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Green Growth Potential Assessment

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With abundant natural capital, especially mineral resources and a booming export commodity market, Peru has achieved remarkable economic strides that also created ripple effects in improving the overall quality of life over the last few years. However, breaking away from the middle-income trap and overcoming the resource curse – while maintaining environmental integrity and climate resilience – represent formidable challenges for Peru in the post-2015 development agenda. Future progress should also bridge the widening disparity between urban and rural areas to promote more socially inclusive growth.

The formulation of Peru's National Green Growth Strategy (NGGS) is envisaged to help address this gap, in synergy with existing national development objectives as well as Peru's global commitments such as the Sustainable Development Goals (SDGs), Paris Agreement, and its aspiration for OECD membership. To build the solid analytical foundation for drafting the NGGS, this report reveals the result of conducting the Green Growth Potential Assessment (GGPA) in Peru, thus providing directions for policymakers on the appropriate interventions in the context of NGGS and Peru's broader development landscape. In this report, Peru's green growth performance has been measured in three dimensions: resource efficient growth, eco-friendly growth and climate resilient growth. Peru's priority issues have been developed from the analysis in these areas.

So what are Peru's priority issues and future agenda through the green growth lens?

Peru has rich natural resources but achieving resource efficiency presents significant areas for improvement. Continuous mineral extraction is escalating material intensity at unprecedented level; the need to address low domestic value added in resource utilization is evident. Peru also grapples with low efficiency levels in water use as current tariff rates do not accurately reflect the actual price of water as a scarce resource. Moreover, low agricultural land productivity is a major concern since arable land is limited and traditional agricultural practices lack technological sophistication that could boost productivity. Improving the nation's overall labor productivity through an optimal allocation of labor is also necessary, as employment is concentrated in the least productive sectors, while the most productive sectors only employ a small fraction of the workforce. Harnessing new technologies, in which Peru is still underperforming, is also expected to boost efficiency levels significantly.

Pursuing green growth also requires Peru to ensure the sustainable use (i.e., ensuring quality and quantity) of its most vital resources. For example, although the changes in forest coverage in Peru has been relatively low compared to its neighbors, even a small change in coverage is significant in absolute terms given Peru's extensive forest resource. Between 2001 and 2013, Peru lost 1.5 million ha of Amazonian forest, and the forest coverage decreased from 55% in 2000 to 53% in 2013 (SPDA 2016). Deforestation, along with excessive pasturing, is a main driver of soil degradation in the Amazon Rainforest leading to worsening soil health. The country also suffers from water stress – despite having one of the highest per capita freshwater availability in Latin America – due to a highly uneven geographical distribution of water resources across its territory. As mining activities intensify, Peru has to grapple with the alarming pace of natural resource depletion, thereby posing sustainability challenges.

Climate change imposes another significant threat to Peru's development. Despite a moderate exposure and sensitivity to climate change impacts, Peru's adaptive capacity is relatively low compared to other countries as it has low availability of resources for sector-specific adaptation. On the mitigation side, much work needs to be done as well. Peru's emission grew at 5.27% during the last five years – considerably higher than its peer countries (2.51%) – mainly due to deforestation in the Amazon rainforest as well as the energy and transport sectors. Furthermore, Peru has been losing its carbon stock three times faster than other upper middle income countries, also due to rapid deforestation. The deployment of renewables could play a major role in Peru's mitigation efforts, but the very low cost of electricity in Peru has so far been the main reason for the low uptake of renewable energy.

In light of the above mentioned issues of Peru, the GGPA analysis has identified five priority sectors derived from the three dimensions of green growth mentioned above as the key entry points for future actions, namely (1) agriculture, (2) mining, (3) energy, (4) forestry, and (5) water and sanitation. These sectors are perceived to be primarily responsible for Peru's low green growth performance, which in turn demonstrates their potentials for making high-impact interventions:

1. **Agriculture:** This sector is key for Peru's economic growth, employing almost a quarter of the total workforce and is thus directly linked to poverty reduction and rural development.

Key interventions include: (1) promoting climate smart and entrepreneurial agriculture that involves farming practices to improve productivity, climate change adaptation, and mitigation; (2) providing financial incentives schemes to improve productivity and reduce environmental pressure; and (3) enhancing irrigation efficiency and strengthening Integrated Water Resource Management (IWRM).

2. **Mining:** Peru's mining sector has been a major economic driver but higher efficiency levels could lead to major productivity gains, strengthened by strong mechanisms to promote equitable sharing of costs and benefits. Thus, the following recommendations are worth considering: (1) promoting green technologies, especially for resource efficiency, renewable energy, and end-of-pipe technologies; and (2) increasing the shared benefits from mining to the local economy by incentive schemes.

3. **Energy:** The main challenge lies in diversifying energy mix, increasing resilience, and mitigating water stress and natural resources depletion. In addition, rural access to electricity needs to be satisfied as a strategy to fight poverty. Key interventions are the following: (1) enhancing long-term energy planning and diversification; (2) improving the legal framework for distributed generation; (3) strengthening current energy efficiency policies and development of financing vehicles; and (4) improving access to electricity through decentralized renewable energy systems.

4. **Forestry:** The Peruvian forests constitute a natural wealth that is not yet contributing significantly to the country's economic development. Peru could thus be perceived as a country of forests, but does not define itself as a "forest country." The following reforms are worth noting: (1) providing incentives for certification of sustainable forest products and value chains; (2) mainstreaming natural capital accounting into GDP calculation and policy making; (3) scaling up bio-trade programs; and (4) improving the implementation of REDD+.

5. **Water and Sanitation:** Despite the important progress in the past, Peru's access levels to water and sanitation are among the lowest in Latin America. In addition to further improving access to basic water services, ensuring availability and quality – items made explicit in the SDG and INDC – come as important priorities for Peru's water sector. Key recommendations include: (1) revising water tariffs and charges; (2) prioritizing investments in green water infrastructure and ecosystem services; and (3) developing and implementing a water re-use strategy.

The aforementioned sector recommendations should enable Peru to defy the resource curse and move up the global value chains by shifting from resource-driven growth to productivity-driven growth based on knowledge economy and high value-added production. The interventions should also safeguard and capitalize the enormous value of ecosystem services; and increase economic productivity and climate resilience through a system of innovation, technological advancement, and human capital development catering to all groups of society, including the marginalized.

About Green Growth Potential Assessment (GGPA) in Peru

GGPA is a rapid diagnostic tool that lays out the appropriate green growth interventions based on solid understanding of a country's key development challenges in various green growth areas. The Peruvian government, through the Ministry of Environment (MINAM), requested that GGGI conduct the GGPA in Peru to utilize the findings as an input to the NGGS. The step-by-step process of GGPA application in Peru is as follows:

1. Extensive desktop research was done to analyze the context and status of green growth in Peru using dashboard and diagnostic indicators (Nov. 2015 - Jan. 2016).

2. A validation workshop was held involving 39 participants from various ministries; two rounds of surveys and four parallel discussion groups were carried out to validate the findings of the preliminary assessment (Feb. 4, 2016).

3. With six issues prioritized and five most relevant sectors identified, expert interviews from more than 10 ministries were conducted to gain an in-depth understanding of the issue-sector linkages (Mar. 14-25, 2016).

1. Introduction

1.1 Green Growth and Development in the Global Context

The world is undergoing a long and slow recovery process after the global economy sank into a recession less than a decade ago. Despite a modest pace of recovery being witnessed in advanced economies, many developing economies are still struggling to find their place in a world of lower commodity prices and gradual slowdown of China's manufacturing-led growth. A recent report by the IMF highlights how "growth in emerging and developing economies – which account for over 70% of global growth – declined for the fifth consecutive year in 2015" (IMF 2016). As economists once again cut their initial forecasts on global growth in 2016, they warn that quantitative easing programs by the central banks of the world's leading economies have played a limited role in addressing the fundamental economic problem; diversifying the engines of growth and sources of jobs.

Despite the economic downturn, the political ambition for "green growth" is escalating across many developing countries. Such momentum is breaking the traditional notion that "green" is costly and can be afforded only by advanced economies. Messages outlined in the recent Paris Agreement is a good example of the reasoning behind this wind of change during an era of economic restructuring; countries engaged in mitigation and adaptation to climate change will enjoy significant economic opportunities which will come in various forms of technology and infrastructure for both new and old businesses. For example, keeping the global temperature rise below 2 degrees Celsius is being reported to present a US$12.1 trillion investment opportunity in areas such as energy efficiency and renewable energy over the next 25 years (Ceres and Bloomberg New Energy Finance 2016).

The post-2015 agenda of the Sustainable Development Goals (SDGs) has also responded to the growing concerns over the impacts of economic crisis on sustainable development – such as rising unemployment and inequality – which can jeopardize the achievements of the Millennium Development Goals. Acknowledging how discussions on sustainable development must transcend the reduction of poverty and draw more attention to economic and environmental restrictions, the 2030 development agenda is committed to covering a wide range of interlinked targets, sectors, and actors. Goals such as promoting sustained, inclusive, and sustainable economic growth (SDG 8); ensuring sustainable consumption and production patterns (SDG 12); and taking urgent actions to combat climate change (SDG 13) represent the fundamental pillars of green growth.

The global development landscape is fast converging toward a common language in a way that further elevates the relevance of green growth as a national and global agenda. However, given the complexity and broadness of green growth as an emerging concept in academic and policy discourse, any approach to adopt green growth should always be context- or country-specific. As various cases worldwide continue to amass more evidence about the co-benefits and synergies of green growth, such trend strengthens the case for making green growth a viable development model. In summary, green growth presents opportunities to accelerate transformation toward sustainable development through the following approaches (GGGI Strategic Plan 2015-2020):

a) Increasing the quantity and quality of natural resources and environmental services. Given these are factors of production, their availability is critical to higher and long-run economic growth.

b) Increasing the productivity of resources: generating higher growth with fewer resources.

c) Driving new technologies or innovative application of existing technologies. Innovation is a key driver of economic growth, as previous industrial revolutions have shown.

d) Focusing on removing market failures present among economic, environmental, and social goals, contributing to more efficient allocation of resources in the economy.

e) Pursuing an inclusive and participatory approach, putting in place mechanisms for benefit sharing, in particular to benefit those who are dependent on natural resources and most vulnerable to climate change.

1.2 GGPA Framework Application in Peru

As a member of the Pacific Alliance – an initiative of regional integration of Chile, Colombia, Mexico and Peru, which launched a platform for green growth in 2016 – the Government of Peru recognizes the urgent need for a transition towards green growth. In this regard, it plans to formulate the National Green Growth Strategy (NGGS) to harmonize all

efforts on green growth, utilize a rigorous framework for laying out the priority areas and sectors, and provide a solid legal foundation for its green growth interventions. The NGGS will enable the formulation of a comprehensive strategy that integrates economic, environmental, and social objectives in one framework – consistent with the national development objectives, SDGs Paris Agreement, and Peru's aspiration for OECD membership. Note that the concept of "green growth" was formally adopted by the OECD through its "Declaration on Green Growth" signed by 34 member countries in June 2009, encouraging efforts to develop green growth strategies to achieve environmentally and socially sustainable economic growth. Peru adopted the OECD green growth principles expressed in the Declaration on Green Growth on 7 October 2015 in a letter to the OECD Secretary General.

Peru's heightened commitment to pursue its green growth ambitions came at a time when GGGI launched its new knowledge product – the Green Growth Potential Assessment (GGPA) – a rapid diagnostic tool that lays out the appropriate green growth interventions based on solid understanding of a country's key development challenges in various green growth areas. Following a series of consultations, the Peruvian government through leadership of the Ministry of Environment (MINAM) has collaborated with GGGI to conduct the GGPA in Peru, support stakeholders in utilizing the GGPA findings as an input to the NGGS, and engage them in a dynamic process of knowledge exchange with other countries that are steps ahead in promoting green growth at the national level. GGPA for Peru thus aims to determine the appropriate entry points for green growth actions, ensuring that the process of issue identification and agenda setting for NGGS is based on a systematic, objective, and participatory approach to country diagnosis.

In light of the increasing demand for assessment tools to inform green growth planning and implementation at the country level, GGPA seeks to diagnose a country's performance in key green growth areas to help identify and transform the areas of underperformance into opportunities for high-impact green growth interventions. Under GGPA, green growth "potential" is framed in the context of focusing on unmet needs with notable room for improvement since high-impact potentials are often most prominent in areas where a country is lagging behind, turning weaknesses into opportunities. Such an approach evolves around how the following key questions must be answered successively in conceptualizing a country's green growth model:

a) What is the country's current performance in key green growth areas compared to other countries in the same income category? (i.e., priority green growth issue)

b) Which activities or sectors of the economy are responsible for the poor showing? (i.e., priority sectors, which are the key entry points for future green growth actions)

c) What does green growth mean to the country? (i.e., goals of country's green growth)

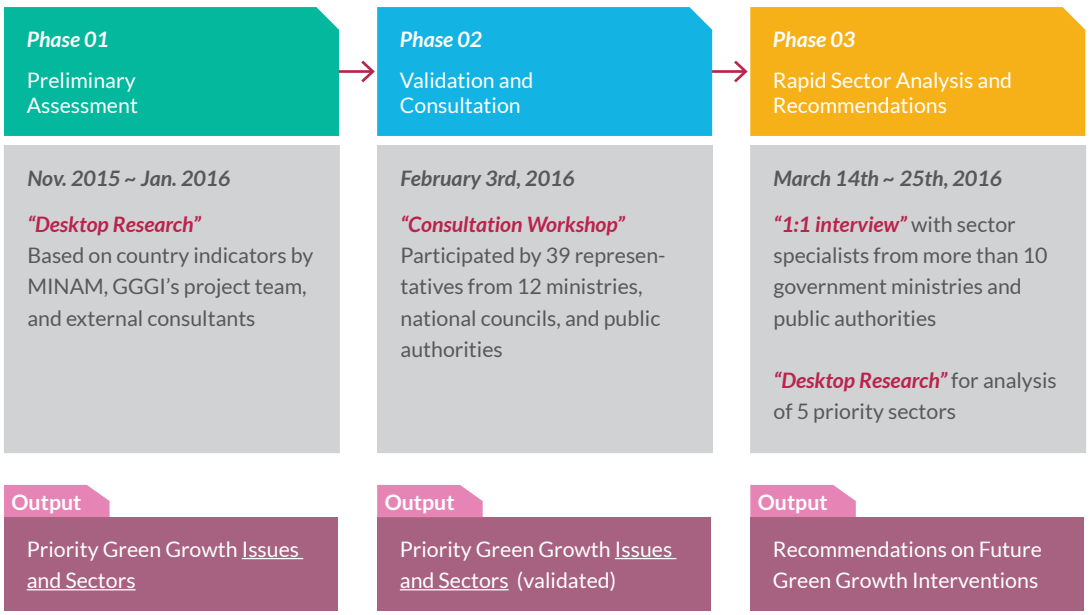


Figure 1: Step-by-step process of GGPA application in Peru

GGPA emphasizes the need to combine top-down (i.e., factual and quantitative evidence building) and bottom-up (i.e., ground truthing information and aligning country's green growth model to the government's strategic interests) measures to address these questions, specifically throughout the three stages: (1) preliminary assessment based on desk research; (2) validation and consultation with stakeholders; and (3) sector analysis and recommendations. Through strong government commitment, all three stages have been completed in Peru as shown in Figure 1.

Phase 1: Preliminary Assessment

- The first stage involved extensive desktop research analyzing the drivers and status of green growth in Peru using dashboard indicators (for a snapshot of Peru's development trends) and diagnostic indicators (for a comparative analysis of Peru's green growth performance with other countries in the same income category).

- Under the diagnostic indicators, GGPA disaggregates green growth into three dimensions – Resource-Efficient Growth, Eco-Friendly Growth, and Climate-Resilient Growth – which serve as the basis for the logical and substantiated selection of 25 indicators/indices. This set of indicators/indices are presented in the form of "spider diagrams".

- Through spider diagrams, Peru's performance was compared with peer countries within the same income group (upper middle income countries as per the World Bank classification), and additionally with high-income OECD countries to assess green growth performance in light of Peru's prospective OECD membership. The assessment also helps identify the specific areas that need more attention at an accelerated pace to meet Peru's green growth ambitions.

Phase 2: Validation and Consultation

- The preliminary results of Phase 1 were validated through a multi-stakeholder consultation process. A validation workshop was held on 4 February 2016 involving 39 participants from various ministries such as Housing, Construction and Sanitation, Environment, Foreign Affairs, Production, Finance, Agriculture and Irrigation, Labor and Employment, Transport and Communications, Foreign Trade and Tourism, as well as bodies such as the National Water Authority, the National Competitiveness Council, National Service of Natural Protected Areas, and the National Forest and Wildlife Service.

- Using the Delphi method, the workshop sought to reach a consensus among policymakers on the priority issues for Peru's green growth. Two rounds of surveys and four parallel discussion groups were conducted to validate the findings of the preliminary assessment to select priority issues and identify sectors relevant to the priority issues.

- Given the participants' limited availability, the workshop was organized as a half-day event. Due to this time constraint, the workshop only focused on the validation of findings and prioritization of issues but did not conclude the final list of sectors, which was done after the workshop taking into account stakeholder input from discussion groups as well as the validated results from the preliminary assessment.

Phase 3: Sector Analysis and Recommendations

- With six issues prioritized and five most relevant sectors identified, the third phase sought to gain an in-depth understanding of the linkages between issues and their related sectors, existing gaps in the sector policy framework and governance structure, and the interventions required to address the priority issues in the respective sectors.

- Therefore, a rapid sector analysis was carried out based on desk research, in addition to 15 semi-structured interviews with stakeholders representing the five sectors, mainly from the public sector. Through the interviews, the issue-sector linkages were validated, policy gaps revealed, and recommended interventions obtained.

- The recommendations were then further analyzed based on their potential to contribute to green growth and wider sustainable development objectives, including aspects of social inclusiveness. The recommendations fall into the following categories: (1) policies, strategies, and plans; (2) market instruments; (3) voluntary public or private action; and (4) institutional strengthening, capacity building, and knowledge generation.

2. Country Assessment

2.1 Country Profile – Drivers of Peru's Green Growth

Over the past two decades, Peru's economy has grown rapidly. The country has been one of the top macroeconomic performers in Latin America with an average growth rate of 6.1% between 2005 and 2014. This remarkable economic performance – characterized by a fast-rising middle class – is inextricably linked to the abundance of natural capital, most notably mineral resources, as Peru takes advantage of the booming export market

Table 1: Dashboard Indicators: Understanding the drivers of Peru's green growth[1]

Theme	Sub-theme	Indicator	Unit	Data Period	Latest data	Status
Natural Drivers	Geography and Climate	Land size	sq. km	2000-2014	1,280,000 (2014)	↔
		Renewable internal freshwater resource per capita	thousand cubic meters per person	2002-2013	54.0 (2013)	↘
		GEF benefit index for biodiversity	0 – 100 (low potential – maximum)	2008	33.36 (2008)	↔
		Average precipitation in depth	mm per year	2002-2012	1738 (2012)	↔
	Demography	Total population	million persons	2002-2012	30.97 (2012)	↗
		Urbanization rate	% of total population	2002-2012	78.29 (2012)	↗
		Urban population growth rate	% growth per year	2002-2012	1.75 (2012)	
Human-Induced Drivers	Economy	Total GDP	billion USD	2004-2014	202.9 (2014)	↗
		GDP growth rate	% growth per year	2004-2014	2.35 (2014)	
		Share of GDP by agriculture	% of GDP	2002-2012	7.45 (2012)	↘
		Share of GDP by manufacturing	% of GDP	2002-2012	14.85 (2012)	↘
		Share of GDP by services and other sectors	% of GDP	2002-2012	55.76 (2012)	↘
		GDP (PPP) per capita	USD	2004-2014	6,594 (2014)	↗
		Unemployment rate	% of total labor force	2003-2013	4.0 (2013)	↘
	Governance and Finance	Foreign direct investment (inflow)	% of GDP	2003-2013	4.59 (2013)	↗
		Ease of doing business index	country ranking	2006-2016	50/189 (2016)	↗
		Corruption perception index	country ranking	2005-2014	38/175 (2014)	↘
	Human Well-being	Access to improved water source	% of total population	2005-2015	86.7 (2015)	↘
		Access to improved sanitation facilities	% of total population	2005-2015	76.2 (2015)	↗
		Access to electricity	% of total population	2000-2012	91.2 (2012)	↗
		Human development index	% of total population	2005-2014	84/188 (2014)	↔
		Population under absolute poverty line (USD 1.25/day)	% of total population	2002-2012	2.89 (2012)	↘
		Gini coefficient	0 – 100 (perfect equality – perfect inequality)	2002-2012	45.33 (2012)	↘

1. Detailed information and sources of each indicator data is presented in Annex

for commodities. The convergence of significant improvements in trade liberalization, foreign direct investments, domestic consumption, financial stability, macroeconomic and structural reforms, and governance system created a strong enabling environment for growth. Furthermore, the country's growing population provides the advantage of a demographic window where Peru can tap the increasing proportion of its working age group to further enhance productivity.

The growth transformation of Peru is well reflected in its economic structure. The economy is mainly based on services, which account for 55.8% of the GDP, followed by industry at 36.8% and agriculture at 7.4% (2012 data; World Bank 2016). The contribution to GDP of both services and agriculture decreased over the years, while industry is increasing steadily due to the growing mining sector. The upswing of mining commodity prices that started a decade ago benefited GDP growth, but at the same time made Peru highly vulnerable to volatile global prices. The mining sector attracted large capital inflows (more than 2/3 of this capital inflows came from FDI) (OECD 2015), upheld by a favorable investment climate and a suitable legal framework to invest and conduct economic activities.

The country's economic boom has significantly improved the overall quality of life in Peru. As a growing middle-income country, the government has made profound progress in terms of employment generation, poverty alleviation, reduction of income inequality, and provision of basic social services. According to the Ministry of Finance, 63% of the poverty reduction rate from 2011 to 2014 could be attributed to economic growth, while the rest is driven by social programs targeting the poor. On the other hand, declining income inequality is the result of decentralized labor market growth that generated new sources of income for families. Moreover, social indicators such as access to water and sanitation, and electricity continue to show significant improvement.

However, the absolute improvements in the aforementioned areas do not reflect geographical differences, especially between rural and urban areas. For instance, in terms of improvement in the Gini coefficient, it is much more notable in urban rather than rural areas. Also, 2.89% of the total population that live under the extreme poverty line are concentrated in the rural areas, specifically in the rural forest and highlands in the Andes. Despite increasing contribution of the private sector, 76% of the urban population and only 53% in rural areas had access to sanitation services in 2015. Moreover, while Peru's growth brought about a substantial decrease in unemployment, this has also mainly been concentrated in urban areas.

Despite improvements in access to basic services, the increasing population and urbanization poses sustainability issues. For example, while Peru's population is growing at a rate of 1.2% annually, water access rates only grow at an average of 0.5%. The situation is similar with regard to access to sanitation. In the early 2000, about 85% of electricity was generated through renewable sources, mainly hydropower. With demand surpassing the hydroelectric generation capacity, coupled with water shortages aggravated by climate change, the country is forced to explore other options such as wind, solar and biomass to guarantee clean energy in the future (MINAM 2010). The renewable internal freshwater resource per capita has been decreasing from 61.4 to 54.0 thousand cubic meter per person only within a decade, which is partly caused by the loss of 39% of Peru's tropical glaciers due to temperature rise.

The environmental impacts brought by rapid urbanization and increasing population, coupled with the adverse effects of climate change are threatening the sustainability of Peru's development process. The country faces diverse threats that can instantly wipe out the development gains achieved so far, 72% of which are related to increased precipitation, drought, and flood (MINAM 2010). Grappling with a less favourable external environment and resource curse, Peru also faces economic uncertainties given the highly volatile commodity export market. These challenges put Peru at a development crossroad where it can either surpass its middle-income status or fall into stunted growth due to complacency or lack of innovative strategy. As it is already evident that Peru's growth model of heavy reliance on export market and material intensity is becoming unresponsive to the evolving development needs, achieving a high-income economic status requires improving competitiveness, achieving environmental integrity and climate resilience, and boosting productivity in a sustainable and inclusive way.

2.2 Policy Context for the Green Growth in Peru

The Government of Peru is currently in the process of developing a National Green Growth Strategy (NGGS), which will help improve the quality of life for all Peruvians by creating more efficient public policies to promote good regulatory practices, improved environmental education of the public, promotion of sustainable patterns of consumption and production and increased resiliency in the face of climate change. The NGGS will harmonize efforts undertaken by the central government on green growth issues, ensuring that they have a common goal and that they are consistent with other national plans and international

Figure 2: Peru's national policies and global commitments on green growth (MINAM, 2016)

agreements signed by the country. The development of the NGGS is grounded on both national interests and international commitment as presented in Figure 2. The GGPA aims to inform the priorities of NGGS, complementing the work of other initiatives like the Partnership for Action on Green Economy (PAGE) of UNEP, which is in the process of defining specific green growth measures in priority sectors.

- As an active player in the international community, Peru strives to honor its global commitments. It aspires for full membership to the Organisation for Economic Co-operation and Development (OECD) to stamp a "seal of guarantee" to its policies that will enable the country to become a developed economy in the medium term (CEPLAN 2015). In relation to this, since 2009 Peru is also one of the signatories to the OECD Declaration on Green Growth, joining 42 other countries that expressed commitment to pursue green growth strategies.[2]

- Peru ratified the Ramsar Convention on Wetlands as well as the Convention on Biodiversity in 1993 and the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and created the National Commission on Climate Change (NCCC) in 1993. As a Non-Annex 1 country, Peru ratified the Kyoto Protocol in 2002 and has submitted its Third National Communication in April 2016. As a member Party of the UNFCCC, Peru hosted the 20th Conference of Parties (COP 20) in Lima. On 28 September 2015, the country submitted its Intended Nationally Determined Contribution (INDC), including an unconditional target and a target conditional on international assistance. Both targets aim to reduce greenhouse gas emissions including those from land use, land use change, and forestry.

- At the regional level, the "Declaration of the Environment Ministers of the Pacific Alliance toward a Green Growth Platform" (April 2016) constitutes another of Peru's commitments, highlighting the need for regional cooperation and dialogue on green growth (together with Chile, Colombia, Mexico).

- At the national level, the National Development Plan (Bicentennial Plan), states a clear need for an integral and long-term vision of the country's growth based on economic, social, and environmental sustainability. Moreover, Peru has developed a number of policies relevant to green growth including the National Environmental Action Plan, the National Climate Change Strategy and the National Energy Strategy, which are all intended to be streamlined and coordinated through the development of the NGGS.

2. Further information can be found here: http://www.oecd.org/env/44077822.pdf

The results of the stakeholder consultation workshop revealed that a combination of both national and global interests drive Peru's green growth ambitions. During the two rounds of survey (GGPA Phase 2), national interests appeared to be more dominant than global commitments, thus indicating a significant level of appreciation of national benefits and local ownership of green growth in Peru (see Figure 3). While at the same time the international green growth policy regimes exert considerable pressure to Peru to likewise pursue green growth, the growing momentum for green growth's potential to serve as an alternative national growth paradigm that helps address poverty and other development issues strengthens the case for a more rigorous promotion of green growth at the national level.

Stakeholders were also asked about their general understanding of green growth in relation to other related concepts such as Economic Growth, Technology & Innovation, and Global Resource Competition. Given how there exists a divide in the way green growth is perceived by different countries, the answers help comprehend the role of and expectations from Peru's green growth model which is critical to building the buy-in necessary for implementation. The results strongly reflected Peru's commitment to finding ways of sustaining the nation's high economic growth rate, while integrating environmental and social well-being in economic planning. It is interesting to note how "economic growth" received greater attention between survey rounds when discussion groups were held to facilitate consensus building; the needs for keeping the county's growth momentum alive was considered vital to achieving the broader development goals.

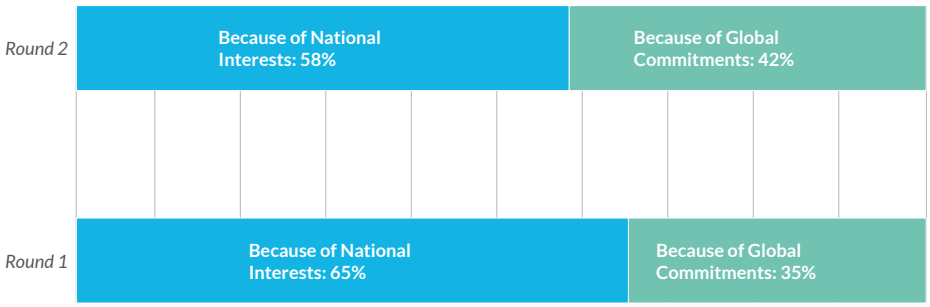


Figure 3: Why should Peru adopt a green growth strategy?

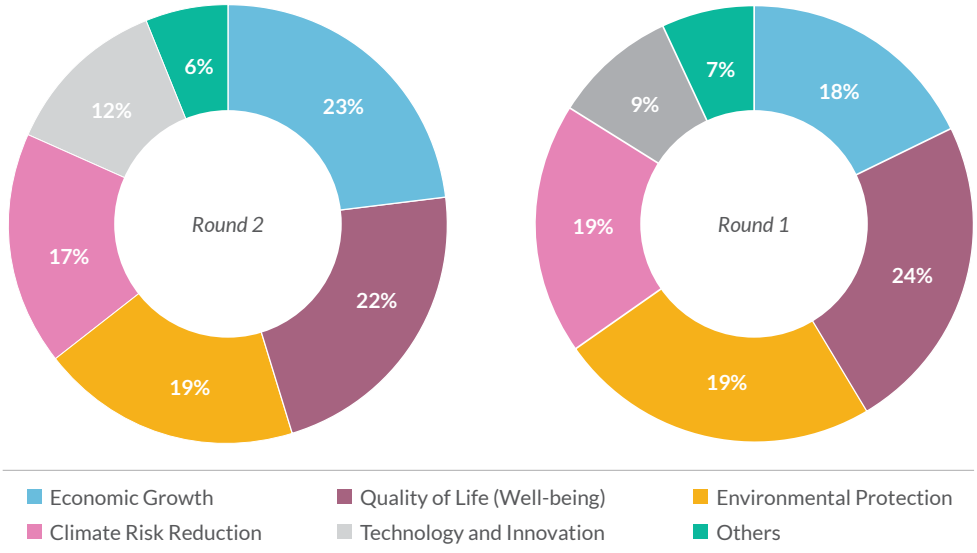


Figure 4: Which concept best represent your understanding of green growth? (up to 3 answers)

2.3 Diagnostic Analysis of Green Growth Pathways

To analyse the current performance of Peru on and how the country ranks in comparison to its peers, diagnostic analysis was conducted on the three dimensions or pathways of green growth: Resource-Efficient Growth, Eco-Friendly Growth, and Climate-Resilient Growth.

- The three dimensions are drawn from GGPA's measurement framework[3] which illustrates the overall casual relations among different components and variables of major economic agents and natural systems. The central idea is that "green growth" can promote growth by: (1) increasing the efficiency of production and consumption, (2) ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies, and (3) reducing the impacts and risks imposed by climate change on the sustainability of economic activities and natural assets. A total of 25 key green growth areas – each represented by an indicator – have been selected to capture the main features of these three pathways, which forms the basis to analysing country performance.
- Diagnostic analysis was undertaken for 24 out of the 25 key green growth areas[4] through the use of spider diagrams. In order to present the indicator data in a way that helps evaluate country performance, the spider diagrams present data on a notionally common scale following a normalization exercise.
- The following sections provide a diagnosis on Peru's underperforming areas (i.e., priority green growth issues), which are the results of Phase 1 (Preliminary Assessment) and Phase 2 (Validation and Consultation).

2.3.1 Country Diagnosis for Resource Efficient Growth (REG)

Increasing the efficiency of production and consumption activities is one of the core values of green growth. This is especially the case for developing countries where low levels of productivity in utilizing resources is often the reason for poor economic competitiveness and inequalities in distribution of goods and services. Key green growth areas or issues pertinent to this pathway include efficiency of energy use (i.e., energy intensity and energy loss), material/resource use (i.e., material intensity, waste generation intensity, water productivity, agricultural land productivity), and other productivity factors (i.e., labor productivity, logistics performance, technological readiness).

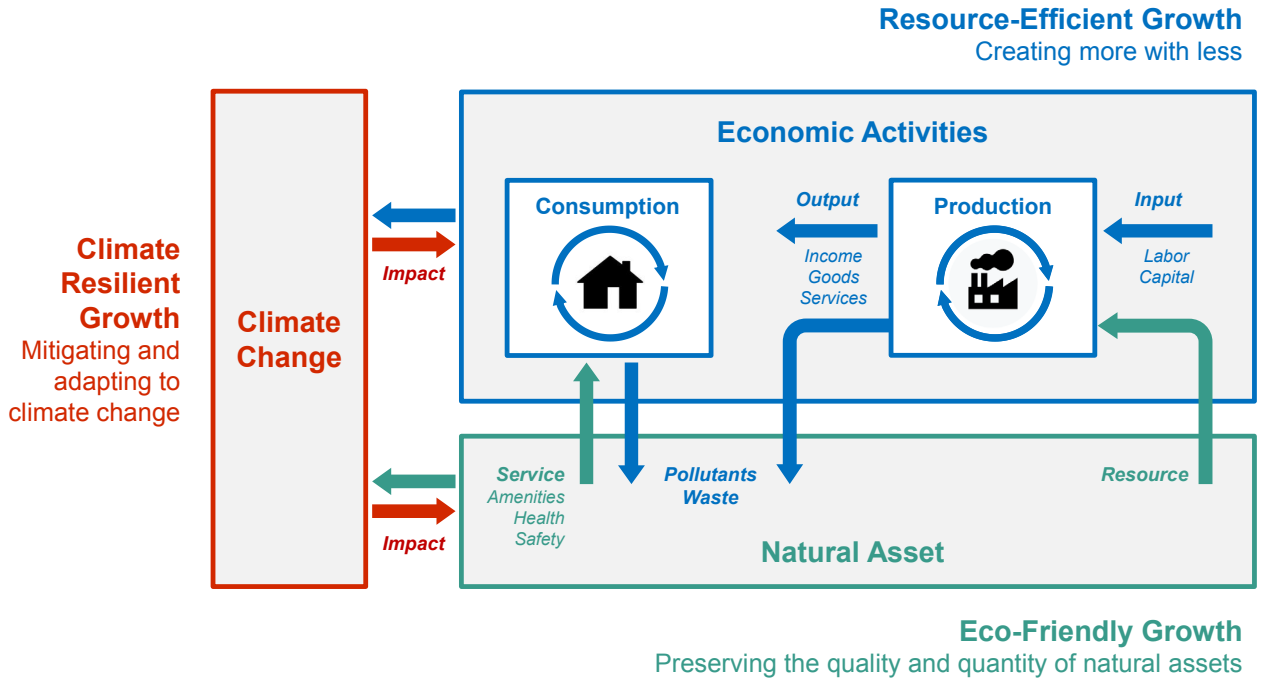
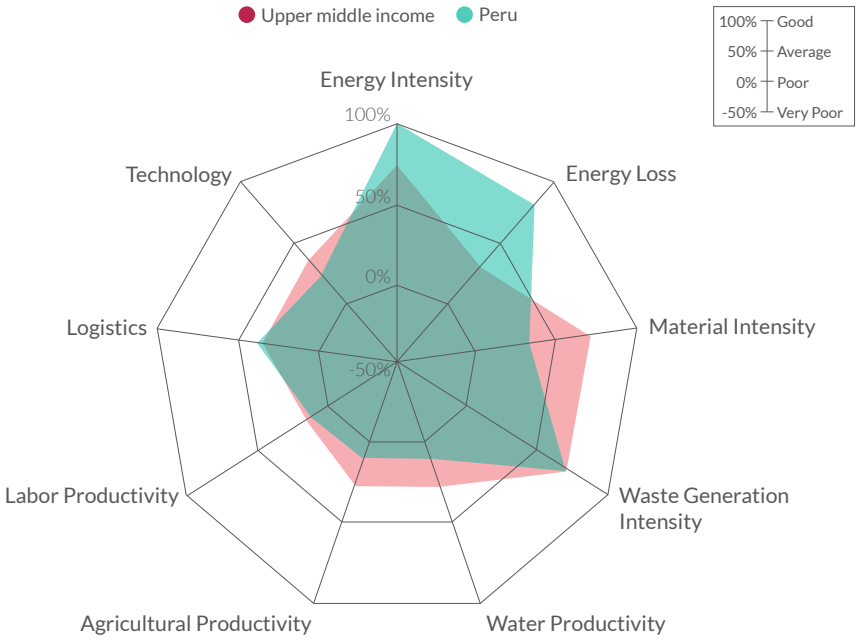


Figure 5: GGPA measurement framework

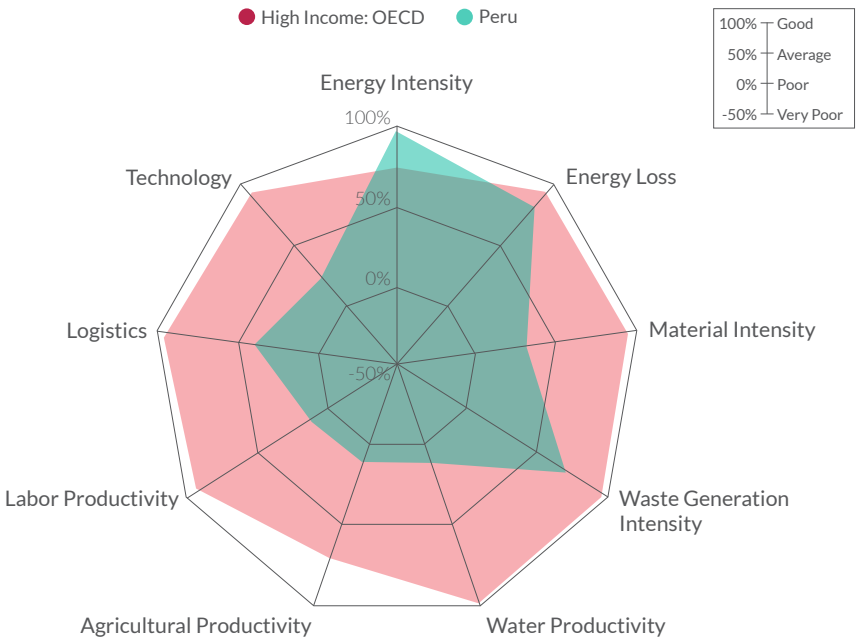
3. The GGPA measurement framework builds on the OECD's Framework for Green Growth Indicators (OECD, 2011)
4. One key green growth area – waste recycling – was not examined due to lack of data in Peru

Overall, Peru is performing equally or better than middl income countries in 4 out of the 9 areas, specifically in Energy Intensity where Peru is even over-performing compared to high-income OECD countries (See Figure 6).

- Energy Intensity is very low since Peru's economy is based on services and resource extraction, with heavy and energy intensive industries not being significant. The performance in Energy Loss is well above that of upper-middle income countries and not far below high-income OECD countries. Low Energy Loss, not only in power transmission



(a) Comparison of Peru with the upper middle income countries



(b) Comparison of Peru with the high income countries of the OECD

Figure 6: Spider diagrams for REG

but also in distribution, is remarkable especially compared to other countries in the region due to strong private sector participation, combined with effective regulation including pricing schemes that compensate or sanction companies based on their performance in transmission and distribution losses (IDB 2014).

- Regarding Waste Generation Intensity, Peru's performance is equal to the middle-income countries' average and significantly below high-income OECD countries.

- Performance in Logistics is slightly above middle-income countries, but far below high-income OECD countries. Within the Logistics Performance Index, Peru scores better in timeliness as well as tracking and tracing of freights, while it scores lower in customs, quality of logistics services, and infrastructure.

In comparison to its peer countries (i.e., the upper middle income countries), Peru is underperforming in 5 out of 9 key areas, indicating how they are to be paid greater attention as priority green growth issues with high potentials for future improvements:

Material Intensity

Material Intensity (in kg of domestic consumption per unit GDP) refers to the quantity of material used to produce goods and services. It is the ratio between GDP and the total amount of domestic materials (construction/industrial minerals, metal, ores, fossil fuels and biomass) extracted.

- Peru's material intensity of 6.45 kg per GDP unit more than doubles the average of upper middle-income countries (3.07 kg) and is six-fold that of high-income OECD economies (0.81 kg). The largest share of this is mineral extraction, including ores (72%) and industrial and construction minerals (10%). Biomass accounts for approximately 15% (including food, feed, animals and forest), with forest biomass being below 1%. Fossil fuel extraction accounts for the remaining 2%, including gas and oil.

- The high share of minerals in the domestic material consumption is due to Peru's position as a major global player in the mining sector, being among the biggest producers of gold, silver, copper, zinc, lead, and tin. The Peruvian mining sector has been growing steadily over the past decades, driven by increasing prices and demands on global markets, which has contributed greatly to Peru's economic development. With falling prices since 2013, on the other hand, Peru's commodity-based economy has been hit recently.

- The share of biomass is based on agriculture and livestock production, contributing approximately 7.5% of GDP (in 2012) and 20% of the export value over the last decade (OECD 2015). The forestry sector is of little significance in macroeconomic terms in Peru, despite the vast share of rainforest that the country hosts. Forest resources are commercialized mostly as low-grade, low-value products with little value added (GGGI and DIE 2014).

- Low domestic value addition to natural resources is what drives high material intensity, and this goes hand in hand with the economy's dependency on commodities, which accounts for 12% of GDP and close to 50% of export value. Gold and copper alone accounted for 31% of total export value in 2014, a higher share than agricultural (26%) or manufacturing (24%) exports (OECD 2015).

Water Productivity

Water Productivity (in GDP per m^3 of freshwater withdrawal) is an indication of the efficiency by which a country uses its water resources. It is calculated as GDP (2005 USD) in constant prices divided by the total annual freshwater withdrawal.

- Peru's productivity level of 9.14 USD/m^3 is three times lower than that of upper middle-income countries, while high-income OECD countries generate more than 10 times as much GDP from each cubic meter of water withdrawn. Considering that more than 80% of freshwater is used for agriculture, generating approximately 7% of GDP, low levels of water productivity in Peru is, to a great extent, driven by agriculture.

- Data for the period 1996-2005 shows that agricultural water productivity in Peru was around 4 USD/m^3, while industrial water productivity was above 100 USD/m^3 (Donoso et al. 2014). Overall irrigation efficiency in Peru is at 30-35%, with traditional gravity irrigation systems with low efficiency levels being predominant and accounting for 88% of the area under irrigation. More efficient sprinkler (4.8%) and drip (7%) irrigation is applied to the rest of the irrigated areas (MINAGRI 2015). Water use efficiency of domestic consumption is at 40-45% and for industrial use at 45-50% (ANA 2014). High water system losses (45%) and a low level of water re-use contribute to low overall water productivity levels.

- Low water productivity is driven by factors related to both the supply and the demand side management. Water charges and tariffs in Peru do not reflect the scarcity of water resources and do not cover the real cost of water supply. As a result, incentives for a more rational use are lacking, as do investments in the operation and maintenance of water supply infrastructure.

Agricultural (Land-Use) Productivity

Land-use Productivity (in USD per ha of arable land) is the ratio between agricultural production and total area of arable land under permanent crops and under permanent pastures. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.

- Peru produces USD 0.03 from each ha of arable land – a third of what upper middle income countries produce on average (USD 0.09), and only a small fraction compared to high-income OECD counties (USD 0.26). The low agricultural land productivity in Peru is a major concern since arable land is limited (19% of total land), and land for crop cultivation is scarce (5.5% of arable land).

- Soil fertility in Peru is naturally low and additionally affected by degradation, especially tropical soils in deforested areas. The most fertile soils are along the water scarce coastal region. Specifically, 52% of land is under irrigation, with 36% being irrigated nationwide. Fertilizer use is low (68.6 kg/ha) compared to Latin America (103 kg/ha) and OECD (114 kg/ha), and the value added per worker (USD 1.905) is far below that of peer countries (USD 14.632 in Latin America and USD 14.289 in OECD).

- The agricultural sector in Peru is characterized by a large share of small and medium size farms: 79% are under 5 ha, and 15% between 5 and 20 ha (World Bank et. al 2015). These produce mostly traditional crops for the domestic market (such as potato, rice, corn, cotton, sugar cane), and party for export (coffee and cacao), applying traditional agricultural practices with relatively low productivity levels. These farms are mostly located in areas where many farmers have only limited access to extension services that promote modernization of agricultural practices (World Bank et. al 2015).

- The remaining 6% of agricultural land are large-scale farms (more than 20 ha) producing non-traditional crops for export (such as mango, paprika, pepper, olives, asparagus, grapes and citrus fruits). These farms are located along the dry coastal region and apply modern agricultural practices with pressurized irrigation systems, and enjoy high productivity levels.

Labor Productivity

Labor Productivity (in USD per worker) measures the amount of output generated per worker of labor force. Thus, it is measured in GDP per worker with ages 15 and older who meet the ILO definition of the economically active population.

- Peru's workforce generates USD 8,204 of GDP per worker, less than two-thirds of what the average workforce of upper middle-income countries generates (USD 12,494 per worker), and far below that of high-income OECD countries (USD 71,313 per worker). A main driver for the low productivity level is allocation of labor, i.e. employment is concentrated in the least productive sectors, while the most productive sectors have low job creation potential and only employ a small fraction of the workforce.

- Labor productivity in the Mining Industry is 7 times higher than the average, and 40 times higher than in Agriculture, but employs merely 1.5% of the workforce while on the other hand, more than 25% of the workforce is employed in Agriculture. In the Manufacturing Industry, labor productivity is more than twice the average, but the workforce has been declining from 12% to 10.6% over recent years. Generally, labor productivity is higher in large and medium sized firms than in small businesses. Despite a low unemployment rate, there is a high rate of informal employment in Peru (exceeding 70%), which is locked in low productivity activities. Note that such informal activities are not fully covered by official production and employment statistics, particulary in developing economies.

- An unmet demand for skilled labor exists, due to gaps in high quality education and training. While access to education has increased significantly at all levels in the past, the quality of education still lacks behind international standards. Peru ranks 83rd of 144 countries in the latest Global Competitiveness Index (WEF 2014) in relation to higher education and training, and ranked last among 65 countries in the latest PISA study (OECD 2014), testing the skills and knowledge of 15-year-old students. Gaps in human capital pose significant challenges to further socioeconomic development by holding back the economy's expansion to highly productive sectors and a

general shift towards a knowledge economy. This is a key element of the so-called "middle income trap" (OECD 2015).

Technological Readiness

Technological Readiness Index (in scores between 1–7; higher scores are better) aims to measure the agility with which an economy adopts existing technologies to enhance the productivity of its industries. The index covers the areas of: (1) technological adoption (availability of latest technologies, firm-level technology absorption, FDI and technology transfer); and (2) ICT use (internet users, broadband internet subscriptions, internet bandwidth, mobile broadband subscriptions, mobile telephone subscriptions, fixed telephone lines).

- Peru's score of 3.30 (out of 7) puts it on rank 92 out of 144 countries, performing below the average of middle-income countries (score 3.71) and way below high-income OECD countries (score 5.53). While availability of latest technologies (rank 80) and firm-level technology absorption (rank 78) are areas of concern in Peru, the country scores well regarding foreign direct investment and technology transfer (rank 27). Peru is among the top 5 recipients of FDI inflow in Latin America (ECLAC 2015), with FDI being concentrated on 5 sectors: Mining (24%), Finance (19%), Communications (17%), Industry (14%) and Energy (12%) (ProInversión 2016). In these sectors – especially in the case of large companies connected to international markets – it is assumed that technology is being transferred to Peru, however, the FDI in Peru in general is not characterized by a large share of medium or high technology investments (ECLAC 2015). This is due to the structure of the economy, being based on natural resource extraction, a large service sector, and a mostly low-tech industry. Peru has a large share of small and micro enterprises, which are disconnected from international markets and investments, and therefore face barriers in terms of technology adoption.

- Regarding Information and Communication Technologies (ICT), individual and business usage is relatively low compared to upper middle-income countries (WEF 2015). A digital divide can be observed with high access and usage rates in urban centers, while rural areas are underserved. While affordability is generally given, gaps in infrastructure and a non-conducive political and regulatory environment are holding back a wider and quicker ICT uptake nationwide (WEF 2015).

- The ability to adapt new technologies is also dependent on the level of education and skills of the workforce, in which Peru is lagging behind international standards (OECD 2015). Furthermore, technological readiness is linked to the innovation capacity of the economy. Despite recent increases in public investments, the level of public and private spending on research, development, and innovation (R&D&I) is low in Peru, and a lack of science-industry collaboration on R&D&I holds back innovation and technology adoption in the industry.

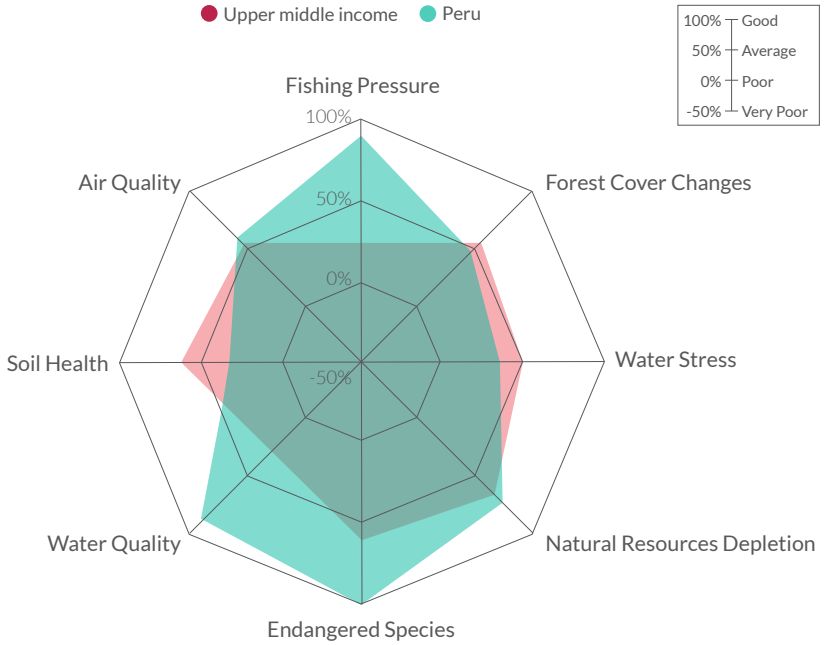
2.3.2 Country Diagnosis for Eco-Friendly Growth (EFG)

Green growth aims to ensure that economic growth and social progress exerts pressure (i.e., in the form of pollution and exhaustion of natural resources) within tolerable levels to the environment in order to maintain its long-term health. The idea of transforming the conflicting goals of environmental degradation and economic growth into opportunities for value addition is at the heart of the green growth model. The main issues of importance under this pathway include the rates of changes in renewable natural resources (i.e., fishery, forest, and water) and non-renewable natural resources (i.e., energy fuels and minerals), and the quality of environment on which our well-being relies (i.e., biodiversity, water quality, soil health, and air quality).

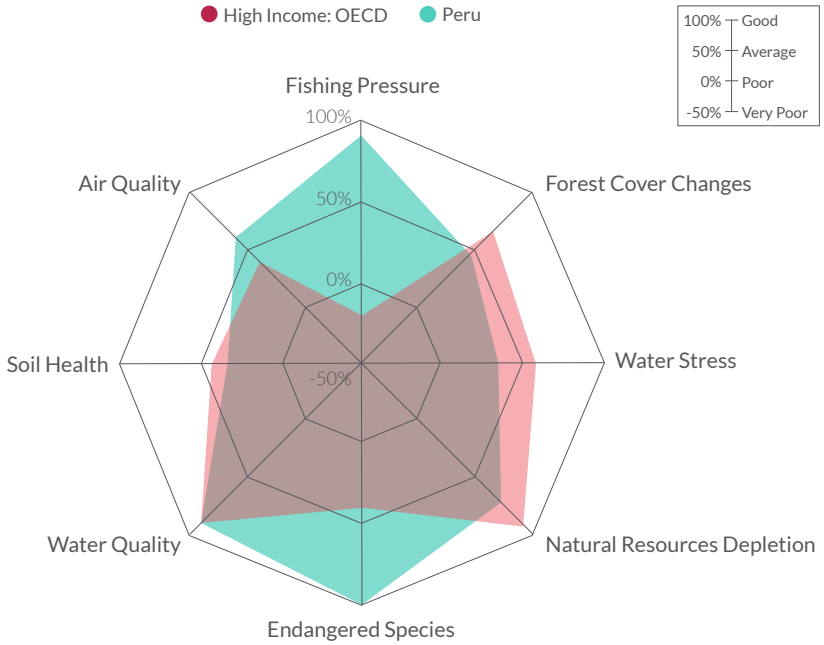
In 5 out of the 8 areas, Peru is performing better than middle-income countries, with a performance in Fishing Pressure, Water Quality, and Endangered Species being far above that of peer countries' average. Similarly, Peru over-performs compared to high-income OECD countries in Fishing Pressure, Endangered Species and Air Quality. Regarding Natural Resources Depletion, Peru's performance is slightly better than middle-income countries, but underperforming compared to high-income OECD countries (see Figure 7).

- As a fishing nation, the fact that Peru has a remarkably good performance regarding Fishing Pressure can be explained by one factor: its coastal waters are extremely deep and hence a large portion of the fishing activities is confined to the continental shelf. Although the overall fishing pressure is low, decreasing stock of a specific family of fishes – anchovies – is a significant challenge, which is a combined result of the effects of El Niño events and overfishing.

- In terms of Water Quality, note that the indicator measures the quality of water resources in their natural environment and not the quality of drinking water. While drinking water quality is regarded a major challenge in Peru, due to high levels of contamination in rivers and near urban settlements, water quality at source is very good.
- Regarding the change in the number of endangered species, Peru performs very well as a "mega-diverse" country, which can be attributed to effective conservation efforts and protection of biodiversity.



(a) Comparison of Peru with the upper middle income countries



(b) Comparison of Peru with the high income countries of the OECD

Figure 7: Spider diagrams for EFG

- Regarding Air Quality, Peru's good performance (especially when compared to high income OECD countries) can be explained by the fact that the indicator measures the population weighted exposure at the national level. To this end, while urban and industrial centres may have higher indices of pollution, large rural areas reduce the average.

In comparison to its peer countries (i.e., the upper middle income countries), Peru is underperforming in 4 out of 8 key areas, indicating how they are to be paid greater attention as priority green growth issues with high potential for future improvements:

Changes in Forest Cover

Changes in Forest Cover (in % change) is the annual percent change in forest cover between 2000 and 2012. "Forest" is defined as the land spanning more than 0.5 ha with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

- In the period 2000-2012, Peru lost 0.19% of its forest cover, while upper middle income countries on average maintained and high-come OECD countries even increased their forest cover by 0.40%. Despite this underperformance in global comparison, deforestation in Peru has been relatively low compared to some of the neighbouring states that share the Amazon Rainforest. However, given Peru's extensive forest cover – the country has the second largest share of the Amazon Rainforest (13%) that covers more than 50% of Peru's territory – even a low deforestation rate is significant in absolute terms: on average, 113,000 ha were deforested annually between 2000 and 2013, a total of almost 1.5 million ha (MINAM.b 2015). A cause for alarm is that this trend has been continuing in recent years.

- The main direct drivers for deforestation in Peru include transport infrastructure development, new and expanding settlements due to local population growth and migration, expansion of agricultural lands in forest areas, as well as (artisanal) mining activities. These drivers are linked to economic growth and rising demand for food and natural resources, and they are closely interlinked: new roads facilitate the transport of agricultural produce and other resources from the rural areas to the urban centers and markets, and drive migration from the mountain region to the rainforest in search of new lands for cultivation; this leads to an expansion of urban settlements and the agricultural frontier (CIFOR 2014). Furthermore, illegal activities including logging, mining and coca cultivation, unclear land rights, and weak law enforcement capacities are other important drivers of deforestation. In fact, deforestation in the Peruvian Amazon takes place mostly in areas without clearly assigned forest rights (46%); forest areas of native communities (16%), permanent production forests without concession (12%), and private plots (11%), according to MINAM (MINAM 2015).

- The GoP estimates that in a business-as-usual scenario, deforestation in the Peruvian Amazon would steadily increase from 150.000 ha/year in 2014 to over 250.000 ha/year in 2030 (MINAM 2015). Against this trend, and given the fact that almost 50% of Peru's GHG emissions originate from deforestation and land use change in its "National Environmental Action Plan 2011-2021" (MINAM 2011), the government of Peru has set the target to reduce the net deforestation rate to zero in an area of 54 million ha of primary forest by 2021.

Water Stress

Water Stress (in scores between 1–7, the higher the score, the greater competition among users) is the ratio of total annual water withdrawals (municipal, industrial, and agricultural) to total renewable supply and the values are normalized from 0 to 5.

- Peru scores 3.20 out of 5 on the Water Stress Index, meaning a high level of stress (40-80%) and competition for water resources, being higher compared to the average of middle-income (2.56) and high-come OECD (2.03) countries. Some parts of the country along the coast are even exposed to extremely high water stress (above 80%). Particularly, Agriculture (3.24) and Industry (3.26) are exposed to high water stress in Peru, whereas domestic consumption faces a medium level of stress (2.75).

- Peru is characterized by high water stress despite being among the countries with the highest per capita freshwater availability in Latin America, at 72,510m^3/year (MINAM 2011). This is mainly due to a highly uneven geographical distribution of water resources between the water scarce coastal region, where most of the population and industry is concentrated, and the less populous rainforest and mountain regions, where water is abundant. The country's 159 water catchments are divided in three hydro-geographic areas: the

Pacific basin along the coast host around 66% of the population and around 80% of GDP are generated here, yet only 2% of the national water resources are available. In the Atlantic basin, 97% of water resources are located, yet only 31% of the population lives here, and 18% of the GDP are created. The remaining 1% of water resources is in the Titicaca basins, where 3% of the population live, and 2% of GDP is generated (ANA 2014).

- With 9.9 million inhabitants, the metropolitan area of Lima hosts around a third of the total national population, with an increasing trend. Although water access is relatively high in Peru's urban areas, rising demands due to population growth will need to be met in the short and medium term, especially in the coastal region. Paradoxically, access to safe drinking water is lowest in those areas with the highest water availability, namely the rural areas.

- A low level of water productivity (excessive use and inefficient distribution networks) and a high water footprint in Agriculture and Agro-Industry exacerbates Water Stress further. Not least, the impacts of climate change pose additional pressure on water resources, and future availability will become more uncertain. Glaciers are a main freshwater source in Peru, especially for rivers feeding the coastal areas, including Lima. Increased glacial melting due to climate change may lead to increased river flows in the medium term, but to less water availability in the long run when glaciers deplete (FESS 2007). This may not only affect the water supply for consumption by agriculture, industry and households, but will particularly have an impact on hydropower production, which depends on the flow of rivers originating from Andean glaciers.

Natural Resources Depletion

Natural Resources Depletion (in % of GNI) measures the sum of net forest depletion, energy depletion, and mineral depletion, as a percentage of GNI. Net forest depletion is unit resource rents times the excess of round wood harvest over natural growth. Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

- Peru's performance of 5.66% of Gross National Income (GNI) is slightly better than that of middle-income countries (6.7% of GNI), however it is well below than that of high-income OECD countries (1% of GNI). A relatively high rate of natural resources depletion compared to GNI is common for countries that are rich in natural resources and dependent to a large extent on natural resource extraction for wealth creation. In the case of Peru, mining drives the rate of resource depletion, with 4.43% of GNI. This reflects the high relevance of the sector for Peru's economy, which however is mainly focused on exporting raw minerals without significant domestic value addition; this keeps its contribution to GDP and employment below its potential. According to UNEP, "Peru is increasingly functioning as an extractive hinterland for other industrialized economies (UNEP 2013)."

- Non-renewable energy extraction (especially natural gas) accounts for the remaining 1.23% of GNI of natural resources depletion. This reflects the importance of natural gas in Peru's energy mix, and the otherwise low dependence on domestic fossil fuel extraction for energy generation. Peru today is a net importer of fossil fuels after being a net exporter throughout the 1980s (UNEP 2013).

- Forest resources do not contribute to natural resource depletion (0.0% of GNI) but this does not mean that there is no depletion or extraction of forest resources taking place; rather, the extracted forest resources contribute very little to national wealth creation. As the indicator only measures extraction in productive systems, deforestation as a result of land use changes are not considered here. Due the incipient status of formal productive systems in Peru, this indicator is low

- Peru does not completely compensate the depletion of non-renewable resources with investments in human and physical infrastructure, which is necessary in order to sustainably grow national wealth and avoid the "resources curse" in the future (the so-called "Hartwick Rule"). Yet Peru has been performing quite well and much better than many other resource-rich countries in this regard (World Bank 2011).

Soil Health

The Trends in Soil Health Index (in scores between 0–50, higher the better) measures: (1) the physical part related to loss of soil mass and structure; and (2) the long term chemical well-being of the soil in terms of nutrients and absence of toxicities built up.

- Peru scores 37.13 out of 50 in the Trends in Soil Health Index, below middle-income countries (42.10) and slightly below high-income OECD countries (38.68). Soil health involves both physical and chemical soil indicators, and soils in different areas in Peru are affected very differently.

- Soil degradation affects to some extent the whole Peruvian territory, with high (27.51%) and medium (33.8%) degradation being widespread. Practically the whole territory is affected by soil erosion to a certain extent (including severe, medium and low levels) with most of severe erosion taking place in the mountain (66%) and the coastal (31%) regions. Desertification affects 26% of the territory, most of which takes place in the mountain region (80%), and to a lesser extent in the coastal region (20%). Soil salinization affects 0.24% of the territory, exclusively in the coastal region (MINAGRI 2015).

- Deforestation and excessive pasturing is a main driver of soil degradation in the Amazon Rainforest, with deforested soils degrading rapidly. The coastal region is affected by desertification due to natural factors (e.g., climatic variability and change) and human activities (e.g., intensive crop cultivation). On many agricultural lands, soil is impacted through the use of fertilizers and pesticides. In the case of mining areas, lead and mercury contamination of soil is reported, especially due to informal and artisanal mining operations, which are prevalent in some regions of Peru.

2.3.3 Country Diagnosis for Climate - Resilient Growth (CRG)

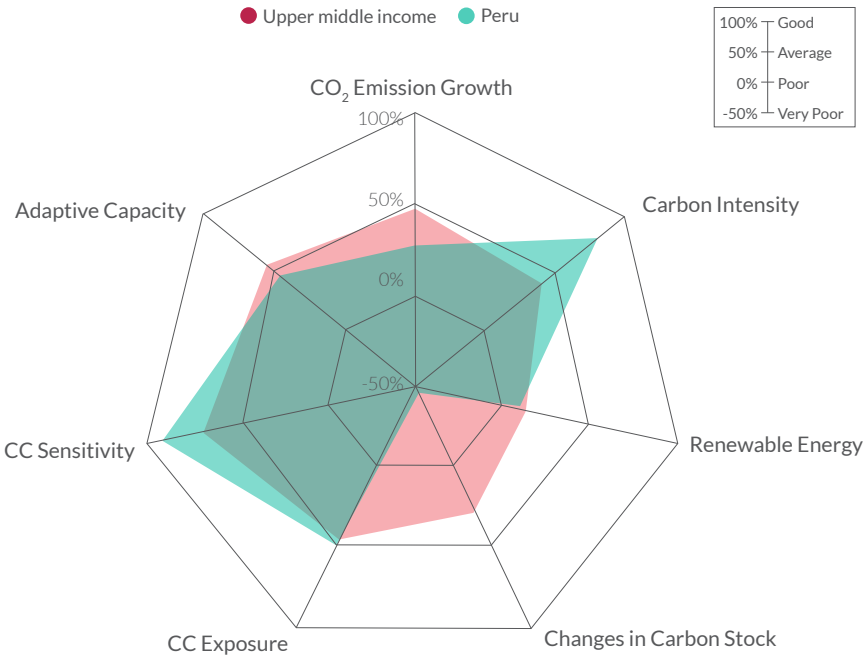
This pathway focuses on the impacts and risks imposed by climate change on production and consumption functions of the economy (i.e., REG), and aspects of environmental sustainability (i.e., EFG). Green growth stresses the need to reap the benefits in climate change adaptation/mitigation and economic growth. The main issues of importance under this pathway include absolute/relative levels of greenhouse gas emissions and sinks (i.e., CO_2 emissions growth rate, CO_2 intensity, renewable energy share, changes in carbon stock changes), and vulnerabilities of economic/social activities to the changing climate (i.e., vulnerability captured in the concept of exposure, sensitivity, and adaptive capacity to climate change impacts).

A diagnosis of CRG indicators in comparison to peer countries shows that Peru is performing well in 4 issues, namely Carbon Intensity, Climate Change Exposure, and Climate Change Sensitivity (See Figure 8). Compared to OECD countries, Peru is only slightly better performing on Climate Change Sensitivity and has a lot to improve in the remaining six issues.

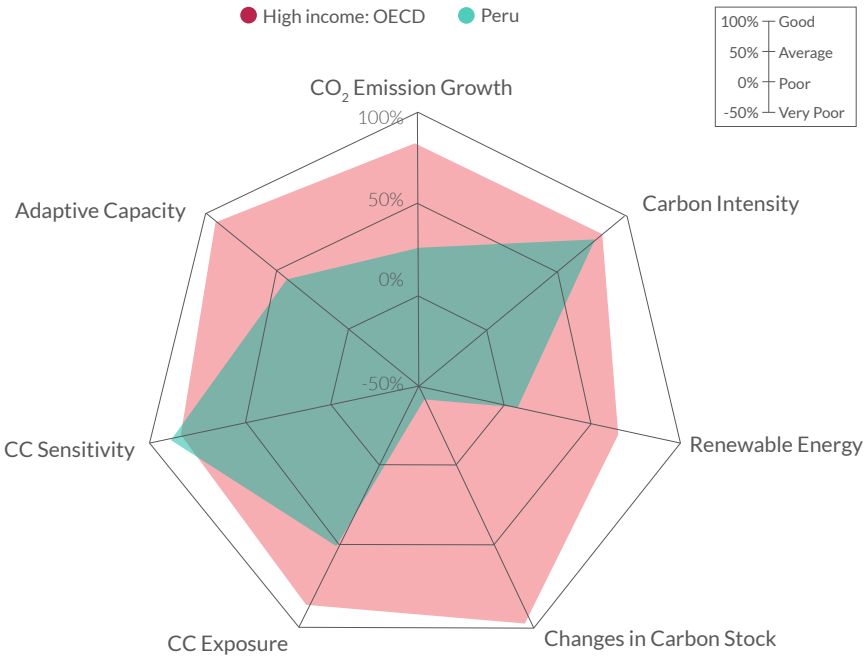
- Among its upper middle income peers, Peru performs well in terms of carbon intensity. The country emits 0.31 TCO_2 eq per unit of GDP, which is about half of what its peer countries emit at 0.63 TCO_2 eq/unit GDP. One of the main factors behind Peru's low carbon intensity is the significant use of cleaner energy sources. The total primary energy supply (TPES) matrix may still be dominated by oil at 50%, but followed by natural gas (27%), biofuels and waste (14%) as well as hydro power (9%), which produce lower carbon emissions. Electricity is mainly generated through hydropower (52%) and natural gas (39%), and thus minimizing carbon emitted to the atmosphere (IEA.a 2016). Furthermore, the GDP is dominated by services and extractive industries, which are not energy intensive in the context of Peru.

- As recognized by the UNFCCC, Peru is considered as a "particularly vulnerable" country to climate change. It has seven of the nine vulnerability characteristics, which encompass, amongst others, fragile mountain ecosystems, disaster-prone areas, and economies highly dependent on natural resources (MINAM 2015). At the same time, the Notre Dame Global Adaptation Index (ND-GAIN) reveals that the extent of climatic stress that Peru is exposed to from a biophysical perspective is moderate, e.g.,

sea level rise impacts would have a minor impact due to low proportion of land areas lower than 4 m above sea level and only very little changes is projected in climate-induced vector-borne diseases. Moreover, a climate change simulation based on the AVOID program shows that climate change may even have positive effects on agricultural lands in Peru (MEM.a 2015). An



(a) Comparison of Peru with the upper middle income countries



(b) Comparison of Peru with the high income countries of the OECD

Figure 8: Spider diagrams for CRG

extreme change is only projected in the duration of warmer periods. Peru's sensitivity to potential climate shock is considered as low indicated by its low dependency on imported energy, food, healthcare facility as well as imported water.

Renewable Energy Production

Renewable Energy (in % of total electricity production) is measured in terms of renewable energy production, which refers to the share of electricity production from renewable energy in total production, including geothermal, solar, tides, wind, biomass, and biofuels, excluding hydroelectric.

- Renewable sources of electricity generation, excluding hydropower, contribute only 1.73% to the total electricity mix of Peru. This puts Peru below both the upper middle-income countries and high-income OECD, in which renewable energy sources constitute 2.16% and 11.61% of the total electricity mix, respectively. The main electricity users in Peru are industry (55.6%), residential (23.9%), commercial (18.2%), and lighting (2.3%) (MEM.a 2015). Peru's electricity is generated by hydropower and natural gas to almost equal shares, with natural gas increasing recently. Electricity demand is projected to rise at an annual rate of 8.8% until 2017 (Medina 2014). The very low cost of electricity in Peru has so far been the main reason for low uptake of other renewables. Yet, rising demand and climate change have led the country to investigate other renewable sources such as biomass, solar power and wind energy, which are currently playing a very minor role in the energy mix (MINAM 2010).

- Furthermore, despite plans and targets that have been in place since the 1970s, Peru's rural electrification rate is one of the lowest in Latin America (Vagliasindi 2013), with only 73% of Peru's rural population having access to electricity (World Bank 2016). While on-grid electricity supply may be cost ineffective due to inhospitable landscape for infrastructure, off-grid solutions from renewable sources can offer appropriate solutions to provide electricity for rural communities. This is supported by the fact that Peru has a great potential for renewable energy sources, which are currently underused: only 0.65% of the total usable potential for wind energy has been exploited, similarly, only 1% for solar and 6.1% for biomass (Mwenechanya 2013).

- The National Energy Plan is targeting 56% of renewable sources in the energy mix by 2025. This includes, hydropower (< 20 MW), wind energy, solar power and others, such as biomass. This illustrates considerable scope for increasing renewable energy sources to electricity generation.

CO_2 Emission Growth

CO_2 Emission Growth (in % change in annual growth rate) refers to the annual growth rate in national emissions of CO_2 over the latest five years available.

- Peru's emission grew at 5.27% during the last five years, which is considerably higher than its upper middle-income peer countries, where emissions grew at an average of 2.51%. At the same time, high-income OECD countries have managed to reduce their emissions by 1.81% in the same period. Peru contributes to 0.3% of the global emissions (MINAM 2015). The total number grew by 42% within only a decade. In 2010, Peru's total emission reached 170.6 Mt CO_2eq and it is projected to grow by 75% until 2030, under a Business as Usual (BaU) scenario (MINAM 2015).

- The main emission contributors are Forestry and Land Use (47.5%), Energy (21.2%, including transportation), Agriculture (18.9%), Manufacturing (6.6%) and Waste (5.7%), which in total emitted 120,023 Gg CO_2eq (MINAM 2010). As a main driver of rapid CO_2 growth in Peru, the deforestation in the Amazon rainforest grows at a rate of 150,000 ha annually (CIFOR 2014). The second highest contributor to GHG emission in Peru is the energy sector, most notably fuel usage by the transport sector. Emissions are mainly produced due to low renewal rate of the vehicle fleet, poor driving practices, inadequate road traffic regulations, and lack of vehicle maintenance. The transport sector contributes 14.9 Mt CO_2eq annually, representing the largest share of overall energy-related emissions (40%) (MINAM 2010).

- Emissions from agricultural activities are produced through the use of fertilizer and enteric fermentation. The lack of cattle productivity improvement coupled with unsustainable consumption patterns have been the main cause of emissions in the sector (MINAM 2010). With regard to the industrial sector, increased competitiveness played a role in curbing the GHG emission contribution. Nevertheless, there is still room to further reduce emissions by introducing new and cleaner technology without compromising productivity. Peru generates lower waste per capita (0.7 kg/day/capita), if compared to other countries in Latin America. Emissions

are produced mainly from extensive open dumping and waste burning practices. The Solid Waste sector contributes to the country's total emission, however the GoP has actively improved the policy framework, identifying potentials for the Clean Development Mechanism, and has developed Nationally Appropriate Mitigation Action (NAMA) projects relevant to the sector.

Changes in Carbon Stock

Changes in Carbon Stock (in annual change, million tons) measures the annual changes in carbon stock, which is a quantity of carbon contained in a reservoir or system of living forest biomass which has the capacity to accumulate or release carbon.

- Peru has been losing its carbon stock at a rapid rate (-15.35%) between 2000 and 2010, three times faster than other upper middle income countries (-5.2%). Meanwhile, the high-income OECD countries have been increasing their carbon stock by 7.42% within the same period (FAO 2010).

- The Peruvian tropical forest is one of the largest in the world. Its Amazon forest area is the second largest after Brazil, with total estimated aboveground carbon stock of 6.9223 Pg (billion metric tons) (CIS 2014). However, for the first time the Peruvian Amazon become a net emitter of CO_2 rather than oxygen in 2012 due to anthropogenic activities (UNDP 2013). Speeding deforestation – attributed to land use changes, mining, industries, agriculture, and energy generation – plays a key role in carbon stock depletion. To minimize the effects of anthropogenic activities in the climate system, natural ecosystems are needed to offset gross emissions through carbon sequestration. This requires a cost effective approach to identify explicit targets for carbon storage enhancement among all landholders within a country. In 2014, MINAM together with the Carnagie Airborne Observatory developed the first ever high-resolution map of carbon geography of Peru aiming to value carbon at a competitive rate as an incentive to reduce greenhouse gas emissions.

Adaptive Capacity

Adaptive Capacity (in scores between 0–1; a lower score means a higher adaptive capacity) to climate change refers to the availability of social resources for sector-specific adaptation. In some cases, these capacities reflect sustainable adaptation solutions. In other cases, they reflect capacities to put newer, more sustainable adaptations into place. Adaptive capacity also varies over time.

- Despite moderate exposure and sensitivity to climate change impacts, Peru's adaptive capacity is relatively low compared to upper middle-income countries, let alone the high-income OECD countries. Peru scores 0.52 on this issue, and only ranks 116 out of 192 countries. Meanwhile, the upper-middle income and high-income OECD countries score 0.46 and 0.22, respectively. The country's vulnerability to climate change as a function of exposure, sensitivity, and adaptive capacity is measured at 0.42 (rank 89 out of 182 countries), and is mostly affected by the low availability of social resources for sector-specific adaptation. The Index assesses the adaptive capacity based on indicators related to Food, Water, Health, Ecosystem Services, Human Habitat, and Infrastructure (ND-GAIN 2014).

- Adaptive capacity includes generic dimensions, such as basic infrastructure, income and health, as well as specific indicators particular to climate change impacts (IPCC 2007). Peru's preparedness to reduce risks of natural disasters is increasing overtime, despite shortcomings in basic infrastructure. Safe water and sanitation, electricity, as well as health infrastructure are not yet accessible for the whole population, despite gradual improvement over the past years (See Country Profile – Dashboard Indicator Analysis). Moreover, although building climate resilient cities is in the interest of the Peruvian government, poor urban planning – which leads to urban sprawls and expansion of urban slums – results in high level of informality and makes it more difficult to close infrastructure gaps.

- Peru has a low level of undernourishment and the impacts of climate change can even have a positive outlook for food security in the country. Nevertheless, uncertainty remains with the potential modification of El Niño Southern Oscillation (ENSO) (MET et al. 2011), which could still severely affect water availability and quality, ecosystem services, livelihood, and human well-being. Furthermore, with increased probability of climate change-induced diseases, the need for improved access to health facility is urgently required. Up to 2012, only 1.1 physicians are available for every 1000 inhabitants, and respectively 1.2 nurses and midwives (World Bank 2016).

- A myriad of issues such as poverty, endangered ecosystems, increased water stress, natural resource-dependent economic activity, low level of institutional capacity – combined with the changing climate – urges Peru to put climate

change adaptation as a top agenda item (MINAM 2010). If this is not done alone, in 2030, under a climate change scenario, the country's GDP would be 5.7% to 6.8% lower than the GDP without climate change. In 2050, the gap would be between 20.2% and 23.4%, which is equivalent to an average annual loss between 7.3% and 8.6% of the potential GDP up to 2050 (MINAM 2015).

2.3.4 Prioritization of issues by stakeholders

The prioritization of issues was done through a stakeholder consultation based on the results of the preliminary assessment. Stakeholders were asked to choose five priorities from the total list of 24 issues that bear the greatest need and/or the highest potential for green growth in Peru. Those sectors with the highest relevance for the priority issues selected by stakeholders are considered for further sector assessment (based on sector-issue pairs) and policy recommendations.

Six issues were prioritized as a result of the validation workshop. The prioritization was obtained based on two rounds of surveys in which stakeholders were asked to prioritize 5 issues out of the 24 diagnostic indicators. Between the survey rounds, discussion groups were held to facilitate consensus building. The overall prioritization result is depicted in Figure 9: The following issues were chosen as priorities in the second survey round, in order of votes obtained:

- Natural Resources Depletion (15%)
- Capacity to Adapt to Climate Change (15%)
- Water Stress (14%)
- Technological Readiness (12%)
- Renewable Energy Production (12%)
- Labor Productivity (8%)

The result of Survey Round 2 show that divergence in opinion was reduced significantly after stakeholder discussions in the working group. While in Round 1 the first 6 issues only received a total of 46% of responses, 76% of all responses concentrated on the 6 priority issues in Round 2.

Overall, stakeholders gave most relevance to issues from the pathway of Resource-Efficient Growth with 37% of all responses, followed by Eco-Friendly Growth with 34%, and Climate-Resilient

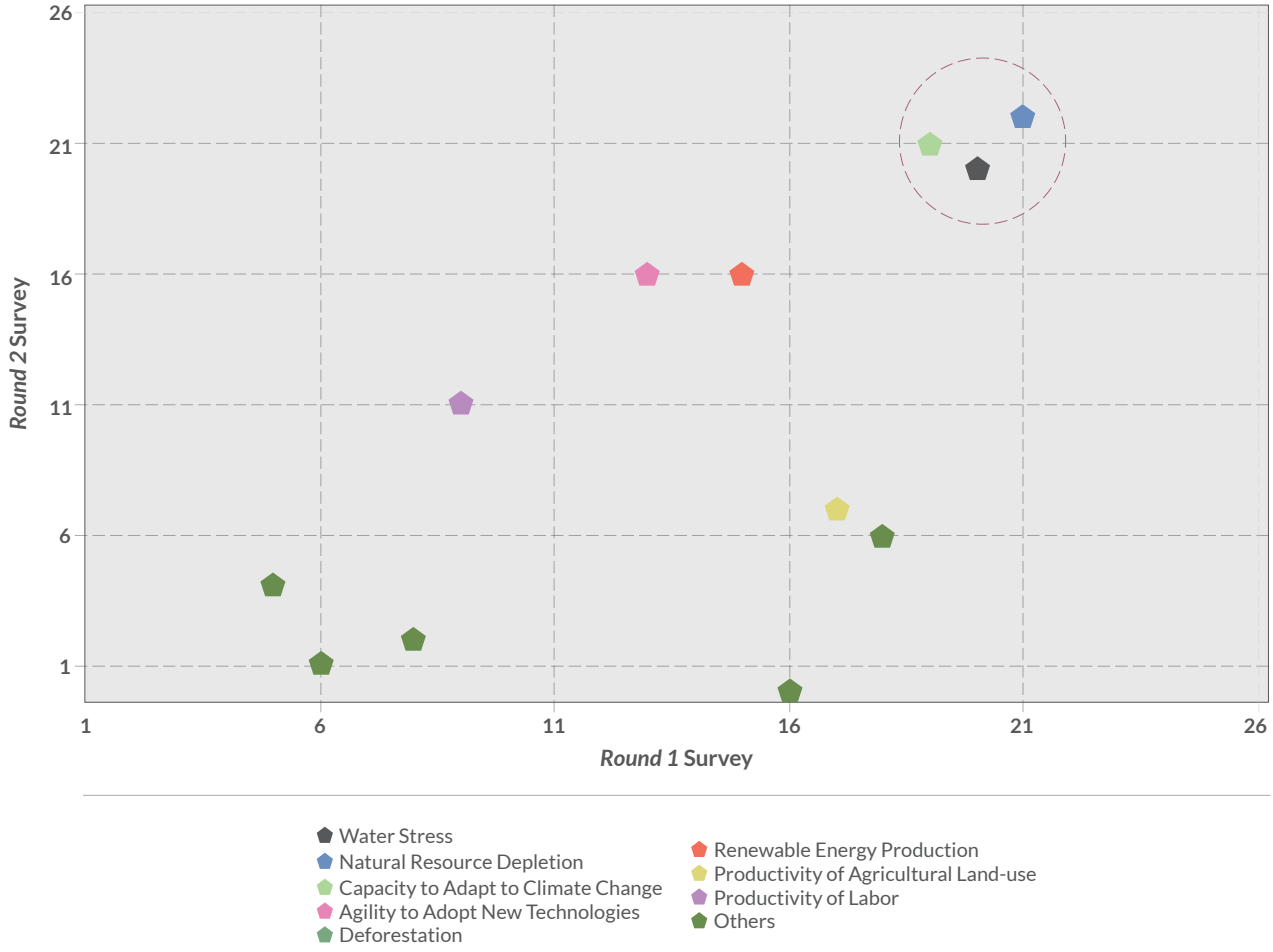


Figure 9: Priority Issues Consensus between Round 1 and Round 2 Surveys

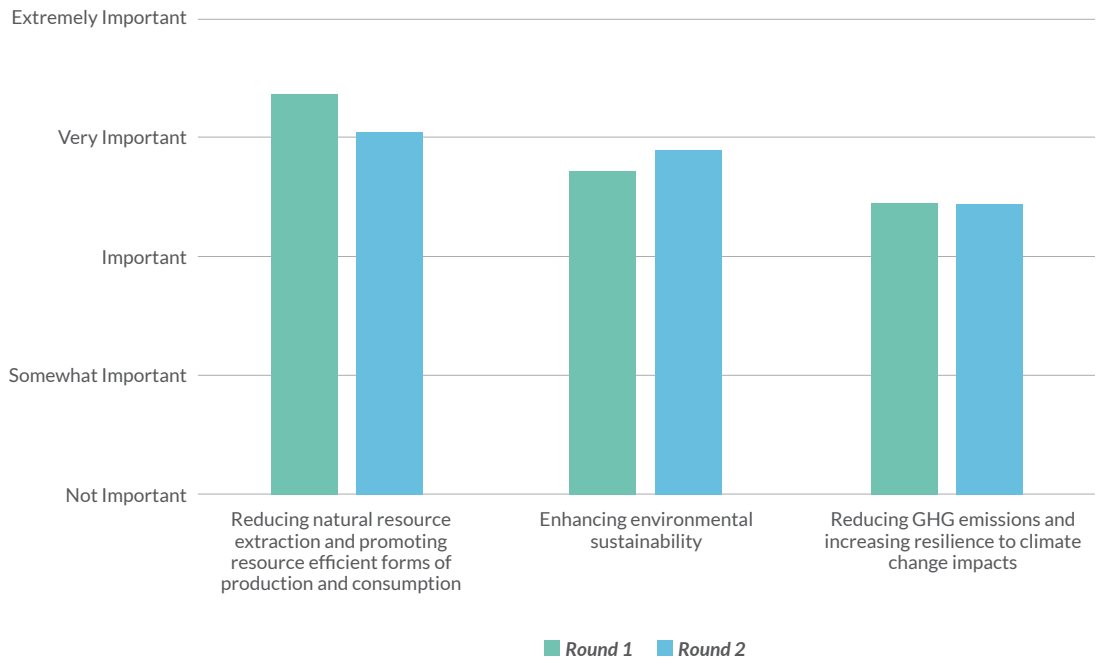


Figure 10: Emphasis of Green Growth Strategy in Peru

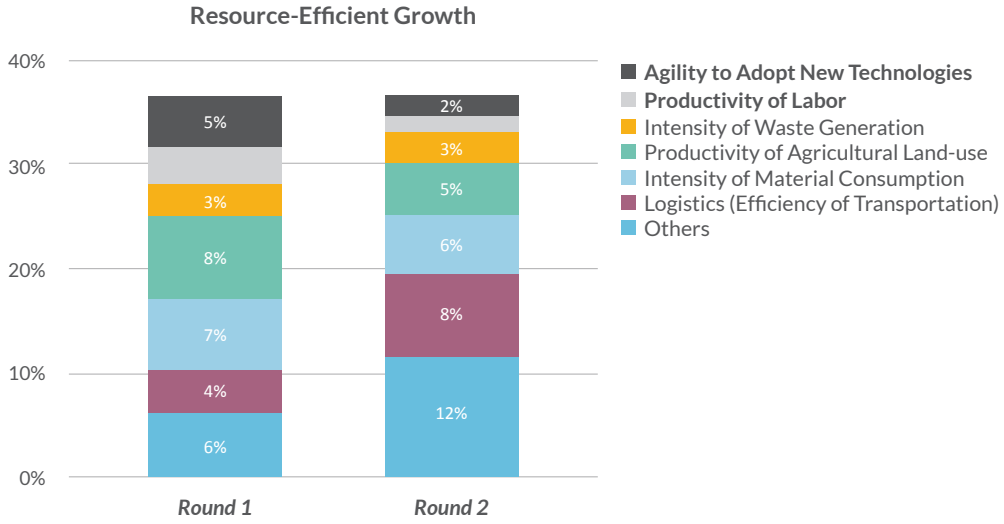


Figure 11: Results of the two surveys for REG (% of total responses collected)

Growth with 29%. This is in line with where the stakeholders render major emphasis on Peru´s Green Growth strategy. The reduction of natural resource extraction and promotion of resource efficient forms of production and consumption are perceived as the most important focus areas, closely followed by enhancing environmental sustainability. The reduction of GHG emissions and an increased resilience to climate change impacts is also perceived as relevant, however on a minor scale. These results are in line with the prioritisation of national interests over international commitments as described in Chapter 2.2. International commitments have an important focus on climate change, while national interests are more related to the economic structure where it will be necessary to change the economic structure from a resource-driven to a more efficiency-driven model.

In the area of Resource-Efficient Growth, Technological Readiness and Labor Productivity were prioritized as the most important issues. Note that no issue dealing with natural resources was selected, but both issues represent productivity factors that are clearly related to the economic angle of green growth. This is in line with the fact that Economic Growth is the aspect prioritized by most stakeholders as relevant for reaching Peru´s green growth potential.

In the area of EFG, stakeholders prioritized Natural Resource Depletion and Water Stress. It is noteworthy that Natural Resource Depletion was not

presented to stakeholders as an underperforming area based on the preliminary assessment (Peru's performance is slightly above middle-income countries), but was nevertheless among the most prioritized issues, especially so in the second survey round. Water Stress received a similarly strong increase in votes between round 1 and 2 of the survey, indicating convergence of views through the discussion groups.

The Capacity to Adapt to Climate Change and Renewable Energy Production were prioritised as the most important issues during both survey rounds. It is noteworthy that renewable energy production was prioritized despite the fact that it was not presented as an underperforming issue based on the results of the preliminary assessment. This underlines the high relevance that stakeholders are giving to the issue. The strong increase in votes for both issues between survey round 1 and 2 shows strong convergence of stakeholder views during the discussion groups.

2.3.5 Conclusions of the Country Assessment: Peru's Triple Challenge

Peru's economic growth is based on abundant natural capital, supported by macroeconomic policies and favorable market conditions. This rapid growth over the past decades has fueled the rise of an emerging middle class and has led to significant progress in improving access to basic services such as health, education, and infrastructure, among others. However, Peru's economy is vulnerable to the volatile international commodity price and also grapples with high material intensity with low resource productivity. In addition, increased wealth and well-being of a growing middle class - with better access and consumption of basic services - is putting heavy pressure on the nation's ecosystems.

Despite the fact that Peru only contributes to 0.3% of global GHG emissions, carbon emission is still rising significantly, largely due to deforestation

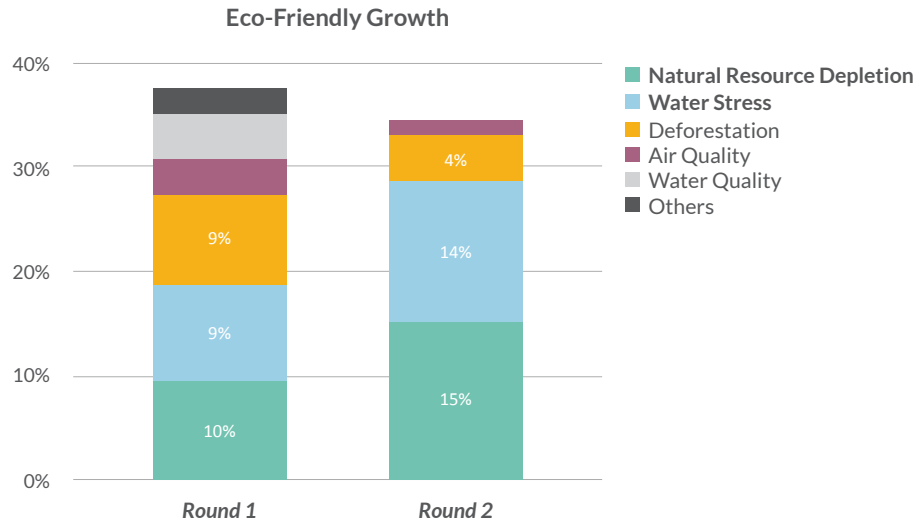


Figure 12: Results of the two surveys for EFG (% of total responses collected)

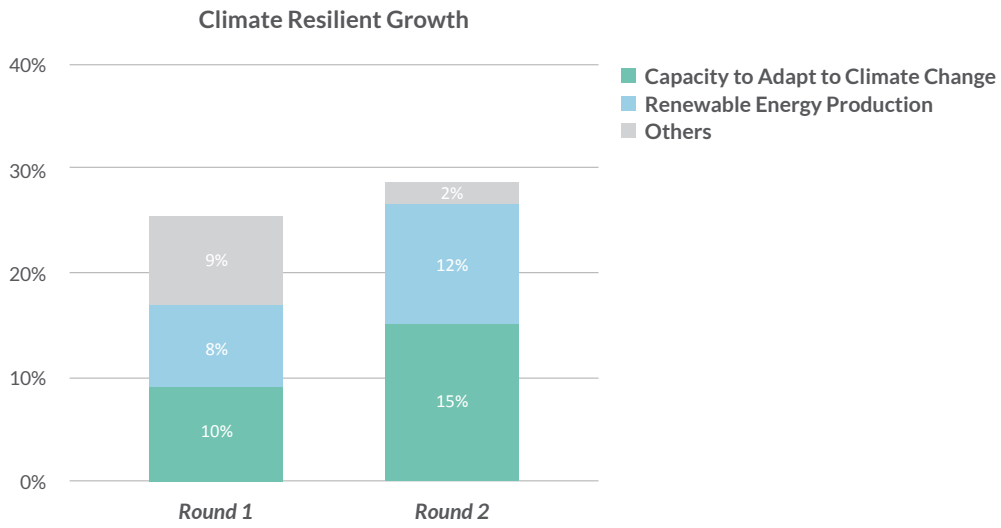


Figure 13: Results of the two surveys for CRG (% of total responses collected)

and fuel combustions. The country may reap some benefits from climate change, for example increased precipitation in the medium term may be useful for agriculture activities in the country; nevertheless, the long term economic costs arising from growing global emissions are significant. The impacts of climate change could easily undo the progress in the past decades. Furthermore, increasing demands for resources put pressure on water, forest, and soil, despite the preservation efforts for vital environmental functions such a biodiversity as well as air and water quality. Environmental deterioration induced by anthropogenic activities is not only exacerbating the adverse impacts of climate change but also compromising environmental integrity.

Peru's economic boom substantially contributed to people's well-being. Efforts in closing infrastructure gaps, increasing the quality of basic services such as education and health, and expanding access to markets for the poor and vulnerable segments of the population are in place. Poverty has been reduced by 50% within less than a decade. However, inequalities persist and discontent rises among the population that is not receiving the benefits of growth. Gaps in human capital lead to shortage of skillful labor resulting in low labor productivity. Strengthening human capital is thus imperative to overcome barriers to growth, increase per capita income.

In summary, Peru confronts a range of green growth issues that pose challenges in its goal to overcome the middle income trap. The current economic structure that is heavily reliant on natural resources and export commodities is not stable due to the uncertainties in the global market. Moreover, the increasing population and rapid pace of urbanization are putting major environmental functions under severe stress, which is exacerbated by the harmful impacts of climate change. A significant gap in productivity is also evident due to low value added of major sectors and low level of human resource capacity and technological innovation. Thus, to avoid the pitfalls of resource curse, Peru needs to improve economic competitiveness while advancing environmental integrity and climate resilience.

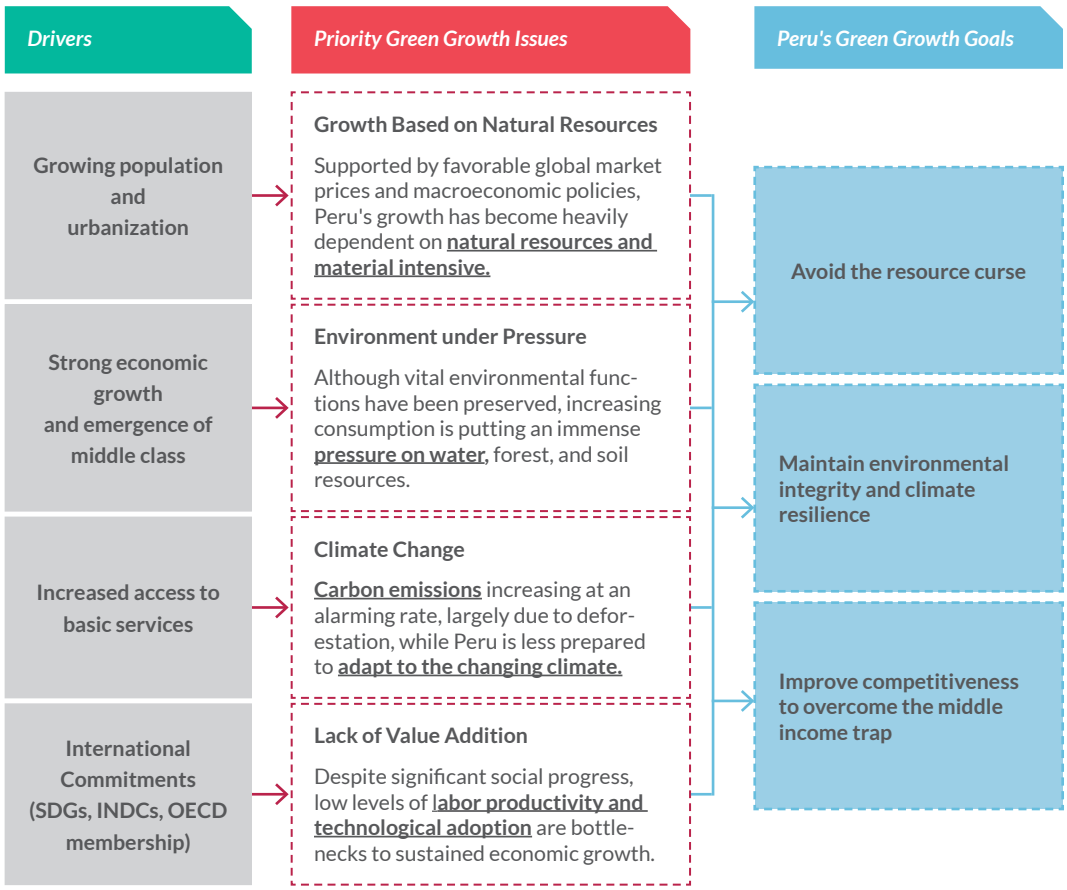


Figure 14: Peru's Green Growth Model

3. Rapid Sector Assessments Prioritized Sectors for Green Growth

The following chapter provides a rapid assessment of five priority sectors, and gives recommendations for green growth interventions to address the priority issues Technological Readiness, Labor Productivity, Natural Resources Depletion, Water Stress, Renewable Energy Production and Adaptive Capacity in the respective sectors. Priority sectors have been selected from a long list of sectors as per OECD[5] classification. The selection has been based on the sector-issue linkages defined for the six

Table 2: Matrix of Issues and Sectors

	PRIORITY ISSUES AND RELATED SECTORS					
	Labor Productivity	Technological Readiness	Natural Resources Depletion	Water Stress	Renewable Energy Production	Adaptive Capacity
Agriculture	x v	x v	v	x v	v	x v
Fishing	v	v	x v			x v
Agro-Industries		v	x v	x v	v	v
Chemical Industries		v				
Mining Industries	x v	x v	x v	v	x v	v
Construction Industry	v	v	x	v		v
Textile and leather Industries	v	v	x		v	
(Other) Manufacturing Industry	x v	x v	x v	x v	x v	v
Wholesale and Retail Trade			v			
Banking, Finance, and Real Estate						
Tourism Industry	v		v		v	
Telecommunications Service Industry		x v				
Energy Generation and Supply	x v	x v	x v	x v	x v	x v
Transportation	v	v	x			v
Water and Sanitation	x	x v	v	x v	x	x v
Waste Management and Disposal		v				v
Forestry and Land-use	v	v	x v	v	v	x v
Urban Development	v		v	x v		x v
Housing and Buildings	v	v	x	v	x	v
Education and Health Services*	x v	x v				x
Public Administration	v	x v				
Household Consumption				x	x	

X : Sector identified in the preliminary assessment V : Sector identified in discussion groups ■ : Selected priority sectors

** Education mentioned related to Labor Productivity and Technological Readiness; Health mentioned in relation to Adaptive Capacity.*

5. For purposes of this GGPA, the term sector is utilized as by the OECD to denote thematic areas that may have several ministries and/or entities involved with policy implementation. In contrast, Peruvian public management terminology denominates these as areas of intervention.

priority issues. The sector selection was supported by discussions during the validation workshop. The five priority sectors are Agriculture, Mining, Energy, Forestry and Water and Sanitation.

Table 2 summarizes the sector-issue links as identified in the preliminary assessment, as well as through stakeholder consultations. In the GGPA application in Peru, five priority sectors were strategically selected for a rapid assessment and recommendations in Step 3. However, it is highlighted that further sectors are considered of strategic importance and of high potential for green growth in Peru, especially Manufacturing, Construction, Agro-Industries as well the Housing, Construction and Sanitation sector. Education and Health, too, are of direct relevance to at least some of the priority issues.

3.1 Agriculture

3.1.1 Relevance of the Agriculture sector to the priority issues

Agriculture is a key contributor to Peru's economic growth. Agribusinesses constitutes 7.45% of GDP in 2012[6] and provides significant employment opportunities while family agriculture directly contributes to poverty reduction, as most rural economic activities are based on agriculture. Despite the unfavorable international economic situation, the agricultural sector still achieved remarkable growth in production, closing the year 2014 with a rate of +1.6% and exports that rounded 20% of growth on FOB (Free on Board) value.

The main differences between the two agricultural models are access to technology and scale of farming. While agribusinesses operate on large new agriculture lands with technified irrigation (especially in the coastal region), family agriculture is small in land size, thus incapable of achieving economies of scale. In terms of land ownership, 5.5% of farmers own 87% of farm land (mostly large scale farm sizes over 20 ha), 79% of farmers own less than 5 ha of land, and 15% of farmers own between 5-20 ha, practicing traditional agriculture (World Bank et al. 2015). Large agro-export companies are concentrated in the coast, while small farms are in the mountains (INEI 2012). In both agricultural models, the main challenges are the sustainability in the use of natural resources (land and water), as well as increasing productivity and capacity of the workforce.

Labor Productivity: The Agriculture sector employs 24.7% of the Peruvian workforce, more than twice compared to Chile or Mexico, and above Colombia and Brazil. In 2012, an agricultural worker generated USD 1,530 to GDP, with the national average being USD 4,235 per employee. While the level of labor productivity is low, the sector showed a remarkable increase in productivity in the last decade, with an annual growth rate of 4.6% (Vasquez 2014) mainly due to the performance of agribusiness. The lack of sufficient access to extension services for farmers is a major constraint in productivity. Equally inadequate is the access to financial services such as loans, credits, and insurance to invest in modern technologies and farming practices (World Bank et al. 2015). The average monthly per capita income for the Agricultural sector nationwide reached USD 242, which is lower compared to other sectors, although twice the income in agriculture a decade ago.

Water Stress: Agriculture is the biggest land and water user in Peru and affects the characteristics of the natural ecosystem and environmental services. It is highly water-dependent and represents 80% of total water consumption. Agricultural production is directly affected by water stress, and the agricultural water consumption pattern has a direct impact on water resources availability for other sectors. Agricultural water tariffs are relatively low, and the costs for operation and maintenance of supply networks are not fully covered (MINAGRI 2015). Only 36% of the total agricultural land is irrigated, while the remaining 64% is rain-fed. The agricultural area under irrigation is mainly found in the coastal region (57%); the mountain region hosts 38% of irrigated land, and the rainforest region only 5%. Rain-fed agricultural land is present in the mountains and rainforests, which account for 51% and 45% respectively. Eighty-eight percent (88%) of irrigation systems use gravity irrigation, 7.0% use drip irrigation, and 4.8% spray systems. The share of modern irrigation systems has not significantly increased over the past decade, despite government programs to promote its adoption (MINAGRI 2015). This means that only 12% uses technical and efficient irrigation system (mainly in the coastal region), thereby representing an opportunity for increased water efficiency in irrigation.

Adaptive Capacity: Peru's INDC identifies agriculture as one of five priority sectors for climate change adaptation, stressing that the scope of adaptation action shall protect the sector and its contribution to the economy, and especially attend to the most vulnerable groups (small-scale and subsistence farmers). The sector is vulnerable to climatic variability caused by extreme events, which affect

6. See Dashboard Indicators

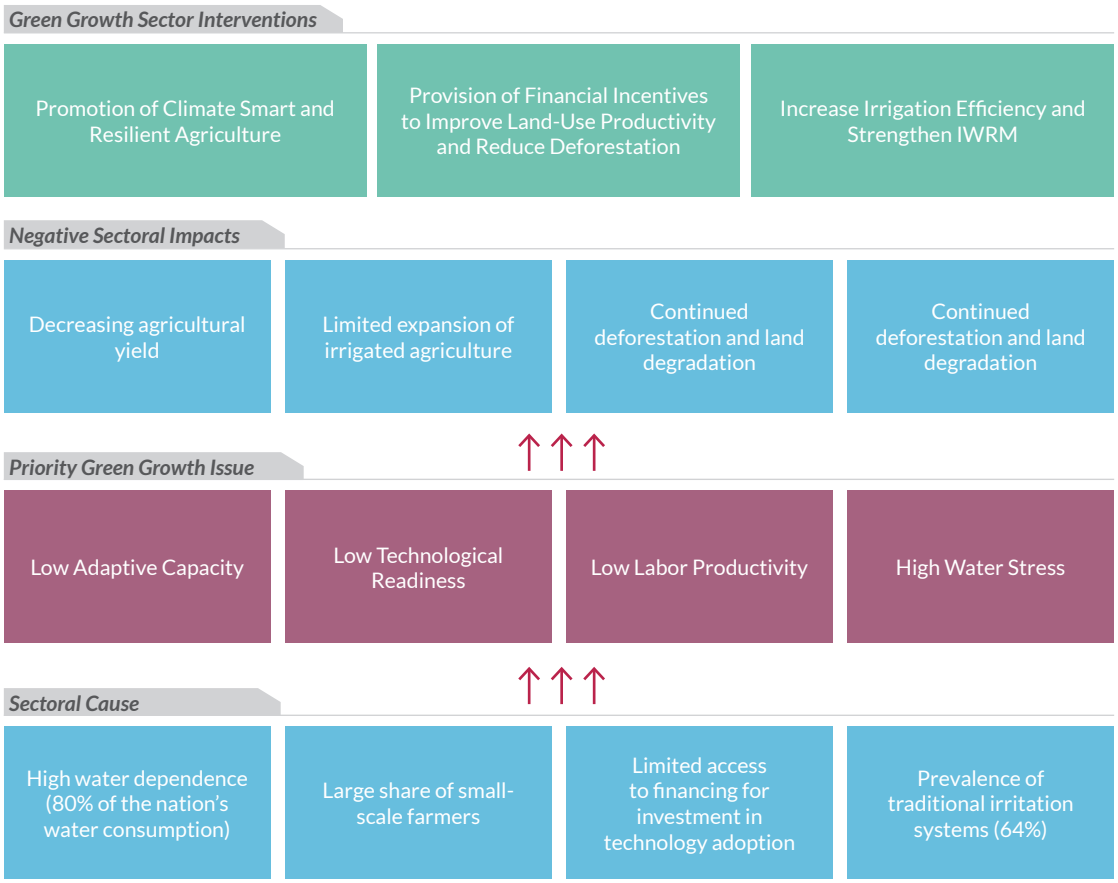


Figure 15: Problem tree analysis for agriculture

farming activity and crop yield. Specifically, 75.25% of all districts in Peru are at risk of droughts, while 39.62% are at risk of flooding, and 43.15% are at risk of frosts. Projections from ECLAC-IDB indicate that the impact of climate change on agriculture will cause a decline in production for the most important crops (potato, rice, sugar cane, banana, and corn) in all scenarios, mainly due to the impacts of temperature increase (IDB et al. 2014). The 66% of agricultural land that is rain-fed, located mainly in the highlands and the rainforest, is particularly vulnerable to changes in precipitation patterns. Also, deficit water storage capacity and irrigation infrastructure make the highlands particularly vulnerable to drought, despite receiving a higher volume of rainfall.

Technological Readiness: Although the agribusiness in Peru uses advanced technology, the overall level of agricultural technological innovation and use of modern technology is still low. Family agriculture has limited access to technology, which is directly linked to low levels of human capital and fragmentation of agricultural land. Technologies such as modern irrigation systems (only 12% of total irrigation is modern irrigation) and climate resilient crops bear an enormous potential for green growth in agriculture, tackling the priority issues of Labor Productivity, Adaptive Capacity, and Water Stress.

3.1.2 Recommendations

The Agriculture sector has already developed a strong policy framework that addresses major elements of green growth. To close some of the gaps identified and to maximize the sector's contribution to green and inclusive development, three recommendations are proposed:

a) Promote Climate Smart Agriculture

Climate Smart Agriculture (CSA) involves farming practices that improve productivity and climate change adaptation and mitigation such as those initiatives related to water efficiency, efficient use of chemical fertilizers, carbon sequestration agroforestry, and ancestral adaptation forestry. While these initiatives are already being implemented in Peru under the Plan for "Risk Management and Adaptation to Climate Change in the Agriculture Sector 2012-2021," scaling up requires stronger efforts in capacity building, institutional coordination, and promoting cross-sector synergies. In general, agricultural activities need to be better integrated into environment and climate change programs.

Enhancing the resilience of family agriculture is key to inclusive economic development and poverty reduction. Accompanying CSA with capacity building and basic business development trainings can further empower farmers, improve their access to markets, and turn them into small rural entrepreneurs. CSA should also include the agricultural value chain, transforming subsistence farmers as partners in social enterprises, improving last mile infrastructure, and developing innovative business models that empower rural communities. CSA bears a great potential in Peru as the practices of conservation agriculture are deeply rooted in ancient Andean farming.

b) *Provision of Financial Incentives Scheme to Improve Productivity and Reduce Environmental Pressure*

To address the challenges associated with small unproductive farming plots and farmers' vulnerability to market fluctuations and climate change impacts, new farming methods that improve productivity, reduce pressure on soils, water and forests, and enhance climate resilience are required. It is also necessary to implement targeted financial incentives and improve access to financial services to shift toward more sustainable farming.

The feasibility and effectiveness of different types of price incentives need to be carefully analyzed, including market price supports, direct payments for on-farm output, or support for production and agricultural inputs. To achieve the desired impacts, it is crucial to develop a coherent incentive scheme based on mapping and alignment of existing financial incentives, removal of existing and potential disincentives (e.g., low water tariffs), and the introduction of new incentives (e.g., credits for climate resilience programs). The direct financial incentives shall be complemented by better access to financial services, such as micro credit programs. At the same time, it will be important to make sure that farmers are financially more independent and have the chance to diversify their income. Access to micro credits and other financial schemes should be closely linked to CSA, and should also focus on income-generating opportunities for farmers, for example through the support of rural entrepreneurship or the development of value-added activities that can help them earn other income sources and make them less vulnerable to the impacts of climate change.

c) *Enhance Irrigation Efficiency and Strengthen IWRM*

The existing water losses in distribution systems and inefficient irrigation practices open opportunity for improved water efficiency in agriculture. Thus, a national program for improving irrigation efficiency should prioritize basins that face water stress, irrigation systems with high vulnerability to climate change, and systems where family farming is conducted.

To measure the real impact of irrigation infrastructure modernization, it is important to clearly define the baseline of irrigation efficiency in the different systems and regions in Peru. The development of an information and benchmarking system can help track progress. Improving irrigation efficiency should also involve a set of coordinated activities for organizational development and capacity building for water users. In addition, the aspects of irrigation water tariffs and cost recovery also need to be addressed in provide appropriate incentives to water users, and ensure financial sustainability of new irrigation systems.

Furthermore, plans and programs for the expansion and modernization of irrigation should be considered in a wider water resources management context. For example, increased irrigation efficiency may lead to diminishing return flows, on which other water users depend. A closer integration of irrigation strategies into water resources management plans on the catchment level is thus imperative. In that sense, different irrigation organizations in the country must be involved within a strengthened IWRM framework, in which water rights are clearly established with a vision of sustainability.

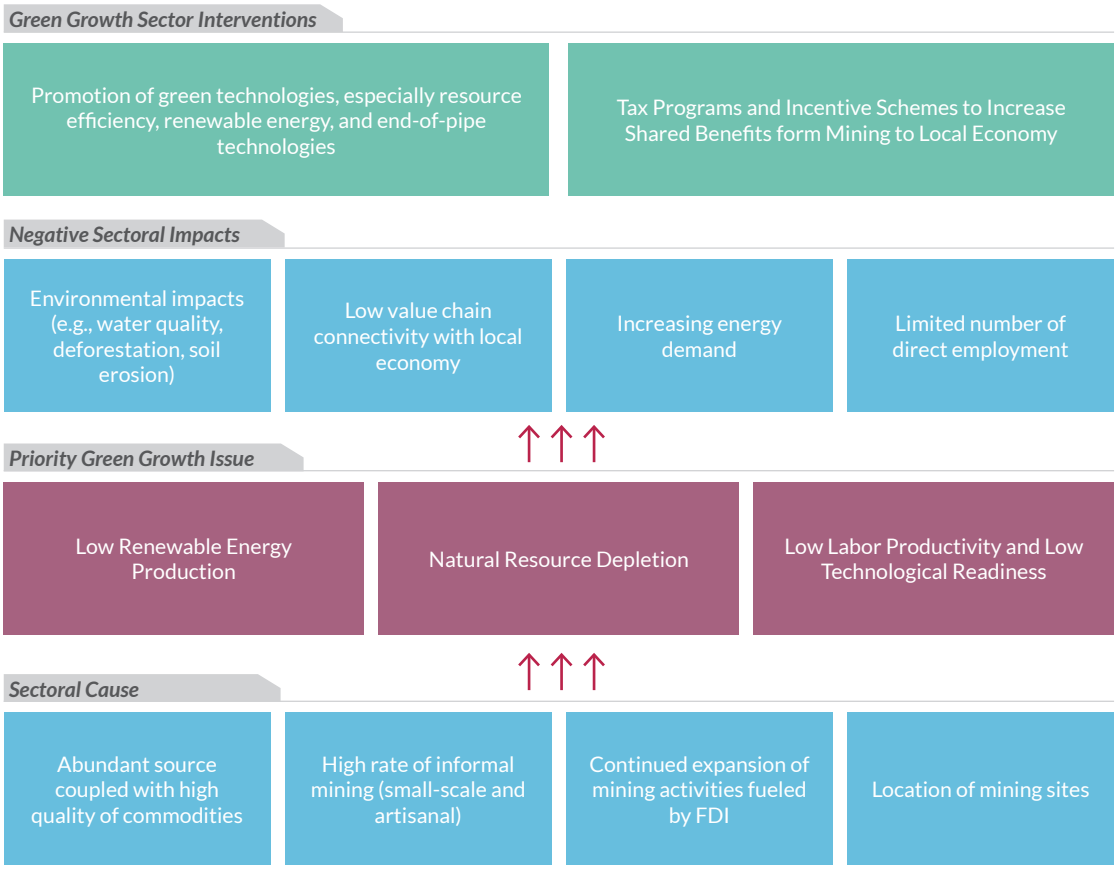


Figure 16: Problem tree analysis for the mining sector

3.2 Mining

3.2.1 Relevance of the Mining sector to the priority issues

Peru's mining sector has been one of the main drivers of economic growth in recent years. On average, it generated 58% of total exports, 16% of fiscal revenues, and 14.4% of the GDP in 2015 (KPMG 2016, OECD 2015) due to favourable commodity prices. Moreover, Peru is now a leader in FDI in South America reaching USD 7.7 billion in 2015 (+1% compared to the 3.89% of GDP in 2014). Peru is the second largest producer of silver, the sixth largest producer of gold, and holds the second largest known reserves of copper in the world (PwC 2016). The sector is very competitive due to the quality of its resources and low cost of production inputs, where labor and energy costs account for 15-25% of the total production (McKinsey 2013).

Natural Resources Depletion: Mining resources account for the highest share of natural resources depletion in Peru. However, only a small percentage of Peru's mineral reserves are actually being exploited. It is estimated that in 2013, only 0.9% of its mining territory was exploited, and based on recent statistics, Peru's production rates are minimal compared to its full mining potential (EY 2014). Hence, the issue of natural resources depletion is less about the supply of mineral resources, but more of the level and pace of exploitation that is deemed sustainable – limiting environmental and social impacts, and ensuring that resource rents are transformed into national wealth, benefitting the present and future generations.

Peru's reporting to the EITI[7] reveals that the government collected USD 5.5 billion from taxes in 2013, royalties and other fees from companies in the mining and oil and gas sector. Although, the mining sector represents one of the main sources of fiscal revenues, they have fallen by 45.5% in 2013 compared with 2012, in the face of lower commodity prices and higher costs. Studies show that Peru's national welfare and wealth accounts do not consider the depreciation of natural resources and the environmental costs (Figueroa et al. 2010). This means that the loss of natural capital is not regarded in the same way as human-made capital, and hence the true national income of mining is overestimated.

Although undeniably positive for the national trade balance, there is much controversy and debate about the impacts of large mining companies in the areas where they operate, as they provoke significant

7. See Dashboard Indicators

social, economic and environmental changes, which are not necessarily positive (Bury 2004, Bebbington and William 2008, Bebbington et al 2008). The best documented impacts of mining operations on local communities relate to how mines appropriate resources (in particular land and water), which in turn compromise livelihoods and the environment (Sosa and Zwarteveen 2012). Likewise, informal and small-scale mining in Peru leads to environmental impacts in natural resources depletion, which negatively impacts the quality of water resources, deforestation, and erosion, amongst other impacts (Medina 2012).

Mining sites are often located in the catchment areas of water sources and rivers (Bebbington and Williams 2008), which means that mining operations impact on hydrological regimes and the quantity and quality of downstream water flows. Water previously used for irrigating pastures and growing subsistence crops is now increasingly used for producing gold for export, an activity where the local gains are likely to be short-lived, in spite of the enormous contributions of the mining company to local development (Sosa and Zwarteveen 2012).

An additional externality related to natural resources depletion is the growing number of abandoned mine lands (AML). In 2014, an inventory of AML by MEM identified 8616 AMLs since 1920. MEM has estimated that more than USD 500 million will be needed for the environmental remediation caused by the AML (Loayza 2015) and set a 40-year period for final closing and identification of responsibilities, which is a difficult task as most of owners cannot be identified.

Labor Productivity and Technological Readiness: While labor productivity in Peru is the highest in the mining industry, the sector provides relatively little direct employment (209,000 people employed in 2012) (IDB 2013), and its impact on overall labor productivity in Peru is limited. The creation of indirect employment (suppliers, logistics, local service industry in mining locations, etc.) is estimated by sector to be around 9 additional jobs for each mining job; however, there is no official data on the exact number or the productivity of these jobs (IDB 2013). In a context where most of Peru's jobs are concentrated in the unproductive sectors, the mining sector represents less than 1.5% of the total employment (OECD 2015). This presents a challenge for growth-enhancing structural transformation in Peru, as high labor productivity in some sectors has created income inequalities, for example the average wage in the mining sector is 12.5 times higher than the average wage in agricultural sector (UN 2014).

The level of technology adoption in the mining industry differs largely depending on company size. While subsidiaries of large multi-national companies use the latest technologies with global standards, medium- sized firms apply mature technologies, and the small-scale and artisanal mining players are generally using obsolete technology and inflict high environmental impacts (e.g., mercury amalgamation). Due to the very specific technology and skill requirements in the mining sector, domestic R&D initiatives in the mining sector activities and spill-over effects to other sectors of the economy are rather limited (OECD 2011).

The concentrated production in the mining sector also presents severe challenges to sustainability to overcome growing social opposition in the mining sector. With the industry undertaking activities at local, regional and national levels, it will require a continuous relationship between communities and the mining sector to achieve the establishment and advancement of environmental standards, as well as the adoption of technological improvements in production and to improve environmental monitoring (OECD 2015). The high gold price, combined with poverty and the lack of employment opportunities in Peru has contributed to a boom in artisanal and small-scale gold mining in recent years. Small-scale mining activities have become increasingly important in the political agenda since 2002 – acknowledging the importance of reducing social conflicts, environmental impacts, and low competitiveness pertaining to illegal activities in this sector. There is no official data on labor productivity in the informal and artisanal mining sector.

In 2002, the government adopted a series of legislative decrees that sought to provide the necessary legal framework to promote sector formalisation. In 2015, the Presidency of the Council of Ministers (PCM) estimated that between 300,000 and 500,000 miners failed to comply with environmental, health and labor standards; in 2011 only 100,000 miners failed to comply, indicating a significant increase in non-compliance (Defensoria del Pueblo 2014).

Renewable Energy Production: Mining is a main driver of increasing energy demand in Peru. The industrial sector including mining represents 55% of total electricity consumption, and the demand for electricity generation brought by an expanding mining sector is expected to increase over the coming years (mining alone represents the 30% of the total country demand) (Mining Press 2015). The costs for energy represent between 20-40% of costs in

the mining industry[8], and most mining operations are connected to the national grid, benefitting from low electricity prices in Peru. Hence, mining companies in Peru generally do not generate their own electricity on site as it is generally supplied via the main distribution grid and also sustained with auxiliary diesel repositories. Yet, with falling costs of non-conventional renewable energy generation – especially solar energy – this is increasingly becoming an attractive option for the mining sector.

Some mining companies have already invested in mini-hydropower as an additional energy sourcing point for their operations (that could replace common diesel source points used currently). However, more information and capacity building is required to address the industry's concerns on the reliability of RE. In this context, the Ministry of Energy and Mining has initiated a platform for dialogue between the mining and renewable energy industries on the opportunities that renewable energy provides for the mining sector (Andina 2016).

3.2.2 Recommendations

Being a key pillar of Peru's economy, the mining sector can play a better role in driving green and inclusive growth by reducing the negative environmental impacts of mining operations while increasing the socioeconomic benefits from mining operations for the local economy and communities. The following recommendations are therefore given:

a) Promote Green Technologies, especially for Resource Efficiency, Renewable Energy, and End-of-pipe Technologies

The increasing energy demand for the mining sector along with the variety of environmental impacts need to be dealt with by more resource-efficient operation and use of cleaner technologies to reduce environmental externalities such as water pollution, air pollution, and abandoned mines. Technological improvements, end-of-pipe technologies, and resource efficiency reduce Natural Resources Depletion while reducing operation costs and making the sector more competitive for the future. However, the capacity of mining operations to adopt new technologies vary between large, medium, and small scale operators. For small-scale and artisanal mining, there is a need to incentivize the adoption of cleaner technologies, requiring capacity building and awareness raising. To achieve the application of best available technology, Peru should promote the development of effective partnerships with the public - private partnerships and directly focus on the promotion of recognized best practices. The technological spill-over potential from large-scale mining companies to medium and small scale firms should be explored and – where available – be promoted and incentivized. Generally, strategic partnerships between the mining industry and other sectors in the economy would also allow the identification of areas where wider technological spill-over is possible, and create benefits in terms of employment generation.

Another area where the mining sector can contribute to green growth and reducing Natural Resources Depletion is the use of RE. Capacity building and awareness will be necessary to get mining companies to replace diesel generators with onsite RE production. Regarding the distributed energy generation, a sound framework needs to be put in place to guarantee planning security for the companies.

b) Increase Shared Benefits from Mining to the Local Economy by improving tax programs and incentive schemes

The integration of local business into the mining supply chain plays a key role in the promotion of inclusive growth. Through improved tax programs and incentive schemes, local economies can benefit more from the mining industry as a driver of local economic growth. In that context, local businesses may need support in the identification and development of business plans to match their products and services with the mining sector needs. Mining royalties are an important source of income for local and regional governments in the areas where the mining takes place, and these resource rents can play a strategic role for advancing local development, if coherent spending criteria and guidelines are applied that take into account environmental and social sustainability principles. It should also ensure that natural resources extraction does not lead to a net loss in resources, but natural capital is transformed into human and physical capital. Therefore, spending capacities of local and regional governments need to be enhanced to make sure that resource rents benefit local communities and foster inclusive and sustainable growth in the regions, while at the same time reducing socio-environmental

8. The data was obtained from the Energias Renovables event in Peru, http://energiasrenovables.perueventos.org/brochure.pdf

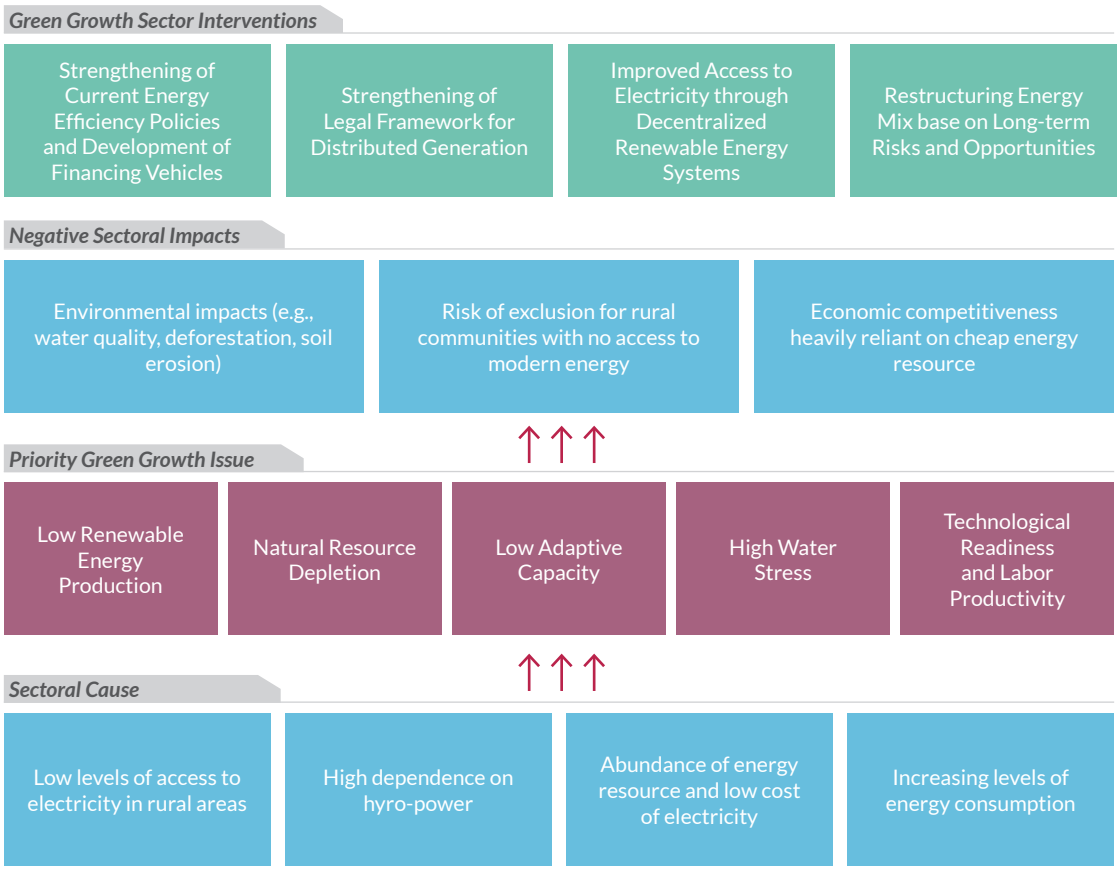


Figure 17: Problem tree analysis for the energy sector

conflicts. Capacity building programs for local governments are necessary to be able to successfully implement participatory spending procedures that benefit all players.

Regarding small-scale and artisanal mining, the promotion of Fairtrade and Fairmined actions should be promoted with an incentive program at national level for those mining operators that are formalizing their activities. This intervention addressed the priority issues of Labor Productivity by creating more business and job opportunities around the mining sector, and it deals with Natural Resources Depletion in the sense that income from natural capital loss is channeled into local development that benefits present and future generations.

3.3 Energy

3.3.1 Relevance of the Energy sector to the priority issues

Growth needs energy; energy is essential for social and economic development. Access to sustainable sources of energy will expand opportunities for the industry in advancing economic, social, and environmental goals. Thus, the challenge for Peru is to diversify its energy mix, increase resilience, and mitigate water stress and natural resources depletion.

In addition, social disparity exists in rural access to electricity and this gaps needs to be addressed as a poverty reduction strategy.

In terms of total energy use, Peru is largely dependent on fossil fuels, considering that diesel, natural gas, and natural gas liquids represent 73% of total energy sources. Transportation is the main user of energy, representing 42% of total use, depending mainly on diesel (91%) (MEM 2014). Note that Peru is currently an importer of oil and distillates, importing 85 MBD of oil and 48 MBD of diesel (MEM.b 2015). This means that Peru is not fully self-sustainable with regards to energy, especially in the area of transportation.

Regarding electricity, the installed effective capacity in Peru is 11,296 MW. The country's electricity mix is driven by the availability of water resources for hydropower and abundant natural gas resources; these two sources meet almost all national demand of electricity, covering 97% of total effective installed capacity. In the last decade, the Energy sector has registered a significant growth, parallel to the increase of GDP. In the period 2005 to 2015, the electricity production increased by 98% (MEM.b 2015). During this decade, Peru had a secure supply of energy, mainly achieved through domestic natural gas that enabled increasing electricity production and also exportation.

The total electricity consumption in Peru has almost duplicated in 10 years, from 20,204 GWh in 2003 to 38,088 GWh in 2013. While industry consumption grew by 80% and residential consumption by 46%, the notable trend was in commercial and public services sector, increasing by 584% (IEA.b 2016). Access to electricity increased from 72.9% in 2000 to 91.2% in 2012.[9] However, significant gaps exist in terms of electricity access especially in rural areas, where rural access is estimated at 78% in 2015 (MEM.c 2015), being a major bottleneck for local economic and human development. Currently, a government plan targets to achieve 99% of rural electrification by the year 2025 (MEM.c 2015). Major challenges include providing 3.3 million people with access to modern energy within 10 years, reaching inaccessible rural areas (especially those in country boundaries) with renewable energy systems, and linking to other social programs.

Natural Resources Depletion: The Energy sector is highly dependent on the exploitation of fossil fuels reserves. Peru mostly exploits natural gas, apart from some oil and very little carbon extraction. The share of fossil fuels in the electricity mix has increased from 18% on 2003 to 47% in 2013 (IEA.b 2016), mainly due to the development of the Camisea gas field, which is the largest natural gas field in Peru and one of the most important in Latin America. Camisea extracts natural gas from the Amazonian region and transports it to the Pacific coast, for internal domestic and industrial consumption and also for exportation. According to recent studies in Camisea, proven reservoir reserves amount to 11,177 billion cubic feet of dry natural gas (OSIGNERMIN 2016). Proven reserves of gas (jointly with the hydropower potential) would allow self-supply for electricity production for the next years.

However, achieving this would require significant investments in infrastructure to reach all regions in Peru and provide electricity to both households and businesses. Hence, the depletion of non-renewable energy sources in Peru is an issue of the sustainability of energy mix considering current and future economic, social, and environmental opportunities. In this sense, an increasing rate of depletion of natural gas reserves today may compromise future choices on the electricity mix, probably pushing the country toward carbon-intensive growth. The availability of low-cost electricity in Peru provides a strategic advantage in terms of economic competitiveness, especially for export-oriented sector, and has enabled economic development domestically. In the last 10 years, residential consumption has increased by 46%, from 5898 GWh in 2003 to 8595 GWh in 2013 (IEA.b 2016). This increase can be attributed to economic growth, as well as missing incentives on energy efficiency due to low energy costs. No major initiatives to enhance efficiency are in place and there is a huge untapped potential to slow down the depletion of non-renewable energy sources through greater efficiency. This is also important if CO_2 emissions are taken into account, even though natural gas is less contaminant than other fossil fuels.

Water Stress: The share of hydropower in Peru's electricity mix decreased from 81% in 2003 to 52% in 2013 (IEA.b 2016) as a result of increased natural gas exploitation. However, hydropower still constitutes a main pillar of electricity generation and provides low cost electricity for households and businesses. Peru's water resources provide an enormous untapped potential to increase hydropower capacity. Three studies, performed independently in 1979, 2011, and 2013, show that this potential is concentrated mostly in the water-rich Amazon basins, sufficient to drive economic development and future consumption. Even in the most conservative scenario, Peru could increase its hydropower generation capacity to up to 58,937 MW from its current 3,357 MW (MEM.d 2015). However, the dependency on water resources availability makes hydropower vulnerable to water stress induced by increasing water consumption in other sectors and climate change. Hence, considering the interlinkages of Water, Energy, and Food Security is key for energy planning when it comes to hydropower development in Peru. There is a high level of uncertainty regarding how climate change may affect the installed and potential hydropower capacity, and it is estimated that the country's hydropower capacity is reduced by 22% during dry season (MEM 2013). This causes an increase in costs as demand needs to be met by other sources, i.e., natural gas. This is significant in hydroelectric plants allocated in the center and south of the country, usually affected by droughts related to ENSO events ("El Niño"). While hydropower as a renewable energy source has strategic advantages in terms of GHG emissions, the negative social and environmental impacts can be significant, as most hydropower plants in Peru are large-scale and storage type plants. These impacts therefore need to be considered when assessing costs and benefits.

Renewable Energy Production: Considering the estimated potential from wind energy, solar energy, geothermal energy and biomass, Peru has an exploitable potential of 25.5 GW, twice the total actual installed capacity (MEM.b 2015). However, the low price of electricity due to the availability of natural gas and large-scale hydropower has so

9. See Dashboard Indicators

far been an obstacle for the market entry of non-conventional renewables without government subsidies. Hence, the uptake of RE in Peru is largely due to the government's goal of achieving up to 5% of generation[10] from non-conventional RE (not including hydropower plants). In 2015, RE reached 4.4% of the electricity mix, but small-scale hydropower (<20MW) represented 52% of the contribution (MEM.b 2015). To achieve this goal, the government had established auctions, aiming to allocate defined amounts of RE into the system with a fix price for the generators. The additional price of electricity is paid by the users, which brings different opinions on the need of this process. However, for long-term energy security and environmental sustainability, it is important to develop a sustainable and diverse energy mix with less CO_2 emissions. Despite abundant energy sources, low costs and a widely interconnected electricity grid, there are still important gaps in access to electricity especially in rural areas. This demonstrates that the recent energy policy favoring large-scale centralized electricity systems based almost exclusively on cost considerations has been lagging behind in achieving pro-poor impacts. The decentralized non-conventional renewable energy sources bear a huge potential to achieve rural electrification, where access through the interconnected system is not economically viable. Currently, solar power is the most widely used technology for this purpose, as the only off-grid RE tender developed in Peru (2014) is fully dependent on photovoltaic energy.

Adaptive Capacity: Despite the fact that the energy sector is not among the five priority sectors for adaptation identified in Peru's INDC, sector representatives indicated that Adaptive Capacity to climate change was an important issue to the sector. Indeed, climate change impacts on water resources availability will have direct implications on energy generation, potentially limiting the capacity of existing hydropower plants and increasing competition with other uses, as well as limiting the potential hydropower capacity in other basins. A diversified electricity mix can be considered a viable strategy to increase resilience of the energy sector. Providing access to basic infrastructure such as electricity is a key determinant of adaptive capacity of communities, and considering that the most vulnerable groups still lack access in Peru, rural electrification is closely linked to climate resilience.

Technological Readiness and Labor Productivity: Enhancing energy efficiency, promoting the uptake of RE and increasing rural electrification will depend on the readiness of the Peruvian energy sector to adopt new technologies. Technology adoption is not only fundamental in tackling the priority issues discussed above, but also creates an environment for new business opportunities and jobs. This in turn would also significantly contribute to enhancing the Labor Productivity in the Energy sector.

3.3.2 Recommendations

The energy sector has the potential to address many of Peru's priority green growth issues, including natural resource depletion, water stress, adaptive capacity, and renewable energy production. Besides, the issues of technological readiness and labor productivity are pivotal for the energy sector to be a driver of green growth in Peru. Four concrete green growth interventions are proposed in order to address these issues:

a) Enhance Long-term Energy Planning and Diversification

It is recommended to apply an energy planning framework that creates consensus on and shapes the national electricity mix in the long term beyond the current period up to 2025. Building on the existing policies and plans in the energy sector, such a planning framework shall systematically assess the long-term risks and opportunities of the different electricity sources based on multiple criteria and alternative scenarios. Besides cost and supply security, GHG emissions levels, climate resilience and the environmental and social externalities are paramount considerations. It is also recommended to directly link the domestic climate change mitigation objectives and international commitments to national energy planning, establishing concrete targets and indicators for the energy sector. Among others, further diversification of electricity mix should take into account the role of natural gas in the medium and long term given resource stocks, the current exploitation rate and export levels (and address current controversy over natural gas exports), the role of hydropower in light of increasing competition for water and climate change impacts on water resources, and the role of unconventional renewable energy sources as a strategic pillar in the electricity mix, also beyond the currently targeted share of 5%.

10. This goal is as stated in DL N° 1002 Decreto Legislativo de promoción de la inversión para la generación de electricidad con el uso de energías renovables, http://www2.osinerg.gob.pe/EnergiasRenovables/contenido/Normas/DL_No_1002.pdf

b) *Strengthen the Legal Framework for Distributed Generation*

To make alternative RE systems more attractive, a further analysis of the different options for distributed generation will be crucial. While the current auction system has been an effective way to get alternative RE developed in Peru, a long-term policy with clear objectives (instead of the 5% rolling goal and auctions that need to be commissioned by the GoP) and incentives framework would encourage companies and investors to further invest in renewable energy projects in Peru. Such a framework should include clear rules for Independent Power Producers as well as a clear framework for grid access with reasonable and predictable costs and procedures for interconnection. This could, on the one hand, be used to encourage private companies, for example in the mining sector to invest in on-site renewable energy, as well as serve as a signal for manufacturers to develop local production, leading to an enhanced competitiveness, and creation of green jobs.

c) *Strengthen Current Energy Efficiency Policies and Development of Financing Vehicles*

Energy efficiency is the most cost efficient way to address potential challenges in energy security, while at the same time reducing CO_2 emissions and saving costs. While MINAM is implementing a wide range of energy efficiency measures, and awareness raising programs, the energy efficiency potential in industry and households is currently untapped. The IFC has estimated the potential for EE investment at around USD 1,000 million, a significant market that could spur economic growth and create new jobs. Local actors do not have enough capacities and information to implement sound energy efficiency measures and there are no ESCOs (Energy Service Companies) that could potentially help industrial companies to reduce their energy consumption (IFC 2011). Building on the existing programs and plans, the GoP should define energy efficiency targets and policies with clearly associated programs to foster green growth, as well as to further increase skills and strengthen the market for energy efficiency services. The creation of ESCOs could be promoted by addressing the existing financial and legal barriers for the establishment and operation of ESCOs, including the standardization of performance contracts and the integration of ESCOs in public infrastructure investments to support the model and stimulate the market for EE services. At the same time, it will be necessary to develop financing vehicles (either through government programs or with financial institutions) that provide incentives for reducing energy consumption and stimulate the EE market. The financial ecosystem for energy efficiency is currently at a very early stage. The capacities of National Development Banks to promote energy efficiency financing should be strengthened, and products that can be offered by private financial institutions should be developed.

d) *Improve Access to Electricity through Decentralized Renewable Energy Systems*

Providing affordable and reliable access to clean electricity to households and businesses is a key component of green and inclusive growth. Building on existing plans and programs, the GoP shall maximize its efforts to provide electricity access in rural areas. Since the expansion of the national electricity grid has now reached its limits in terms of economic and technical viability, further actions to electrify rural areas will need to build on decentralized systems, making use of renewable energy sources. As most communities without electricity access today are remotely located and have very few households, providing access to electricity involves a significantly higher cost per user than in urban areas that are connected to the national grid. This should be taken into account when evaluating the feasibility of RE options for rural electrification in specific communities, and the direct and indirect benefits of off-grid RE systems shall be systematically assessed beyond a mere cost-per-user calculation, including the benefits for climate change mitigation and adaptation as well as the benefits for well-being as a result of access to basic services such as electricity.

In order to select the best available technology for each specific area, an in-depth country-wide assessment is required. Productive uses of electricity are being considered only recently in rural electrification programs, and pilot projects are just being initiated. Providing electricity for productive uses in rural areas bears great potential for increasing the productivity of local rural economies and can help transform local value chains. In that way, local communities can increase their resilience to climate change. It is hence recommended to scale-up projects for productive electricity use in rural areas, in synergy

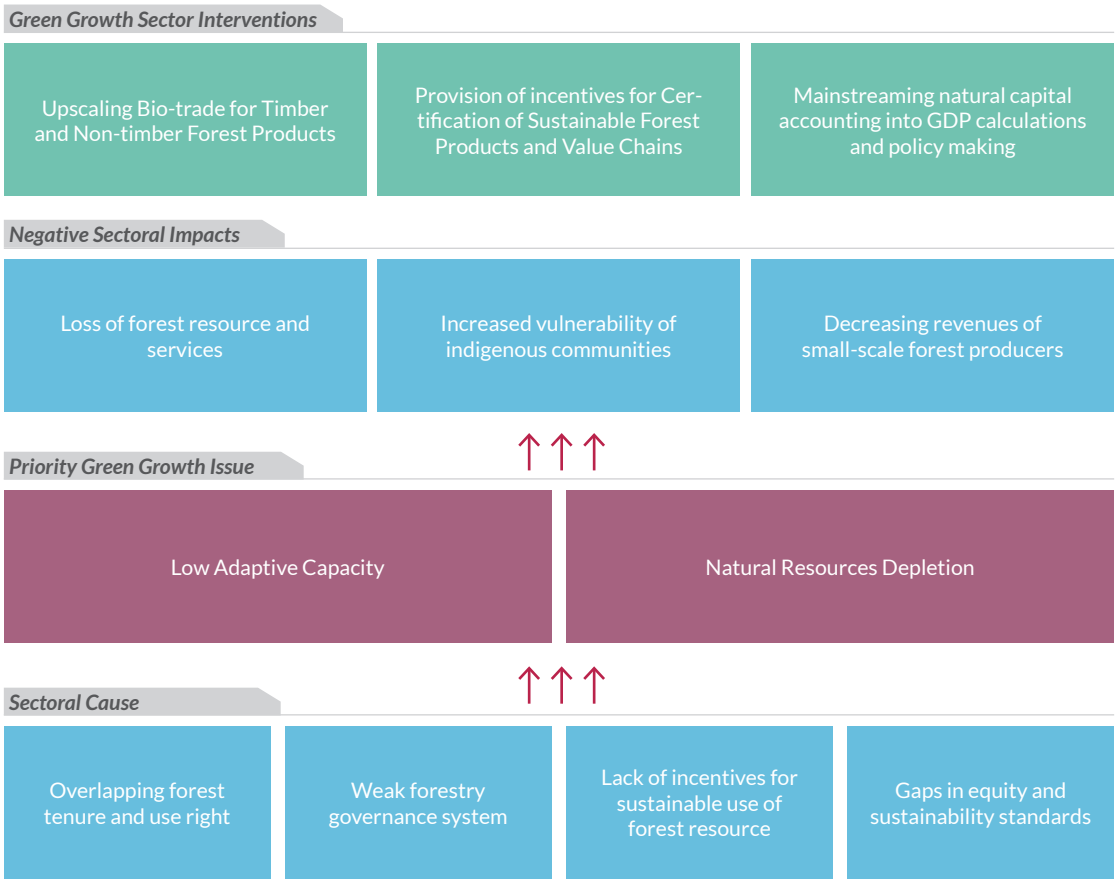


Figure 18: Problem tree analysis for the forestry sector

with the Agriculture sector. At the same time, it is necessary to develop the technical skills on the installation and maintenance of decentralized RE systems in rural areas. This will again lead to new jobs in areas where economic development is mostly based on agriculture.

3.4 Forestry

3.4.1 Relevance of the Forestry sector to the priority issues

Peru has the fifth highest global percentage of primary forest coverage (4%), in relation to the total national territory, which equates to the second largest forest extension (67.8 million ha) in Latin America occupying more than half of the total land area in Peru (53%) (FAO 2010). Peru's forests contribute enormously to the country's biodiversity, which has a fairly high potential of 33.36, according to the GEF Benefits Index for Biodiversity.[11]

However, the Forest Investment Program reveals that forest-related activities account for no more than 1% of the country's GDP (CIF 2016). This is markedly lower than Peru's neighbouring countries like Chile, where forestry accounts for around 3% of GDP. The Peruvian forests constitute a natural wealth that is not yet contributing in any significant economic form to the country's development. Therefore, Peru could be seen as a country of forests, but does not define itself as a "forest country" (Bosques 2015).

Natural Resources Depletion: Between 2001 and 2013, Peru lost 1.5 million ha of Amazonian forest, and the forest coverage decreased from 55% in 2000 to 53% in 2013 (SPDA 2016). Despite the fact that net forest depletion[12] in Peru is reported to be 0, the loss of forest resources is of high priority, not least due to the large number of high revenue products extracted: amarillo, hualtaco, and algarroba (cut for railway ties and for charcoal fuel); cedar, mahogany, moena, tornillo, and congona (broadleaf hardwoods); rubber (wild and plantation), and leche caspi (a chewing-gum base); as well as tagua nuts, balata, coca, fibers, and a wide range of medicinal plants (Nations Encyclopedia 2016). Peru, up to and including 2014, had 40,810 ha of forest plantations, with exportations of USD 395 million/yr and employed 500 workers (ITTO 2015). This is however, well behind its neighbors Ecuador (250,000 ha) and Chile (2.1 million ha, USD 4,000 million/yr

11. See Dashboard Indicators
12. Net forest depletion defined as: the product of unit resource rents and the excess of roundwood harvest over natural growth, as a

with 250,000 employees). Peru is the only country in Latin America that has not developed efficient and competitive forestry plantations (MINAGRI 2014). As a matter of fact, the loss of forest resources in Peru is mainly associated with unsustainable management practices beyond commercial forest plantations, such as poor management of new development (roads; new settlements; expansion of the agricultural frontier; hydrocarbon exploitation and mining), as well as unsustainable management of the demographic, economic, political, and institutional/legal issues. The institutional and legal drivers for the loss of forest resources are based on weak enforcement and implementation of existing laws, and the unregulated tenure and land rights. Against this background, it is also evident that the Forestry sector lacks adequate natural accounting practices that capture the value (and depletion) of forests resources in a broader sense. There is, however, vast potential to develop the value of Peru's forests through the promotion of mechanisms such as certification schemes for sustainable forestry products; upscaling BioTrade programmes; mainstreaming natural capital accounting, as well as carbon markets related to REDD+. These mechanisms can generate incentives for the conservation and sustainable use of forests, but it is crucial to include smallholders and local communities in these initiatives.

Adaptive Capacity: Peru's INDC includes Forestry as one of five priority sectors for climate change adaptation. It highlights that the most vulnerable groups requiring adaptation action are the small forest producers. According to the INDC, the scope of climate change adaptation in the Forestry sector needs to focus on protecting forest ecosystem services, including indigenous communities and the small forest producers.

The Peruvian forests provide services supporting livelihoods and well-being with services such as: soil erosion prevention; carbon capture; water treatment and retention, and pollination and pest management functions that are usually not captured by the market. These and many other services have been estimated to provide as much as USD 406 per ha in tropical forests in Latin America (FAO 2010). There are initiatives that can access the economic value of these ecosystem services, however there still remains immense potential for growth based on Peru´s forest resources (GGGI and DIE 2014). However, the current development policies are likely to drive further deforestation and natural resource depletion due to supporting road infrastructure to expand the transport network into rural areas in the Amazon, making previously inaccessible areas accessible (CIFOR 2014). Therefore, the adaptation process should promote comprehensive land management with a landscape approach, oriented to increase forest resilience to climate change, and to reduce the vulnerability of the local population.
Forest revenue problems can be corrected by better forest pricing policies for timber and forest concessions (certification of sustainable forest products), coupled with improved forest fee design (natural capital accounting), collection and enforcement, and correct implementation of REDD+ and Payment for Ecosystem Services schemes (OECD 2009). In addition, the Biotrade programs, if scaled up, can provide important adaptive capacity to climate change as the 27 BioTrade[13] initiatives that have so far participated in the National BioTrade Promotion Program (NBPP) in Peru, have reported sales of USD 5.725 million in 2010, accounting for 0.2% of GDP for total export (Riviera and Mayer 2008).

Regarding REDD+[14], Peru has many forest carbon projects under development and several REDD+ projects are active within the voluntary carbon market. However, the problems plaguing concessions has in fact opened up the sector to less sustainable forest exploitation. Although REDD+ has strong support within some sectors of the Peruvian government and civil society, it is currently facing major challenges in the implementation phase due to the lack of both coordination and inter-sectoral support for socioeconomic development that encourages conservation and mitigation of deforestation and degradation.

3.4.2 Recommendations

In order to tackle the identified green growth priority issues related to Natural Resources Depletion and Adaptive Capacity, a set of interventions are proposed:

a) Provide Incentives for Certification of Sustainable Forest Products and Value Chains

Certification schemes promote transparency and traceability regarding the origin and value chain of forest products, including sustainable forest management practices and compliance with the regulations and environmental and social standards. Although important progress

13. Biotrade is defined as the activities of collection, production, transformation, and commercialisation of goods and services derived from native biodiversity under the criteria of environmental, social and economic sustainability
14. Reducing Emissions from Deforestation and Forest Degradation (REDD+) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and to invest in low-carbon pathways for sustainable development and green growth.

has been made in increasing certification (such as the FSC scheme), the persistence of illegal logging reveals gaps in the effectiveness of incentives for logging practices, including certification schemes. According to the Environmental Investigation Agency (EIA), between January 2008 and May 2010, more than 35% of all timber shipments that left Peru were illegal (EIA 2012). To address this, new incentives for concessions and certifications of sustainable forest (timber and non-timber) products should be designed, developed, and promoted. These mechanisms should include ownership titles and involve local communities in the formulation of these concessions. To reduce illegal logging, additional incentives for plantation development need to be analyzed and put in place apart from concessions in natural forest areas. This needs to be accompanied by strict compliance control through audits and inspections. Therefore, the capacities of local authorities need to be strengthened. Increasing the volume of certified exports with high quality standards and transparency has the potential to position Peru internationally as a trusted country of origin for sustainable timber and non-timber products, which in turn would create new business and job opportunities, including industries that add value to raw materials domestically. Promoting environmentally and socially responsible trade can help address extreme poverty in the Amazon region and contribute to inclusive economic development that benefits the most vulnerable communities. The intervention addresses the priority issue of Natural Resources Depletion by promoting sustainable resources management practices, and increased Labor Productivity by promoting new business opportunities and markets in the Forestry sector.

b) *Mainstream Natural Capital Accounting into GDP Calculation and Policy Making*

The relatively low contribution of the Forestry sector to the national gross domestic product is partly due to low productivity of commercial exploitation of forest products. At the same time, however, the GDP only takes a narrow perspective on timber and non-timber products and does not reflect the real economic value that forests generate, including ecosystem services such as carbon capture, water source protection, recreation, soil erosion prevention, shade and pollination for crops. Hence, despite the huge forest area in Peru, its economic value is underestimated, and promoting investments in sustainable forest management and forest conservation therefore has received relatively low priority in economic policy making. Therefore, it is recommended that official economic accounting incorporates natural capital and ecosystem services that forests provide to the national economy. Natural capital accounting in the Forestry sector would further enable to account for natural capital loss that is driven by other sectors and development processes, including infrastructure development, agricultural expansion, and urbanization. MINAM has already developed a guidance document on implementing Satellite Environmental Accounts, which, together with programs such as the WAVES partnership, can serve as a basis for wider application and policy mainstreaming. This intervention addresses natural resources depletion by informing policymakers and other stakeholders of the value that forest ecosystems contribute to national wealth, and could leverage prioritization of the forestry sector in decision making. Ideally, this would generate more national and international financing for sustainable forest management and conservation in Peru, including payment for ecosystem services schemes.

c) *Scale up BioTrade Programs*

Peru is one of the most bio-diverse countries in the world. BioTrade (excluding cochineal) currently only represents 0.3% of total exports, but is considered to have huge growth potential, so that the industry could contribute almost 2% to the country's total exports by 2020 (Riviera and Mayer 2008). Considering this, BioTrade has the potential to attract local and foreign investments. In order to realize this, existing programs and initiatives supporting biodiversity-based business opportunities need to be scaled up, by actively promoting investment in biodiversity-based products and services and promoting BioTrade in the international trade fora and by improving market access, fiscal incentives, and access to financing for producers and SMEs. Considering that the biodiversity-based products are mainly generated in the rural areas of Peru, promoting BioTrade directly contributes to not only environmentally sound production, but also to inclusive economic development based on pro-poor value chains, thereby increasing the resilience of the rural and indigenous communities, which are among the most vulnerable groups of the population.

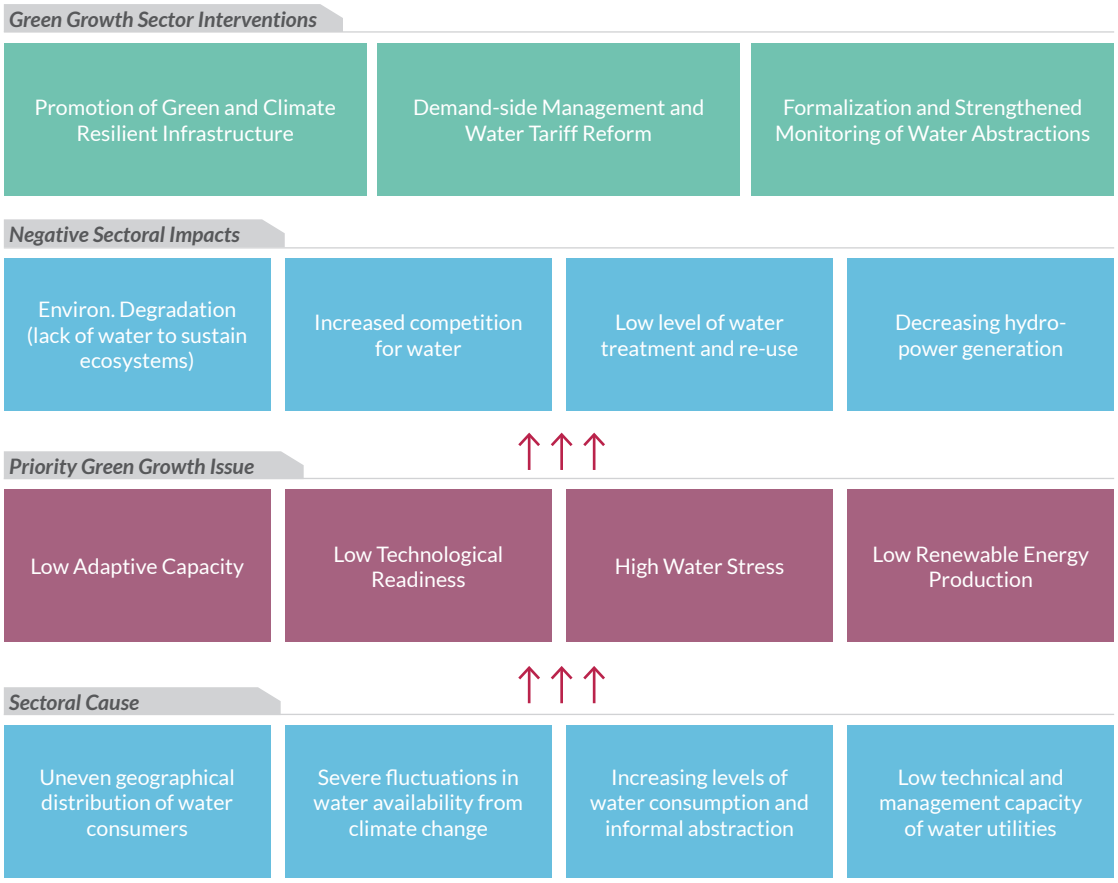


Figure 19: Problem tree analysis for the water sector

d) *Improve Implementation of REDD+*

Although REDD+ has strong support within some sectors of the Peruvian government and civil society, it is currently facing major challenges in the implementation phase due to the lack of both coordination and inter-sectorial support for socioeconomic development that encourages conservation and slowing of deforestation and degradation. Weak governance and conflicts of interest between local communities and logging companies are threats to effective, efficient, and equitable long-term implementation of REDD+ in Peru. In terms of carbon finance value, between 2007 and 2014, Peru's forests had a value of USD 112 million in the voluntary carbon markets (Forest Trends 2015). However, in 2009, the World Bank estimated that Peru's greenhouse gas emissions from forests amounted to 56 million tons (41% of its total emissions). In the voluntary market, the mitigation of these emissions would be worth USD 330 million. Improved REDD+ coordination between government, civil society, and the private sector together with inter-sectoral support for socioeconomic development that encourages forest conservation will move towards an improved implementation of the REDD+ program in Peru, providing a strong green growth strategy with a major source of revenue with positive social impacts.

3.5 Water and Sanitation

3.5.1 Relevance of the Water and Sanitation sector to the priority issues

As a critical commodity for economic growth and a public good that supports all life systems, the importance of water cannot be overstated. In the last decade, renewable freshwater resources per capita in Peru decreased by 13%, from 61,688m^3 in 2002 to 53,688m^3 in 2013[15], mainly due to high population growth rate, urbanization, and economic development. The nation has made important progress in improving public access to sanitation services, from 64.9% in 2002 to 73.1% in 2012[16]; this was accompanied by continued increase in access to improved water sources, from 80.9% in 2002 to 85.5% in 2012.[17] Still, access levels are among the lowest in Latin America (WHO and UNICEF 2014).

15. See Dashboard Indicators
16. Ibid
17. Ibid

In addition to further improving access to basic water services, ensuring availability and quality – items made explicit in the SDG and INDC – come as important priorities for Peru's water sector.

Water Stress: While being a water-rich country, the distribution of water resources in Peru is highly uneven. This significant asymmetry between supply and demand for water poses challenges in water management: 2% of total water sources have to satisfy the demand of 63% of the total national population and 80% of national production located in the coastal region (ANA and WWF 2015). Climate change impacts are likely to further aggravate water stress, through seasonal rainfall variations in the Andean mountains, which are the main source of freshwater.

Water management in Peru is thus tasked with matching the increasing demand for water with the available resources, and managing the potentially competing water uses. This includes consumptive uses mainly from agriculture (80% of total consumption), households (9%), industry and mining (2%), non-consumptive mainly by hydropower plants.[18] Water efficiency is relatively low in Peru – agriculture is around 30% (MINAGRI 2016), and 64% in water supply (SUNASS 2015) – aggravating water stress and competition, and at the same time bearing a high potential for alleviating water stress though increasing the performance.

Wastewater treatment and re-use is still an important gap. In urban areas, 12% of total wastewater effluent is not going to any wastewater treatment plant, polluting water sources for downstream users. In addition, 50% of total wastewater treatment plants in operation are actually overcharged, and basic treatment technology (stabilization ponds) is used in 75% of treatment plants (SUNASS and GIZ 2015). This situation poses limits to water re-use, as better water quality is needed for irrigation purposes. In the case of Lima, for example, only 5% of the treated wastewater is being re-used for irrigation.

The water and sanitation sector is key for ensuring water-, energy- and food security as a prerequisite of economic development and human wellbeing. Addressing the issue of water stress is hence of utmost priority for water to act as driver, instead of bottleneck, of growth.

Adaptive Capacity: Access to basic services – including safe water and sanitation – is a key determinant of the adaptive capacity of communities. The water sector's mandate to provide these services puts it at the core of climate change adaptation action, considering that around 10 million people in Peru do not have access to sanitation and almost 4 million do not have access to safe drinking water (60% in Amazonian and 50% in Andean regions). Peru's INDC identifies the water sector as one of five priority sectors for climate change adaptation, and explicitly recognizes the implications of climate change impacts on water resources for other sectors – the water sector has hence a cross-cutting role in ensuring the economy's resilience to climate change. The INDC's objective is to encourage and promote actions and projects that increase the availability of water in the context of climate change.

However, uncertainties remain regarding the short- and long-term effects of climate change on precipitation patterns and the occurrence of droughts and floods, the resilience of existing water infrastructure, as well as the consequences for water-dependent sectors. There is a need for improving the knowledge base on the impacts of climate change on the hydrological regime at the national level, e.g., through expanding hydro-meteorological monitoring. Also, enhancing public understanding and consciousness on the needs for adaptation is critical in Peru, as climate change is a gradual process, and long-term impacts may not be witnessed as such.

In light of global climate change, the melting of glaciers and vulnerability to droughts make it imperative to explore alternative water sources. Desalination in Peru is a viable alternative especially for industrial purposes, especially mining companies. Research in low-cost desalination technologies is a strategic opportunity, as the most important urban areas in Peru are located very close to the sea. Besides, water re-use is a promising alternative water source in Peru.

Renewable Energy Production: Water is a strategic resource for Peru's electricity production. The share of hydropower in the electricity mix is large (51.5% in 2013) (IEA.b 2016), and the untapped potential remains high, including for small-scale hydropower plants (under 20MW capacity). As Peru's entire electricity network is interconnected, any potential basin can supply the increasing demand on the national level. Although being a non-consumptive water user, hydropower plants nevertheless face competition with other water users; also an increasing challenge for hydropower projects is compliance with ecological river flows, as introduced by the National Water Authority. Besides, climate

18. Detailed information can be found in Plan Nacional de Recursos Hídricos – Resumen Ejecutivo, ANA, accessed May 4 2016. http://www.ana.gob.pe/sites/default/files/archivos/paginas/a_resumen_ejecutivo_parte_2_0_0.pdf

change impacts on river flows can have a direct impact on the hydropower generation capacity. In addition, the water and sanitation sector is also a potential source of electricity through renewable energy from biomass in wastewater treatment plants, which is currently explored in a pilot case.

Technological Readiness and Labor Productivity: The water and sanitation sector is one of the many sectors that is accountable for the nation's low levels of technological readiness and labor productivity. In urban areas – where local authorities run water utilities – the capacity for renewing infrastructure and for improving water and wastewater treatment is low. The limited income from water tariffs and charges cover only operational and maintenance costs, but not investment costs and ecosystem services. The adoption of better technology could increase the utilities' productivity and service quality significantly, by identifying and reducing water losses (by 2014, 36% of total water produced in water utilities is lost in waterworks and wrong billing (SUNASS 2015)) and by improving water and wastewater treatment efficiency (utilities only treat 45% of total wastewater) (SUNASS and GIZ 2015). Of course, quality of labor is an important strategic pivot for the water sector in making such technological advancements; availability of technology is often not the major concern, but it is the capacity to identify and apply the right technology. Finding qualified technical and managerial staff is challenging, especially outside the urban areas, and this affects the quality of service by water utilities. Looking beyond the water sector performance itself and its importance for green growth, technology transfer and its adoption in Peru's water and sanitation sector has the potential to create new business opportunities and markets, and new jobs.

3.5.2 Recommendations

The water and sanitation sector thus has the potential to address many of Peru's priority green growth issues, including water stress, adaptive capacity, and renewable energy production (to a lesser extent). Besides, the issues of technological readiness and labor productivity are pivotal for the water and sanitation sector to be a driver of green growth in Peru. Three concrete green growth interventions in the water and sanitation sector are thus proposed:

a) Revise Water Tariffs and Charges

The aim of a water tariff revision is to incorporate not only the costs for operation and management of water and sanitation infrastructure, but also fully consider investment costs and compensate for ecosystem services (e.g., contributing to water funds). Furthermore, in the case of groundwater use, abstraction charges need to reflect the resource scarcity in the coastal region, and to cover costs for groundwater control and management. A well-designed water tariff system in Peru has to be pro-poor and ensure affordable access to water and sanitation services (e.g., through means-tested social tariffs). As the poorest areas often lack access to water and sanitation infrastructure in the first place, pro-poor measures should focus on those communities that depend heavily on informal distribution methods.

As in many regions of the world, the price of water is a highly sensitive political issue in Peru, with market mechanisms in the water sector being widely perceived with suspicion, and misconceptions prevailing on the real costs of water. The willingness to pay for water is also strongly related to the perceived infrastructure and service quality by water users. Ensuring tariff transparency and creating public awareness on the water tariffs system is key in this regard. Cooperation between the relevant sector authorities and a broad political backing are required for a successful water tariff reform. Taking water tariffs on the national green growth agenda can create such an enabling environment.

Setting economic incentives through tariffs and charges to promote efficient water use and water savings is an important demand side measure to reduce pressure on heavily demanded and scarce water resources, hence alleviating water stress. Besides the demand side effect on water consumption, tariffs and charges fulfill a crucial function to ensure the quality and sustainability of water supply and sanitation services, and are therefore contribute to the country's capacity to adapt to climate change.

b) Prioritize Investments in Green Water Infrastructure and Ecosystem Services

Intact ecosystems such as wetlands and forests provide vital benefits as "natural" or "green" infrastructure regulating water quantity and quality, and are often a viable low-cost and resilient alternative to traditional "grey" infrastructure. Increasingly, payment for ecosystem services (PES) schemes have been introduced to finance investments in green

infrastructure, and water funds have been set up in recent years in several Latin American countries including Mexico, Colombia, Ecuador, and Peru.

In Peru, several initiatives to protect water-related ecosystem services have been implemented to secure water availability and quality at the watershed level, most of them with support from non-governmental organizations and international cooperation agencies. The largest fund is the "Aquafondo" for the Lima and Callao metropolitan region. These pilots demonstrate that the costs for green infrastructure can be considerably lower than for grey infrastructure, and generate a wide range of co-benefits, for agricultural production, recreational value of intact ecosystems, and easing social conflict. Therefore, scaling up green water infrastructure through water funds bears a great potential for Peru, building on good practices and lessons drawn from the already existing interventions. Formalizing cooperation with the Agriculture, Energy, and Finance Ministries will be crucial for scaling up green infrastructure projects. Further, there is a need to more clearly define the statutes of the water funds and functions of the management committee, including the roles and responsibilities of the involved actors; and the need to diversify income beyond water tariff, such as private sector water users, international cooperation funds, and gaining interests from reserve funds (CIAT 2015). Upstream watershed conservation financed through water funds aims at securing water availability and enhancing resilience of water-related ecosystems. Hence, a wide application of the intervention has the potential to significantly reduce water stress and enhance the capacity to adapt to climate change in the water sector.

c) Develop and Implement a Water Re-use Strategy

Increasing water re-use is especially relevant in Peru's coastal area, where water resources are scarce, while demand keeps increasing. Population growth in the urban areas will require a larger share of water for domestic supply, which in turn decreases available water for other uses such as agriculture and industry. Re-using treated domestic (and to a lesser extent industrial) wastewater for irrigation in agriculture and green areas, for reforestation or for industrial use is therefore a promising way of tackling water scarcity and competition.

Led by the Ministry of Housing, Construction and Sanitation, the government of Peru has set up an inter-sectorial working group on water re-use that includes ANA, SUNASS and the Ministries for Environment and Health. Also, legislation has been adopted that enables water utilities to sell treated wastewater for irrigation. However, the actual level of re-use is still very low. Key elements of a strategy to increase water re-use are to provide guidance on good practices for irrigators on wastewater use; to strengthen the cooperation between users and the water utilities, and to develop procedural and technical guidance for water re-use projects and agreements; and to consider water-reuse more strongly as a factor for prioritization of infrastructure projects to be funded by public means.

The intervention addresses the priority issue of Water Stress, which will be key to enable further economic development, especially along the Peruvian coast, where most of the country's economic activity is concentrated. Given the high importance for technology adoption and technical capacity of labor, increasing water re-use is a strategic intervention that can generate wider business opportunities and create employment.

Acknowledging ongoing efforts by the Peruvian government related to environmentally sound and socially inclusive development, the recommendations given in this GGPA report have the potential for Peru to embark its national development onto a green growth trajectory, boosting resource efficiency, conserving environmental assets, and increasing climate resilience. By harnessing the identified green growth potential in the Agriculture, Mining, Energy, Forestry, Water – and potentially other important sectors such as the Manufacturing, Construction and Agro-Industries – the triple challenge that Peru is facing can be addressed. It is recommended that a national strategy on green growth shall build on (and complement) these recommendations, including a mix of regulatory, marked-based and voluntary policy approaches. The importance of combining and making best use of different types of policy approaches was confirmed by stakeholders during the validation workshop, giving some preference to market-based mechanisms over the other two types of policy instruments.

Peru's National Green Growth Strategy should prioritize and adopt policy interventions that have a high impact on the country's performance in the identified priority issues, and pursue to:

1. Move up global value chains, and shift towards a knowledge economy
2. Safeguard and capitalize the enormous value of ecosystem services
3. Increase economic productivity and climate resilience through innovation, technology and human capital development

These goals are in line with existing ambitions of Peru, both based on national interests and international commitments. Indeed, the institutional set-up and the policy framework in place are sound in many respects. Yet, across all five sectors featured in the assessment, a common challenge exists in terms of implementation, including the effectiveness of cross-sectoral and multi-level coordination and the available resources. Also, gaps can be identified in terms of communicating the existing efforts adequately, like other countries that have managed to position themselves as "Green Growth countries" and create a brand around their GG and sustainability activities.

Hence, a national strategy on green growth shall create a common vision on Peru's green growth model, integrate the main policy objectives from across sectors, and operationalize and monitor the implementation and achievement of the Peru's green growth objectives, and clearly communicate and raise awareness both domestically as well as internationally.

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Annex A. Validation Workshop - Summary

The validation workshop was held on the 4th of February at the Hilton Hotel in Lima, Peru. A total of 39 key stakeholders mainly representing the Government of Peru participated in the workshop. The objective of this workshop was to validate the results of the desktop research preliminary assessment and to gain an appreciation of the key stakeholders understanding of green growth and where Peru should focus its efforts to achieve green growth. The Preliminary Assessment highlighted 11 main issues to be prioritised and analysed. The results of the preliminary assessment were presented to the key stakeholders where they were asked to subsequently vote on a number of survey questions in the form of an adapted Delphi method. Following the first round of survey results, the stakeholders broke out into 4 groups, where the results were presented to the group and active discussions were facilitated. After the break-out session, the stakeholders were once again asked to vote on the exact same questions in the second round survey, where a consensus was sought.

Based on the workshop results the following 6 priority issues were highlighted:

Resource-Efficient Growth	Eco-Friendly Growth	Climate-Resilient Growth
1. Technological Readiness	3. Natural Resources Depletion	5. Adaptive Capacity
2. Labor Productivity	4. Water Stress	6. Renewable Energy Production

Accordingly, the following sectors were prioritized: Agriculture; Mining Industries; Energy generation and supply; Water and Sanitation; Forestry and Land-use. Finally, the preliminary assessment and the key issues prioritised by the key stakeholders were validated with only two issues being picked up by the key stakeholders that were not highlighted in the preliminary assessment. The results of Phase 1 and the workshop will now feed into Phase 3 of the GGPA process.

Annex B. List of Participants in Validation Workshop (Phase 2)

#	First Name	Surname	Institution	Sector
1	Amalia	Cuba Salerno	Consultant	Private
2	Natalia	Alayza	Consultant	Private
3	Carlos	Azurín	CNC	Public, Competitiveness
4	Jose Manuel	Sandoval GGGI	GGGI Colombia	International
5	Lucetty	Ullilen	SERFOR	Public, Forestry and Biodiversity
6	Laura	García Villegas	MINAM	Public, Environment
7	Rosa María	Del Castillo	PRODUCE	Public, Industry
8	Nancy	Zapata Rondón	MEF	Public, Economy
9	Roberto	Prieto	MVCS	Public, Building, Housing, Sanitation
10	Lourdes	Fernández	PRODUCE	Public, Industry
11	Sandra	Bazán Velasquez	MTC	Public, Transport and telecommunications
12	Yveth	Villanueva	MINAM	Public, Environment
13	Patricia	Concha Flores	AUSEJO CONSULTING	Private
14	Rafael	González	MTPE	Public, Labor
15	Duilia	Mau Torres	PRODUCE	Public, Industry
16	Maria del Carmen	Antayhua Ortiz	MINAGRI (DGPA)	Public, Agriculture
17	Rudy	Valdivia Pacheco	SERNANP	Public, Forestry and Biodiversity
18	Carlos	Maldonado	MVCS	Public, Building, Housing, Sanitation
19	Claudia	Tirado Pérez	MRE	Public, International Affairs
20	Richard	Alca	PRODUCE	Public, Industry
21	Ivan	Valentino	MEF	Public, Economy
22	Lourdes	Alvarez	PRODUCE	Public, Industry
23	Jaime	Cabrera	MINAM	Public, Environment
24	Jose Luis	Albarrán Tello	MINAGRI	Public, Agriculture
25	Juan Ronny	Flores Cáceres	MTPE	Public, Building, Housing, Sanitation
26	Hector	Sedano Malca	MEF	Public, Economy
27	Miguel	Brette	PAGE	Private
28	Roxana	Orrego	SERFOR	Public, Forestry and Biodiversity
29	Guillermo	Jopen Sanchez	MEF	Public, Economy
30	Omar	Ruíz Zumaeta	MINAM	Public, Environment
31	Guillermo	Avanzini Pinto	ANA	Public, Water
32	Flavio	Ausejo	Ausejo Consulting	Private
33	Elisa	Galarza	CIUP	-
34	Eliana	Vicuña Dextre	MINCETUR	Public, Trade and Tourism
35	Sara	Ledesma Posadas	MTPE	Public, Labor

36	Yury	Pinto Ortiz	ANA	Public, Water
37	Lady Vanessa	Zuta Jiménez	MINAM	Public, Environment
38	Roger	Loyola	MINAM	Public, Environment
39	Susan	Estrella	MINAM	Public, Environment
Organization Staff				
40	Yong Sung	Kim	GGGI Hq.	
41	Chiden	Balmes	GGGI Hq.	
42	Aaron	Drayer	GGGI Peru	
43	Renzo	Mendoza	GGGI Peru	
44	Maemi	Chinen	GGGI Peru	
45	Elena	Costa	GGGI Peru	
46	Steffen	Schwörer	GGGI Consultant	
47	Mercedes	Castro	GGGI Consultant	
48	Alejandro	Conza	GGGI Consultant	
49	Fernanda	Palomino	GGGI Consultant	
50	Beatriz	Medina	GGGI Consultant	

Annex C. List of interviewees – Sectorial Analysis (Phase 3)

#	First Name	Surname	Institution	Sector
1	Carlos	Aranda	Southern Peru	Private, Mining
2	Katty	Gonzales	SNMPE	Private, Energy and Mining
3	Caterina	Podestá	SNMPE	Private, Energy and Mining
4	Elvis	Medina	MEM, Environmental issues	Public, Energy and Mining
5	Ivan	Lucich	SUNASS	Public, Water and Sanitation
6	Paula	Carrión	MINAGRI	Public, Agriculture
7	Orrego	Roxana	SERFOR - MINAGRI	Public, Forestry and Biodiversity
8	Gustavo	Suárez	PNCB-MINAM	Public, Forestry and Biodiversity
9	Victor	Guevara	MVCS	Public, Building, Housing, Sanitation
10	NN	NN	MVCS	Public, Building, Housing, Sanitation
11	NN	NN	OSINERGMIN	Public, Energy and Mining
12	NN	NN	OSINERGMIN	Public, Energy and Mining
13	Jordi	Pastor	INCLAM	Private, Water and Agriculture
14	Guillermo	Avanzini	ANA	Public, Water
15	Llenia	De Fatima	MEM	Public, Mining Energy
16	Roca	Javier	MEF	Public, Economy and Finance
17	Alayza	Natalia	MEF	Public, Economy and Finance

Annex D: Information on Indicators

Theme	Sub-theme	No.	Indicator	Unit	Definition	Source
Resource-Efficient Growth	**Energy Efficiency**	1	Energy intensity	MJ/USD	Ratio between energy supply and gross domestic product measured at purchasing power parity http://data.worldbank.org/indicator/EG.EGY.PRIM.PP.KD	WB
		2	Distribution losses of electricity	% of total	Ratio of total electricity generation and losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS	
	Resource Productivity	3	Material intensity	Kg of domestic consumption per unit GDP (USD)	Ratio between gross domestic product and the total amount of domestic materials (construction/industrial minerals, metal, ores, fossil fuels and biomass) extracted http://www.materialflows.net/data/datadownload (flow type "Extraction" flow sub-type "Used" reference parameter "Per GDP"	SERI
		4	Fresh water productivity	Unit GDP (USD) per m^3 of freshwater withdrawal	Gross domestic product in constant prices divided by the annual freshwater withdrawal http://data.worldbank.org/indicator/ER.GDP.FWTL.M3.KD	WB
		5	Municipal solid waste generation intensity	Kg of waste per unit GDP (USD)	Ratio between gross domestic product and municipal solid waste generated http://www.atlas.d-waste.com/ http://data.worldbank.org/indicator/NY.GDP.MKTP.CD	Dwaste, WB
		6	Recycling rate of solid waste	% of total waste generated	Recycling rate of municipal solid waste generated http://www.atlas.d-waste.com/	Dwaste
		7	Agricultural (land) productivity	USD per hectare of arable land	Ratio between agricultural production and total area of arable land under permanent crops, and under permanent pastures. http://faostat3.fao.org/download/Q/QV/E (Gross Production Value constant 2004-2006) http://data.worldbank.org/indicator/AG.LND.AGRI.K2	FAO WB
	Other Productivity Factors	8	Labor productivity	GDP (1,000 USD) per worker	Gross domestic product per worker of labor force http://www.ilo.org/global/statistics-and-databases/research-and-databases/kilm/lang--en/index.htm *(Indicator: Output per worker (GDP constant 2005 US $)*	ILO
		9	Logistics performance index	1 – 5 (higher the better)	Performance of countries in six areas that capture the most important aspects of the current logistics environment http://data.worldbank.org/indicator/LP.LPI.OVRL.XQ http://siteresources.worldbank.org/INTLAC/Resources/ConnectingtoCompete.pdf	WB
		10	Technological readiness	1 – 7 (higher the better)	The technological readiness index aims to measure the agility with which an economy adopts existing technologies to enhance the productivity of its industries; the index covers the areas of (1) technological adoption (availability of latest technologies, firm-level technology absorption, FDI and technology transfer) and (2) ICT use (internal users, broadband internet subscriptions, internet bandwidth, mobile broadband subscriptions, mobile telephone subscriptions, fixed telephone lines) http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf	WEF

Theme	Sub-theme	No.	Indicator	Unit	Definition	Source
Eco-Friendly Growth	Quantity of Natural Assets	11	Coastal shelf fishing pressure	ton/km^2	Intensity of fish catch using gears such as trawlers that operate on the shelf http://www.epi.yale.edu/files/fisheries_0.xls	EPI
		12	Changes in forest cover	% change during 2000-2012	Percent change in forest cover between 2000 and 2012 (Definition of forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use http://faostat3.fao.org/download/R/RL/E	FAO
		13	Water stress index	0 – 5 (Higher the greater competition among) users)	Total annual water withdrawals (municipal, industrial, and agricultural) to total renewable supply http://www.wri.org/sites/default/files/aqueduct_coutnry_rankings_010914.pdf	WRI
		14	Natural resources depletion	% of GNI	The sum of net forest depletion, energy depletion, and mineral depletion, as a percentage of GNI. Net forest depletion is unit resource rents times the excess of round wood harvest over natural growth. Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. http://data.worldbank.org/indicator/NY.ADJ.DRES.GN.ZS	WB
	Quality of Natural Assets	15	Changes in the number of engendered species	% change during 2013-2015	Changes in number of endangered species in a country, based on the "IUCN Red List of Threatened Species" http://cmsdocs.s3.amazonaws.com/summarystats/2015-4_Summary_Stats_Page_Documents/2015_4_RL_Stats_Table_5.pdf	IUCN
		16	Water quality index	0 – 100 (Higher the better)	Water Quality Index (WQI) uses three parameters measuring nutrient levels (Dissolved Oxygen, Total Nitrogen, and Total Phosphorus) and two parameters measuring water chemistry (pH and Conductivity) to understand levels of water quality http://www.epi.yale.edu/files/2010epi_data.xls	EPI
		17	Trends in soil health	0 – 50 (Higher the better)	Trends in Soil Health Index measures: (1) The physical part related to loss of soil mass and structure and (2) the long term chemical well-being of the soil in terms of nutrients and absence of toxicities built up. http://www.fao.org/nr/lada/index.php?option=com_docman&task=doc_download&gid=773&lang=en	FAO
		18	Average exposure to PM2.5 events	micrograms per m^3 (average during 2003-2010)	Average exposure to PM2.5, or particles smaller than 2.5 micrometers http://www.epi.yale.edu/files/air_quality_0.xls (Sheet name: PM2.5 Exceedence_Avg)	EPI

Theme	Sub-theme	No.	Indicator	Unit	Definition	Source
Climate-Resilient Growth	**Climate Change Mitigation**	19	CO_2 emission trends	% change in total emission during the last 5 years	Percent change in national emissions of greenhouse gases including CO2, CH4, N2O, PFC, HFC and SF6 over the latest five years available http://data.worldbank.org/indicator/EN.ATM.CO2E.KT	WB
		20	Carbon Intensity	tCO_2. per unit GDP (USD)	Amount of carbon dioxide emissions (those stemming from the burning of fossil fuels and the manufacture of cement) per unit of gross domestic production http://data.worldbank.org/indicator/NY.GDP.MKTP.CD http://data.worldbank.org/indicator/EN.ATM.CO2E.KT	
		21	Renewable energy production	% of total electricity production (excludes hydro)	Share of renewable energy in total production (renewable energy follows the definition by IEA) http://data.worldbank.org/indicator/EG.ELC.RNWX.ZS	
		22	Carbon stock in living forest biomassvv	% change in biomass during 2000-2010	Percent change in carbon stock, which is a quantity of carbon contained in a reservoir or system of living forest biomass which has the capacity to accumulate or release carbon http://www.fao.org/docrep/013/i1757e/i1757e14.pdf	FAO
	Climate Change Adaptation	23	Climate change exposure	0 – 1 (lower the less exposed)	The degree to which a system is exposed to significant climate change from a biophysical perspective. It is a component of vulnerability independent of socio economic context. Exposure indicators are projected impacts for the coming decades and are therefore invariant overtime. http://index.gain.org/ranking/vulnerability/exposure	NDGAIN
		24	Climate change sensitivity	0 – 1 (lower the less sensitive)	The extent to which a country is dependent upon a sector negatively affected by climate hazard, or the proportion of the population particularly susceptible to a climate change hazard. A country's sensitivity can vary over time. http://index.gain.org/ranking/vulnerability/sensitivity	
		25	Adaptive capacity to climate change	0 – 1 (lower the higher adaptive capacity)	The availability of social resources for sector-specific adaptation. In some cases, these capacities reflect sustainable adaptation solutions. In other cases, they reflect capacities to put newer, more sustainable adaptations into place. Adaptive capacity also varies over time. http://index.gain.org/ranking/vulnerability/capacity	

Annex E. Institutions Relevant to Each Sector

Institutions Relevant to the Agriculture Sector[19]

Ministry of Agriculture (MINAGRI)	Develop the national agricultural policy applicable at all levels of government, generating goods and services of excellence to agricultural production sectors, with emphasis on rural families and small farmers, promoting -in a sustainable environment- growth and competitive development, with social equity and cultural identity.
National Institute of Agricultural Investigation (INIA)	Promote national agricultural technological innovation to increase productivity and improve competitiveness levels, the valorization of genetic resources and the sustainability of agricultural production.
National Water Authority (ANA)	Management and monitoring the rational use of water resources, ensuring the quality, quantity and good ecological status, creating a water culture of value and efficiency.
National Forestry and Wildlife Service (SERFOR)	Public agency attached to MINAGRI to promote sustainable and participatory management of forest resources and wildlife, and use of ecosystem services, providing quality services that contribute to the welfare of citizens.
National Service of Agricultural Sanitation (SENASA)	Serves as national authority, protecting and improving agricultural health; promoting and controlling the quality of inputs, organic production and the food safety for sustainable and competitive agriculture development.
Compensation Program for Competitiveness (AGROIDEAS)	Implementing agency under the MINAGRI that promotes partnerships and strengthens business management and the adoption of environmentally sustainable agricultural technologies for small and medium agricultural producers in Peru, helping to improve their competitiveness and well-being.
Rural Agricultural Productive Development Program (AGRO RURAL)	Implementing agency under the MINGARI that designs, promotes and manages rural agricultural development models that facilitate joint public-private investment and contribute to poverty reduction and the inclusion of rural families.
Subsector Irrigation Program (PSI)	As a decentralized program of the MINAGRI, the PSI contributes to increased production and productivity of irrigated agriculture through actions that enable capacity building and management of the Boards of Users, improved utilization of water resources and increased efficiency in arable land use.
Sierra Exportadora	Public implementing agency that seeks to promote and develop exportable quality to connect the Peruvian highlands to national and international markets. Sierra Exportadora encourages local entrepreneurship and innovation of production processes to convert the Andean region into a competitive region.
AGRICULTURAL BANK (AGROBANCO)	Provides financial products and services that promote rural savings and accompany the development of production, agricultural business and complementary activities in rural areas, focusing on the inclusion of the population with fewer resources and greater restrictions.

19. Detailed information can be found in Plan Nacional de Recursos Hídricos – Resumen Ejecutivo, ANA, accessed May 4 2016. http://www.ana.gob.pe/sites/default/files/archivos/paginas/a_resumen_ejecutivo_parte_2_0_0.pdf

Institutions Relevant to the Mining Sector[20]

Ministry of Energy and Mines (MEM)	Promote private investment in mining and energy activities in a competitive legal framework, within sustainable development and promoting research and training; also contributing to the preservation of the environment, to achieve a safe industry, harmonious relations between actors and energy development criteria of subsidiarity.
Ministry of Environment (MINAM)	Preserve the quality of the environment and to ensure present and future generations the right to enjoy a balanced and appropriate environment for the development of life. To this end MINAM encourages and ensures sustainable, responsible, ethical and rational use of natural resources and the environment that sustains them, and contributes to the overall social, economic and cultural development of the human being, in constant harmony with its surroundings.
Supervisory Agency of Investment in Energy and Mining (OSINERGMIN)	Regulate, supervise and monitor the energy and mining sectors with autonomy, technical capacity, clear and predictable rules, so that activities in these sectors develop in safety conditions, ensuring the availability of a reliable and sustainable supply of energy.
National Society of Mining, Petroleum and Energy (SNMPE)	Private association that represents and brings together mining and energy companies. It aims at ensuring the competitiveness of the sector and the sustainable use of natural resources.
Geological, Mining and Metallurgical Institute (INGEMMET)	Public entity, which aims at obtaining, storing, recording, processing, administration and dissemination of geoscience knowledge.
Agency for Environmental Assessment and Enforcement (OEFA)	Exercise and promote effective environmental enforcement that harmonizes economic activities with environmental protection and sustainable development.
Agency of Environmental Licensing for Sustainable Investments (SENACE)	Public agency under the MINAM, whose main role is to evaluate and approve environmental impact assessments for Peru's major investment projects.
Agency for Private Investment Promotion (PROINVERSIÓN)	Public entity attached to the Ministry of Economy and Finances, responsible for the execution of the national private investment promotion polices. PROINVERSIÓN promotes private investments in public services and public infrastructure through Public-Private Partnerships, and provides assistance to sub-national public entities.

20. Information on mandates taken from the Portal de Transparencia Estándar (http://www.peru.gob.pe/transparencia/pep_transparencia.asp) and/or official websites of the respective institutions.

Institutions Relevant to the Energy Sector[21]

Ministry of Energy and Mines (MEM)	Promote private investment in mining and energy activities in a competitive legal framework, within sustainable development and promoting research and training; also contributing to the preservation of the environment, to achieve a safe industry, harmonious relations between actors and energy development criteria of subsidiarity.
Supervisory Agency of Investment in Energy and Mining (OSINERGMIN)	Regulate, supervise and monitor the energy and mining sectors with autonomy, technical capacity, clear and predictable rules, so that activities in these sectors develop in safety conditions, ensuring the availability of a reliable and sustainable supply of energy.
Economical Operational Committee of Interconnected National System (COES)	COES is a private, non-profit entity under public law, formed by all actors realted to the Interconnected National Electricity System SEIN (generators, transmitters, distributors and free users), and its decisions are binding. Its purpose is to coordinate the operation of the SEIN in the short, medium and long term at minimum cost while preserving the security of the system.
National Society of Mining, Petroleum and Energy (SNMPE)	SNMPE is a private association that represents and brings together all companies operating in those productive areas. It aims to promote investment, by ensuring the competitiveness and the sustainable use of natural resources. SNMPE operates through different technical, commercial, support, sectoral, and legal committees.
National Water Authority (ANA)	Management and monitoring the rational use of water resources, ensuring the quality, quantity and good ecological status, creating a water culture of value and efficiency. ANA, with over 50% of electricity produced by hydropower plants and new projects being considered, is the responsible institution for granting flows to hydropower plants.
Ministry of Environment (MINAM)	Preserve the quality of the environment and to ensure present and future generations the right to enjoy a balanced and appropriate environment for the development of life. To this end MINAM encourages and ensures sustainable, responsible, ethical and rational use of natural resources and the environment that sustains them, and contributes to the overall social, economic and cultural development of the human being, in constant harmony with its surroundings.
Agency for Environmental Assessment and Enforcement (OEFA)	Exercise and promote effective environmental assessment and enforcement that harmonizes economic activities with environmental protection and sustainable development.
Agency of Environmental Licensing for Sustainable Investments (SENACE)	Public agency under the MINAM, whose main role is to evaluate and approve environmental impact assessments for Peru's major investment projects.
Agency for Private Investment Promotion (PROINVERSIÓN)	Public entity attached to the Ministry of Economy and Finances, responsible for the execution of the national private investment promotion polices. PROINVERSIÓN promotes private investments in public services and public infrastructure through Public-Private Partnerships, and provides assistance to sub-national public entities.

21. Information on mandates taken from the Portal de Transparencia Estándar (http://www.peru.gob.pe/transparencia/pep_transparencia.asp) and/or official websites of the respective institutions.

Institutions Relevant to the Forestry Sector[22]

Ministry of Agriculture (MINAGRI)	Develop the national agricultural policy applicable at all levels of government, generating goods and services of excellence to agricultural production sectors, with emphasis on rural families and small farmers, promoting -in a sustainable environment- growth and competitive development, with social equity and cultural identity.
Ministry of Environment (MINAM)	Preserve the quality of the environment and to ensure present and future generations the right to enjoy a balanced and appropriate environment for the development of life. To this end MINAM encourages and ensures sustainable, responsible, ethical and rational use of natural resources and the environment that sustains them, and contributes to the overall social, economic and cultural development of the human being, in constant harmony with its surroundings.
Ministry of Production (PRODUCE)	Achieve greater productivity, quality and value-added to economic activities of responsibility of the Production Sector, in harmony with environmental protection and conservation of biodiversity, through policy measures, regulatory, throughout the national territory and with the participation of regional and local governments.
Supervisory Agency for Forest and Wildlife Resources (OSINFOR)	Supervise forest law enforcement, including monitoring and sanctioning non-compliance of concessionaries, private land owners and communities with their own annual management plans as well as with regional or national regulations.
National Forestry and Wildlife Service (SERFOR)	Public agency attached to MINAGRI to promote sustainable and participatory management of forest resources and wildlife, and use of ecosystem services, providing quality services that contribute to the welfare of citizens.
Agency for Environmental Assessment and Enforcement (OEFA)	Exercise and promote effective environmental enforcement that harmonizes the exercise of economic activities and environmental protection to sustainable development.
National Institute of Agricultural Investigation (INIA)	Promote national agricultural technological innovation to increase productivity and improve competitiveness levels, the valorization of genetic resources and the sustainability of agricultural production.
National Service of Agricultural Sanitation (SENASA)	Serve as national authority, protecting and improving agricultural health; promoting and controlling the quality of inputs, organic production and the food safety for sustainable and competitive agriculture development.
National Water Authority (ANA)	Manage and monitor the rational use of water resources, ensuring the quality, quantity and good ecological status, creating a water culture of value and efficiency.

22. Information on mandates taken from the Portal de Transparencia Estándar (http://www.peru.gob.pe/transparencia/pep_transparencia.asp) and/or official websites of the respective institutions.

Institutions Relevant to the Water and Sanitation Sector[23]

National Water Authority (ANA)	Manage and monitor the rational use of water resources, ensuring the quality, quantity and good ecological status, creating a water culture of value and efficiency. ANA leads the National IWRM System (SNGRH) and is in charge of sector and inter-sectorial coordination with many other national institutions related to water management.
Ministry of Environment (MINAM)	Preserve the quality of the environment and to ensure present and future generations the right to enjoy a balanced and appropriate environment for the development of life. To this end, MINAM encourages and ensures sustainable, responsible, ethical and rational use of natural resources and the environment that sustains them, and contributes to the overall social, economic and cultural development of the human being, in constant harmony with its surroundings.
Ministry of Agriculture (MINAGRI)	Develop the national agricultural policy applicable at all levels of government, generating goods and services of excellence to agricultural production sectors, with emphasis on rural families and small farmers, promoting -in a sustainable environment- growth and competitive development, with social equity and cultural identity.
Ministry of Housing, Construction and Sanitation (MVCS)	Governing body in urban planning, housing, construction and sanitation, responsible for designing, regulating, promoting, monitoring, evaluating and implementing sectoral policy, contributing to the competitiveness and sustainable territorial development of the country, benefiting preferably the population with less resources.
Ministry of Production (PRODUCE)	Achieve greater productivity, quality and value-added to economic activities of responsibility of the Production Sector, in harmony with environmental protection and conservation of biodiversity, through policy measures, regulatory, throughout the national territory and with the participation of regional and local governments.
Ministry of Energy and Mines (MEM)	Promote private investment in mining and energy activities in a competitive legal framework, within sustainable development and promoting research and training; also contributing to the preservation of the environment, to achieve a safe industry, harmonious relations between actors and energy development criteria of subsidiarity.
National Superintendence of Sanitation Services (SUNASS)	Regulate, supervise and oversee the market development of potable water and sewerage, as well as resolving conflicts arising from them, acting with autonomy, impartiality and efficiency, in order to encourage the improvement of quality of services and coverage.
Technical Organ for the Management of Sanitation Services (OTASS)	Take precautions so that water utilities (EPS) are managed adequately, with autonomy, efficiency and social and territorial integration; ensuring that the respective sector policy concerning water utilities is executed correctly.
General Direction for Environmental Health (DIGESA)	Technical regulatory body responsible for formulating policies, regulate and control interventions related to Environmental Health, exercising stewardship at national level with quality and efficiency through surveillance, prevention and control of environmental risk factors that affect the health and welfare of the population, contributing to improving individual and collective health of citizens.

23. Information on mandates taken from the Portal de Transparencia Estándar (http://www.peru.gob.pe/transparencia/pep_transparencia.asp) and/or official websites of the respective institutions.