**Peru**

**IFD/FMM/ICES**

**Consultancy on Urban Development and Climate Change for Huancayo, Peru**

**Terms of Reference**

1. Background
   1. Cities have a key role in the diffusion of innovations, generation of expertise, concentration of specialized labor, development of more dynamic economic activities and provision of educational, cultural and recreational services. It is also worth noting that 180 million people (33% of the LAC population) live in conditions of poverty and 66% of these are presently concentrated in the cities. This population has increasing and unsatisfied demands for urban and social services, decent housing conditions, employment and opportunities to generate income.
   2. The accelerated urban growth of LAC presents a series of challenges that should be dealt with comprehensively to ensure the future sustainability of the region’s cities, especially the intermediate-sized ones. Since the 1980s, the region’s large cities have been growing more slowly compared to the region’s intermediate cities (Cristini et al., 2008).
   3. This growth has occurred while these cities have simultaneously faced a series of challenges that jeopardize their sustainability and negatively affect the quality of life of their inhabitants. These problems are varied and interrelated, which makes the measures taken to resolve them even more complex.
   4. As a response to the current situation of the cities and the region’s urbanization process, the Bank developed the Emerging and Sustainable Cities Initiative. The purpose of the Initiative is to contribute to improve the quality of life in LAC’s emerging cities, in the environmental, urban, and fiscal sustainability dimensions.
   5. The Bank is supporting cities through this Initiative, by combining the capacities of different internal sectors in the formulation of action plans designed to guide the actions of local government in search of sustainability. The Bank is involved in this effort not only as the most important development bank in the region, but also because of its familiarity with the countries, in addition to the potential opportunities that the support of the Initiative represents for the institution.
   6. One of the topics that have been prioritized in many cities of the region is urban growth and territorial expansion, and the negative environmental, social and economic impact that formal and informal occupation is producing in the landscape of cities and their immediate regions.
   7. Policy makers at the municipal level in intermediate cities of the region usually lack adequate supporting information and analysis to aid them in the design of policies that help to promote growth in an orderly, sustainable way. The links between how the city grows and the municipal budget (in terms of infrastructure investment and operation costs) are not clear. Furthermore, the environmental impacts of the growth of the city footprint are usually not fully considered; i.e. how conservation areas, aquifer recharge areas, natural disaster-prone areas, areas vulnerable to the effects of climate change and Greenhouse Gas emissions levels are influenced by the type of growth the city promotes.
   8. The studies to be undertaken as part of this consultancy aim to provide this understanding and awareness on the dynamics of the urban footprint, and on the impacts of different growth patterns, by analyzing infrastructure costs associated with different growth scenarios (low density sprawl, medium to high density mixed-use communities), as well as the Greenhouse Gas Emissions implications. These studies will allow urban planners to make the necessary adjustments to the territorial development plans, allowing for growth while protecting key green infrastructure (e.g. conservation areas, aquifer recharge areas, etc.), avoiding occupation of highly vulnerable areas, and keeping infrastructure costs and greenhouse gas emissions down.
   9. The impacts of climate change on cities are becoming clearer. The foreseen increase in the number and intensity of extreme climate events together with the lack of resilience and socio-economic fragility of urban centers elevate the risks for flooding, landslides and droughts. For instance, coastal communities’ livelihoods are at increasing risk of sea level rise due to a combination of different factors including the high sensitivity and exposure of economic assets and the limited capacity to cope with rapid changes in the shoreline due to physical processes accelerated by climate change. Half of LAC urbanized areas with a population of over 5 million people are located in low-lying coastal areas. According to Dasgupta et al. (2007), the damage caused by sea level rise in LAC would cost between 0.54% and 1.30% of the regional GDP.
   10. The lack of an adequate urban and rural planning significantly also exacerbates the risk of disasters’ occurrence, as occupied land is usually located on areas highly exposed to environmental risks (i.e. river banks, wetlands and areas with steep slopes). This issue, together with changes in the occurrence probability and intensity of certain natural hazards will deepen the impacts of floods, hurricanes and earthquakes on the poorest.
   11. In the case of hydro-meteorological events, the situation is critical due to the accentuation of extreme phenomena and the non-stationarity of hydrological cycles echoed by higher climate variability. The potential effects of this phenomenon on the cities and their inhabitants are projected to increase economic and human losses, reduce water availability and production capacity, aggravate erosion, threaten coastal areas and generate significant social impacts. According to ECLAC/IDB (2009), if LAC does not take actions to reduce the effects of extreme events in the following decades, it could cost up to an estimated 250 billion USD at 2100.
   12. In the case of adaptation to climate change and disaster risk management, our mid-sized cities usually lack of a robust risk assessment. Based on these findings, the Bank has decided to provide each of the cities of the Sustainable Emerging Cities Initiative with tools that will enable them to have observed and projected data on key climate and geophysical hazards and vulnerability parameters to analyze variance in those on a short and long term bases. Counting with valuable projections and concrete adaptation measures will help improve the adaptive capacity of the city.
   13. Urban areas in LAC are not major Greenhouse Gas (GHG) emitters. However, the great challenge of the region is to achieve sustainable development in accordance with its economic and social realities while preserving its historic low-carbon footprint; that is, to be able to consider future generations when the present ones still lack essential elements such as food, housing and basic utilities, and social services. The challenge is to promote a culture of efficiency, savings and respect for the environment while enhancing the quality of life in today’s cities. This requires a concerted, holistic effort with a long-term vision, combining the actions of the different parties involved under the leadership of local governments and with the participation of their citizens. The Bank is an involved party in this effort, not only because it is the major financing institution of the region’s policies and programs, has a close relationship with the countries and knows them well, but also because this initiative offers the potential for the Bank to accelerate a sustainable development agenda in the region.
2. Consultancy objetives
   1. The expected outcome of the consultancy is to develop an understanding of the urban dynamics that will aid the city in planning its growth policies. The study will analyze the historic growth of Huancayo, Peru, its projected growth under current trends, and the effects that the vulnerability to natural disasters and to climate change adaptation and mitigation will have on its growth.
   2. The consultancy will include three specific consulting assignments for Huancayo, Peru:
      1. **Inventory of Greenhouse Gas Emissions**. This study will develop a GHG Inventory for the city, as well as for city government operations, including forecasts and potential mitigation actions for specific sectors.
      2. **Risk assessment and vulnerability to climate change**. The study will provide the city with a probabilistic disaster risk assessment, impact analysis and mapping including prioritized hydro-meteorological and geophysical hazardous events and sea level rise (where applicable), taking into account the impacts associated with climate change.
      3. **Urban footprint and growth scenarios**. This study will take into consideration the urban form and its dynamics under past and current trends and policies, for the assessment and implementation of successful infrastructure and environmental planning at the city and regional levels. In addition, it will produce an analysis of costs for the provision of basic infrastructure and GHG emission levels under two different growth scenarios (current trends growth, and smart growth), including policy recommendations.
3. Main activities
4. A. Consulting Assignment 1: Inventory of GHG emissions.
   1. The consulting firm will undertake the following activities:

a. Develop a GHG inventory for the city, based on existing methodologies for estimating GHG emissions, in accordance with the national context and taking into consideration methodological approaches used by the IDB, the Global Protocol for Community-scale Greenhouse Gas Emissions developed by ICLEI, UNEP, UN-Habitat and the World Bank in 2012; and other documented methodological sources of international recognition.

b. Develop a baseline scenario for key economic sectors including transport, solid waste, water, energy consumption (residential, industrial and commercial) and energy supply. This analysis will provide an understanding of challenges and opportunities facing these sectors.

c. Identify and prioritize mitigation options, for planned policies and potential “beyond policies” scenarios, including measures in sectors such as energy efficiency, promotion of renewable sources of energy, local regulatory frameworks to incentivize sustainability, sustainable transport, opportunities of methane capture in landfills, among others.

d. Investigate the relationship between air quality and GHG inventories at a local level in Huancayo.

e. Compare the identified potential mitigation options for the sectors (including energy, transportation, solid waste, wastewater, industry and land use change and forestry) with regards to GHG emission reductions (MRV), including their costs and benefits, non-GHG related co-benefits and investment and financial flows needed for each measure. The follow up of this diagnostic will monitor the effectiveness of the actions put into practice.

1. B. Consulting Assignment 2: Develop a probabilistic hazard and risk assessment study.
   1. Each consulting firm should include in their proposal a detailed description of the methodology that will be applied to fulfill the requirements of these Terms of Reference. It is desirable that the aforementioned methodology has been applied by the firm in similar cases in the past. If the methodology has not been applied by the firm in the past, the proposal should also include a detailed description of the reasons why such methodology has been chosen and provide examples on where and when it has been applied in the past by other firms and the results of its application in those cases. In the cases that the methodology has never been applied in the past by any firm, then a more thorough description should be included. This description should include technical data and a quantitative and qualitative analysis that describes why this methodology has been chosen.
   2. The consulting firm will undertake the following activities:

Identify and summarize available information (study and literature) including historical disaster data, risk information and climate change scenarios. The information includes international study results (IPCC) and other recent studies conducted by regional and national organizations.

Estimate probable disaster risk analysis, including climate change scenarios, with the following steps:

* + - 1. The consultant will develop an estimated probabilistic hazard analysis of the priority hazards in the city. Depending on data availability the consultant will incorporate in hazard analysis projections of hydro-meteorological variables based on climate change scenarios. Otherwise consultant shall estimate hydro-meteorological changes under climate change with the best available data.
      2. Exposure value calculation. The consultant will develop an inventory of critical infrastructure and residential and commercial areas that may be affected by those hazards. The data should include health infrastructure, potable water supply, sanitation, drainage, electricity supply, solid waste collection, houses and roads. In the case of residential areas, the consultant will define construction area, value of assets and exact location of construction. In case that the cadastral information is not available at residential level the consultant shall apply a methodology of approximation (proxy).
      3. Description and identification of vulnerability functions. The consultant shall define, with the appropriate technical justification, the physical vulnerability function of each type of construction and infrastructure for the considered hazards. Existing vulnerability functions developed by other IDB projects (e.g. CAPRA[[1]](#footnote-1)) may be applied.
      4. Risk estimation. Based on the information of hazards, exposure value and function of vulnerability, the consultant will develop a quantitative probabilistic risk analysis in terms of physical and human losses. This calculation includes the probable maximum loss and expected annual loss from the prioritized hazards.
      5. Analysis of socio-economic impacts of prioritized slow onset hazards (as droughts, heat wave and sea level rise) including climate change scenarios.
      6. Development of impacts assessment maps for the projected floods to include the following city sectors: (i) education facilities; (ii) municipal buildings; (iii) medical facilities; (iv) road system; (v) productive sectors (agriculture and industry); and (vi) current and future urban footprint. The maps will use a street-light indicator using red for critical impact, yellow for moderate and green for no impact.
      7. Development of maps that illustrate the result of: (i) the analysis on probabilistic disaster risk analysis, including climate change scenarios; and (ii) analysis of socio-economic impacts of slow onset hazards including climate change scenarios. A target scale of the mapping will be 1:10,000/1:25000 in accordance with the city studied. The generated maps should include the city and surroundings (metropolitan area), including watersheds.

The Assessment Report for the city that shall include:

* + - 1. Hazard, and risk maps at appropriate scale (e.g.1:10,000/1:25,000 scale, depending on the city) including GIS data archive. The scale of the map proposed should be justified on technical grounds.
      2. Documents on the analysis of probabilistic hazard and disaster risk assessment including climate change scenarios.
      3. Documents of Projections of slow onset hazards and its socio-economic impacts including climate change scenarios.

1. C. Consulting Assignment 3: Develop an urban footprint study and analysis of growth scenarios.

Current and Historic Urban Footprint.

Define a study area spatially and temporally, deriving its boundaries from human and natural systems geographies and data by using a spatial boundary which encompasses both the metropolitan statistical area as well as infrastructure services and supporting natural systems.

Produce and analyze past and current urban footprints based on satellite imagery and remote sensing technology. All imagery analysis must be done on 30 meter (or better resolution) remote sensing data. All the data must be produced in spatial data structure following the ISO 19115 standard.

Prepare a baseline land cover classification leading to the definition of the urban footprint on the baseline imagery, using object oriented supervised classification methodology that has been adopted by mayor governmental agencies (such as the United States Geological Survey’s (USGS) or British Geological Survey (BGS)).

Collect remotely sample points or training data to establish the land use and other characteristics for classification, through imagery and site survey of the city. Experts from the consulting team will travel to the city to collect ground sample to calibrate training data that will be used to produce this classification. If an existing ground sample or land cover data is available, classification process must be able to incorporate those data in sampling process.

The consulting firm will specify in their proposal the number of land cover classes that will be interpreted from satellite imagery, including the technical grounds for it. Urban areas will have three separate categories based on their population density: high, medium and low density (20-50%; 50% to 80%; and 80% to 100%). Categories such as agriculture and pasture land will be separated with a dependable rule set that can be replicated on all data sets.

Final land cover classification will be checked for any quality assurance and quality control (QA/QC) issues. Land cover classes shall address any logic/illogic issues. For example, a speckle of urban categories in the middle of lake or river will be an illogical classification.

A Metadata library will be generated for all the land cover classification data using standard process as guided by FGDC. It will include a comprehensive spatial inventory of the best available information on green and gray infrastructure using satellite imagery classifications, open street map databases, and other relevant sources.

Urban Growth Scenarios. Review information on planned infrastructure (roads and bridges, energy infrastructure, and other) that may have an impact on future land use.

Analyze census data, including population projections, allocated densities and uses in urbanized areas.

Review existing urban development plans and identify areas where various kinds of development are currently allowed and at what densities.

Perform a market segmentation analysis to determine a proposed number of classes appropriate to the region, taking into account available calibration information. At least three types of land development should be considered, corresponding to high, moderate and low density visible in satellite imagery. Further refinement is at the discretion of the contractor.

Develop a set of constraining factors to future development, such as environmental masks that identify areas where various forms of development are impractical or inadvisable and should be protected by urban growth policies. For example, general constraints should include public lands, steep slopes, aquifer recharge areas, as well as flood plains. Areas that are highly vulnerable to natural disasters (as resulting from the Consulting Engagement 2) will also be added to the constraints. Specific constraints should include areas where industrial uses or agriculture uses are specifically zoned. For each market segment, the current legally and practically-buildable land supply in hectares should be estimated.

Perform an analysis of recent historic land cover change and its associations with various potential non-spatial explanatory factors, such as aggregate population and employment growth. For each market segment identified, the contractor will project future land use demands (in hectares) for the forecasting horizon (e.g. demand for total urban residential land should be related to jobs, population growth rates, and built density, etc.).

Analyze the spatial factors that can potentially explain the spatial patterns exhibited in recent historic change (attractiveness factors), which are expected to remain important across future scenarios for each market segment (e.g. distance or travel times to various amenities).

Develop a future-oriented “attractiveness” or “suitability” model which estimates the relative likelihood of each legally and practically-buildable unit to be developed.

Using the information gathered (green and gray infrastructure, planned infrastructure, census and population projections, urban development plans and satellite imagery), perform an economic calculation to determine land attractiveness for various uses across all potential development areas using a 20-30-year projection of land cover, taking into account land use conflicts, vulnerable areas, economic changes, and existing planning rules and regulations. The objective of this calculation is to estimate the distribution of future populations over time, resolving land use conflicts using adjustable rules.

Analyze two different urban growth scenarios (“current trends” scenario and “smart growth” scenario). The latter scenario will take into account increases in growth density, as well as infill and densification of urbanized areas.

With the collected data, and using the results of the Consulting Engagement 1 (GHG Inventory for the city) develop an estimation analysis for GHG emissions change for both the current trends and smart growth scenarios, by analyzing changes in the transport, land use change, energy and other relevant sectors.

Analyze the investment costs required for the provision of basic infrastructure to accommodate growth in the different scenarios. The consulting firm should specify and technically justify in their proposal the type of infrastructure selected for the cost analysis, which could include potable water supply, sanitation, drainage, electricity supply, urban mass transit, solid waste collection, roads, and mitigation works required to reduce natural disaster risk. Local costs for infrastructure should be considered.

Based on the results of the cost projections, provide an analysis that includes detailed policy recommendations which can be used to improve the urban development plan.

* 1. In carrying out the aforementioned activities, the consulting firm will be responsible for the information collection and data analysis. In addition to travelling to the selected city to gather information, it is highly recommended that the consulting firm hires local consultants for aiding in the data collection process and in the follow up with local officials. The consulting firm should not rely on the local Municipality as the sole source of information. It will be a responsibility of the firm to find alternative information sources and expert calculations to reach the desired results.

1. Reports
   1. All Reports, technical background material, briefings, articles and news in the context of this consultancy must follow the Bank specifications[[2]](#footnote-2). The outputs of the consultancy as well as reports must follow the Bank publication’s protocol.
2. D. Consulting Assignment 1: Inventory of GHG emissions.
   1. The consulting firm must produce the following studies for the city in the scope:
   2. Preparation of a GHG emissions inventory.
   3. Identification of baseline scenarios (for sectors).
   4. Identification and prioritization of mitigation options and scenarios for each sector, including an analysis of cost-efficiency of different mitigation scenarios, including investment and financial flows needed and other co-benefits (social, environmental, health, etc).
   5. Analysis of air quality in the city, including observed relationship of Nitrogen Dioxide (NO2), ground-level Ozone (O3) and particulate matter (PM10) and its impacts on health. This analysis should be based on existing studies based on officially and scientifically approved data or studies.
   6. Proposal to streamline a decision making process that allows selecting mitigation options, financing them and ensuring that GHG emissions reductions are monitored, verified, reported and updated continuously. This proposal needs to take in consideration the city’s development priorities and goals. International examples of mitigation measures with successful outcomes will be an asset to give the municipality different options of emission reduction actions.
   7. Organize and carry out a capacity building workshop in the city for the technical teams of the municipality to be capable of replicating the exercise and understand the results of the activities of the Consulting Engagement 1 from the Activity section in this document.
   8. Provide the municipalities and the Bank with a manual that will list all the activities to be performed in order to update this study.
3. E. Consulting Assignment 2: Develop a probabilistic hazard and risk assessment study.
   1. The consulting firm must produce a Risk assessment report and Mapping for the city. The result of the map and spatial dataset shall provide including a description of the dataset and its format. The format shall be PC compatible with ESRI ArcGIS.
4. F. Consulting Assignment 3: Urban footprint study and growth scenarios.
   1. The consulting firm must produce the following documents and studies:

GIS Database - Development of Geospatial data infrastructure. A Geographic Information System with relevant geo-referenced data, including densities (existing densities measured in inhabitants per hectare in the consolidated portion of the city and in the periphery) and land uses, key green and gray infrastructure, natural disaster-prone areas, among others.

Report on Current and Historic Urban footprint. A historic analysis of the urban change since 1984-85 for the city that presents the composition of the urban footprint in terms of land cover using 10 classes, and the identification of the areas of change since 1984, including a study of the historic densities associated with each urban footprint, and a study of the current densities for the city with documentation and imagery and photographs samples of each density category.

Report on Development of Urban Growth Scenarios: A simulation analysis for current trend conditions up to 2030 (or closer temporal demographic data set available), and for a smart growth approach, including: a) a cost analysis of infrastructure for the two growth scenarios analyzed (current trends and smart growth); b) analysis in terms of the impacts of each scenario (costs and GHG emission level implications), assessing which of the two would be more convenient for the city, and policy recommendations; and c) a planning summary for policy makers expressing major findings of the analysis performed.

1. Timeframe
   1. The activities under these terms of reference should be completed within six (6) months from the starting date of the contract. It is expected that the Consulting Firm will submit an advanced draft of the studies for Huancayo, Peru 3 months after the starting date of the contract.
2. Payment Schedule
   1. The payments will be done according to the following schedule:
3. 30% upon Signature of the contract and agreement on the scope of work and deliverables.
4. 30% upon Consultant submitting an advanced draft for the 3 key studies for the city. This advanced draft should include: a) GIS Database and draft report on Current and Historic Urban Footprint; b) draft Risk Assessment report and mapping; and c) draft Inventory of GHG Emissions, including identification of mitigation options.
5. 40% upon the Bank's approval of the final reports and all deliverables corresponding to Huancayo, Peru.
6. Coordination and Supervision
   1. The supervision of the consultant’s work and deliverables will be supervised by Mr. Huascar Eguino, Senior Specialist (IFD/FMM), in close coordination with Mr. Ellis Juan, General Coordinator of the Emerging and Sustainable Cities Initiative (VPS/VPS).

1. See ([ATN/MD-11335-RG](http://www.iadb.org/en/projects/advanced-search,1301.html?query=RG-T1587); RG‑T1587). [↑](#footnote-ref-1)
2. The report(s) should be presented to the Bank in electronic form in one file. The document must contained cover, main document and annexes. No zip, PDF, or PowerPoint Presentation file will be received as a final report, according to the regulation in the Record administrative Section. [↑](#footnote-ref-2)