Pacific coast, a solution could be seawater desalination combined with solar power generation.
- In the Amazon catchment deforestation needs to be stopped in order to protect its capacity for the regulation of the hydrological cycle.

- The installed capacity in electricity generation based on renewables should be extended considerably. Furthermore, solar thermal power and wind power have the potential to compete with gas-based solutions and can further reduce emissions.
- Expected water scarcity shows the need for the development of drought resistant species and high yield crop varieties.
- The creation of synergies in forestry should be supported by REDD+ instruments. Cattle ranching should not be expanded further and needs to be controlled by effective institutions.
- Agricultural producers needs better access to markets, in particular for smallholders in mountainous areas.
- Resilience of the society can be improved by further development of industry and service sectors and long-term plans for sustainable business opportunities.

4.14 Philippines

Country size	300,000 sq km	[1]
Coastline	36,289 km	[1]
Population	100.1 millions	[2]
Rural population (%)	55.5	[2]
Human Development Index	0.66 (117 of 187 – Medium)	[3]
Life expectancy at birth	68.7	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Energy and agricultural production are the most relevant sectors for mitigation potential. 60% of the Philippines' total energy supply is based on fossil-fuels, while the per capita emissions remain constant during the last 20 yrs on a level of 0.9 to CO_{2e}.

Vulnerability, Adaptive Capacity and Development: The vulnerability of the Philippines to climate change and associated weather extremes is remarkable high. As a mountainous archipelago, several coasts are threatened by sea level rise. In addition, changes in rainfall pattern, instable hill slopes due to deforestation and recurrent hits by tropical cyclones sometimes lead to double or even triple exposures. The parallel lack of competitiveness in key sectors, insecurity of property rights, complex regulations and low private and public investments have led to an unsatisfactory growth pattern, making the Philippines additionally susceptible against external shocks. Furthermore, the industry is stagnant in the Philippines, while income inequality and poverty are high and non-decreasing. The economy

is lowly diversified and not specialized. Energy supply is an issue in the countries' policy making.

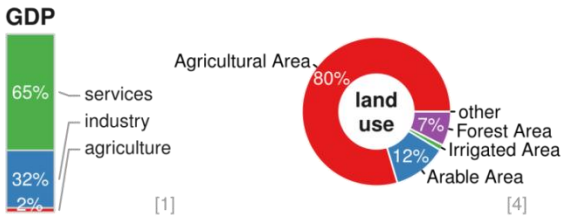
Tradeoffs: The increasing energy production has not been transformed into higher standards of human development, but will still lead to higher GHG emissions in the future. The Philippines are not food self-sufficient; further extension of agricultural areas at the cost of forests will cause further emissions. Without a suitable disaster risk management Philippines cannot cope with expected changes.

Action for the Potential Creation of Synergies:

- Energy efficiency in electricity generation offers an important potential for reducing emissions and lowering coal imports.
- The country needs structural changes including diversification and specialization of the economy.
- Strategies should be implemented to reduce income inequality and improve social conditions. (e.g. higher population income, institutional development, and enhanced governance)
- To develop a suitable adaptive capacity, the country requires a considerable sustainable economic growth rate.
- The country needs modern technologies and an improved governance capacity that fosters higher agricultural productivity. The international community can support efforts through development programs.

4.15 South Africa

Country size	1,219,090 sq km	[1]
Coastline	2,798 km	[1]
Population	53.14 millions	[2]
Rural population (%)	35.7	[2]
Human Development Index	0.66 (118 of 187 – Medium)	[3]
Life expectancy at birth	56.92	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: In terms of per capita emissions South Africa has approached a level similar to OECD countries (9.3 to/cap yr, 2011) (WRI 2014, WorldBank 2015a). South Africa accounts for about 30% of total primary energy consumption on the entire African continent.

Due to the fact that the largest proportion of GHG emissions stems from the energy sector, there is a clear potential for GHG emission reduction.

Vulnerability, Adaptive Capacity and Development: South Africa is a country which might benefit from climate change, because precipitation is projected to increase. This will have positive effects on agriculture. Nevertheless, variability will increase as well, leading to more and prolonged droughts and floods. While 90% of South Africa is cultivable land only 11% is used for permanent agriculture. Thus, the potential of the agricultural sector is large. Overall, the economy depends on mining as the main income source. Increasing Inequality ranks the second highest amongst the countries studied. The poverty headcount ratio is still very high (45.5% by 2011) (WorldBank 2015a,b). Capital is highly concentrated in some sectors, but investments in capital formation are very low. South Africa needs to bridge gaps in services and health.

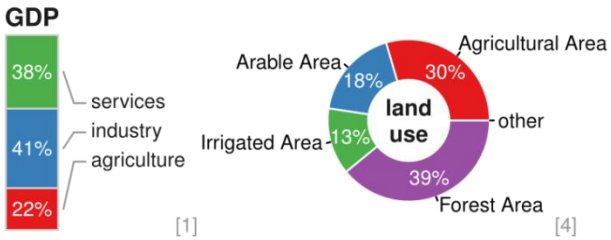
Tradeoffs: Reductions of GHG emissions are mandatory, but only achievable if properties of income generation will be broadened. If the amount of people who currently rely on fuel wood substitute their energy demand by petroleum, emissions can rise even further. The one-eyed focus on the mining industry does not create wealth for all, i.e. it hinders development, which is a prerequisite for a modern and sustainable society.

Action for the Potential Creation of Synergies:

- South-Africa has a considerable potential to increase the efficient use of energy. The International Energy Agency stated that 63.73 Mtoe of primary energy was delivered to the power plants, but 41.8 Mtoe (e.i. 66,4 %) were lost during the conversion process (IEA 2015).
- In order to develop market-based mitigation mechanisms, more costly renewable energy production needs to be adopted, which also requires higher population income.
- A more inclusive growth model is required for adaptive capacity.
- Unemployment is very high, while labor productivity is low due to the low demand for specialized labor. An inclusive growth requires closing the gaps in the provision of basic services.
- To develop an advanced agriculture sector that benefits from the availability of agricultural land and the expected increases in precipitation, investments are required, e.g. for irrigation equipment and the creation of reservoirs.

4.16 Vietnam

Country size	331,210 sq km	[1]
Coastline	3,444 km	[1]
Population	92.55 millions	[2]
Rural population (%)	67	[2]
Human Development Index	0.64 (121 of 187 – Medium)	[3]
Life expectancy at birth	75.94	[1]



[1] CIA World Factbook 2013, [2] UN 2014, [3] UNDP 2014, [4] FAO Stat 2013

Mitigation Potential: Emissions from industry are growing and per capita emissions approach 2 to/yr in 2011 (cf. IPCC 2001, WBGU 2009). Similar holds for the agricultural sector, but emission seem to stabilize here. Energy production and transport will force an exponential growth of emissions if adequate actions are not taken.

Vulnerability, Adaptive Capacity and Development: Climate change will affect agriculture, road infrastructure and economic activities in areas below 1m exposed to sea level rise (e.g. in Mekong river lowlands). Labor productivity needs to grow by more than 50% by 2020 to sustain the current rapid growth. Current productivity is affected by a low agricultural productivity, inefficient energy production and usage, and low added value of manufacturing. Vietnam is consistently developing its infrastructure and the capacity to provide domestic credit (WorldBank 2015a,b). Indicators show a process of economic diversification. Low inequality and adequate policies to reduce poverty are increasing the adaptive capacity.

Tradeoffs: An accelerated economic growth path copies the OECD (fossil-rich) development of the past. This induces rapid fossil emission growth as well. Agriculture is important for internal food security and most fertile regions are threatened by sea level rise. Paddy rice growing is also relevant in terms of methane emissions.

Action for the Potential Creation of Synergies:

- A long-term oriented plan for economic diversification and specialization needs support from international donors to significantly increase the share of renewable sources in electricity generation.
- Vietnam needs to improve macroeconomic policies and financial institutions to reduce risk and transaction costs. In order to enhance its adaptive capacity, the country requires developing further human governance.

- Agriculture represents the sector with the second largest share in emissions, but these have been decreasing since 1991, i.e. from 2.2 to 0.7 $MtCO_2e$/year in 2010. This process should be further supported.

5 Final Remarks

This study has shown that for an effective implementation of policies that maximize climate protection, suitable adaptation to the unavoidable consequences of climate change, resources protection and human development, any of the investigated countries needs to invest efforts in human capital development, strengthen governance bodies and invest into the stabilization and improvement of the financial sector.

It can be synthesized that for strengthening adaptive capacity, a sustainable and climate friendly economic growth and societal development are urgently needed. Nevertheless, questions remain as to what kind of growth suits the demands in each country for a more effective adaptation, effective environmental protection and GHG mitigation, and adequate growth targets. This answer is not easy to solve and needs more detailed and more model-based analyses. The current work provides a first glance of potential action in these countries based on a multivariate indicator set. However, the project laid a cornerstone for future development of a more dynamic and integrated model approach for a country trajectory analyses.

Summing up a few common issues of the investigated countries:

1. Fresh water scarcity: Pakistan, Peru and Kenya are suffering from a current scarcity of fresh water, which will continue in the future. Large amounts of river runoff in Pakistan and Peru are supplied by glaciers. While an increase can currently be observed due to an accelerated melting, the runoff will substantially decrease in the future. Pakistan, India, Ethiopia, South Africa, Mexico, Peru and some desert parts of Colombia suffer from severe water scarcity. These countries need to develop technologies and practices for inter-seasonal water harvesting. Moreover, disaster risk management strategies are needed in these countries to cope with extreme events. The population impacted by severe droughts in Kenya has grown exponentially over the last two decades, but effective response mechanisms have not been implemented. International development assistance may play an important role helping these countries to develop their capacity in water management.
2. Food security is of central importance in a number of countries like Pakistan, Kenya, India, Mali and Peru. Under current agricultural production standards the minimal locally produced food supply necessary for the future is not achievable in Grenada, Ethiopia, Kenya, Pakistan and Peru. Moreover, due to the rapid introduction of western lifestyle and further population growth, the future food demand will grow considerably. National food self-sufficiency cannot be achieved in countries like Grenada, Ethiopia, Kenya, Indonesia, Pakistan, Peru, and the Philippines even if current advanced agricultural practices for closing potential yield gaps are to be applied.
3. Development of the agricultural sector: The agricultural sector will remain the main source for further economic growth and human development in Nicaragua, Kenya,

Ethiopia, Mali, Pakistan, India, Indonesia and Cambodia. These countries should develop coherent policies to improve the productivity of small and medium sized farms. These countries need to develop long term plans for capital formation in rural communities to foster the use of modern agricultural technologies and practices. International programs like REDD+ or CDM should be accompanied by regional institutions to create incentives for the integration of agricultural development, carbon sinks and GHG mitigation in agriculture.

4. Water governance: Cambodia, Nicaragua, Grenada, Colombia, Pakistan and Mexico require further development of their capacities in fresh water governance. In particular Disaster Risk Management (DRM) strategies need to be improved in the above countries to enhance their capacity to cope with extremes events Apart from this fresh water oriented view DRM is tremendously relevant also for the Philippines.

5. Synergies in the forestry sector: In most of the investigated countries, forestry is the sector in which largest synergies may be achieved. In Kenya, the protection and the expansion of forest areas and water towers is almost the only means to enhance water resources. In Pakistan, the enhancement of forests in the North is crucial to regulate regional water cycles. REDD+ should be enhanced in these countries due to water security reasons. International assistance should prioritize the development of national capacities in those countries with the highest potential for GHG mitigation provided by forests, i.e. Cambodia, Nicaragua, Mexico, Philippines, Vietnam, India, Indonesia, Brazil, South Africa, Colombia, Peru, Nicaragua, Mali and Ethiopia.

6. Definition of sustainable growth plans: For the creation of synergetic processes and the development of adaptive capacity sustainable growth paths need to be defined, investigated and implemented in all countries. Higher income per capita and the development of markets are required for an increased adaptive capacity. The effective functioning of institutions like carbon markets, REDD+ or CDM requires more educated people with better income opportunities. In many of the countries studied emissions from the combustion of fossil fuels are growing fast while indicators of human development remain almost stagnant. This disparity has been shown to correlate with high inequality and low governance. For climate resilient pathways these countries need an inclusive growth model, based on knowledge, equity, technology, and good governance.

7. Development of carbon markets: Some more developed countries e.g. South Africa, India, Brazil and Mexico have developed conditions for the creation of carbon markets, but these should be further supported by international programs. However, inequality in Brazil, South Africa and Mexico represent a bottleneck for their implementation. Low human governance and corruption further restrict the potential for the successful implementation of progressive taxes in these countries.

The interested reader is urged to have a look at the main report for further details. In comparison to the full report this short version only provides a concise summary and many mechanisms are not explained in depth.

Nevertheless, this short version gives an insightful overview of synergies and tradeoffs between measures of climate protection, adaptation and sustainable development available to countries in different stages of economic development.

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