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Nepal Environment Sector Diagnostic:

Path to Sustainable Growth Under Federalism

(A COUNTRY ENVIRONMENTAL ANALYSIS)

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ACRONYMS AND ABBREVIATIONS

a.i.	active ingredient	**FAO**	Food and Agriculture Organization
ACA	Annapurna Conservation Area	**FCNA**	Federalism Capacity Needs Assessment
ADB	Asian Development Bank	**FDF**	Forest Development Fund
AQM	air quality management	**FG**	federal government
BAU	business as usual	**FPDB**	Forest Products Development Board
BTK	Bull trench kiln	**FRA**	Forest Resource Assessment
CA	conservation area	**GDP**	gross domestic product
CBFM	community-based forest management	**GESU**	Geo-Environment and Social Unit
CBFUG	community-based forest user group	**GHG**	greenhouse gas
CBS	Central Bureau of Statistics	**GW**	gigawatt
CCS4All	Clean Cooking for All by 2030	**ha**	hectare
cf	cubic feet	**HHK**	hybrid Hoffman kiln
CFUG	community forest user group	**HPPCL**	Herbs Production and Processing Company Limited
CO2	carbon dioxide	**ICIMOD**	International Centre for Integrated Mountain Development
DFO	district forest office	**ICS**	improved cookstove
DFPSC	District Forest Product Supply Committee	**IEE**	initial environmental evaluation
DFSC	Department of Forests and Soil Conservation	**IPM**	integrated pest management
DISC	Developing Improved Solutions for Cooking (Program)	**IQ**	intelligence quotient
dl	deciliter	**IWRM**	integrated water resource management
DNPWC	Department of National Parks and Wildlife Conservation	**JMP**	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
DOE	Department of Environment	**K**	potassium
DOED	Department of Electricity Development	**kg**	kilogram
DOF	Department of Forests	**km**	kilometer
DOLI	Department of Local Infrastructure	**km²**	square kilometer
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads	**l**	liter
DOR	Department of Roads	**LG**	local government
DSCWM	Department of Soil Conservation and Watershed Management	**LPG**	liquefied petroleum gas
EIA	environmental impact assessment	**LRN**	local road network
ENR	environment and natural resources	**m**	meter
EPA	Environment Protection Act	**m³**	cubic meter
EPI	Environmental Performance Index	**MAI**	mean annual increment
EPR	Environment Protection Rules	**MALD**	Ministry of Agriculture and Livestock Development
ESD	Environment Sector Diagnostic	**MEWRI**	Ministry of Energy, Water Resources and Irrigation
ESF	Environmental and Social Framework	**MFSC**	Ministry of Forests and Soil Conservation
ESIA	environmental and social impact assessment	**mg**	milligram

MITFE	(provincial) Ministry of Industry, Tourism, Forest, and Environment	**SEA**	strategic environmental assessment
MLMAC	(provincial) Ministry of Land Management, Agriculture and Cooperatives	**SESA**	strategic environmental and social assessment
MLMCPA	Ministry of Land Management, Cooperative and Poverty Alleviation	**SFM**	sustainable forest management
MOFAGA	Ministry of Federal Affairs and General Administration	**SNA**	System of National Accounts
MOFE	Ministry of Forests and Environment	**SRN**	strategic road network
MOPIT	Ministry of Physical Infrastructure and Transport	**SWM**	solid waste management
MPE	Ministry of Population and Environment	**T&T**	travel and tourism
MW	megawatt	**TCN**	Timber Corporation of Nepal
MWS	Ministry of Water Supply	**tCO2e**	ton of carbon dioxide equivalent
NBT	nature-based tourism	**TOR**	terms of reference
NDC	Nationally Determined Contribution	**TSA**	tourism satellite account
NGO	nongovernmental organization	**UNFCCC**	United Nations Framework Convention on Climate Change
NNRFC	National Natural Resources and Fiscal Commission	**UNICEF**	United Nations Children's Fund
NPC	National Planning Commission	**UNWTO**	United Nations World Tourism Organization
NPR	Nepalese rupee	**US$**	United States dollar
NTFP	non-timber forest product	**VAT**	value added tax
NTNC	National Trust for Nature Conservation	**VSBK**	vertical shaft brick kiln
NWP	Nepal Water Policy	**VSL**	value of statistical life
OECD	Organisation for Economic Co-operation and Development	**WASH**	water, sanitation, and hygiene
PA	protected area	**WECS**	Water and Energy Commission Secretariat
PG	provincial government	**WHO**	World Health Organization
PM	particulate matter	**µg**	microgram
PPM	parts per million		
PPP	purchasing power parity		
SDG	Sustainable Development Goal		

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EXECUTIVE SUMMARY

The 2015 constitution ushered in not only the federalization of Nepal's government structure but also a shift in natural resource management from a protection-focused approach to one that aims to harness resources sustainably. Nepal's rich water, forest, and biodiversity resources, aided by extensive hydropower, transport and irrigation infrastructure development would thus fuel economic growth and prosperity and help achieve the goal of becoming a middle-income country by 2030. The shift to a productive use of natural resources would be a formidable governance challenge for any country, but it is even more so for Nepal, where under the new federalism significant powers have been devolved to 7 provincial and 753 local governments—all newly created and with very little institutional capacity. While the devolution of powers to the jurisdictions where the resources are has advantages in terms of efficiency and accountability in the long run, in the short run, lack of capacity, a focus on meeting one's community's quest for increased prosperity, and limited appreciation of the impact of local decisions on other communities may lead to unsustainable uses of natural resources. Capacity constraints will also limit subnational governments' ability to mitigate not only environmental risks but also natural disaster and climate change–related risks, including floods caused by higher monsoon precipitation and glacial lake outbursts, droughts, landslides, and earthquakes.

The objective of this Environment Sector Diagnostic (ESD) is to inform policies, investments, and institutional capacity-building measures in key areas of natural resource use and environmental management to support sustainable growth and prosperity in Nepal in the context of federalism. Thus, the ESD aims to inform investment projects and government policies and facilitate the implementation of the World Bank's new Environmental and Social Framework in the context of the projects it supports. The federal, provincial, and local governments constitute a prominent part of the ESD's targeted audience, but the ESD also intends to reach out to development partners and notably, the Nepali civil society and general public.

The key natural resource use themes addressed in the ESD are forest management, nature-based tourism, hydropower development, agricultural intensification, and river quarrying. For each theme, the ESD highlights the economic gains of more productive use of the associated natural resources, where possible through quantitative modeling, and points to investments and policy and institutional measures to ensure sustainability. With regard to adverse environmental impacts, the ESD focuses on pollution (including air pollution), solid waste (including hazardous substances), and road construction. It estimates the cost of pollution to the economy and provides recommendations to lower this cost. These themes were selected for their current and potential role in the economy and their current and potential impact on the environment.

Better Harnessing Natural Resources for Sustainable Growth

Sustainable Forest Management

Community forestry has greatly reduced forest degradation in the middle hills, but the protection- and subsistence-oriented forest management policy has resulted in timber imports covering some 25 percent of domestic demand and stifled job creation. Forests cover more than 40 percent of Nepal's land area and contribute to the econ-

omy and livelihoods in poor communities. They contribute directly by providing timber, fuelwood, and non-timber forest products, and indirectly through a host of ecosystem services for key sectors like agriculture, hydropower generation, and tourism. Community forestry, which covers about 40 percent of Nepal's forest areas, has greatly reduced forest degradation in the middle hills over the past three decades. At the same time, protection-focused forest management has failed to meet the country's demand for timber, resulting in imports of about 1 million cubic meters annually in recent years, and hindering employment generation by the local processing industry. Furthermore, although forest cover has increased nationally, there are localized high levels of deforestation and widespread forest degradation, potentially undermining Nepal's ability to honor its Nationally Determined Contribution (NDC) pledge to maintain forest cover at 40 percent or more. The government's new forest policy aims to change this by transitioning to sustainable forest management (SFM) and transferring most of the government-managed forests to community-based forest user groups (CBFUGs).

Modeling of timber production and sales indicates that under sustainable forest management, annual rents and government revenues from Nepal's forests could be US$456 million and US$83 million, respectively, which is six to seven times the amount under the current practices. The model included two scenarios: (i) business as usual (BAU), where 1.45 million hectares (ha) of potential production forest continues to be managed achieving mean annual increments (MAIs) of 1.0 m3/ha–1.5 m3/ha with yield factors ranging from 0.05 to 0.20, and annual deforestation ranging between 0.2 percent and 0.6 percent; and (ii) sustainable forest management, under which MAIs double with yield factors reaching 60 percent of MAIs, deforestation rates in Chure and the Terai are limited to 0.02–0.05 percent, and most productive forests are under community-based management. Based on these parameters, the model predicts that in 2030, under SFM, the total annual rents generated from Nepal's productive and protected forests could be around US$456 million, or about six times the amount generated under BAU. Similarly, under SFM, government revenues—including royalties, taxes on sales of sal trees by CBFUGs, and value added tax (VAT)—could be US$83 million, which is almost seven times the BAU estimate. The increase in production would more than cover the current level of imports and generate jobs and value add in local processing enterprises (see Table ES1). SFM would also provide opportunities for Nepal to engage in international carbon markets and receive payments for verified carbon emissions reductions.

Realization of these higher rents and government revenues requires overcoming several constraints related to the existing policy and regulatory framework and institutional capacity. The transition to federalism necessitates the restructuring of forest institutions so that they can fulfill the necessary forest management functions and their mandates at the local, provincial, and central levels. To do this, a functional review should be undertaken to analyze the institutional tasks required at each level (including assessing which functions could be assumed by the private sector, for example, harvesting and processing), assign responsibilities (following best international practice, for example, separating the functions of managing the state's forest assets and supervision), estimate the resource requirements, and prepare draft standard operating procedures. Separation of functions of control and supervision from managing the resource will be key to transparent and trusted governance.

Transfer of government forests to CBFUGs to be sustainably managed for production purposes will require significant technical assistance in the preparation and implementation of SFM plans, as well as in the monitoring of their implementation. This will require more forest officers who under-

Table ES1. Timber-Related Rents and Government Revenues Under the BAU and SFM Scenarios

	Baseline 2017	BAU 2030	SFM 2030
Production (m^3, millions)	0.96	1.11	2.89
Rents (US$, millions)	69	77	456
Government revenues (US$, millions)	11	12	83

stand and have knowledge of SFM practices. To meet this demand for technical forest officers skilled in SFM, the government has already established a Forest Research and Training Center in Kathmandu and one in each province. For the staff in the new institutions to carry out successfully their new roles, and to undertake the necessary extension and support tasks, an SFM training program needs to be initiated for forest officers and CBFUGs.

Good forest policy, strategy, and validation, as well as SFM planning, implementation, and monitoring, depend on good quality data and good data management systems. The 2015 Forest Resource Assessment (FRA) contributed to an elaboration of the 2015 Forest Policy and Forest Sector Strategy. It will be important that the Forest Research and Training Center, under the purview of the Ministry of Forests and Environment, be adequately resourced to carry out partial but incremental FRA updates on a continuous basis. Access to information and regular and transparent publication of forest data can contribute toward improving accountability and governance. Improved forest management information systems should also facilitate the move toward the development of online forest product auctions, which would help eliminate market distortions, increase competitiveness and transparency, and reduce sales costs, collusion, intimidation, and associated weak practices.

Nature-Based Tourism

Nepal's protected areas (PAs) and the rich biodiversity and unique landscapes they harbor already attract 70 percent of all tourists visiting Nepal; however, with an average per visitor per day spend of US$54, Nepal ranks lower than many comparable nature-based tourism (NBT) destination countries. This mainly is due to the overwhelming number of budget tourists, the low quality of accommodations, and limited offerings for more leisure-orientated nature-based tourists. In addition, the current high visitation to a few PAs threatens the integrity of their ecosystems. Notably, in 2017/2018, about 600,000 of the 700,000 visitors to Nepal's PAs visited only four of them: Shivapuri-Nagarjun National Park, the Annapurna Conservation Area, the Chitwan National Park, and the Sagarmatha National Park. Unhealthy price competition among local governments to attract more tourists can only exacerbate the problem. Yet, Nepal boasts a total of 20 PAs covering 23.2 percent of its land area and could diversify its NBT offering.

Several factors constrain Nepal's ability to diversify and increase the return on its NBT offering. The key constraint to the development of new PAs as tourism destinations is the lack of connectivity and tourism infrastructure. Complex regulations regarding tourism activities, especially in national parks, limit the development of higher-quality tourist services and facilities. Furthermore, the PAs that have already been established as major NBT destinations could benefit from more coordinated and integrated planning for a well-balanced and diverse mix of tourist facilities and services, ensuring environmental sustainability and tourist safety, and access from gateway cities. Local communities' ability to benefit from NBT is limited by a lack of integration in value chains and limited entrepreneurial skills.

The following key measures are recommended to enhance the ability of Nepal's PA system to generate higher revenues and em-

ployment opportunities for local communities while maintaining its natural assets: (i) invest, in partnership with the private sector, in disaster and climate-resilient and environmentally friendly transport infrastructure, starting with the PAs that have the highest market potential; (ii) simplify regulations concerning commercial activities and concessions within PAs; (iii) develop participatory integrated destination vision plans involving stakeholders from in and around the PAs, including gateway cities; (iv) upgrade environmental protection and safety measures in PAs, including management of visitor numbers to avoid overcrowding; and (v) provide advice to businesses on value chain integration, access to finance, marketing, and improving service standards.

Hydropower Development

Hydropower development is key for achieving Nepal's economic development goals. It offers the potential for uninterrupted power to productive sectors and can generate import earnings and royalties to help fund infrastructure and social capital investments. Electricity generation may also contribute to the reduction of air pollution and its associated health burden (see below) by providing a clean alternative to fossil fuels in households and allowing the popularization of electric cars, one of the government's plans to reduce vehicular emissions in urban areas. The government intends to increase the installed generation capacity from around 1,000 megawatts now to 15,000 megawatts in 2030.

Hydropower development, however, involves significant environmental and social risks and is subject to the impacts of climate change. Environmental risks concern biodiversity, aquatic life, water availability for downstream uses, slope stability (landslides), and water quality and sedimentation; social risks include loss of land and livelihoods, and displacement. Hydropower development may be also impacted by floods caused by glacial lake outbursts and a modified monsoon regime, both consequences of climate change. The Environmental and Social Impact Assessment Guidelines and a Hydropower Environmental Impact Assessment (EIA) Manual adopted in 2018 address environmental-, social-, and climate change–related risks. However, the EIA process in hydropower development is plagued by inadequate alternatives analysis (regarding particularly e-flows, fish biodiversity, sedimentation/siltation, and watershed management) and report quality, reflecting a lack of a qualified cadre of EIA professionals, and a perfunctory approach by developers. Another critical issue is the handling of forest and biodiversity clearance in a manner that balances the expected economic benefits from hydropower development on the one hand, and economic and social losses from forgone ecosystem services on the other.

A new institution, the Nepal Electricity Regulatory Commission, established in 2017, has been assigned a very powerful role in the governance of the energy sector. In particular, it is responsible for setting tariffs, setting construction and safety standards, and establishing operating procedures and rules for power plants, the electricity authority, and the transmission and distribution network. However, the institution's full range of powers will likely take time to become effective (its chairman and members were appointed only on May 6, 2019).

Key recommendations are that the EIA system be improved (see below), an aggregate forest/biodiversity compensation/offset mechanism be instituted (see below), benefit sharing with indigenous communities and local groups be systematized, and a comprehensive nationwide integrated water management policy be adopted.

Environmentally Friendly and Climate-Smart Agriculture

There are hot spots of intensive commercial crop cultivation where agrochemicals are applied indiscriminately, endangering both the environment and human health. Overall, fertilizer and pesticide application rates are lower in Nepal than in South Asia (with an average

nitrogen application of 45.5 kg versus the South Asian average of 94 kg per hectare of cropland, and a pesticide use of 0.25 kg/ha versus 0.3 kg/ha), causing the average yields of most crops to be below regional averages. However, use of agrochemicals is rampant in pockets of intensive irrigated fruit and vegetable cultivation in valleys and in parts of the Terai, such as Kabhre and along the highway connecting Kathmandu with Pokhara. Hospitalizations and deaths of farmers who ingest or apply toxic pesticides without protective gear have been reported. Global experience suggests that excessively and inappropriately applied pesticides and nutrients are also likely to contaminate groundwater and surface water resources.

Nepal's rightful wish to increase agricultural yields through expansion of irrigation may also expand harmful soil fertilization and pest management practices unless mitigated by building on promising policies and initiatives and better targeting others. The government has banned the use of 16 toxic pesticides; has regulations in place for the use, production, formulation, and distribution of pesticides; and has adopted an integrated pest management (IPM) program as national plant protection strategy. It also has good experience in conducting IPM training programs. There is also a program of district-level soil analysis; however, this program is not sufficiently granular to inform farm-level nutrient management. On the other hand, the government is implementing a fertilizer subsidy that benefits mostly large farmers and may incentivize overfertilization. It is recommended that (i) the distribution of powers and responsibilities with regard to pest, pesticide, and soil nutrient management be clarified and subnational staff capacity be built accordingly; (ii) broad-based training of trainers and farmer training on IPM be resumed in particular in areas in irrigated areas; (iii) farm nutrient management be introduced and supported by affordable farm-level soil testing, advice and farmer training, and train-the-trainers programs, especially in irrigated areas; (iv) the fertilizer subsidy be targeted to poor farmers and linked to nutrient management; and (v) guidelines for efficient irrigation be issued.

Sustainable River Quarrying

Mining of sand, stones, and aggregates from rivers, fueled by the growth in construction in Nepal and neighboring India, has provided jobs to communities and revenues to local governments, but it also has led to environmental damage. Excessive, uneven, or untimely quarrying has caused a range of adverse environmental impacts, especially in the environmentally sensitive Chure, including notably flooding, disturbing fish and aquatic life, affecting the livelihoods of fishing communities; damage to infrastructure such as roads and bridges; dust pollution in the settlements and increased noise near crusher plants and roads; and damage to agricultural land. In response, the government issued an export ban. Yet, sustainable quarrying of these materials is possible and at times desirable to avoid flooding. A number of regulatory and planning actions are recommended to this end: (i) consolidate and revise regulatory provisions scattered around multiple regulations; (ii) clarify the powers and responsibilities of the three tiers of government; (iii) develop guidelines for small-scale river quarrying; (iv) strengthen the planning and technical capacities of the relevant agencies and introduce a system of licensing based on assessment of annual yields, appropriateness of sites, and environmental and social impacts; (v) identify suitable larger-scale quarry sites at strategic locations, building on the work already done by agencies such as the Department of Mines and Geology, and using environmental and social criteria; and (vi) introduce a robust and reliable monitoring and enforcement mechanism, including a grievance redress mechanism.

Mitigating Adverse Impacts of Growth on the Environment and Natural Resources

Reducing Environmental Pollution and Related Costs to the Economy

Pollution constrains Nepal's development through its human and economic costs. The

Environmental Performance Index (EPI) by Yale University ranked Nepal fifth to last out of all countries in overall environmental performance in 2018, and second to last in air quality. Pollution has well-documented impacts on human health, including mortality, which has financial costs to households along with wider economic costs. Pollution degrades human capital—the sum of people's productive capacity—an important economic concern given that human capital is fundamental for accelerating economic growth.

Air pollution levels are high and growing. Average annual ambient concentrations of fine particulate matter ($PM_{2.5}$), the component of air pollution that is most strongly linked to health outcomes, reach 50 to 80 µg/m³, considerably exceeding World Health Organization (WHO) guidelines of 10 µg/m³. $PM_{2.5}$ has been shown to cause cardiovascular and pulmonary diseases and lung cancer in adults, and lower respiratory infections in both children and adults.

The sources of $PM_{2.5}$ pollution vary across the country, with transportation, household biofuel use, construction, and brick kilns being the biggest sources in the Kathmandu Valley. Across the country, household biofuel use dominates, with a further large fraction from agricultural residue burning. With alternative cleaner fuels, such as liquified petroleum gas (LPG) and electricity, still too expensive, nationally, around two-thirds of households use biomass for cooking, facing estimated annual average exposure of over 450 µg/m³. Hot spots for ambient air pollution include the Kathmandu Valley (particularly, Kathmandu City) and cities in the Terai, including Lumbini, a major tourist destination. Geographical conditions and cross-border impacts also play a role. Nepal borders countries that are similarly struggling with severe air quality issues, and the region could be described as facing a regional environmental crisis. India and Bangladesh are ranked among the bottom five countries of the EPI, and their pollution has cross-border impacts on Nepal.

Rubble burning in a river in a Kathmandu suburb. Photo: © Lewis Tse Pui Lung / Shutterstock.com

Nepal has recorded improvements in water, sanitation, and hygiene (WASH). But upgrades are still needed. The proportion of Nepal households with access to basic water services increased from 79 percent to 86 percent between 2000 and 2016. However, only around 27 percent of the population has a safely managed water supply, defined as free from contamination, available on premises, and available on demand, by WHO and UNICEF (United Nations Children's Fund). Around 46 percent of the population has access to at least basic sanitation facilities that are unshared. Inadequate WASH harms human health directly by causing diarrhea and other health problems, especially in young children, and indirectly by contributing to poor nutritional status. Infrastructure deficiencies resulting from delayed reconstruction and rehabilitation and damage inflicted by the 2015 earthquake are one of three primary causes of inadequate WASH in Nepal. A second is insufficient investment in maintenance, which has caused a gradual running down of functionality in many systems; in 2014, only 25 percent of systems were considered well-functioning by the then Ministry of Water Supply and Sanitation. The low quality of source water available is a third contributing factor to inadequate WASH, and a contributing factor to high costs of water treatment. The Bagmati River in the Kathmandu Valley, which is eutrophic in some areas, is a particularly severe example. Nationally, about 45 percent of all water sources (including piped water, well water, and surface water) were found to be contaminated with E. coli in 2014, with contamination rates higher in urban areas than in rural areas. Inadequate fecal sludge management is a major contributor to the contamination of water resources.

Solid and hazardous waste management remains an important challenge for the livability of Nepal's cities. Inadequate solid waste management leads to contaminated waterways, injury to wildlife, and lower urban amenity, and it is detrimental to the tourism industry. It can also pose a threat to human health: Poor solid waste management promotes conditions for insect and animal disease vectors, including mosquitoes. At 87 percent, the rate of solid waste collection is high in the Kathmandu Valley compared to other metropolitan cities, but given a lack of sanitary disposal capacity, most of the collected waste is informally dumped in the Bagmati River or at overloaded transfer stations, degrading the local environment. Collection rates vary significantly in secondary cities, and a lack of adequate disposal facilities is a common problem, leading to inappropriate riverside or roadside dumping. Also affected are mountainous tourism destinations and corridors, including protected areas, where the altitude, nature of waste, and seasonality of waste generation make effective management challenging.

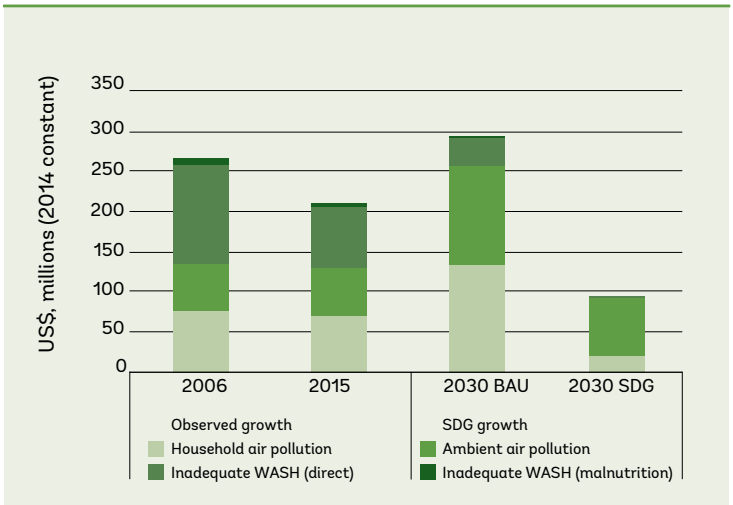
Additional challenges are posed by toxic metals and hazardous wastes. While the government's ban on paint containing levels of lead about 90 parts per million (ppm), and efforts to reduce carcinogenic asbestos imports have reduced workplace and household exposure to these toxic elements, lack of proper collection and treatment of lead-acid batteries, asbestos from demolished structures and other hazardous waste such as medical and dental waste and pesticide packaging are causing water and soil pollution risks to public health.

The annual mortality burden from pollution is estimated to be at least 33,500, a death toll greater than the devastating 2015 earthquake. This is slightly down from 2006, the last time the World Bank calculated the mortality burden of pollution for Nepal, when premature deaths were around 36,700. Both then and now, these deaths are attributable mostly to air pollution. Deaths attributable to inadequate WASH are a smaller but still significant component, causing approximately 11 percent of pollution-related deaths. While deaths owing to air pollution held roughly constant between 2006 and 2015, WASH-re-

lated mortality decreased rapidly in line with improvements in sanitation and access to safe water. By 2030, the overall pollution-related mortality is expected to be around 23,800 deaths should the current pollution trends continue (business as usual - BAU), and much lower, 8,800, if the Sustainable Development Goal (SDG) targets are reached.

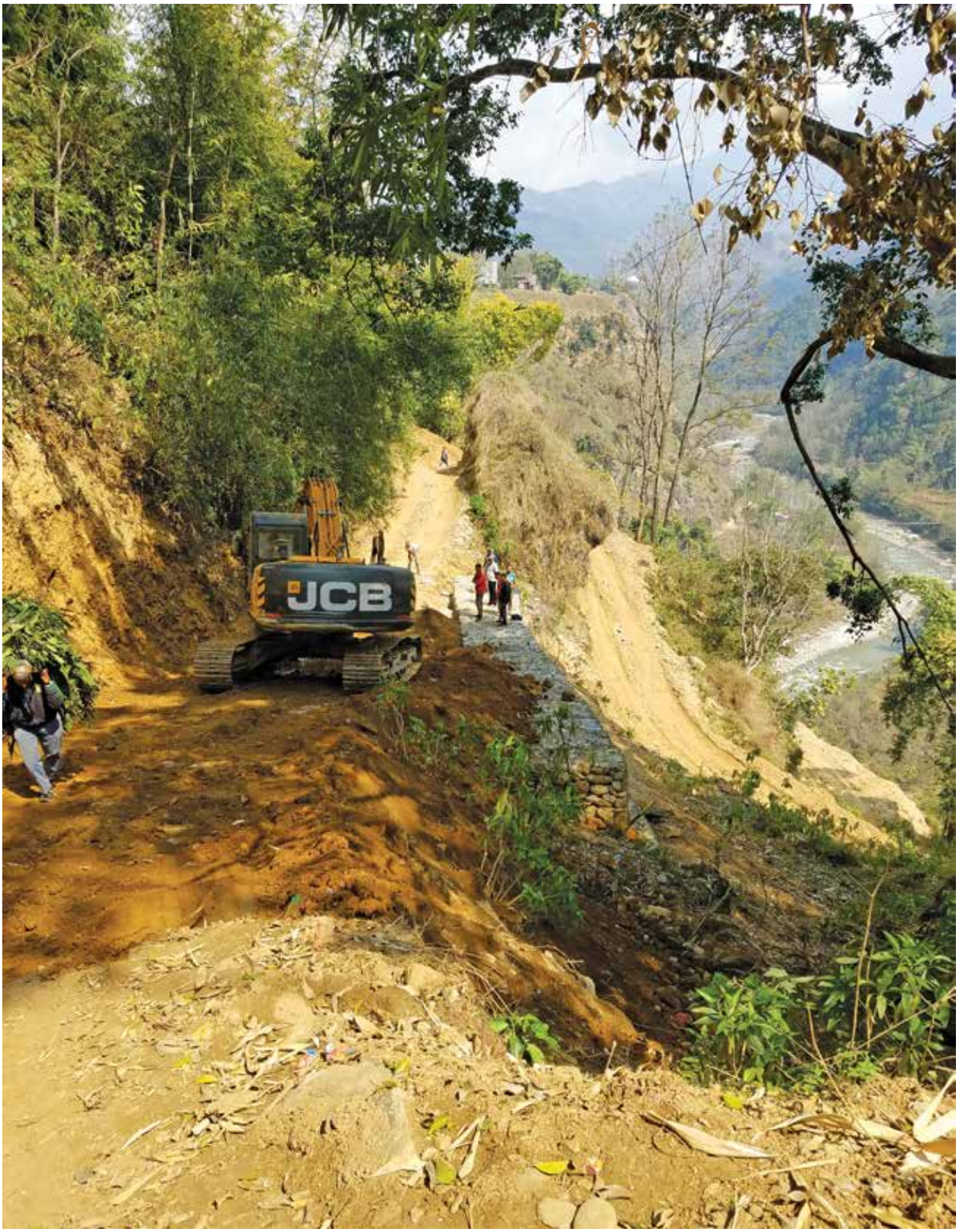
The economic cost of the health burden in terms of forgone output is estimated at US$259 million in 2015 (equivalent to 1.22 percent of Nepal's 2015 gross domestic product). In terms of lost welfare, which goes beyond lost earnings to include the nonfinancial value that individuals place on their own lives, the costs are much greater: US$1,803 million in total, equivalent to around 8.5 percent of Nepal's GDP in 2015. $PM_{2.5}$ is the greatest contributor to Nepal's overall pollution burden, with a total forgone output cost in 2015 of US$130 million per year, and a total welfare loss of US$1,362 million in 2015. These costs are equivalent to around 0.6 and 6.4 percent of GDP, respectively. Relative to the total, $PM_{2.5}$ contributes around 50 percent of forgone outcome losses, and 83 percent of welfare losses in 2015. $PM_{2.5}$ costs are roughly evenly split between household sources and ambient sources and are slightly higher (relative to population) in rural areas.

Figure ES1. Cost of Pollution in Terms of Forgone Output by Year, Scenario, and Cause



Air pollution costs continue to grow to 2030 if pollution levels continue to rise at current rates (business as usual, BAU). However, if SDG pollution targets can be met, the 2030 costs are projected to be considerably lower than at present. Under BAU, the forgone output cost grows from around US$130 million in 2015 to US$136–$256 million in 2030 (the range indicates costs under low and high rates of economic growth, respectively). These trends are driven by worsening ambient air pollution in urban areas and increasing urbanization that will bring a greater share of the population into contact with these elevated concentrations. In addition, the use of biomass for cooking in rural areas falls only marginally under BAU, from 87.8 percent to 80 percent, which is not enough to outweigh the impact of increased ambient $PM^{2.5}$. By contrast, SDG conditions see total $PM_{2.5}$ costs fall to US$47–$93 million in 2030 in terms of forgone output, and to US$591–$1,386 million in terms of lost welfare terms (again depending on rates of economic growth) (Figure ES1).

To improve the air quality in the Kathmandu Valley and other hot spot areas, it is advisable to develop an air quality management (AQM) plan and to clarify the institutional responsibilities for AQM at the three levels of government. AQM is a continuous and circular process of monitoring air quality, identifying sources, developing and adjusting policies, and implementing priority investments for pollutant reduction. In Nepal, there are 19 continuous monitoring stations, of which 12 are in Kathmandu. Data are being collected, but there is a need for capacity building to analyze the data, undertake source apportionment studies, and design effective policies. Importantly, there is a need to clarify institutional responsibilities for AQM in the new federal structure for effective implementation of these functions.



Non-engineered road construction using heavy equipment. Photo: © Annu Rajbhandari / World Bank.

Building and Maintaining Green and Resilient Roads

Road development is key for local and national economic development through improved access to markets and services, and notably, allowing development of new tourism destinations. An expansion of the strategic and local road networks from the current total of about 65,000 kilometers to about 220,000 kilometers, as suggested by the SDG target on road density, however, entails significant environmental, disaster, and climate risks. In the hills and mountains, the risk is mainly landslides; in the Terai, it is floods. Roads in the strategic road network are generally constructed following engineering design standards and some measures for greening roads and climate resilience have been applied, but there is room for mainstreaming these in Department of Roads (DOR) policies, planning, and operations. Institutionally, DOR's Geo-Environment and Social Unit should be empowered to play a leading role in this regard. In terms of policy, strategic environmental and social assessments, including cumulative impact assessment, combined with upstream planning, would be recommended as a useful tool. Furthermore, the planning and design stage needs to consider that roads often lead to encroachment: People tend to concentrate along roads and at crossroads because improved transportation of goods and people generates economic opportunities. If not managed according to sound land use planning, this influx may cause an irreversible destruction of natural resources, including forest clearance for building houses or agriculture.

The local road network comprises district road and village roads, which include agricultural roads. These roads, particularly village roads, are being constructed by local communities in a haphazard manner that does not follow technical standards or environmental risk mitigation measures. Consequently, in the hilly and mountainous regions, they have been linked with an increasing incidence of landslides, causing deaths and injuries and damaging agricultural land, forests, water, infrastructure, homes, and other structures. As the damages often impact other communities, a broader master planning process, led by provincial governments, may be warranted.

Key recommendations include (i) dimensioning local roads according to number of and types of users to make the most of infrastructure grants; (ii) preparing watershed or province-level master plans for local road network development based on cost-effectiveness and environmental, disaster, and climate risk considerations; (iii) developing a manual to guide the selection, design, construction, and maintenance of rural roads, which should consider the physical environment to avoid areas prone to erosion and deforestation; (iv) instituting programs to raise awareness on the damages associated with unplanned substandard road construction and to build technical capacity at the appropriate government levels; (v) making intergovernmental funding for infrastructure conditional on cost-effective, environmentally sustainable, and climate/disaster-resilient design as well as current performance in road maintenance; (vi) using hazard maps to inform disaster and climate-resilient road construction (however, lack of high-resolution topographical maps would limit this endeavor; therefore, preparation of high-resolution topographical maps, which form the basis for hazard maps is a priority measure); (vii) internalizing environmental aspects into the technical planning and design; (viii) strengthening the EIA/initial environmental evaluation (IEE) implementation mechanism and monitoring system; (ix) providing the possibility of recourse to the judicial system to ensure that local governments are accountable; and (x) further analytical work on resilient rural roads with a focus on of obtaining robust cost estimates of required measures for environmental sustainability and resilience in different topographical and climatic conditions.

Strengthening Governance for Sustainable Development Under Federalism

Assessing and Monitoring Environmental Impacts

There is a risk of resource degradation in the shift from a protection-oriented natural resource management approach to one that is oriented to sustainable production and is to be regulated and overseen by new subnational governments, which have severe capacity constraints and face high expectations from their electorates. The continuing lack of clarity on the division of powers and accountability arrangements further exacerbates the risk. The ongoing process of federalism, which involves the clarification of mandates that were left ambiguous in the 2015 constitution, must be managed in a way that reduces this risk. To this end, a timed and prioritized action plan for policy and regulatory revisions to clarify the division of concurrent powers, as well as for institutional capacity building at subnational governments should be put in place and with periodic status checks and possibility to adjust course.

Environmental impact assessment is a priority area for regulatory enhancement at all three tiers of government, given the large amount of planned infrastructure investments. Although the EIA/IEE procedures have been integrated in development project preparation, the process has been largely perfunctory; the EIA documents have been mostly of low quality and thus ineffective in mitigating negative environmental impacts. Current practices should be improved in terms of quality of alternatives analysis, documentation, public consultations, and access to information. Moreover, the EIA process will remain weak if compliance monitoring and enforcement is not strengthened. Furthermore, the EIA process should apply as effectively to public entities as to private enterprises. There should also be the possibility of recourse to the judicial system to ensure that all levels of government are accountable for actions that do not comply with the Environment Protection Act (EPA). Regarding management of pollution from industrial and cottage industries, one recommended approach consists of setting up a registry of polluting facilities, which would allow authorities to monitor them more easily. A pollution tax commensurate with the level of pollution or nuisance generated may also be considered. For small-scale projects, which are implemented by local governments and may have significant cumulative impacts, such as local roads, a monitoring system could help with the enforcement of the EPA requirement that initial environmental evaluations be carried out for such activities and penalties for noncompliance be applied.

The draft new Environment Protection Act (EPA 2019) shares many principles that are core to the World Bank's Environmental and Social Framework, but it lacks some critical elements and requires additional regulations and institutional capacity for implementation. The draft EPA 2019 lacks adequate attention to climate change, cumulative impacts, and public consultation and participation. The Environment Protection Rules (EPR) 1997 have not yet been revised to describe institutional powers and responsibilities across the three tiers of government, preventing the effective implementation of the principles contained in the draft EPA 2019. Staff capacity to review and monitor the implementation of EIA/IEE documents at relevant levels of government will be also be critical. Furthermore, to improve the quality of EIA reports, a certification, accreditation and vetting system of EIA practitioners is recommended. In addition, a platform for geographical environmental data and sharing of knowledge for planning purposes, hosted by the National Planning Commission, is recommended.

The lack of clarity on the division of roles and responsibilities for compliance monitoring, inspection, and enforcement among the three tiers of government needs to be

eliminated and new mechanisms need to be developed to strengthen monitoring. In the absence of a permit system, approved EIA/IEE documents prescribe the parameters related to pollutant discharges and emissions, waste management, and other types of environmental impacts of an enterprise or a project, based on relevant regulations and standards. The draft EPA 2019 stipulates that some monitoring, inspection, and enforcement-related roles and responsibilities will be devolved to subnational governments, but it does not provide operational details. Therefore, here again, the revision of EPR 1997 coupled with sectoral guidelines and manuals for EIA/IEE studies will be necessary to define roles and responsibilities of the different levels of government and provide the tools for the said devolution to be effective. An additional strong recommendation stemming from a widely applied practice (for example, the European Pollutant Emission Register) is the preparation of a comprehensive registry of polluting facilities ranging from large industrial enterprises or estates to medium, small, and micro enterprises, classifying them according to size and type of pollutant. The registry would also indicate different thresholds per responsible tier of government in charge of monitoring, inspection, and enforcement.

Enhancing Institutional Capacity at the Subnational Government Level

The Federalism Capacity Needs Assessment carried out by the World Bank in 2019 and stakeholder consultations confirm the weak capacity of most subnational governments for carrying out their environmental management mandates in the face of major plans for infrastructure development and shift to productive natural resource use. This finding points to the need for a substantial, long-term continuous program addressing gaps in various aspects of capacity, which may vary by location, thematic priorities, and size of municipality and province. Capacity is a multidimensional concept that includes staffing levels; skills and knowledge; physical facilities; financial resources to fund investments in and maintenance and operation of environmental protection infrastructure, as well as capital and recurrent expenses of regulatory activities; and intergovernmental and public communication. Capacity needs will evolve as the concurrent roles and responsibilities are further clarified in the dynamic federalism process. Nevertheless, given the significant environment and natural resources challenges, capacity enhancement urgently needs to begin.

Functional reviews at local and provincial governments should guide the capacity enhancement program. The functional review should evaluate the abovementioned aspects of capacity in the light of the mandates. It should be focused and efficient, and easy and inexpensive to repeat as the mandates and thematic needs evolve. Regarding the staffing aspect of capacity, different studies suggest that in some urban municipalities there may be more positions than prescribed by the Ministry of Federal Affairs and General Administration, but the key question to explore is whether the skills of the existing staff match the current mandates. Adjustments need to be made accordingly by altering the staffing mix and trying to upgrade skills where possible through training programs. A key skill needed in all municipalities and provinces will be to evaluate and monitor environmental impacts of private and public investments. Training programs may start with modules on fundamental government functions in environmental management, becoming more specialized depending on individual government units' needs.

Access to information and accountability are also key aspects of environmental governance. Currently, both aspects would benefit from improvements. It is therefore recommended that (i) a transparent monitoring and tracking system be established to provide information to all stakeholders on major projects and activities impacting the environment and natural resources; (ii) public access

to information be promoted; (iii) an effective grievance-redress mechanism be introduced to allow citizen to dispute decisions that may affect the environment; and (iv) transparency of the decision-making process be promoted.

Offsetting Forest and Biodiversity Loss due to National Priority Projects

Where options to "avoid," "minimize," and "mitigate" the potential adverse impacts of large development projects on forests have been exhausted, and there is no other option but to clear forests in a proposed national priority project area, an "offset" is the last resort to compensate a society for the ecosystem services that would be lost. Nepal's national priority projects, notably hydropower-related structures, roads, and airports, may indeed require the clearance of forests in national forests areas and protected areas, as well as, to a lesser extent, nonforest habitats in protected areas. The extent of forest clearance under a national priority project will vary; run-of-the-river hydropower plants will likely cause limited clearance, while transportation infrastructure projects may involve extensive clearance. A good example is the proposed Nijgadh International Airport, which would require the clearance of approximately 8,000 hectares of natural forests.

A compensation/offset mechanism is needed to handle potentially extensive or cumulative forest/habitat clearance activities in an environmentally sound and socially acceptable manner while avoiding undue burdens to investors. Such a mechanism would collect cash payments from developers and use them to (i) establish and maintain physical offsets, and (ii) compensate users of the cleared forest for the loss of productive and other benefits they derive from it. The compensation/offset mechanism should follow these principles:

- Offsets should result in no net loss and preferably a net gain of forest biodiversity.
- Offsets and user compensation should be socially acceptable.
- The developer's cash payment should be enough to cover the costs to establish and manage the offset.
- The developer's cash payments should be economically efficient, reflecting the value to the society of lost ecosystem services.
- The developer's cash payment should be determined in a way that is fair, simple, and transparent.
- The compensation/offset framework should be governed according to good international practices.
- The compensation/offset framework should be monitored and evaluated regularly.

It is recommended that the government move toward an "aggregated forest/biodiversity offset" because of the efficiency and more strategic approach it provides compared with one-off single offsets and because the government is planning multiple national priority projects that may require substantial cumulative forest and other habitat clearances. Compensation/offsetting clearance of forests and other habitats in protected areas should be commensurate with the significance of the biodiversity under protection, placing an important role on the alternative analysis and the EIA process. Liberia's biodiversity offset roadmap, which targets a network of protected areas for offsetting the biodiversity impacts of large-scale mining activities, represents a relevant example for Nepal.

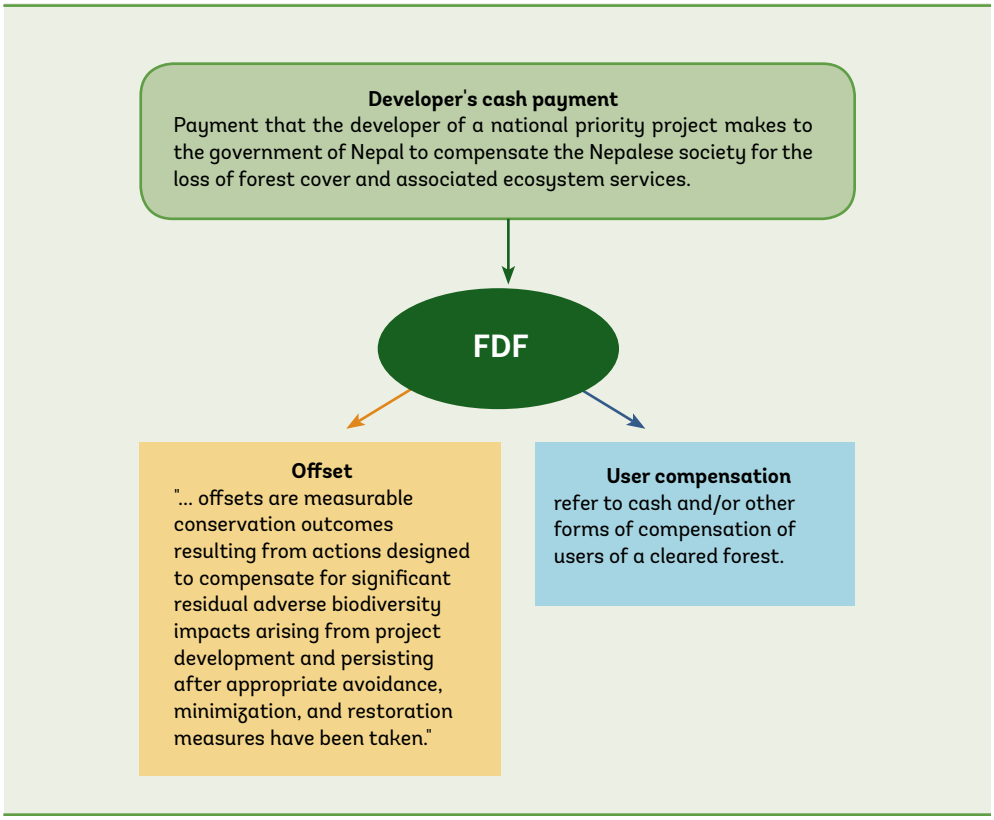
The government has put in place some of the building blocks for a compensation and offset mechanism. First, the use guidelines for national forests allow developers to make cash payments to the government or carry out in-kind afforestation/reforestation in equivalent degraded forest areas. Second, in early 2019, the government set up a Forest Development Fund (FDF) as the mechanism to collect developers' cash payments. The resources are to be used for establishing the forest offsets and for compensating the users of the cleared forest (Figure ES2). It is recommended that the

next key steps be to (i) define the governance for FDF; (ii) finalize the standards and norms for determining the cash compensation amount to be paid by developers; (iii) identify areas feasible for re- or afforestation and rehabilitation (especially degraded lands) and increased habitat protection; and (iv) prepare the guidelines for user compensation. These additional building blocks are essential for developing an aggregate forest/biodiversity offset mechanism to be managed by the Ministry of Forests and Environment in collaboration with the provincial governments.

Intergovernmental Financing as Incentive for Improved Environmental Management

The mechanism of intergovernmental transfers offers opportunities to incentivize investments in reducing environmental externalities in line with national and provincial goals and standards. The 2015 constitution provides for intergovernmental revenue sharing and fiscal transfers to ensure that subnational governments have enough resources to carry out programs within their own mandate and "their part" of federal and provincial programs. The National Natural Resources and Fiscal Commission (NNRFC) has helped set up a revenue sharing program and four different grant programs for fiscal transfer to provincial and local governments using indexes to account for key socioeconomic conditions in the receiving jurisdictions. The existence of intergovernmental financing itself is positive for environment and natural resource (ENR) management as it lessens the risk of subnational governments resorting to excessive natural resource extraction. At the same time, the majority of the transfers are in the form of uncon-

Figure ES2. Compensation/Offset Framework



ditional grants. Given most local stakeholders' preferences for infrastructure with immediate material benefits such as roads or water supply, unconditional grants are unlikely to be allocated to substantial investments reducing environmental externalities such as wastewater treatment or proper waste disposal, especially where these impact other communities. Therefore, it is recommended that the NNRFC explore the option of establishing a conditional grant dedicated to mitigating environmental externalities. The NNRFC may also consider instituting an element of competitive federalism, by including in the allocation formulas of conditional and infrastructure grants indicators on environmental quality or level of efforts by provincial and local governments to reduce ENR degradation, such as road maintenance and compliance with road standards and environmental requirements.

Summary of Recommendations

Table ES2 compiles the ESD's key recommendations to address the issues identified above.

Table ES2. Main Recommendations of the Nepal Environment Sector Diagnostic

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Better harnessing natural resources for sustainable growth			
Sustainable forest management (SFM)	Carry out functional review of the divisional and subdivisional forest units	MOFE, PG	S
	Initiate training program for divisional and subdivisional forest officers and community forest user groups in SFM	MOFE	S
	Empower the Forest Research and Training Center to carry out annual partial updates of forest resource assessment	MOFE	M - L
	Separate functions of managing forests and supervision Institute an appropriate framework of incentives and sanctions to minimize chances of corruption	MOFE	M
	Pilot online auctioning	MOFE, PGs	M - L
Nature-based tourism (NBT)	Develop participatory integrated destination plans for protected areas, surroundings, and gateway cities	PGs, MOFE	S - L
	Enhance connectivity to protected areas with high NBT potential	MOFE, PGs, LGs	M - L
	Simplify regulations concerning activities and concessions within protected areas	MOFE	S
	Upgrade environmental protection and safety measures in protected areas	MOFE	S - M
	Provide advice to businesses on value chain integration, access to finance, marketing, and improving service standards	MOFE, PGs, LGs	S - M - L
Hydropower development	Enact a comprehensive nationwide integrated water management policy as well as relevant technical guidelines	MEWRI	M
	Systematize the use of strategic environment assessments (regional or sectoral), cumulative impact assessment to capture sectoral, regional, or national environmental and social considerations	MOFE, MEWRI	M
	Clarify mandates of the three tiers of government regarding hydropower development and management	Government	S
Environmentally friendly agriculture	Clarify the distribution of powers and responsibilities with regard to pest, pesticide, and soil nutrient management and build subnational staff capacity accordingly	Government, MALD	S
	Resume broad-based training of trainers and farmer training on integrated pest management, in particular in areas in irrigated areas	MALD, MLMACs	S
	Introduce farm nutrient management supported by affordable farm-level soil testing, advice, and farmer training, and train-the-trainers' programs especially in irrigated areas	MALD, MLMACs	M
	Target fertilizer subsidy to poor farmers and link it to nutrient management	MALD, MLMACs	M
	Issue guidelines for efficient irrigation	MEWRI	M

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Sustainable river quarrying	Consolidate and revise regulatory provision scattered around multiple regulations	MICS, MOFE	M
	Clarify the powers and responsibilities of the three tiers of government	Government	S
	Issue guidelines for small-scale sustainable river quarrying	MICS, MOFE, LGs	M
	Clarify principles for exporting aggregates from river quarrying	Government	S
	Strengthen the planning and technical capacities of the relevant agencies and introduce a system of licensing based on assessment of annual yields, appropriateness of sites, and environmental and social impacts	MICS, MOFE, Government	M
	Introduce a robust and reliable monitoring and enforcement mechanism	DOE, MICS, LGs	S
Mitigating adverse impacts of growth on the environment and natural resources			
Air pollution	Issue point source air emission standards and update those for brick kilns	DOE, MOI	M
	Update ambient air quality standards	DOE	L
	Increase density and management of air monitoring networks	DOE	M
	Improve and enforce vehicle (and fuel) emission standards	DOE, MOPIT	M - L
	Incentivize use of electric vehicles in the administration and public transportation fleet	MOF, MOPIT, MOFE	M
	Enforce measures to reduce road-based sources of dust pollution	PGs, LGs	M
	Promote cleaner cooking methodologies, including electric cooking, to reduce indoor air pollution	DOE, NGOs	S
Water, sanitation, and hygiene (WASH)	Carry out thorough diagnostic of WASH infrastructure and develop a nationwide maintenance and rehabilitation plan	MWS	M
	Define responsibility of three tiers of government with regard to construction and maintenance of WASH infrastructure and strengthen capacity	Government	S
	Carry out investments and maintenance in line with the 2016 National Water and Sanitation Strategy	MWS	M - L
	Carry out a nationwide assessment of contamination by agrochemicals from agricultural runoffs	DOE, MALD	M
	Carry out a nationwide heavy metal contamination survey of surface and ground water	DOE, MWS	M
	Undertake spatial planning to protect watersheds	MEWRI, MOFE	M
Solid and hazardous waste management	Develop hazardous waste management policy and act	MOFE	S
	Carry out a survey of survey of sources of soil contamination attributable to inappropriate elimination of hazardous waste (batteries, asbestos products, etc.)	DOE, MOFAGA	M
	Introduce a deposit-refund system to incentivize recycling	NPC, NNRFC, DOE	M
	Improve waste collection in mountainous areas and protected areas	MOFE	S

Theme/Issue	Recommendations	Key stakeholders[a]	Priorityb Short, Medium, Long term
Resilient and green roads	Expand application of guidelines for construction of more climate- and disaster-resilient roads, particularly for the local road network	DOR	S
	Mainstream disaster and climate risks, sustainability aspects, and green approaches throughout the project cycle from upstream planning, construction, operation and maintenance, and closure/decommissioning	DOR	M
	Clarify roles of three tiers of government regarding construction and maintenance of the road network	Government	S
	Ensure Geo-Environment and Social Unit within DOR has sufficient resources and clear mandate	DOR	S
	Develop local road network (LRN) development guidelines including cost-effective appropriate scaling, technical standards, environmental risk mitigation measures, and climate and disaster proofing elements	MOFAGA	S - M
	Develop master plans for LRN based on cost-effectiveness and environmental, disaster, and climate risk considerations. Strategic environmental and social assessments should be carried out to provide the basis for environmental, disaster, and climate risk considerations	PGs	M
	Institute long-term programs to raise awareness in local and provincial governments on environmental, disaster, and climate risks and cost to the economy associated with local road development and to build technical capacity for design, planning, and evaluation commensurate with mandates	MOFAGA	M
	Make allocation of intergovernmental grants for infrastructure development contingent on design that optimizes road dimensions based on vehicles per day and minimizes environmental damage and takes into account climate and disaster risks Make performance in maintenance of existing roads one of the criteria for deciding on funding allocation by federal and provincial governments for new infrastructure	NNRFC, FG, PGs	M
	Develop high-resolution topographical maps followed by hazard maps for rural areas	MLMCPA	M - L
	Carry out analytical work to identify requirements for more environmentally resilient rural roads, particularly focusing on the optimizing budget/cost aspects	DOLI	S
	Organize capacity strengthening programs/activities to reinforce the implementation efficiency and monitoring system in road design, construction, and maintenance	DOLI, provincial ministry in charge of transportation	S
	Issue guidelines defining the process for internalizing environmental considerations into technical planning and design of roads	MOPIT, MOFAGA	S
Governance for sustainable growth under federalism			
Devolution of powers	Pass regulations detailing rights and responsibilities of the three tiers of government regarding environmental management	Government	S
Regulatory framework	Finalize and enact the revised Environment Protection Act and the corresponding Environment Protection Rules as well as impact assessment guidelines	MOFE	S
	Strengthen requirements for ensuring appropriate quality of environmental impact assessment/initial environmental evaluation	DOE	S
	Introduce strengthened public consultation and environmental disclosure requirements	DOE	S
	Establish a registry of polluting activities, including level of taxation based on importance of pollution and nuisance generated	DOE	M

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Use of offset mechanism	Amend the Forest Use Guidelines 2017 defining the standard for developer's cash payment	MOFE	S
	Define and regulate the governance mechanism for the Forest Development Fund	MOFE	S
	Identify and prioritize areas feasible for re- and afforestation and rehabilitation (especially degraded lands) and increased habitat protection	MOFE	S - M
	Define guidelines for user compensation	MOFE	S - M
	Develop aggregate forest offset mechanism	MOFE	M
Capacity strengthening	Develop and deploy urgent capacity strengthening program for enhancing the environmental management capacity of province and local governments	MOFE, sectoral ministries	S
	Conduct a large consultation for defining the most appropriate approach (top-down or bottom-up) to fill the capacity gap in provincial and local governments	MOFE, NGOs	M
	Develop a comprehensive mechanism for collecting environmental data and information to improve management and ensure Nepal fulfills its international commitments	DOE, sectoral ministries, CBS	S - M
Access to information	Promote public access to environmental information	DOE	S
	Introduce an effective grievance-redress mechanism to allow citizens to dispute decisions that may affect the environment	DOE, MOFAGA	S - M
Accountability	Promote transparency of the decision-making process to ensure accountability	Government	S
Financing mechanisms	Adopt an explicit formula for competitive fund transfer to incentivize good environmental and natural resource stewardship by provincial and local governments	NNRFC	M

Note: CBS = Central Bureau of Statistics; DOE = Department of Environment; DOLI = Department of Local Infrastructure; DOR = Department of Roads; FG = federal government; Forest Use Guidelines 2017 = Procedure Relating to the Use of National Forest Area for National Priority Projects 2017; LG = local government; MALD = Ministry of Agriculture and Livestock Development; MEWRI = Ministry of Energy, Water Resources, and Irrigation; MICS = Ministry of Industry, Commerce and Supplies; MLMAC = (provincial) Ministry of Land Management, Agriculture and Cooperation; MLMCPA = Ministry of Land Management, Cooperatives and Poverty Alleviation; MOFAGA = Ministry of Federal Affairs and General Administration; MOF = Ministry of Finance; MOFE = Ministry of Forests and Environment; MOI = Ministry of Irrigation; MOPIT = Ministry of Physical Infrastructure and Transportation; MWS = Ministry of Water Supply; NGO = nongovernmental organization; NNRFC = National Natural Resources and Fiscal Commission; PG = provincial government.
a. The stakeholders listed here are meant to be those in leading role. Undoubtedly, there will be a need for the cooperation of stakeholders from within and outside the concerned sector, to realize synergies and mitigate externalities.
b. Short term (S): up to two years; medium term (M): up to six years; long term (L): up to 10 years.

1. THE CONTEXT

1.1. Nepal's Constitution of 2015

The 2015 constitution frames Nepal's political and economic future based on the implementation of a radical federalism framework. It also commits this development to be sustainable by focusing on the improvement of the citizens' well-being and the responsible and balanced use of natural resources for growth and prosperity.

Federalism

In 2008, Nepal became a parliamentary republic after years of civil strife. In 2015, a new constitution introduced a decentralized, federated system of seven provinces and 753 local governments. The first elections for local governments and the federal House of Representatives were held in 2017. The constitution redistributes decision-making powers, including those related to environment and natural resources (ENR) management, among the three tiers of government but also grants some concurrent powers. The development of legislation, including revision of sectoral laws and regulations, to enable the new administrative arrangements of the new federated system is ongoing, as is staffing of administrative cadres. The speed of progress in clarifying administrative roles and responsibilities and of filling corresponding positions will have important repercussions for ENR management.

Sustainable Growth

While the 1990 constitution stated that the "State shall pursue a policy of mobilizing the natural resources and heritage of the country in a manner which might be useful and beneficial to the interest of the Nation,"[2] it emphasized that the "State shall give priority to the protection of the environment and also to the prevention of its further damage due to

Box 1.1. 2015 Constitution on Policies Relating to Protection, Promotion, and Use of Natural Resources

The State shall pursue policies to

(1) Protect, promote, and make environmentally friendly and sustainable use of natural resources available in the country, in consonance with national interest and adopting the concept of intergenerational equity, and make equitable distribution of benefits, according priority and preferential right to the local communities;
(2) Make multipurpose development of water resources, while according priority to domestic investment based on public participation;
(3) Ensure reliable supply of energy in an affordable and easy manner, and make proper use of energy, for the fulfillment of the basic needs of citizens, by generating and developing renewable energy;
(4) Develop sustainable and reliable irrigation by making control of water-induced disasters, and river management;
(5) Conserve, promote, and make sustainable use of, forests, wildlife, birds, vegetation and biodiversity, by mitigating possible risks to environment from industrial and physical development, while raising awareness of general public about environment cleanliness;
(6) Maintain the forest area in necessary lands for ecological balance;
(7) Adopt appropriate measures to abolish or mitigate existing or possible adverse environmental impacts on nature, the environment, or biological diversity;
(8) Pursue the principles of environmentally sustainable development such as the principles of polluter pays, of precaution in environmental protection and of prior informed consent; and
(9) Make advance warning, preparedness, rescue, relief, and rehabilitation to mitigate risks from natural disasters.

Source: Nepal 2015 Constitution, Article 51 (g).

2 Nepal 1990 Constitution, Article 26 (3).
3 Nepal 1990 Constitution, Article 26 (4). The same article continues to say that "the State shall also make arrangements for the special protection of the rare wildlife, the forest and vegetation."

physical development activities."[3] Nepal's 2015 constitution is much more explicit and detailed about both underwriting the citizens' right to a clean environment and emphasizing balancing conservation and development.[4] It details the state's responsibility to pursue policies related to the protection, promotion, and use of natural resources (see Box 1.1). The provisions that commit the state to developing environment-friendly, quality, and sustainable infrastructure and prioritizing environment-friendly technologies in transportation further epitomize its internalization of sustainable growth.[5]

1.2. Nepal's Economy and Plans for Sustainable Growth

"Nepal aspires to emerge as an inclusive, equitable, and prosperous middle-income country by 2030 with the spirit of welfare state. The country aims at sustainable poverty reduction and promotion of human development with low vulnerability and higher human security" (Nepal, NPC 2017, 14). Nepal's socioeconomic development aspirations are reflected in the SDG targets, of which a most relevant subset to this ESD is presented in Table 1.1.

Nepal is a land-locked, low-income country endowed with extensive natural capital which, however, generate limited returns.[6] The country is home to about 28 million people and covers a land area of 147,000 square kilometers spanning elevations from 93 meters to 8,848 meters in five different physiographic regions, with climatic conditions ranging from subtropical to arctic. While endowed with rich natural resources—including forests that cover some 40 percent of its geographical area, unique scenic landscapes and biodiversity, fertile soils in the Terai, water availability and hydropower potential—Nepal's economy is characterized by low productivity and underinvestment in physical and human capital (World Bank 2018).

Low returns are also prevalent in sectors that are based on the natural resource endowment, namely forestry, nature-based tourism, energy generation, and agriculture. Notably, of the estimated exploitable hydropower potential of some 43 gigawatts (IHA 2017), just above 1 gigawatt is currently exploited, which led, until recently, to frequent load shedding, which in turn hampered industrial activities. Consequently, Nepal's GDP growth rate averaged 4 percent from 1995 to 2015. The impressive gains in poverty reduction, from 46 percent in 1996 to 15 percent in 2011,[7] were made possible among others by international remittances, which contributed 30 percent of the GDP. On the other hand, migration, especially of young males, to the richer Terai region in the south and to Southeast Asian and Middle Eastern countries has led to labor shortages in the central middle hills, affecting the tourism, agriculture, and construction sectors.

Besides increasing hydropower generation capacity, Nepal can benefit from transitioning to sustainable uses of other natural resources. For instance, moving from protection-based forestry to production-oriented sustainable forest management, diversifying and improving the quality of the tourism offering in its protected areas to attract more tourists from higher-income segments, and using its water resources to promote higher-yield irrigated agriculture. Higher returns thus achieved could help finance improvements in physical and human capital, further increasing economical productivity. They can also be used to finance investments needed to protect these assets, so they generate high returns in the long run.

4 Nepal 2015 Constitution, Article 30, states that "(1) every citizen has the right to live in a clean and healthy environment and (2) the victim shall have the right to obtain compensation, in accordance with law, for any injury caused from environmental pollution or degradation." Article 30 (3), goes on to say, "This Article shall not be deemed to prevent the making of necessary legal provisions for a proper balance between the environment and development, in development works of the nation."

5 Article 51(f) and Article 51(h).

6 With a GDP per capita of US$849 (2017) (data.worldbank.org).

7 Based on international US$1.90 (2011 PPP) per day per capita (World Bank 2018).

Nepal has been making progress in addressing "traditional" types of environmental pollution but is now more and more confronted with "modern" types of pollution associated with economic growth and urbanization. Traditional pollution includes contaminated drinking water and household air pollution caused by use of biomass for cooking. Nepal has been on a promising track in improving drinking water quality, as well as sanitation and hygiene, and has made modest gains in reducing household air pollution. On the other hand, "modern" types of pollution, namely ambient air pollution, are increasing fast because of urbanization, an increase in vehicular transportation, and industrialization. The growth of cities, economic development, and tourism lead to the generation of increasing quantities of solid and hazardous waste, the safe disposal of which is proving particularly challenging. Finally, similar factors cause pollution of Nepal's rivers and groundwater, not only making treatment for drinking water supply more expansive but also impacting aquatic life and recreational amenities.

Nepal faces climate change and disaster risks, which require enhanced resilience of livelihoods and infrastructure. The degree

Table 1.1. Select SDG Indicators and Targets Related to Nepal's Economic Development Plans

Indicators	Baseline (2015)	Target (2030)
2.1.1 Prevalence of malnourishment (%)	36.1	3
2.1.3 Per capita food grain production (kg)	320	530
2.2.4 Population below minimum level of dietary energy consumption (%)	22.8	4.6
3.2.1 Land productivity (metric ton per hectare)	3.6	6.0
2.3.2 Fertilizer use (kg/ha)	97	100
2.3.5 Round the year irrigated land in total arable land (%)	40	80
6.1.5 Population using safe drinking water (%)	15	90
6.3.1 Proportion of untreated domestic wastewater (%)	99	65
6.3.2 Proportion of untreated industrial wastewater (%)	99	10
7.1.3 Households using solid fuel as primary source of energy for cooking (%)	74.7	10
7.2.2 Installed capacity of hydropower (MW)	782	15,000
8.1.1 Per capita GDP growth (%)	2.3	7
8.2.1 Growth of agricultural sector (%)	0.8	5
8.2.2 Growth of construction sector (%)	3.1	15
8.2.3 Annual growth of real GDP per employed person (%)	1.6	10
9.2.1 Industry's share in GDP (%)	15	25
9.2.2 Manufacturing value added as a proportion of GDP (%)	6.6	15
8.9.1 Tourist arrival (million)	0.8	3
8.9.2 Tourism direct GDP as a proportion of total GDP (%)	2.6	8
8.9.3 Annual number of jobs in tourism industries ('000)	90	1,000
9.1.1 Road density (km/km^2)	0.44	1.50
9.1.2 Paved road density (km/km^2)	0.01	0.25
9.2.1 Industry's share in GDP (%)	15	25
9.2.2 Manufacturing value added as a proportion of GDP (%)	6.6	15
11.6.3 Concentration of $PM_{2.5}$ (μg/m^3, 24 hours' average)	40	20
11.6.9 Municipalities provided with sewerage services (%)	45	100
12.2.1 Proportion of total water resource used (%)	10	20
15.1.1 Forest under community-based management (% of total dense forest) areas)	39	42
15.1.2 Conservation area (including forest, in % of total land area)	23	23.3
15.3.1 Rate of forest loss and degradation (%)	1.9	0

Source: Nepal, NPC 2017.

and nature of vulnerability to natural disasters vary across Nepal. Rainfall levels are on average higher in the Terai, but drought has the largest monetary and welfare impact. Glacial lake outburst floods and landslides pose a significant national and regional risk that is increasing because of climate change–induced glacier thinning and retreat in the Himalayas. Poor road construction has also been linked to increased incidence of landslides and associated losses. In the non-Himalayan region, climate change projections indicate that the risk of flooding will increase considerably in Nepali river basins because of higher monsoon precipitation (a projected increase of 14–40 percent by the 2030s and 52–135 percent by the 2090s) (World Bank 2018).

1.3. Nepal's International Commitments

Nepal is committed to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), and to managing its rich biological diversity, as detailed in its National Biodiversity Strategy and Action Plan for 2014–2020 presented to the Conference of the Parties of the United Nations Convention on Biological Diversity (CBD) (Nepal, MFSC 2014). At 0.2 tCO2e/year, Nepal's per capita greenhouse gas (GHG) emissions are among the lowest in the world. Together, land use changes resulting in deforestation and forest degradation account for the single largest source of Nepal's GHG emissions (Nepal, MOPE 2014). Nepal's 2016 Nationally Determined Contribution (NDC) (Nepal, MOPE 2016) highlights the role of forest management for emission reduction (see chapter 2). Nepal's NDC also lists key actions for adaptation, including community-based flood risk reduction, and for enhancing resilience by mainstreaming climate risks in development.

1.4. Opportunities and Risks for Sustainable Growth Under Federalism

The federal structure of Nepal presents opportunities for sustainable growth, but the swift, far-reaching devolution of power to subnational governments carries risks for natural resources and the environment. In the long run, the new federal framework can provide greater efficacy, transparency, and accountability by entrusting powers to subnational governments. Indeed, the transfer of power from central to local institutions brings decision makers closer to impacted stakeholders and enables quicker decisions. Local elected officials are motivated to attend to local issues because they will be accountable for their decisions in the next elections. On the other hand, local decision makers may have less overview of and less inclination to consider the (external) impacts that activities in one local government may have on other localities (for example, landslides caused by substandard local roads in one locality may damage natural and built assets in another locality). Local governments may also consider natural resources such as forests as a quick source of income to meet local needs and not be motivated to engage in sustainable management activities whose returns may be lower but steady over the years. Furthermore, capacity building in newly established local governments usually trails big bang devolutions, leaving the resource unattended for some time until staffing is complete and resources have been allocated. The repercussions can be devastating for some natural resources. Similarly, local governments will not be able to handle adequately increasing environmental pollution, notably air pollution and waste, brought economic growth and urbanization, until they are endowed with adequate institutional capacity.

1.5. Objective and Content of the Environment Sector Diagnostic

The objective of this Environment Sector Diagnostic is to inform policies, investments, and institutional capacity-building measures in key areas of natural resource use and environmental management to support sustainable growth and prosperity in Nepal in the context of federalism. The ESD is envisaged to inform investment projects, such as those under preparation with the World Bank support on forest management and nature-based tourism, and government policies, including those supported under planned and ongoing World Bank development policy credits aimed at promoting energy generation and maximizing finance for development. Importantly, the ESD aims to facilitate the implementation of the World Bank Environmental and Social Framework to World Bank investments conceptualized after October 1, 2018.[8] While the federal, provincial, and local governments constitute a prominent part of the ESD's targeted audience, the ESD is also intended to reach out to other development partners and notably, the Nepali civil society and general public.

The present report presents a synthesis of several analytical background pieces and consists of five chapters. Chapter 2 focuses on sustainable utilization of key natural resources, namely forests, biodiversity/landscapes, water, soil, and minerals. Chapter 3 addresses mitigation of risks for the environment associated with development, including notably urbanization and road development. This chapter also presents estimates of the cost to the economy of select areas of environmental degradation. Chapter 4 reviews policy and institutional challenges to realizing sustainable natural resource use and affectively mitigating environmental risks associated with economic growth in the context of federalism, and provides recommendations. Chapter 5 summarizes the key recommendations. Discussion of crosscutting issues, including notably gender and climate change, is incorporated across all chapters as relevant. The ESD was not intended to be comprehensive, covering all ENR issues in Nepal; rather, it focuses on selected areas of particular relevance to Nepal's dual transformation mentioned above.

It is worth noting that the ESD was carried out in a very fluid context as all three tiers of government were engaged in updating the country's institutional and legal framework in accordance with the constitution. An effort was made to provide long-term recommendations while recognizing achievements made in the short term. Nevertheless, some of the findings and recommendations will inevitably be outdated soon after this report is published. At the same time, there continues to be areas where further analysis needs to be carried out to inform policy and institutional strengthening, as discussed in chapter 4.

8 The World Bank Board of Directors adopted the framework in 2017 and made its application mandatory to all Bank-supported investment projects for which project concept note review meetings are held on or after October 1, 2018.

2. BETTER HARNESSING NATURAL RESOURCES FOR SUSTAINABLE GROWTH

This chapter reviews the key natural resource uses in terms of potential for contribution to economic growth, key policies for sustainability, and implications of federalism. The focus is on the sustainable use of the following: forest management, nature-based tourism, hydropower development, agricultural intensification and irrigation, and river quarrying.

2.1. Sustainable Forest Management

This chapter reviews the economic potential of transitioning from a protection and subsistence-oriented approach to one of sustainable forest management to build productively on gains achieved through community-based forest management. According to the Food and Agriculture Organization, "SFM can be viewed as the sustainable use and conservation of forests with the aim of maintaining and enhancing multiple forest values through human interventions. People are at the center of SFM because it aims to contribute to society's diverse needs in perpetuity" (FAO 2019). This section also discusses policy, regulatory, and capacity (technical and institutional) constraints in the context of federalism.

2.1.1. The Asset

Covering more than 40 percent of Nepal's land area, forests are an important asset contributing to the economy, both directly and indirectly. The forest areas are estimated to total around 5.96 million hectares, or 40 percent of the country, with an additional 0.65 million hectares (4 percent) covered by other wooded land (Nepal, DFRS 2015).[9] Thirty-eight percent of forests and other wooded lands are in the middle hills, 32 percent in the high mountains, 23 percent in Chure, and 7 percent in the Terai (Nepal, MFSC 2015).[10] Protected areas (PAs), including national parks and their buffer zones, reserves, and conservation areas, cover about 24 percent of Nepal (see Figure 2.2). Nepal hosts 27 Key Biodiversity Areas.[11] Most of Nepal's forests are owned by the state and are classed as (a) national forests and (b) forests in PAs, with the latter making up about 17 percent of all forests. Registered private forests occupy less than 1 percent.[12] Per the Forest Act 1993, national forests are subdivided into six management regimes: (i) government-managed forests, (ii) protected forests, (iii) collaborative forests, (iv) community forests, (v) leasehold forests, and (vi) religious forests. Community forests cover about 35 percent of Nepal's forest areas.

As a natural asset, forests provide critical ecosystem services beyond timber and fuelwood and support key sectors of the economy, including agriculture, hydropower generation, and tourism. The forest sector's contribution to Nepal's GDP is not measured separately but together with agriculture,[13] which was estimated at 29.5 percent

9 "Other wooded land" is defined as "the land not classified as forest spanning more than 0.5 ha, having at least 20 m width and a tree canopy cover of trees between 5% and 10%" (Nepal, DFRS 2015).

10 The Terai is the lowland belt in the south of Nepal; Chure is the low range of hills between the Terai and the middle hills.

11 Key Biodiversity Areas are sites that contribute significantly to the global persistence of biodiversity (http://www.biodiversitya-z.org/content/key-biodiversity-areas-kba). For those in Nepal, see http://www.keybiodiversityareas.org/site/mapsearch.

12 Some 54,900 hectares (Nepal, MFCS 2016). However, private forest area is increasing given natural regeneration on abandoned farmland in the middle hills. Some believe that the share is much higher (Rai et al. 2017).

13 There is no commonly agreed definition of the forest sector. Ideally, the sector should be defined to include all economic activities that mostly depend on the production of goods and services from forests. This would include commercial activities that are dependent on the production of wood fiber (that is, production of industrial roundwood, wood fuel, and charcoal; sawn wood and wood-based panels; pulp and paper; and wooden furniture). It would also include activities such as the commercial production and processing of non-timber forest products and the subsistence use of forest products. It could even include economic activities related to production of forest services (although it would be difficult to determine exactly which activities are really dependent on forest services). (www.fao.org/docrep/007/ad493e/ad493e05.htm)

14 Retrieved from the National Accounts of Nepal 2017/2018, Central Bureau of Statistics, Kathmandu (accessed December 13, 2018), http://cbs.gov.np/naoNepal201718.

in 2016/2017.[14] Previous estimates of the forest sector's contribution to GDP were 4.4 percent for the period 1990 to 2000 and 3.5 percent in 2000 (Nepal, MFSC 2009), and 2.2 percent (primary wood products)[15] (MSFP 2016). Some of these GDP estimates are limited to **provisioning services** such as timber products, and do not fully reflect non-timber forest products (NTFPs). As Nepal has not adopted the System of Environmental-Economic Accounting (SEEA), GDP estimates do not account for critical forest ecosystem services including r**egulating services** such as erosion prevention, hydrological services, and pollination; and **cultural services** such as the provision of habitats for biodiversity. Although these services contribute directly to value added of agriculture, tourism, and hydropower they are not adequately valued, leading to over or misuse (Rai et al 2017). Forest use also generates significant employment, with the number of jobs estimated at 1.7 million, of which about 145,000 are formal (ERI 2011 as reported in MSFP 2014).

2.1.2. Gains From Community-Based Forest Management

Community-based forest management is largely credited with the reversal of the deforestation and degradation trend between the 1960s and 1990s in the middle hills. Forest cover in Nepal consistently declined from 1957 to 1994, with the percentage of forest area falling from 45.5 percent in 1964 to 29 percent in 1994 and the percentage of shrubland growing from 4.7 percent in 1978/79 to 10.6 percent in 1994 (Nepal, MOFE 2018). These figures evidence both the loss of forest goods and services (degradation) and changes to other land uses (deforestation) during that period. This trend was most pronounced in the middle hills, where forest lands were used for grazing and fuelwood extraction in an uncontrolled manner or increasingly converted to cropland (Paudel et al. 2016). Codified in the Forest Act 1993, community-based forest management (CBFM)[16] aims to achieve conservation outcomes as well as meet household forest subsistence requirements. CBFM entails decentralizing forest management to village-level self-governing user groups who have use and management rights over village forests under extraction rules regarding timber and non-timber products agreed with the Department of Forests (Shyamsundar and Gathe 2014) through an operational plan. As of May 2017, 2.9 million households organized in community forest user groups (CFUGs) were managing 22,266 community forests of total 2.2 million hectares (Nepal, DOF 2017). Studies on community forestry's impact found reduced fuelwood extraction in the presence of CFUGs (Tachibama et al. 2001; Edmonds 2002) and an association between length of period of community management and the density of pole-size trees (indicating the rehabilitation of forests) (Poudel, Fuwa, and Otsuka 2015). Community forestry has been favorable for ecosystem services provision, including greenhouse gas sequestration, provisioning of NTFPs, and habitat for biodiversity (Birch et al. 2014). In addition to community forestry, natural regeneration on abandoned agricultural lands in the middle hills has contributed to the recovery of forest cover (Thierry et al. 2015).

Community forest management has had some positive impacts on livelihoods, but women's participation in CFUGs remain significantly below targets. A study of community forestry in Nepal found that CFUGs have had a positive impact on livelihoods and food security. A five-year study covering 2,700 households from 26 CFUGs in the Koshi Hills showed large-scale improvements on people's livelihoods and food security (Ojha, Persha, and Chhatre 2009). It showed that 46

15 The year of the estimate is not specified in the source document.

16 Nepal, MFSC (2016, xiii) defines CBFM as a set of forest management modalities that involve local people in planning, implementation, and benefit sharing, including community forest management, pro-poor leasehold forest management, collaborative forest management, buffer zone management, public land management, and urban forestry.

percent of the poor users improved their economic situations and long-term capacities because of their participation in CFUGs. On the other hand, women's participation in CFUGs is significantly below the official target of 50 percent set by the Nepali community forestry guidelines. A study published in 2015 found that only 1,000 out of 18,000 forest user groups included women (RECOFTC 2015). Research links the lack of equal participation to the typically weak or nonexistent land tenure rights of women (Buchy and Rai 2008). Anecdotal evidence suggests, however, that the number of women in CFUG committees has increased substantially since 2015 because of the enforcement of new community forestry guidelines; a detailed study of all CFUGs is yet to be carried out to confirm the increased percentage of women in the committees and the extent to which they have been empowered to influence decisions as compared to their male counterparts.

2.1.3. An Underperforming and Threatened Asset

However, the protection-oriented forest management policy has failed to meet the country's demand for timber, resulting in significant imports and stifling employment generation by the local processing industry. Kanel et al. (2012) projected the total domestic demand for timber in 2015 to 3,750,000 cubic meters. A model developed under this ESD indicated that production in 2017, estimated at nearly 1 million cubic meters, fell significantly short of this amount (see Table 2.2 and next section for details). Part of the deficit is covered through imports from African countries, Australia, Denmark, Indonesia, Malaysia, Myanmar, New Zealand, and Vietnam, among others. For example, in fiscal years 2015/16 and 2016/17, Nepal imported 1.2 million cubic meters and 0.83 million cubic meters at CIF values of roughly US$1 billion million and US$1.5 billion,[17] respectively (Nepal, DFSC 2019).

Furthermore, although forest cover has increased nationally, there are high levels of deforestation in certain parts of the country as well as widespread forest degradation. The Terai, which has the lowest percentage forest cover of Nepal's regions (20.8 percent), experienced an annual deforestation rate of 0.44 percent over the period 1999–2010. Key drivers for deforestation in the Terai have been urbanization and resettlement, encroachment, and mining and excavation of sand, boulders, and stones. Degradation of Terai forests has been driven by unsustainable and illegal harvesting, overgrazing, weak forest management, mining and excavation, expansion of invasive species, and forest fires. The Chure region, with a forest cover of 73.6 percent, had an annual deforestation rate of 0.18 percent over the same period, driven by the same three factors, as well as by infrastructure development and manmade disasters. The forest cover has increased in the middle mountains, which has 53.7 percent forest cover, and in the high mountains and high Himal, which together have a forest cover of 37.8 percent. Nevertheless, the forests in the middle mountains are strongly impacted by infrastructure development, and those in the high mountains are particularly sensitive to forest fires and overgrazing, and impacted by infrastructure development (Nepal, MOFE 2018). Indirect drivers of deforestation and forest degradation include lack of clarity over land and resource tenure, poor forest governance and cross-sectoral collaboration, demographic and cultural complexities, limited access to markets and related livelihood opportunities, and high opportunity costs for agricultural land use compared to forest use.

2.1.4. National Policies Related to Forest Management

The government's new forest policy is grounded on the goal to increase forests' contribution to national prosperity. The 2015 Forest Sector Policy describes the vision

17 CIF = cost, insurance, and freight.

Box 2.1. 2015 Forest Sector Policy: Key Areas of Implementation

- Increase the productivity of forest sector and production of forest products through SFM.
- Increase the benefits from environmental services, including biodiversity and resource conservation, and ensure their justifiable and equitable benefit distribution.
- Integrate conservation and management of watershed areas to increase land productivity through water and land conservation.
- Make community-managed forests—including community, leasehold, collaborative, buffer zone, community, protection, and religious forests—environmentally, economically, and socially capable, with justifiable and equitable sharing of the benefits.
- Create green employment and value addition by involving the private sector in forest development and expansion through forest enterprise promotion, product diversification, and marketing.
- Implement the mitigation and adaptation approaches for the negative impacts of climate change.
- Capacitate the management for good governance, inclusion, and social justice promotion in the forest sector.

Source: Nepal, MFSC 2015.

of the government of Nepal as one where the "potentials of forest ecosystems, biodiversity and watersheds [are] fully optimized for peoples' prosperity" (Nepal, MFSC 2015). The policy also provides that forest ecosystems and watersheds be managed to be sustainable and climate resilient, sustainably managed through a decentralized, competitive, and well-governed forest sector providing inclusive and equitable incomes, employment, and development opportunities. The policy highlights the need for sustainable forest management to increase forests productivity and production to fulfill national demand. SFM is mentioned as a tool for achieving the forestry ministry's vision, "Forests for Prosperity" (Nepal, MFSC 2015) (see Box 2.1).

The 2016 Forest Sector Strategy also underscores the need for sustainable forest management to harness potential productivity and the contribution to local livelihoods and national socioeconomic development. The strategy has set ambitious targets on economic contributions of forests. By 2025, the forest sector is to contribute at least 7.5 percent to GDP, generate at least six times more jobs, reduce annual timber imports by 50 percent, and increase commercial timber supply to the domestic market annually by six times (Nepal, MFSC 2016). Nepal, MFSC (2009) estimates a total sustainable timber production potential of 8.34 million cubic meters per annum from 1.39 million hectares of production forests with an annual productivity of 6 m3/ha, and 13.31 million cubic meters in 4.43 million hectares of hill and mountain forests with a productivity of 3 m3/ha, totaling 21.64 million cubic meters annually.[18]

Nepal is committed to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) and to reducing its carbon emissions. Nepal's 2016 NDC (Nepal, MOPE 2016) points out that Nepal aims to enhance its forest carbon stock by at least 5 percent by 2025 compared to the 2015 level and to decrease the mean annual deforestation rate by 0.05 percent from about 0.44 percent and 0.18 percent in the Terai and Chure, respectively. Nepal pledged that at least 40 percent of its area will remain under forest cover. Forest productivity and products will be increased through sustainable management of forests. Emphasis will equally be given to enhance carbon sequestration and forest carbon storage and improve forest governance. Nepal is active in REDD+ and aims to put in place a forest carbon trade and payment mechanism by 2025.

Nepal is also a signatory to the Convention on Biological Diversity (1994) and is committed to protecting and sustainably man-

18 Table 2.1 in Magrath et al. (2013).

Table 2.1. Estimated Timber-Related Rents, Royalties, and Taxes Under BAU and SFM Scenarios

	Baseline 2017	BAU 2030	SFM 2030
Production (m3, millions)	0.96	1.11	2.89
Trade (m3, millions)	0.56	0.67	2.50
Rents (US$, millions)	68.96	77.02	455.90
Government revenues (US$, millions)	11.39	11.89	83.48
Royalties (US$, millions)	2.89	2.77	0
Sales tax on Sal (US$, millions)	0.78	0.49	25.07
VAT (US$, millions)	7.72	8.63	58.41

aging its globally important biodiversity. Nepal's revised National Biodiversity Strategy and Action Plan 2014–2020 has a long-term vision (35 years) and specific short-term (up to 2020) strategies and priorities for action. The latter are clustered into six sectoral thematic areas (protected areas, forests outside protected areas, rangelands, wetlands, agriculture, mountains) designed to address key biodiversity threats, gaps and issues, the Aichi Biodiversity Targets, and the Millennium Development Goals.

2.1.5. Estimating Rents and Government Revenues From Nepal's Forests

As part of the ESD, a model was developed to estimate timber production, associated rents, royalties, and tax revenues from trade. A 2017 baseline scenario and two stylized scenarios in 2030, business as usual (BAU) and SFM, were considered. Resource rent is defined as "a surplus value, i.e. the difference between the price at which a resource, or the output from it, can be sold and its respective extraction and/or production costs, including normal returns" (Scherzer and Sinner 2006). The resource rent associated with timber may be captured by the government on behalf of the state, which owns the forests through royalties or stumpage fees. Where the royalty is less than the rent, the difference is captured by the initial buyer of the timber or by users of timber in down the value chain (Scherzer and Sinner 2006). The model focuses on four key tree species, namely sal, asna, pine, and sissoo. It accounts for differences among the regions and management regimes as reflected in mean annual increment, yield factors (the actually harvested amount of the MAI), and annual deforestation and degradation rates. The model is described in Box 2.2. The scenarios are stylized to estimate the potential of SFM. Many factors will impact the speed of transition to and the implementation of SFM over the area considered in the model.

Model estimates indicate that under SFM production, sales, rent, and government revenues could be multiples of BAU levels. As Table 2.1 indicates, total annual rent generated from Nepal's productive and protective forests could be around US$456 million or six times the amount generated under BAU. Correspondingly, under SFM, government revenues, including from royalties, taxes on sales of sal by CFUGs, and VAT, could be about US$83 million or more than seven times the amount under BAU. It is important to note that the difference in production would be more than sufficient to cover the imported amount and help generate jobs in local processing enterprises. See Box 2.2 for a description of the model.[19]

It should be noted, however, that the transition to SFM would require significant investments. The time direct cost of transitioning to SFM, including a one-time cost of preparation of SFM plans and annual

19 In estimating timber related rents in the BAU 2030 and SFM 2030 scenarios it was assumed that the current market prices would prevail. In reality, higher domestic supply of timber may lead to different market prices depending on the level of demand. Demand itself will be affected by factors like economic and population growth, migration and urbanization trends, availability and prices of alternative construction materials and global timber supply. Market prices for timber will in turn impact the level of supply by CBFUGs and private producers.

Box 2.2. Description of the Timber Model

The model estimates timber production and trade by community-based forest user groups, private producers, and the government in the 2017 baseline, the 2030 BAU scenario, and the 2030 SFM scenario.

The production estimates from CBFM forests and government-management forests are based on the CFUG database (2017) and the Forest Resource Assessment (Nepal, DFRS 2015) for areas of national forest in the Terai, Chure, and middle hills. (The forests of the high-hill and Himalayan regions were excluded from the model because of their inaccessibility.) These areas were divided into potential production and protection forests,* with the former being identified in accordance with the government's SFM-related guidance documents (Nepal, MFSC 2014; Nepal, PCTMCDB 2015).†

The total potential production forests were thus estimated at 1.45 million hectares and protection forests at 2.17 hectares in the baseline. Assumptions on the mean annual increments and yields, as well as deforestation and degradation rates in both types of forests and in all three scenarios, are detailed in Table A1.1 in annex 1 (where Tables A1.1–A1.4 are located).‡ For production forests, the Department of Forests records on trade in 2017 are used as the basis for estimates on production in the baseline, and for production and trade in the BAU and SFM scenarios (see Table A1.2). Estimates of production under different scenarios and management regimes, and derivation of traded volumes are presented in Tables A1.3 and A1.4, respectively. These estimates allow for 20 percent unrecorded sales (over the sales recorded by district forest offices [DFOs]) in the case of private producers, and about 100 percent over those originating from government-managed forests (see Tables A1.1 and A1.4). (In government-managed forests, especially in the middle hills, abandonment of felled logs in the forest is common, justifying the stated assumption.)

The Baseline. The mean annual increment is assumed to be 1.5 m3/ha in the Terai and 1.0 m3/ha in the middle hills (Dhungana 2018).§ The assumed yield factors are low, ranging from 0.05 to 0.20, reflecting the current protection focus in the country (see Table A1.1). Timber is traded by private producers, community-based forest user groups (CBFUGs), the Timber Corporation of Nepal (TCN), DFOs, the District Forest Product Supply Committee (DFPSC), and others from government-managed forests. Most of the timber from government-managed forests is sold at market prices by the TCN and at harvesting cost plus royalty by DFOs, while the rest is sold by the DFPSC at prices significantly below the market level to households in need of post-disaster reconstruction.** The state also collects from DFOs, TCN, CBFUGs,, and private producers a VAT of 13 percent on market prices and a specific additional sales tax of 15 percent on sales of sal by CBFUGs.

BAU Scenario. Under the BAU scenario, the baseline assumptions perpetuate until 2030. The forest area and growing stock decline due to deforestation and degradation.

SFM Scenario. It is assumed that all potential productive forest areas with SFM potential are transferred to CBFM. The government's vision is that eventually the majority forests that are currently managed by the government will be transferred to CBFM,†† and all forests under CBFM that meet the SFM conditions will implement SFM (Nepal, MFSC 2016). MAIs were conservatively assumed to be double that of the baseline levels, or 3.0 m3/ha/yr in the Terai and 1.5 m3/ha/yr in the Hills, and that the actual harvest is estimated at 60 percent of the MAIs (Dhungana 2018). Furthermore, the deforestation rate is assumed to be 0.05 percent per year in the Terai and Chure, in line with the government's target.

* "Production forest" is defined as forest area designated primarily for production of wood, fiber, bio-energy and/or non-wood forest products (FAO 2019).

† Subsection 2.2 of the MFSC's Scientific Forest Management Working Procedures (Nepal, MFSC 2014) specifies that an area less than 100 hectares is not eligible for SFM. The Chure Master Plan recommends eligibility of forests with a slope of less than 19 degrees for forests in the Chure, Terai, and Inner Terai valleys. According to this plan, such forests are eligible for preparing an action plan applying an appropriate silviculture system with the objective of increasing forest productivity (Nepal, PCTMCDB 2015, 69).

‡ A detailed methodology note is also available from the authors upon request.

§ The MAIs and yield estimates are for community forests and government-managed forests together assuming medium condition forest with less than 200 m3/ha average growing stock (Nepal, DOF 2004, 51). For community forests, the guidelines specify that yield may not exceed 60 percent of average annual growth and local forest office may add further location-specific restrictions in the community forest operational plans. Magrath et al. (2013, 41) mention that "[t]he current annual increment of the forests in Nepal is estimated to be about 0.6 to 1.2 cubic meters per hectare."

** Subsidizing forest products by selling at less than the market price, while understandable from a social welfare perspective, undermines the true value of the forest, creating a number of negative impacts (it discourages efficient utilization, creates opportunities for windfall profits, and can lead to poor governance and investment decisions). There are other more transparent and fairer methods to provide subsidies and social welfare.

†† Excluding forests in protected areas or protected forests.

Table 2.2. Changes in Institutional Roles and Responsibilities Envisaged Under Federalism

Issue	Before federalization	After federalization
Right to demarcate national forests and to acquire private property in and around national forests with appropriate compensation	District forest officer	Divisional forest officer
Preparation of management plans for government-managed forests	Department of Forests to be approved by Ministry of Forests and Soil Conservation	Provincial forest directorate to be approved by the province-level Ministry of Industry, Tourism, Forest and Environment (MITFE)
Implementation of management plans for government-managed forests	District Forest Offices	Division Forest Offices
Declaration of a national forest as protected forest	Government of Nepal	Provincial government
Preparation of management plans for protected forests and implementation	Government of Nepal	Provincial forest directorates, approved by MITFE, and implemented by divisional forest offices
Hand over any part of national forest as community forests, and provide technical or other support to the users for formation of community forest user groups (CFUGs)	District forest officers	Divisional forest officers
Preparation of operational plans for community-managed forests	CFUGs supported by district forest officers	CFUGs supported by divisional forest officers
Hand over any part of national forest as leasehold forests	Regional forest directorates with approval from Ministry of Forests and Environment	Provincial forest directorate, with approval from MITFE
Hand over any part of national forest as religious forests	District forest officers	Divisional forest officers can hand over to religious groups or institutions
Register private forests	District forest officers	Divisional forest officers can issue certificate to any individual or organization, who has submitted application for registering private forests

Note: Changes are those envisaged per Forest Act 1993, Third Amendment.

incremental operational cost of implementing them, is estimated at US$100/ha and US$102/ha/annum, respectively (Dhungana 2018). In addition, there will be the indirect cost of institutional restructuring and capacity building, which is discussed further below.

2.1.6. Capacity and Policy Enhancement Needs for Successful Implementation of SFM

Realization of these higher rents and royalties requires overcoming several constraints related to the existing policy and regulatory framework and the institutional capacity in the transition to federalism. A summary of the constraints, a review of government efforts to address them, and targeted recommendations are provided below.

2.1.6.1. Institutional Capacity

The 2015 constitution introduces a new division of power and responsibilities regarding the management of Nepal's forests. It accords the power to make national forest policy to the federal government, while the management of national forests and ecology within provincial borders is a provincial mandate. The federal and provincial governments have concurrent powers over forests, wildlife, and national parks spanning more than one province. Federal, provincial, and local governments have concurrent powers over forest management. The federal, provincial, and local levels have concurrent powers for royalties received from natural resources. On the other hand, all management is under provincial jurisdiction (see Table 2.2 and Table 4.1).

The transition to federalism has necessitated the restructuring of forest institutions. Prior to federalism, management of national forests, including those under CBFM, were under the purview of the district forest offices (DFOs)

Table 2.3. Institutional Setup in the Forest Sector

Level of government	Number of governments	Forest institutions
Federal	1	MOFE
Provinces	7	MITFEs, 84 forest divisions and 528 subdivisions
Local	753	CFUGs; private forest owners

Note: CFUG = community forest user group; MITFE = Ministry of Industry, Tourism, Forest, and Environment; MOFE = Ministry of Forests and Environment.

of the Department of Forests (DOF).[20] Forest management functions previously carried out by the DFOs have now been transferred to provincial ministries of industry, tourism, forest and environment and their provincial forest directorates and provincial forest divisions (see Table 2.2). Currently there are 84 divisions and 528 subdivisions. There are 753 local governments. The divisions are in the process of delineating the boundaries of the subdivisions in a way to coincide with local government boundaries. The Ministry of Forests and Environment's long-term vision is to create subdivisions in each local government to avoid conflicts between local government, provincial government, and forest offices (Dhungana 2018) (see Table 2.3). At the same time, the legal basis for making subdivisions congruent with local government jurisdictions is not clear, neither is the role of local governments in forest management.

T**he power-sharing arrangements between provincial and local governments are evolving.** As per the 2015 constitution, local governments have no management responsibility over forest resources. But they will receive a certain percentage of income once the revenue-sharing arrangement among all three levels of government is finalized. In the future, provinces will develop forest laws, in which some management responsibilities may be given to local bodies, in some cases.

Staffing provincial-level institutions has been a challenge. To staff the new organizational structures, 84 undersecretary-level divisional forest officers, 528 forest officers, and around the same number of lower forest officers such as rangers and forest technicians are needed. While this number of forest officers are available in the ranks of the Department of Forests and Soil Conservation,[21] relocating civil servants from the capital city to the provinces and from the federal government to provincial governments initially proved challenging because of concerns about reporting arrangements, career advancement and mobility, and lack of equivalent facilities needed by families. On the other hand, provincial governments were unable to hire "civil servants" on their own account because no law existed to guide the hiring, development, retainment, and exiting of civil servants, and nor were there independent "public service commissions" at the province level to recruit civil servants. The adoption of the Civil Service Readjustment Act 2017 removed the former constraint, while provincial public service commissions are still in the process of being established.

Successful implementation of SFM will require not only full staffing at provincial and local levels but also significant improvements and retuning of skills. The transfer of government forests to communities to be sustainably managed for production purposes will require technical assistance to such groups in the preparation and implementation of SFM plans, as well as monitoring of their implementation. This will necessitate not only a greater number of forest officers but also those with training and experience in sustainable forest management. While forest officers have been generally exposed to SFM in their academic training, hands-on experience has been limited to pilot scientific forest management

initiatives. To meet the demand for technical forest officers skilled in SFM, the government has already established a Forest Research and Training Center in Kathmandu and one in each province. In addition, the Ministry of Forests and Environment (MOFE) plans to hire freelance technical experts who will be certified through the Forest Council (Dhungana 2018). A Forest Council bill has been prepared and is currently under discussion. For the design of a comprehensive capacity-building program, a functional review of the new institutions and structures needs to be carried out, taking into account different institutional mandates, including management and control (see below).

2.1.6.2. Planning and Management Tools

Steady generation of good-quality and consistent data are essential for policy making and validation and for SFM planning and monitoring. The 2015 Forest Resource Assessment (Nepal, DFRS 2015) filled a long-standing gap for a forest inventory and has contributed to the elaboration of the 2015 Forest Policy and Forest Sector Strategy (2016). It will be important that the MOFE Forest Research and Training Center (formerly Department of Forest Research and Survey – DFRS) be adequately resourced to carry out annual partial updates. Furthermore, forest accounts that gauge the ecosystem services provided by forests can contribute to forest policy making. Forest ecosystem services can also be reflected in the System of National Accounts (SNA) through the adoption of the System Environmental Economic Accounting (SEEA).

2.1.6.3. Policies

Separation of functions of control and supervision from managing the resource will be key to transparent and trusted governance. Numerous documents have reported alleged misconduct of district forest officials, including illegal logging and trade, leading to distrust by stakeholders involved and suggestions for alternative institutional configurations (Magrath et al. 2013; Prasai et al. 2018). This issue will assume larger significance under SFM where misguided interpretation of production orientation may lead to large-scale unsustainable harvesting. International experience (Broekhoven, Savenije, and von Scheliha 2012) indicates that separating the functions of managing forests, including supporting the design and implementation of SFM plans, from supervising the same is an effective way for avoiding misconduct, in addition to an appropriate framework of incentives and sanctions. A participatory process with all stakeholders will be necessary for the development of such an institutional setup.

For CBFUGs and small and medium enterprises processing forest products to thrive and generate jobs, market distortions and unfair competition by parastatal organizations should be eliminated. When the parastatal organizations—the Timber Corporation of Nepal, the Herbs Production and Processing Company Limited (HPPCL), and the Forest Products Development Board (FPDB)—were established some four to six decades ago,[22] there may have been a justifiable need for state involvement in producing, procuring, processing, and selling forest products to targeted groups at lower-than-market prices. However, there is no longer a need for parastatals to carry out functions that the private sector can carry out. The private sector has the capacity to harvest and process timber and NTFPs locally. MOFE has attempted to reform these parastatals by merging the TCN and FPDB into a single entity called Nepal Forest Corporation, with an aim to transform it into a "Plantation and Forest Management Authority" in the long run, while at the same time, upscaling HPPCL. Nepal's private sector, however, is critical to the success of this government initiative.

22 The TCN and FPDB were established in the 1960s and the HPPCL in 1981.

The government's role now should be to create the enabling environment so more businesspeople can invest in these enterprises. In contrast, analysis after analysis has shown that these parastatals distort market prices to the disadvantage of CFUGs and small and medium enterprises (Mitchell, Bajracharya, and Baral 2001; Magrath et al. 2013). As such, they would undermine the commercialization of the additional timber and NTFPs to be produced under SFM. Furthermore, most of time these parastatals run losses on their operations and as such are a burden on the government budget (Magrath

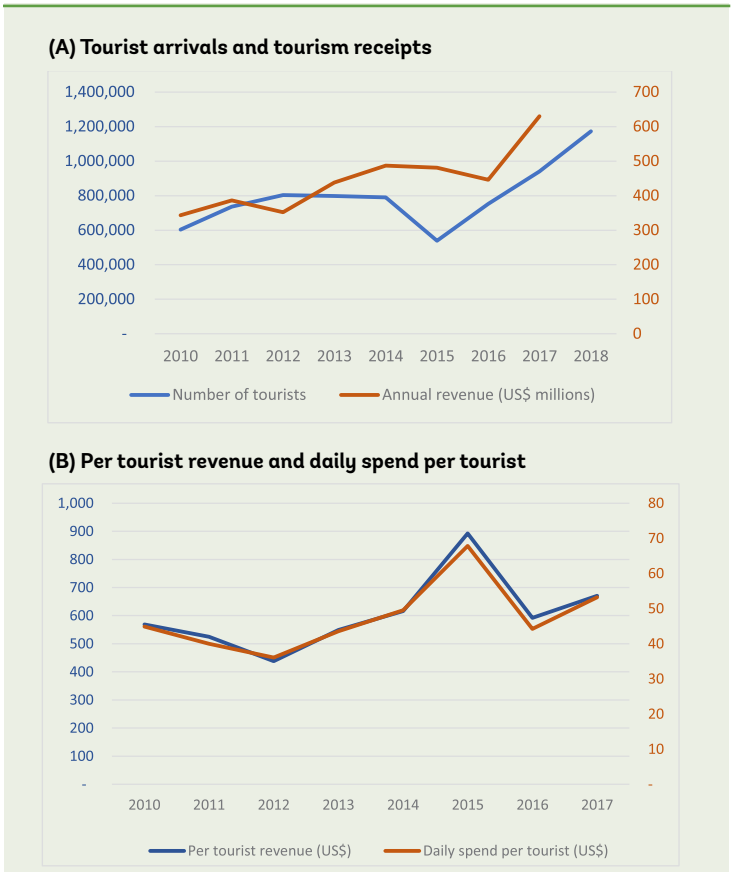
Box 2.3. Online Auctioning of Timber

Online timber sales methods have been developed in a number of countries in Europe over the last 20 years or so. They have the following features in common:

- They allow for competitive sale of timber and timber products through
  - Online notices (of the proposed date of sale or auction), and catalogues of the description of the lots for sale to include product (for example, standing roundwood, roundwood at roadside, rough sawn timber, treated fence posts, pulpwood delivered, wood pellets), species, quality, location, information of how the lots can be inspected by prospective buyers); and
  - Online bids, submitted from bidders' own computers in their own offices in real time, thereby reducing the opportunities for intimidation, collusion, and bid rigging.
- Online timber sales save sales-related costs, increase prices, and ensure equal access to timber sources.
- Lots can be designed to meet the requirements of different buyers (for example, large lots of defined specification for industrial users such as pulpwood, to smaller parcels of sawlogs for smaller more local buyers).
- Sales can be through different methods, for example, real-time competitive auctions or through the equivalent of sealed bid tenders.
- Systems allow for increased transparency through the accurate collection and publication of production and sales data. Some examples of online timber sales systems:
  - The Belarusian Universal Commodity Exchange was incorporated on May 25, 2004, as a state-owned joint stock company. The first trading session, to sell timber, took place on June 2, 2005. The exchange proved so successful that it was later expanded to include agricultural and metal products, consumer products, and government e-procurement. In 2012, average round timber prices sold at the exchange auctions exceeded the prices of round timber sold under civil contracts outside of the auctions by 30–50 percent. State forest enterprises upload the details of their sales into the system for sale on a given date. Numerous products and grades are sold on a regular basis (for example, weekly, monthly, or as needs) depending on availability and demand and are purchased by both domestic and international buyers (230 international buyers from 20 countries). http://www.butb.by/trade-for-timber/wood-resources-of-belarus/
  - The United Kingdom's Forest Enterprise (the part of the Forestry Commission responsible for managing the state-owned forest) sells timber through the Forestry Commission Electronic Sales System (e-sales). Under this system, details of the sales are uploaded onto the system as catalogues of sales to be sold by a given deadline. Bidders then submit the equivalent of sealed bid tenders online. https://england.etimbersales.net/
  - TimberAuctions is a round timber marketing service for buyers and sellers throughout the United Kingdom. TimberAuctions' monthly electronic timber sales have been operating nonstop since 1995, selling over £16 million worth of hardwood and softwood timber from both private and state woodlands. Timber sellers can enter parcels of standing or felled timber into forthcoming sales using the online entry form and then watch live timber auctions on their own computer at home or office. Timber buyers can download catalogues containing details of all currently available timber parcels and all users have free access to the latest timber price information, including the annual electronic sales event calendar, newsletters, and press releases. The monthly sales are operated in accordance with an industry-wide agreed practice standard. The standard sets out how electronic timber sales should be conducted in the United Kingdom. http://www.timberauctions.co.uk/about.html

et al. 2013). Therefore, it would be advisable for the government to phase out these parastatals and allow private sector enterprises in the timber production and processing to operate in a competitive environment based on market principles. Furthermore, to transition to a transparent competitive timber market, the government may consider online auctioning (see Box 2.3).

Figure 2.1. Total Tourism Arrivals, Revenues, and Average Revenues



Sources: Nepal, MOCTCA 2019; UNWTO 2014, 2016, 2019.
Note: The high average tourism revenues in 2015 is an anomaly and may reflect influx of post-earthquake financial assistance.

2.2. Sustainable Nature-Based Tourism[23]

2.2.1. Current and Potential Contribution to the Economy

Tourism is an important contributor to GDP and employment generation in Nepal and inbound tourism is on an increasing trend in terms of both visitor numbers and revenues. The World Travel and Tourism Council (2018) estimated the direct contribution of travel and tourism to Nepal's GDP at US$1 billion in 2017, representing 4.0 percent of GDP. There are also high spillover effects to other sectors, such as agriculture, manufacturing, transport, and aviation. For example, hotels and restaurants demand diverse agricultural inputs and most tourists look for destination-branded specialty products as souvenirs. Considering these indirect impacts as well as induced impacts,[24] the total contribution of tourism was estimated at US$1.9 billion, or 7.8 percent of GDP 2017. The total contribution to jobs was estimated at 1,027,000 in 2017,[25] representing 6.6 percent of total employment (WTTC 2018). In 2017, the number of foreign visitors exceeded the pre-earthquake levels (904,000 in 2017 versus 790,000 in 2014), as did the revenues (US$630 million in 2017 versus US$487 million in 2014) and the per tourist revenues (US$670 in 2017 versus US$616 in 2014) The daily tourist spend increased from US$50 in 2014 to US$53 in 2017 (Figure 2.1).

The government of Nepal wants to see this growing contribution of tourism to the economy continue to help it reach its targets for 2030. Specifically, the government's

23 This section draws partially on World Bank 2019b.

24 Direct contribution of travel and tourism to GDP includes commodities (accommodation, transportation, entertainment) and industries (accommodation services, food and beverage services, retail trade, transportation services, and cultural, sports and recreational services), whereby the sources of spending are residents' domestic travel and tourism (T&T) spending, businesses' domestic travel spending, visitor exports, and individual government T&T spending. Indirect contributions include T&T investment spending, government collective T&T spending, and impact of purchases from suppliers. Induced contribution comprises spending of direct and indirect employees on food and beverages, recreation, clothing, housing and household goods (WTTC 2018).

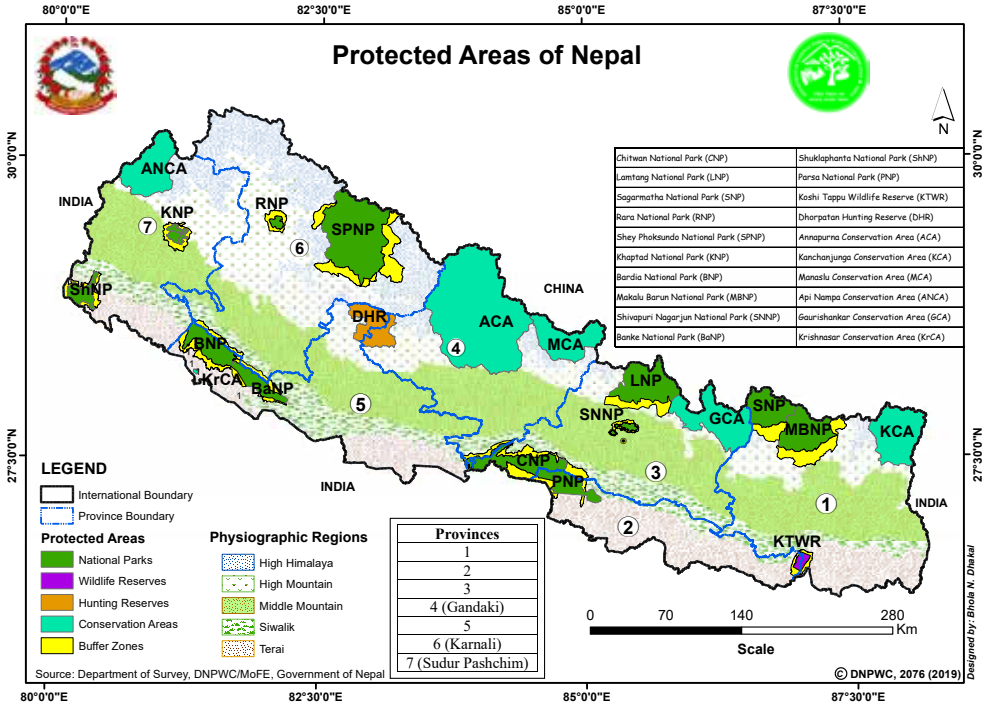
25 Including direct, indirect, and induced contributions.

target is to increase the annual number of jobs in tourism industries tenfold from 90,000 in 2015 to 1 million in 2030, and to increase the direct contribution of tourism to GDP by four times from 2.6 percent in 2015 to 8 percent in 2030 (Nepal, NPC 2017) (see Table 1.1).[26] The 2030 target for tourist arrivals is 3 million (see Table 1.1).

Nepal's unique landscapes and rich biodiversity contribute significantly to the tourism sector and have potential for more. Nepal has 20 well-established protected areas, including national parks (with associated buffer zones), wildlife reserves, conservation areas, and hunting reserves, covering 23.2 percent of the country's land area (see Figure 2.2). Nepal's PAs have registered excellent achievements in species conservation, but several of them underutilize their tourism potential. An additional 2 percent of the land area is classified as protected forest, featuring scenic landscapes. In 2017, around 630,000 visitors, representing 67 percent of all arrivals visited, one or more PAs. Culture is one of the main tourist attractions in the Kathmandu Valley, which hosts seven UNESCO World Heritage sites. Several temples and other pilgrimage sites are found throughout Nepal.

This diversity and Nepal's proximity to the Asian markets strategically position Nepal to benefit from tourism and travel trends in the region. Nepal is well positioned relative to global trends in favor of wellness travel, a global phenomenon which grew by 12.8 percent between 2015 and 2017 (GWI 2018), adventure tourism, and more generally NBT, which is estimated to account for 20 percent of international travel in 2020, or about 240 million global trips a year. More specifically, Nepal's tourism sector is benefiting from the growth of the middle class in neighboring India and China, as well as from domestic tourism. As

Figure 2.2. Protected Areas of Nepal



Source: DNPWC.

incomes rise and urban populations increase in Asia, the desire to vacation in PAs grows.

2.2.2. Constraints to Realizing the Higher Potential

Nepal's PAs could benefit from the rising demands in global NBT, but only in a limited manner as its potential beyond trekking has not been well developed. Nepal is globally known for its trekking destinations, namely the Annapurna Conservation Area (ACA) and the Sagarmatha National Park (home to Mount Everest). However, these treks generally take one to three weeks and do not appeal to individuals who do not enjoy these types of activities or are physically unable to do strenuous nature activities. For those, shorter hikes, birdwatching, and indigenous flower tours would be more appealing. Wellness and adventure tourism, which tend to attract the higher-value market segment, have also been explored in a limited manner. Furthermore, while Nepal has a total of 20 PAs, only a few function as significant tourism destinations. In 2017/2018, about 600,000 of the 700,000 visitors to Nepal's PAs visited only four PAs: Shivapuri-Nagarjun National Park, ACA, Chitwan National Park, and Sagarmatha National Park. As Nepal's Tourism Strategy (2016–2025) indicates, several of Nepal's PAs have the potential to be developed and become attractive NBT destinations, including but not limited to those featuring pristine high-altitude lakes. However, tourism development is constrained by restrictions on commercial activities within the PAs, particularly in national parks in the Terai region.

Most PAs and other NBT destinations lack adequate tourism infrastructure and facilities and modern arrangements for visitor safety, which would enable a diversification of the offering. Most nature destinations areas suffer from low quality and poor maintenance of small and medium infrastructure (for example, trekking trails, small bridges, camping sites, picnic spots, recreational parks), inadequate services (for example, water, waste management, electricity) and inadequate planning and zoning. The PAs are also ill equipped to address effectively safety-related incidents related to high altitude sickness, extreme weather conditions, or natural disasters including landslides and flooding. A recent survey of visitors at the ACA found that, while the overall satisfaction with the experience was good, there were challenges regarding the quality of roads, quality of trekking trails, and toilet hygiene and sanitation. The quality of accommodation, a key touchpoint in the evaluation of any tourism destination, was also identified by respondents as needing improvement. Overall, the price perception of the destination was not considered optimal: Thirteen percent found the ACA "very expensive" and another 50 percent thought it "expensive" (Hidria and Metcon 2019).

Another key constraint to diversifying NBT destinations is accessibility. Access to some of the protected areas from Kathmandu, notably those in western Nepal, requires multiple means of transportation, including air travel, hours-long ground transportation, and then hours of walking. Some large investments in the road and air transport have been recently launched, but implementation is slow.[27] Furthermore, infrastructure investments in gateway cities are often planned without a tourism perspective, limiting access to tourism destinations. For visitors who travel by bus, terminal facilities in the gateway city and/or the associated PA are not well developed. Similarly, within existing PAs in the mountains, such as the ACA and the Manaslu Conservation Area, access to potential alternative sites for trekking or other potential NBT activities is limited by poor, unsafe, or lacking roads. Where air transportation is the only feasible mode of transportation, landing facilities are often substandard.

27 Improvement of the Tribhuvan International Airport (TIA) in Kathmandu, construction of the Gautam Buddha International Airport (GBIA) in Bhairahawa/Lumbini, and construction of the Pokhara International Airport are all under way; the government also plans a second international airport in Nijgadh.

2.2.3. Risks

Nepal faces the risk of becoming a low-value mass tourism destination… While the number of visitors increased sharply in recent years, tourism receipts are still low compared with competing destinations. With an average of US$592 per international visitor in 2016, Nepal's international receipts were almost half of the global average and one-third those of Thailand and India (UNWTO 2017). The daily average spend per tourist remains low at US$53 in 2017 compared to regional and global comparators, such as Bhutan (US$62), Cambodia (US$102), Costa Rica (US$110), Georgia (US$118), Guatemala (US$133), Myanmar (US$73), and Sri Lanka (US$168).[28] This low level of average tourist spend is closely linked to a predominantly low quality of service, with 80 percent of Nepal's hotels in the tourist standard category, catering to the low-tier tourist segment. Furthermore, an unhealthy price competition among service providers and increasingly among local governments aimed at maximizing visitor numbers further drives prices down. Consequently, in some PAs, visitor numbers during the high season exceed the area's ecological capacity, making tourism environmentally unsustainable.

…damaging the very natural assets on which the sector depends. Large numbers of tourists exert large pressure on the environment, notably through waste and wastewater. The more tourists who visit the country or a protected area, the larger the impact on the environment through waste and wastewater generation, pressure on ecosystems, and use of limited natural resources, such as drinking water, and hence more resources are needed to mitigate these impacts. Conversely, larger per visitor per day revenues from the same total number of visitors will generate more funds to put in place waste and wastewater treatment and other sustainable ENR management measures to mitigate tourism's negative impact and make it sustainable. Service providers and local governments who decide to cut prices to attract more tourists do so in the absence of wastewater and waste management services. They do not incur any additional financial costs related to higher pollution; however, eventually, a tipping point will be reached whereby the natural resource is so degraded that it starts driving away tourists (also see the section on waste management in chapter 3).

2.2.4. Toward Sustainable, Higher-Value, and Inclusive Nature-Based Tourism

Sustainable tourism requires maximizing value rather than the number of tourists. Sustainable tourism is defined as "tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities. Sustainable tourism should thus make optimal use of environmental resources, respect host communities and ensure viable, long-term economic operations, providing benefits that are distributed fairly among all stakeholders" (UNEP and UNWTO 2005). Higher-value sustainable tourism inevitably requires a move from the current dominance of low-income tourists to a more balanced mix comprising a sizable fraction of middle- and high-income segments by offering a more diverse set of higher-value sustainable nature activities and higher-quality facilities that appeal to the middle- and high-income tourists.

Higher-value tourism must not mean excluding communities who currently derive their livelihoods from budget tourists; in fact, their income can increase. By increasing the quality of their service only modestly, as mentioned above, even basic accommodation and food providers can fetch higher pric-

28 Authors' calculations based on UNWTO (2018a), UNWTO (2017), and UNWTO e Library Tourism Statistics (accessed December 12, 2018), https://www.e-unwto.org/toc/unwtotfb/current. The per day per tourist spends quoted for Cambodia, Georgia, and Sri Lanka are 2016 figures; the others are 2017 figures.

es and increase their revenues. Higher-income tourists are also willing to buy more food items, souvenirs, and services, all of which can provide employment opportunities for local communities. Upgrading one's facilities or initiating a business requires access to finance, business intelligence, and connection with the value chain, as well as managerial, financial, and technical skills. The limited availability of skilled local workforce, notably due to outmigration of young males to the Terai and other countries, is also a constraint to improving the quality of services. Therefore, any government action plan aimed at increasing tourism's contribution to prosperity would need to include actions addressing these challenges.

Women's role in tourism economic activities can be enhanced. Nepal's Tourism Strategic Plan (2016–2025) identified women as key actors in communities in NBT destinations, with women playing key roles as caretakers of both households and communities at large (Nepal, MCTCA 2016, 184). In Nepal, women represent 20 percent of the tourism labor force, whereas the global average is 61 percent (Twining-Ward and Zhou 2017). The data show higher female engagement in homestays (57 percent) than in other services, such as hotels (23 percent), domestic airlines (20 percent), travel agencies (18 percent), trekking agencies (10 percent), and rafting agencies (4 percent). Homestays account for higher numbers of women as employees (62.3 percent) and as self-employed workers (55.8 percent). While women are increasingly involved in popular trekking trails as porters, guides, cooks, cleaners, and farmers, more can be done to improve their role in economic activities with higher revenues.

The 2015 constitution established a new distribution of powers in tourism development. Tourism policy and the management of national parks, wildlife reserves, and conservation areas remain at the federal level, entrusted to the Ministry of Culture, Tourism and Civil Aviation and the MOFE Department of Natural Parks and Wildlife Conservation (DNPWC), respectively. The DNPWC continues to delegate the management of several protected areas to the National Trust for Nature Conservation (NTNC), an autonomous, not-for-profit organization.[29] On the other hand, the constitution transferred tourism promotion and local project implementation to the local governments. The new division of competencies needs to be further clarified in practice to enable a coordinated and holistic tourism approach to NBT involving national agencies, local governments, local communities, and the private sector, to address the constraints discussed above.

The realization of Nepal's great NBT potential in a sustainable manner requires policy upgrades and institutional capacity building. Overall, the governance of PAs needs to be reoriented from a strong protection orientation that falls short of adequately dealing with tourism's growing adverse impacts to one that promotes sustainable NBT, including maintaining the integrity of the ecosystems under the protection. This shift in focus needs to be reflected in the DNPWC's and NTNC's plans and programs, as well as their staffing composition. PA management plans need to be revised based on an analysis of tourism potential, reflecting a conservation and visitor management strategy. On the policy side, the MOFE guidelines on concessions within PAs need clarification and upgrading in the light of proven international experience to attract higher-quality private investments that will also generate good local jobs. NBT policy making and planning for value would benefit from better data generation and management, including the creation of a tourism satel-

29 NTNC's programs in the lowlands are the Biodiversity Conservation Center in Chitwan, the Bardia Conservation Program, and the Suklaphanta Conservation Program in Kanchanpur. The Annapurna Conservation Area Project, Manaslu Conservation Area Project, and Gaurishankar Conservation Area Project are three protected areas managed by the trust.

lite account (TSA).[30] Given the importance of environmental sustainability for Nepal's tourism, the government of Nepal may also consider participating in the United Nations World Tourism Organization's (UNWTO) Measuring Sustainable Tourism Project.[31]

2.3. Sustainable Hydropower Development

Hydropower development is key for achieving Nepal's economic development goals, by providing uninterrupted power to productive sectors, including industry, tourism, and irrigated agriculture, as well as households and key social services, including hospitals and schools, and generating royalties and import earnings to help fund infrastructure and social capital investments. Electricity generation may also contribute to the reduction of air pollution and the associated health burden (see chapter 3) by providing a clean alternative to fossil fuel in households and allowing the popularization of electric cars, one of the government's plans to reduce vehicular emissions in urban areas. The government of Nepal estimates a total national theoretical hydropower generation of 83,000 megawatts, of which 42,000 megawatts are considered to be technically and economically feasible. The government plans to increase the installed generation capacity from the current 1,080 megawatts to 15,000 megawatts by 2030 (see Table 1.1). The World Bank (2019a) estimates the necessary electricity sector investments by public and private investors at US$1.3 billion–$2.1 billion annually between 2018 and 2040.

The following subsections review the environmental risks associated with hydropower development and offers recommendations for mitigating them. Section 4.2 addresses the specific issue of forest clearance in national forest areas and protected areas and proposes a compensation and offset mechanism that is environmentally sound and socially acceptable and avoids undue burdens to investors.

2.3.1. Environmental Risks Associated With Hydropower and Ancillary Facility Development

Hydropower development entails significant environmental risks, which may be exacerbated by the consequences of climate change. Most hydropower dams in Nepal take advantage of the high head potential offered by middle and high Himalayan mountain ranges and are located in narrow mountain gorges. They are of the run-of-river type, and consequently, the area under water is relatively limited. Nevertheless, the impacts remain significant and need to be minimized, mitigated, or compensated:

- **Modification of the flow regime downstream of the dam,** particularly for run-of-the-river dams, where a large portion of the flow is diverted from the dam through a canal or a tunnel leaving a stretch of the river much drier. To minimize the impact of the decrease in flow, particularly on fish ecology, and on other downstream water usage, an environmental flow must be determined that guarantees that even during the driest season there will be enough water to sustain

30 The TSA is harmonized with the System of National Accounts, which Nepal uses like most countries to summarize national economic activities. The TSA allows "the generation of tourism economic data (such as Tourism Direct GDP) that is comparable with other economic statistics" by "contrasting data from the demand-side (the acquisition of goods and services by visitors while on a tourism trip) with data from the supply-side of the economy (the value of goods and services produced by industries in response to visitor expenditure)" (UNWTO 2018a; UN 2010).

31 The Statistical Framework for Measuring Sustainable Tourism (MST Framework) aims to extend the current statistical frameworks beyond their economic focus, to incorporate environmental, and social dimensions and at relevant spatial levels: global, national, and subnational. "In the field of environmental sustainability, the MST Framework will bridge the United Nations standards of the Tourism Satellite Account (TSA) with the System of Environmental Economic Accounting (SEEA) therefore addressing some vital policy questions, including: (i) environmental impacts of tourism: emissions, solid waste, wastewater, disruption of ecosystems and biodiversity; (ii) dependency of tourism on the environment: water and energy requirements, healthy and good quality ecosystems (beaches, reefs, forests); (iii) environmental protection expenditure and environmental taxes; (iv) some socio-economic impacts and dependencies of tourism such as employment" (UNWTO 2018b).

freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.

- **The inundated area upstream of the dam** might also impact natural (forests, protected areas, biodiversity) as well as built assets (fields, houses, cultural assets), which also have to be minimized, mitigated, or compensated as necessary.
- **Some parts of Nepal that have strong hydropower potential are inhabited by indigenous groups,** which implies the need for specific measures to ensure these groups' engagement and commitment to the project.
- **Associated facilities, notably transmission lines and roads,** come with their own set of impacts that need to be minimized, mitigated, or compensated. These infrastructures can also affect forests and protected areas as well as human assets despite their linear nature.

The following potential impacts are caused by disasters and climate change:

- **Risk of dam failure:** Dams are large structures with a potential for failure during earthquakes. Nepal's propensity for frequent earthquakes requires that very strict safety measures be built into the design and operation of these facilities.
- **Sedimentation and siltation:** The watershed upstream of the dam will generate water flow as well as silt that will accumulate in the reservoir and decrease its operational life span. In Nepal, silt generation is a significant problem because of the fragile geology and glacial silt of the Himalayas. In addition, hilly road construction with direct muck dumping in the rivers is one of the anthropogenic influences that is affecting sedimentation in reservoirs and slow-moving water downstream stretches. Silt can be managed by releasing it downstream from time to time, but this has potentially detrimental impacts on the ecological functions of the river. Siltation and settling of larger sediments may be reduced through interventions in the upstream catchment area, including afforestation or reforestation, bioengineering and engineering work for slope stabilization.
- **Damage or failure due to glacier lakes outburst floods:** These floods are specific to the Himalayas and caused by the rupture of high-altitude lakes formed by melted snow. Water pressure or tectonic movement can lead to these lakes rupturing and releasing a sudden wave of water downstream with catastrophic impacts. The dams downstream must be designed to sustain the water surge in such an event. A recent publication by the International Hydropower Association contributes to this discussion by presenting a decision-making process for assessing the extent to which climate resilience has to be taken into account in hydropower projects and the series of measures based on best industry practice to mitigate the said risks (IHA 2019).

2.3.2. Institutional and Regulatory Framework

The 2015 constitution (Schedules 5, 6, 7, 8, and 9) assigns the responsibility of large electricity projects to the federal government, that of provincial-level electricity projects to provincial governments, and small electricity projects to local governments. Institutionally, the Ministry of Energy, Water Resources and Irrigation (MEWRI) has the overall responsibility of hydropower development in Nepal. The newly formed ministry has institutional arrangements in place at policy, operational, implementation and regulation levels. The Department of Electricity Development (DOED) under this ministry is responsible for implementation of the policies related to electricity. It ensures transparency of the regulatory framework, and it accommodates, promotes, and facilitates the participation of the private sector by providing a "one window" approach to services and licenses for power projects. The department facilitates projects brought forward by national and international power produc-

ers for speedy development of electricity generation, transmission, and distribution. It also studies and coordinates multipurpose projects and provides suggestions and feedback as and when needed.

The primary responsibility of the government-owned Nepal Electricity Authority (NEA) is to generate, transmit, and distribute adequate, reliable, and affordable power by planning, constructing, operating, and maintaining all generation, transmission, and distribution facilities in Nepal's power system both interconnected and isolated. The Water and Energy Commission Secretariat (WECS) has the mandate of assisting ministers and departments in the formulation of policies and planning of different projects in the water and energy sector. The Investment Board of Nepal (IBN), chaired by the prime minister, promotes public-private partnerships as well as domestic and foreign private investment to accelerate industrialization. Besides seven other sectors, the investment board supports hydropower development and provides a "one window" service for investors to help them navigate the requirements for investing in Nepal by functioning as a central agency for investment promotion and facilitation.

A new institution, the Nepal Electricity Regulatory Commission, established in 2017, has been assigned a very powerful role in the governance of the energy sector. In particular, it is responsible for setting up tariffs, setting construction and safety standards, and establishing operating procedures and rules for power plants, the electricity authority, and the transmission and distribution network. However, it is likely that the full range of powers of this new institution will take time to become effective (its chairman and members were appointed only on May 6, 2019).

With regard to national policy and regulations, the Hydropower Development Policy (HPD) 2001 governs the sector. Other policies or regulations to hydropower development include the Nepal Biodiversity Strategy and Action Plan 2014–2020, Investment Board Act 2011, Water Guidelines for Study of Hydropower Projects 2003, Environment Protection Act 1997, Environment Protection Rules 1997, National Environmental Impact Assessment Guidelines 1993, Water Resources Act 1992, Electricity Act 1992, Electricity Regulation 1993, Foreign Investment and Technology Transfer Act 1992, Nepal Electricity Corporation Act 1984, and Land Acquisition Act 1977.

The main act and regulation pertaining to environmental management of hydropower development are the Environment Protection Act 1997 and the Environment Protection Rules 1997 (see chapter 4 for more details on these regulatory instruments). An initial environmental examination is conducted for projects up to 50 megawatts, whereas an environment impact assessment is carried out for projects with more than 50 megawatts. The Ministry of Energy, Water Resources and Irrigation approves EIAs, whereas the DOED examines and reviews the terms of reference (TOR) for the IEE prior to submitting to the ministry. For the EIAs, the DOED examines the TOR and the scoping document, and submits them to the ministry, which then forwards them to the Ministry of Forests and Environment for approval.

The following sections will discuss some important additional institutional aspects as well as specific technical aspects related to hydropower development.

2.3.3. Watershed Management

Nepal is one of the most water-abundant countries in the world, with 6,000 rivers, a total mean annual runoff of 224 cubic kilometers, and a per capita water availability of 9,000 cubic meters. However, the hydrology of Nepal is primarily monsoon-driven, and about 85 percent of the rainfall occurs in June–September. The temporal variability of rainfall and runoff is hence very high, and the

problems of excess water during the monsoon and water scarcity during the dry season affect all aspects of life in the country.

The Himalayan mountain range is relatively young and has the capacity to generate huge amounts of sediments that are then carried downstream through the river system. Thus, erosion is an important problem because it affects watersheds, ecosystem services, and downstream agricultural potential and also contributes to the siltation of reservoirs. These two issues can be managed through decisive integrated watershed management.

The institutional development of watershed management in Nepal started in 1974 with the establishment of the Department of Soil Conservation and Watershed Management (DSCWM, now the Department of Forests and Soil Conservation, DFSC) as the principal authority for undertaking watershed management. The DSCWM started by piloting a program in four selected watersheds and river training activities at priority sites, and gradually expanded with the establishment of District Soil Conservation Offices (DSCOs). Seven pieces of legislation have been developed to address the watershed management issues: The Soil and Watershed Conservation Act 1982, Land Act 1964, National Parks and Wildlife Conservation Act 1973, Environment Protection Act 1996, Forest Act 1993, Water Resources Act 1992, and Local Government Operation Act 2018.

However, these regulations are currently being amended to take into account the federalism context. These acts suffer from overlapping responsibilities, unclear jurisdiction for implementation, lack of clear resource allocation for watershed management, and lack of emphasis on coordination on the ground.[32] The DFSC has been implementing watershed management programs in line with policies and strategies formulated so far. The DFSC has incorporated programs on land use planning, land productivity conservation, infrastructure protection, community soil conservation and extension, group mobilization and empowerment, nursery management, and seedling production. In addition to this, the federal government has established four regional offices in the Karnali, Gandaki, Koshi, and Mahakali river basins named River Basin Management Centers. These centers will work in the area of watershed conservation, ecosystem services, water yield and water quality, landscaping, safeguarding, and mitigation for landslide control, but they will not focus on the water usage and water balance. A learning and research center called the Federal Watershed Management Learning Resource Center has been established for research, knowledge enhancement, and training, and to conduct specific research activities. The government of Nepal must be credited for these measures, but they are limited and still suffer from the lack of inter-sectoral collaboration and coordination. The functions of the then District Soil Conservation Offices were meant to be transferred to all 753 local governments with sufficient technical staff, programs, and budgets as per Schedule 8 of the constitution. However, the Organization and Management Survey carried out by MOFAGA for local governments did not realize this concept. As a result, the technical staff with expertise in watershed management and soil conservation were made redundant by collapsing 61 District Soil Conservation Offices, while no such staff has been placed in any local government. The four regional offices established at the basin level do not have the sufficient number of staff to provide services in the area they cover.

In 2005, the Water and Energy Commission Secretariat formulated the Nepal Water Policy (NWP) in consultation with

32 Krishna Paudel, "Watershed Management in Nepal: Challenges and Constraints" (no date), Department of Geography Education, Tribhuvan University, Kathmandu.

relevant sectoral ministries.[33] This policy included integrated water resource management (IWRM) and the notion of river basin management for ensuring that water resources development is carried out in an effective and sustainable manner. The NWP is a framework to guide all stakeholders for developing and managing water resources and water services in an integrated and comprehensive manner. However, the draft act that outlined the institutional framework defining the modalities for implementing the IWRM was never approved over the objection of the then Ministry of Energy. In 2010, WECS prepared the Koshi River Basin Management Strategic Plan.[34] The plan was drafted in partnership with the World Wildlife Fund rather than through collaboration with sectoral ministries. Consequently, the plan was never considered a legal policy document. Apart from WECS, the Groundwater Resources Development Board (GWRDB) and Department of Water Induced and Disaster Prevention (DWIDP), both under the Ministry of Irrigation (MOI); the Department of Soil Conservation and Watershed Management under the Ministry of Forestry and Soil Conservation (now the Ministry of Forests and Environment); and the National Planning Commission (NPC) have endorsed basin planning approaches and have respectively come up with different proposals to establish basin offices in various and sometimes overlapping locations throughout the country. Formalizing the adoption of a watershed and basin approach would ensure that resources are efficiently allocated.

It is relevant to note that, to a great extent, the river basin management agenda has been largely implemented through a donor-funded-project approach on a pilot scale. Major international development partners like the World Bank, Asian Development Bank (ADB), and International Centre for Integrated Mountain Development (ICIMOD) have been promoting IWRM application, basin and watershed management in Nepal toward more holistic and sustainable water resources management. The World Bank has been supporting the Ministry of Energy, Water Resources and Irrigation in the preparation of master plans for four major river basins. These river basin master plans will consist of gender-responsive and socially inclusive integrated river basin and watershed management frameworks, and will identify critical watershed areas, develop systems, and generate knowledge to enhance river basin considering all aspects of water use. The government of Nepal is in the process of bringing out two legislations, namely, the Integrated Water Resource Policy (2019) and Water Resource Act (updated), which will integrate river basin management approaches. However, the government needs to formulate policies, acts and rules, and an institutional framework (governance structure), and develop management instrument/tools for implementation. MOFE has also initiated the preparation of an IWRM strategy for four major river basins (Koshi, Gandaki, Karnali, and Mahakali) under the direct responsibility of the National Planning Commission.

Adopting integrated watershed management is urgent and should be based on more robust collaboration and coordination between the relevant ministries and agencies mentioned above.

2.3.4. Environmental Flows

Water diversion from rivers for electricity generation generally leads to a drastic flow decrease in the downstream stretch creating adverse impacts, particularly during the dry season, on aquatic and terrestrial ecosystems, including the livelihoods of local people. To maintain the ecological system, the Hydropower Development Policy, however, has provisioned for releasing at least 10 percent

33 WECS was established in 1975, with the broad mandate to develop Nepal's water and energy resources in an integrated and accelerated manner and to assist the government with formulating policies and planning projects in the water resources and energy sectors.

34 See *Integrated Water Resources Management in Nepal: Key Stakeholders' Perceptions and Lessons Learned,* by Diana Suhardimana, Floriane Clement, and Luna Bharati.

of the minimum monthly average discharge of the river or as mentioned in the EIA report. The Working Policy for Construction and Operation of Physical Infrastructure Within Protected Area (2009) has also specified the amount of minimal flow as 50 percent of monthly discharge of natural flow if the water diversion activity takes place within a national park, wildlife reserve, or hunting reserve. There lies a challenge of implementing such provisions as guided by the policies or referred by the EIA. It is generally observed that downstream sections have no or very little flow, especially during lean seasons (mainly during December to May). Although MOFE is mandated to carry out this monitoring, it has neither developed nor implemented an appropriate mechanism to that effect. A few measures that could be considered, in addition to strengthening the capacity of MOFE, would be to strengthen the EIA procedures to include international good practices for assessing the impact on changes in instream flows using environmental flow modeling (hydrological models, other scientific approaches) or methodologies considering fragmentation of ecological corridors taking into account aquatic ecology on the basis of holistic approach to rivers.

2.4. Environmentally Friendly and Climate-Smart Agricultural Intensification

Agriculture in Nepal contributes 27 percent of the GDP and accounts for 60.4 percent of employment, but it is characterized as being volatile and producing low yields compared with those in neighboring countries. The government plans to decrease volatility and improve yields by intensifying agriculture, notably through increased irrigation, fertilization, and other improved technologies such as quality seeds. Food grains such as rice and wheat occupy most cultivable land, but rice yields are lower than in Bangladesh and India and wheat yields have been consistently lower than in Bangladesh, India, and Pakistan over the past decade (World Bank 2016). The average fertilizer use is significantly lower than the South Asia average, with nitrogen applications being 45.5 kg versus 94 kg per hectare of cropland. At 0.25 kg/ha, the average use of pesticides is lower than the South Asian average (0.3 kg/ha) and one-tenth the global average.[35] Low cereal yields are linked to malnutrition (Nepal, MOAD 2016), which is characterized by 36.1 percent of the population being malnourished and 22.8 percent consuming less than the minimum dietary energy levels in 2015 (Nepal, NPC 2017; see Table 1.1). The government plans to increase land productivity from 3.6 m^3/ha in 2015 to 6.0 m3/ha in 2030 and the growth of the agriculture sector from the baseline of 0.8 percent in 2015 to 5 percent in 2030. To this end, it plans to increase the arable land under round-the-year irrigation from the 2015 baseline of 40 percent to 80 percent in 2030 (Nepal, NPC 2017; see Table 1.1). The Agriculture Development Strategy 2015–2035 (Nepal, MOAD 2016) aims to improve crop fertilization and pest management to improve crop productivity.

Expansion of irrigation will inevitably lead to intensification of crop cultivation, increasing the use of pesticides and fertilizers, potentially with serious consequences for the environment and human health. While the pesticide and fertilizer use national average is low, it is rampant in pockets of intensive irrigated fruit and vegetable cultivation in valleys and in parts of the Terai, such as Kabhre and along the highway connecting Kathmandu with Pokhara. Regarding pesticide, there is abundant anecdotal evidence on excessive and inappropriately timed application of pesticides to vegetables and fruits, such as zucchini, cabbage, beans, tomatoes, cucumbers, eggplants, as well as tea and rice. One study found that in terms of active ingredient (a.i.),

35 Data are from FAOSTAT (database), Food and Agriculture Organization, Rome (accessed May 9, 2019), http://www.fao.org/faostat/en/#data.

the Kabhre district ranked highest (1.854 a.i. kg/ha), followed by Rautahat (1.731 a.i. kg/ha), Jhapa (1.656 a.i. kg/ha), Banke (1.25 a.i. kg/ha), and Chitwan (0.712 a.i. kg/ha) (MountDigit Technology Ltd 2014). Hospitalizations and deaths of farmers who ingest or apply toxic pesticides without protective gear have been reported (Sharma et al. 2012). Pesticide residues constitute a threat to public health and limit the competitiveness of Nepal's produce (World Bank 2016). Furthermore, while no specific studies are available for Nepal, global experience suggests that excessive and inappropriate application of fertilizers and pesticides likely lead to pollution of groundwater, which is one of the main drinking water sources in the Terai, and of river water, affecting aquatic biodiversity. Excessive nitrogen fertilizer application also leads to emissions of nitrous oxide, a greenhouse gas linked with climate change. Finally, uncollected pesticide containers can lead to water and soil contamination, and when burned in an uncontrolled manner, will contribute to air pollution, emitting toxic chemicals such as dioxin that may be contained in the packaging material.

Regulatory restrictions and training farmers in integrated pest and pesticide management are the primary means to mitigate similar risks in newly irrigated agricultural land and the government of Nepal has made important gains in this area. The government has banned the use of 16 toxic pesticides, including the eight toxic persistent organic pollutant pesticides and WHO class Ia, Ib, and II chemicals that are extremely hazardous, highly hazardous, and moderately hazardous, respectively, to humans (WHO 2010; Nepal, MALD 2018). The government regulates the use, production, formulation, and distribution of pesticides. The government has adopted an integrated pest management program as a national plant protection strategy. It aims to reduce reliance on pesticides and encourage the use of alternatives for pest management; to encourage the use of low risk pesticides as the last resort; to use useful natural enemies and parasites to suppress crop pests; and to enhance farmers' knowledge on pests and agroecosystems.

Farm nutrient management supported by affordable soil testing; advice and farmer training; and a smart fertilizer subsidy would help avoid inappropriate fertilization by saving costs, mitigating GHG emissions, and reducing environmental pollution. Nepal has a fertilizer subsidy that not only is untargeted and mostly beneficial to large farmers as opposed to the intended poor small farmers (World Bank 2016), but also likely incentivizes overfertilization. A program of nutrient management that entails applying a combination and quantity of nutrients nitrogen, phosphorous, potassium, and micronutrients at appropriate times according to plant needs and soil nutrient content is advisable in the new irrigation areas. While the government has introduced district-level soil nutrient analysis, this level is not sufficiently granular to take into account significant localized differences that can occur in soil nutrient contents. Farmers should have access to soil-testing facilities for their farm and get help in nutrient management from government extension service providers based on the nutrient demand of their crops. The fertilizer subsidy should be targeted to farmers who cannot afford fertilizers (World Bank 2016). Avoiding excessive or inappropriately timed fertilizer application, whether synthetic or organic/bio fertilizers, would reduce GHG emissions and soil and water pollution.

Improved water and irrigation management would save costs to farmers, reduce demand for water, and contribute to climate change adaptation and mitigation. Recommended practices are efficient irrigation such as ridge and furrows in potatoes, solar-based irrigation in rice, or micro-irrigation in vegetables (World Bank 2016). These practices use less energy, reducing the cost of irrigation, and reduce the demand for water, which is impor-

tant given that irrigation in the Terai will, in many places, rely on groundwater extraction, thus competing with the needs for drinking water supply.

The ongoing transition to a federal structure is posing challenges. The 2015 constitution accords the provinces the mandate over agriculture, but pesticides are a concurrent responsibility shared by the federal and provincial governments (see Table 4.1). Under the federal Ministry of Agriculture and Livestock Development, the Plant Quarantine and Pesticide Management Center is responsible for formulating policy, standards, laws, and regulations for import, distribution, use, and management of pesticides and tasks related to quarantine of plant and plant products. Specifically, it regulates the potential risk on plant health arising from the international trade of plants and plant products and import, distribution, use, and management of pesticides used for the management of the plant pests on different plants and plant products on the field and their postharvest stage. There is lack of clarity, however, concerning the rights and responsibilities of the provincial Ministry of Land Management, Agriculture and Cooperatives regarding pesticide regulation. A pesticides management bill aimed at defining the responsibilities of different tiers of government has been tabled.

2.5. Sustainable River Quarrying

Basic natural construction materials like stones, sand, and aggregates are abundant in Nepal's mountainous, hilly terrain and numerous rivers have enjoyed growing demand in recent years owing to a construction boom domestically and in neighboring countries. The trend of urbanization and road and housing development is likely to continue to grow in the next five to ten years given the more stable political situation, the emphasis of all tiers of government on infrastructure development, as well as urbanization. In addition, there was, until recently, a demand for these construction materials from neighboring India where infrastructure development is also on the rise, and to a lesser extent from Tibet. The value chain (collection, quarrying, crushing, processing, and supply) of these materials provided jobs, revenues to local governments from license fees, and export revenues until the exports were banned because of concerns about adverse environmental impacts (although this cannot be fully enforced because of the open border with India).

Adverse environmental impacts are caused by haphazard, uncontrolled, inappropriate, and excessive mining of sand, stones, and aggregates. The adverse impacts include disturbance to river regime leading to riverbank cutting, flooding, deepening of riverbeds affecting irrigations, impacts on fish and aquatic life also affecting livelihood of fishing community, degradation of infrastructure such as roads by overloaded trucks, risks to bridges because of extraction of materials adjacent to the bridges, dust pollution in the settlements near crusher plants and roads, increased noise near crusher plants, degradation of agricultural land, accidents and deaths caused by the heavy vehicles transporting these materials, and poor health and safety of workers. A significant part of the mining occurs in the Chure Range, which is environmentally sensitive and fragile. Degradation of Chure will have implications in the downstream plain areas.

However, sustainable quarrying of these materials is possible and at times desirable. Rivers originating from or flowing through Chure bring substantial amounts of sand and gravel annually, and deposit them downstream in the riverbed and along the banks. Removal of the deposited sand, gravel, and debris may be needed in situations where they pose flood risks. The method of mining should be manual or using hand tools rather than heavy equipment. Excessive, uneven, or untimely quarrying may be avoided though licensing based on an assessment of annual yields at different sites.

Clauses related to the operation of quarries and extraction of sand, gravel, and stone are scattered in several different acts, regulations, and guidelines and directives—many of which are being amended in the transition to federalism. Enforcement of these provisions is poor for various reasons, including unclear mandates and responsibilities (such as registration of quarry/crusher industries, IEE/EIA approval, permit for extraction, compliance checking), lack of monitoring, and lack of human and financial resources. The enforcement issues are further complicated by the process of federalism.

Given the above context, Nepal could consider the following going forward:

- Consolidate and revise provisions related to quarrying, mining, collection, and extraction of stones, sand, and gravel, building on the existing criteria and provisions scattered in many different acts, regulations, and guidelines/direction. Consider their practicality, recommendations included in various studies commissioned in the past, and good international industry practices, and look at the quality, value chain, and life cycle of the operation. This is timely in the context of ongoing revisions of the legal instruments in the transition to federalism.
- Clarify the mandate and responsibilities of the three tiers of government, empowering local-level governments in monitoring and compliance as well as building their capacity.
- Develop guidelines for small-scale quarrying and extraction of sand, gravel, and stone manually or using hand tools only (no heavy machine and equipment)—particularly addressing the self-employed poor people's activities; training and support is also needed.
- Strengthen the planning and technical capacities of the relevant agencies, and introduce a system of licensing, particularly for collecting sand and gravel from river, based on assessment of annual yield at a location/site, appropriateness of site/location, as well as assessments of environmental impact, including disaster risk and social impact and necessary avoidance, minimization, mitigation, and offset measures.
- Identify suitable larger-scale quarry/mining sites at strategic locations, building on the work already done by agencies such as the Department of Mines and Geology, and using environmental and social criteria also, connect these sites by basic infrastructure such as road and electricity, carry out social and environmental assessment, prepare plans for using the area after the life of the quarry/mine (for settlement, or industry, or agriculture, as it may suit), and engage developers to develop and operate the quarry/mining sites. These could supply construction material for domestic purpose and may also export to neighboring countries.
- Introduce a robust and reliable monitoring and enforcement mechanism, including a grievance redress mechanism.

3. MITIGATING ADVERSE IMPACTS OF GROWTH ON THE ENVIRONMENT AND NATURAL RESOURCES

This chapter reviews the potential adverse impacts on the environment and natural resources of infrastructure development and urbanization that are associated with economic development. The chapter is divided into environmental pollution and ENR impacts of road development.

3.1. Reducing Environmental Pollution and Related Costs to the Economy

Pollution constrains Nepal's development through its human and economic costs. The Environmental Performance Index ranked Nepal second to last out of all countries in overall air quality in 2018 (Yale University 2018). The same index placed Nepal in the bottom 30 countries for access to drinking water and sanitation. To a lesser but still important degree, heavy metals and occupational hazards constitute environmental health risks. The hazards captured by these statistics have well-documented impacts on human health, including mortality. This mortality, as well as associated morbidity, has financial costs on households along with wider economic costs, including loss of income and time, expenditure on medical services, costs of suffering, and reduced intellectual capacity and productivity. Pollution degrades human capital—the sum of people's productive capacity—an important economic concern given that human capital is fundamental for accelerating economic growth and lifting productivity (World Bank 2019a). Reducing the burden of environmental degradation further improves conditions for growth by encouraging foreign investment, tourist inflows, recreation opportunities, and quality of life.

Rubble burning in a river in a Kathmandu suburb. Photo: © Lewis Tse Pui Lung / Shutterstock.com

This section presents the levels, sources, and costs of pollution, including air pollution, inadequate water, sanitation, heavy metals, and solid waste. It begins with a presentation of estimates of the health burden in terms of mortality caused by pollution in the SDG baseline year of 2015, and then examines the trendlines in these costs over the prior 10 years and projects them into the future (2030) under different pollution and economic growth scenarios. This is followed by monetary estimates of the cost of the health burden to the economy for the points in time and scenarios under consideration. The section concludes with recommendations on policy options for reducing pollution costs.

3.1.1. Levels and Sources of Pollution

3.1.1.1. Air Pollution

Air pollution levels are high and growing in Nepal. High concentrations of $PM_{2.5}$, the most damaging component of air pollution (see Box 3.1), are found in the Kathmandu Valley, north of Kathmandu and Pokhara against the Himalayas, and in the Terai (see Figure 3.1). Average annual ambient air pollution concentrations of 50 to 80 μg/m^3 nationwide considerably exceed World Health Organization guidelines of 10 μg/m^3. Trends over time show rapidly increasing annual mean $PM_{2.5}$ pollution. Simultaneously, progress has been slow on increasing access to clean fuel for cooking, a key determinant in exposure to household air pollution (Figure 3.2). Nepalis' access to clean cooking remains below the average for South Asia (37 percent).[36]

The sources of $PM_{2.5}$ pollution vary across Nepal, with transportation, household biofuel use, construction, and brick kilns the biggest sources. In the Kathmandu Valley, the transportation sector contributes over a third of total $PM_{2.5}$ emissions (Figure 3.3), which is not surprising given the strong growth in vehicle numbers over the past two

Box 3.1. Air Pollution and Related Health Impacts

Air pollution comprises a range of harmful substances, including particulate matter (PM). As the component of air pollution most strongly linked to health outcomes, PM is the component of air pollution that this chapter focuses on. PM is fine particles of soot, dust, and smoke, and the most damaging to human health are those particles less than 2.5 m in diameter ($PM_{2.5}$). Their small size allows them to penetrate deeply into the lungs, bloodstream, and heart, causing cardiovascular disease, chronic obstructive pulmonary disease, and lung cancer among adults, and lower respiratory infections among both young children and adults (Landrigan et al. 2017).

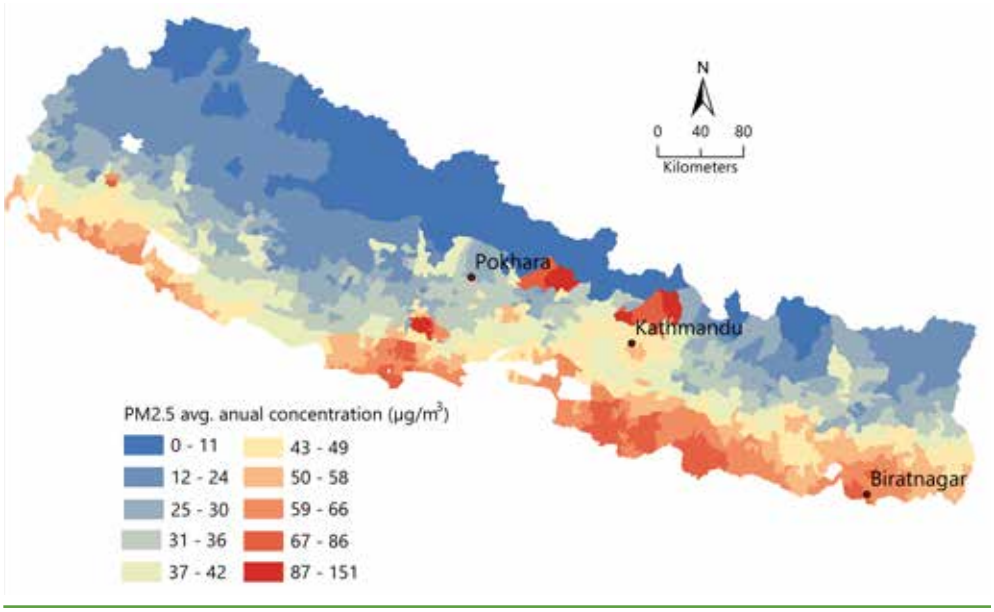
In Nepal, $PM_{2.5}$ pollution has been directly linked to rates of hospitalization. One recent study in the Kathmandu Valley found that a temporary 10 μg/m^3 increase in PM pollution was associated with a 1 percent increase in total hospitalizations, and a 2.29 percent increase in cardiovascular related hospitalizations (Gurung, Son, and Bell 2017).

Women, who have traditionally taken on a majority of cooking responsibilities within the home, are discordantly affected by household $PM_{2.5}$ air pollution. A hospital-based case-control study in Nepal recruited 606 lung cancer cases and 606 healthy controls matched on age, gender, and geographical residence. The study revealed a considerably higher risk of lung cancer associated with longer exposure to household air pollution from biomass combustion (Raspanti et al. 2016).

In addition to damaging human health, air pollution affects social and economic outcomes in a variety of other ways not captured by this analysis. Dense pollution increases cleaning costs, including domestic time spent on cleaning tasks. Reduced amenity and livability from pollution harms tourism and the competitiveness of cities as economic hubs (Jiang and Shen 2010), and can also cause agricultural yield losses (Marshall, Ashmore, and Hinchcliffe 1997; Shindell et al. 2012). While these are all clearly important economic impacts, this report focuses on the costs of health impacts; thus, the estimates presented should be considered a lower bound on total costs.

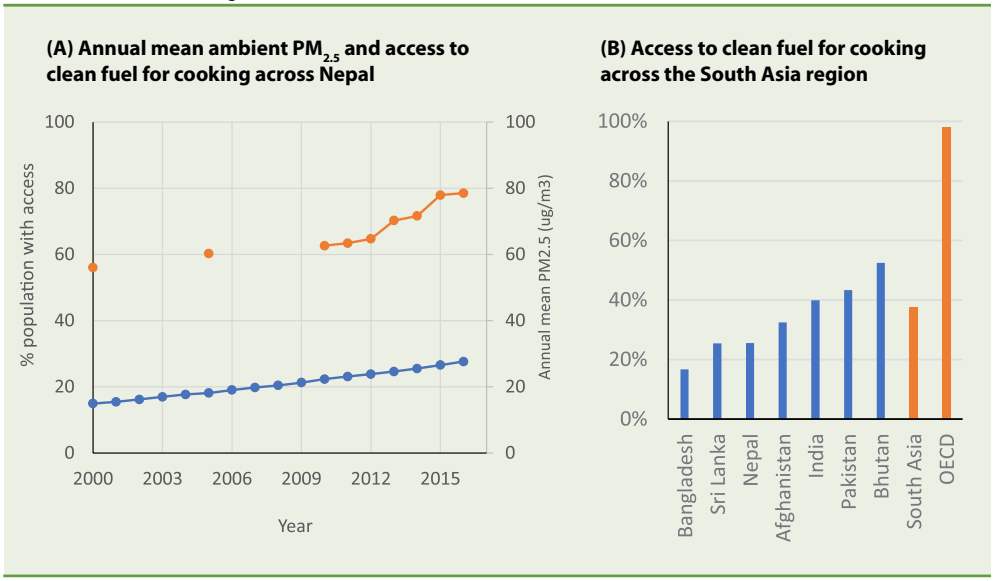
36 World Bank Open Data (database), Washington, DC (accessed October 30, 2018), https://data.worldbank.org.

Figure 3.1. Satellite Measurements of Air Pollution Concentrations Across Nepal, 2016



Sources: Compiled using World Bank subnational poverty maps and the Hidden Dimensions of Poverty dataset, with air quality data from Brauer et al. (2016).
Note: Average annual $PM_{2.5}$ concentrations as determined by satellite measurements.

Figure 3.2. Trends in Air Pollution in Nepal, 1990–2016, and Regional Comparison of Access to Clean Fuel for Cooking

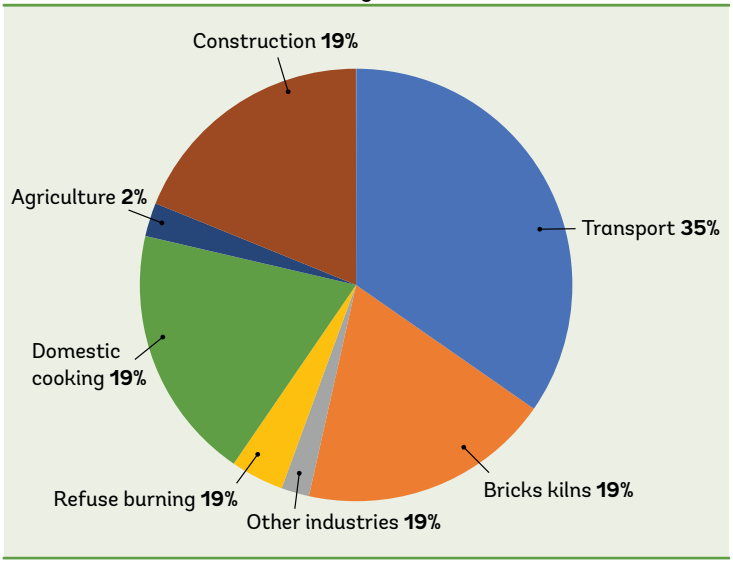


Source: Data are from the World Bank Open Data (database), Washington, DC (accessed October 30, 2018), https//data.worldbank.org.
Note: Panel A is not intended to indicate a causal relationship, it displays trends in these metrics in the same chart for space purposes only.

decades (Figure 3.4). Contributions from brick kilns, construction, and household biofuel use are estimated at around one-fifth of the total (Nepal, MOPE 2017c; Kim et al. 2015). The emissions source profile across the country as a whole (beyond the Kathmandu Valley) differs substantially: Household biofuel use dominates (78 percent) with a further large fraction from agricultural residue burning (18 percent) (Sadavarte et al. 2019).[37]

A second key source of air pollution is brick manufacturing. The industry produces around 5 billion bricks each year from around 1,600 kilns across the country, including over 120 in the Kathmandu Valley (Eil et al. 2018). Kiln numbers have roughly doubled since 2000, and despite damaging many kilns, the 2015 earthquake has driven much of the recent growth of the industry because of the demand for bricks for reconstruction. Brick kilns contribute between 15 and 25 percent of the $PM_{2.5}$ burden in the Kathmandu Valley, and a lesser proportion for the country overall.

Figure 3.3. Relative Source Contributions to Particulate Matter Emissions in the Kathmandu Valley



Source: Compiled using data in Gautam et al. (2017), an inventory analysis specific to the Kathmandu Valley.

Note: Emissions proportions are based on PM_{10} data and assumed similar for $PM_{2.5}$. Resuspension proportions are calculated by adding 10 percent of PM_{10} resuspension estimates to emissions estimates. The 10 percent scaling represents the reduced impact of resuspension on $PM_{2.5}$ relative to PM_{10} (see Cowherd and Ono 2006).

Indoor air pollution from biomass burning is a third major contributor, and likely the greatest overall source of personal exposure in Nepal. In 2016, nationally, around two-thirds of households used solid fuels such as charcoal, wood, straw, or animal dung for cooking, while one-third used cleaner cooking fuels, mainly bottled gas (World Bank and AEPC 2017) (Table 3.1). For those households which are using biomass, the annual average exposure is estimated at over 450 µg/m^3 (see companion technical paper for more details). Use of biomass for cooking is driven by cost,[38] tradition, and a lack of reliable alternatives.

Geography and climate amplify these factors. A proportion of the pollution load is windborne from India, home to some of the most polluted cities in the world. In addition, Nepal's topography traps pollutants in some areas, compounding the problem of locally generated pollution. The bowl-shaped Kathmandu Valley, for example, is bounded by the Himalayas in the north and the Mahabharat Range in the south. The high mountains trap air and restrict

Table 3.1. Use of Biomass for Cooking in Nepal, 2016

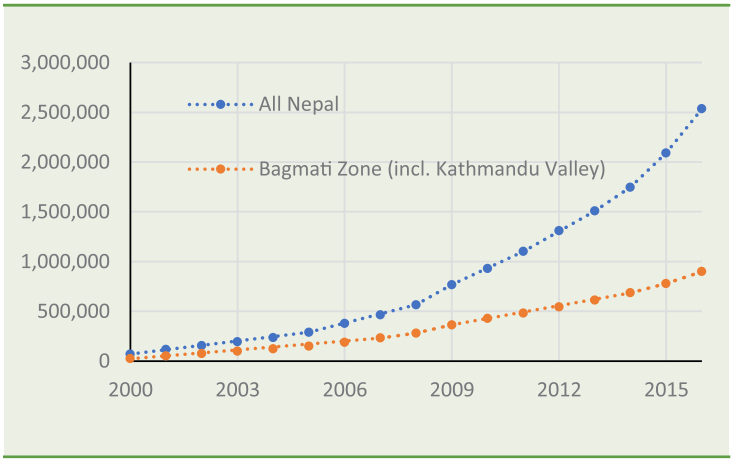
Percent of Households	Rural	Urban	Total
Biomass[a]	**87.8**	**51.8**	**65.7**
Non-biomass	**12.2**	**48.2**	**34.2**

Source: Nepal, MOH 2017.
a. Biomass includes charcoal, wood, straw/shrubs/grass, agricultural crops, and animal dung.

37 The studies from which these ranges are taken estimate pollution sources in different ways. Nepal, MOPE (2017) and Sadavarte et al. (2019) estimate emissions based on known fuel use and efficiency factors across industries and activities (emissions inventory). Kim et al. (2015) take physical samples and analyze their chemical signatures, allowing samples to be linked to known sources (receptor modeling).

38 Cooking three typical meals per day for an average size Nepali household with liquified petroleum gas would cost around US$12/month, or over 9.5 percent of the average monthly income. Electricity costs are also high relative to neighboring countries (World Bank and AEPC 2017).

Figure 3.4. Vehicle Registrations in Nepal, 2000–2016



Sources: Nepal, CBS 2015a; Nepal, DTM 2018.

Note: Vehicle registrations do not capture vehicle scrappage rates, which would reduce the total vehicle population relative to the trajectory (Thygerson, Sanjel, and Johnson 2016). However, growth in both registration and vehicle population remains very high.

the movement of wind (Saud and Paudel 2018).

3.1.1.2. Inadequate Water, Sanitation, and Hygiene

The proportion of Nepal households with access to basic water services increased from 79 percent to 86 percent between 2000 and 2016 (Table 3.2 and Figure 3.5). However, only around 27 percent of the population have a safely managed water supply, defined as free from contamination, available on premises, and available on demand, by WHO and UNICEF (JMP 2017). At least basic sanitation infrastructure is available to over 80 percent of households (Nepal, MWSS 2016a), while around 46 percent of the population has at least basic sanitation infrastructure that is also unshared between households (JMP 2017),[39] a slightly lower proportion than the South Asian average (47 percent).

Infrastructure deficiencies are the primary cause of inadequate WASH in Nepal. The past 20 years have seen substantial investment in new water supply capacity. However, expenditure on upkeep and maintenance has been insufficient, leading to system degradation, failure, and contamination. The current infrastructure requires maintenance as a priority over further system extension: Only 25 percent of water supply systems in 2014 were classed as well functioning (Figure 3.6) (Nepal, MWSS 2016a). In addition, the earthquake of 2015 also set back the government's efforts to provide greater water and sanitation coverage to Nepali households. Of the total 11,288 water supply systems found across the 14 most severely quake-affected districts, 1,570 sustained major damages and 3,663 were partially damaged. (Nepal, MWSS 2016a). There is also anecdotal evidence on debris and landslides caused by substandard road local construction inflicting damage to drinking water sources and infrastructure (see section 3.2).

The low quality of source water available is a second contributor to contaminated water, and a contributor to high costs of water treatment. For example, water quality in the Bagmati River, Kathmandu Valley, is classed as poor, with dissolved oxygen levels below 1 mg/l (anoxic) by the time the river reaches Tilganga, reflecting a heavy load of nitrates and other pollutants (Shrestha et al.

Box 3.2. Health Impacts of Inadequate Water, Sanitation, and Hygiene

Inadequate WASH harm human health directly and indirectly. Directly, inadequate WASH causes diarrhea and other health problems by facilitating the transmission of a variety of waterborne pathogens. Diarrhea episodes can last multiple days, causing fatal dehydration, loss of salts, and septic bacterial infections, especially in young children. In addition, inadequate WASH contributes to poor nutritional status in young children, and in severe cases, physical and cognitive stunting (Cumming and Cairncross 2016). Stunting and poor nutritional status in turn increase the risk of child mortality from disease as well as cause delayed or inhibited cognitive development.

39 In contrast to the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), the government of Nepal allows shared sanitation facilities to be classed as improved (thus giving a higher proportion). This study provides cost of environmental degradation estimates based both on the JMP sanitation definition and the government of Nepal definition.

Table 3.2. Proportion of the Population With Access to Improved Water and Sanitation

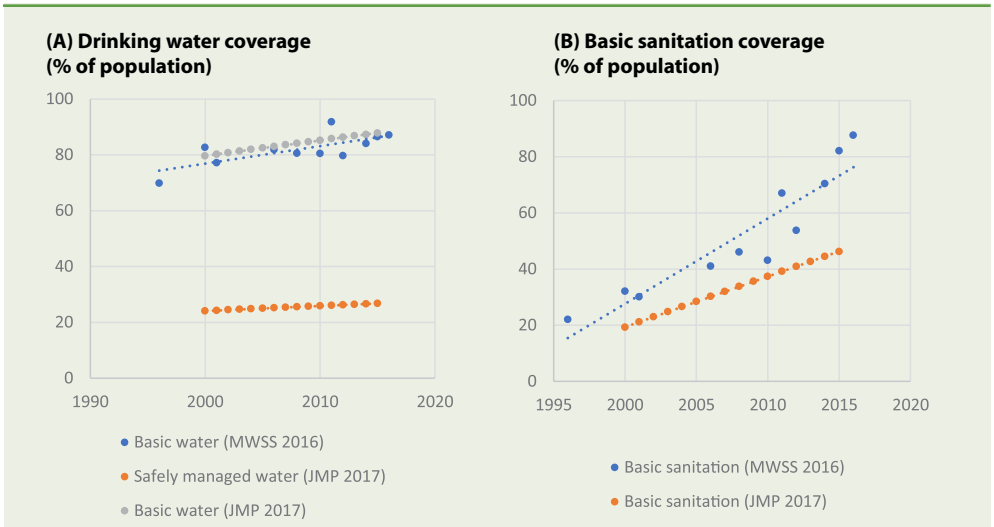
Sanitation category	Percent	Drinking water category	Percent
At least basic (unshared)	46	At least basic	88
Latrine	9	Accessible on premises	61
Septic tank	33	Available when needed	81
Other	5	Free from contamination	27
		Safely managed water[a]	27
Limited (shared)	19	Limited (> 30 mins)	2
Unimproved	5	Unimproved	7
Open defecation	30	Surface water	3
Total	100	Total	100

Source: JMP 2017.
a. The "safely managed water" category includes only those households with water that is accessible on premises, available when needed, and free from contamination; thus, it is a subset of the broader "at least basic" category.

2015). In rural areas, households mostly use single pit latrines or poorly constructed septic tanks (allowing fecal sludge contaminants to escape), while in urban areas, wastewater treatment facilities are very limited. These deficiencies result in high levels of bacteriological contamination of drinking water sources. While data are limited because of a lack of regular pollution monitoring on many key waterways, nationally, around 45 percent of all water (including piped, well, and surface sources) was found to be contaminated with E. coli in 2014, with contamination rates higher in urban areas (Nepal, CBS 2015b). The government of Nepal is taking action to reduce contamination; for example, a target of 2020 has been set to make the Bagmati River sewage free and is upgrading one plant and constructing four others to achieve this.[40]

Groundwater contamination from arsenic is a problem in specific areas, although it is a second-order problem compared to organic contaminants. When the government of Nepal tested tube wells across the Terai, it found approximately 8 percent of wells to ex-

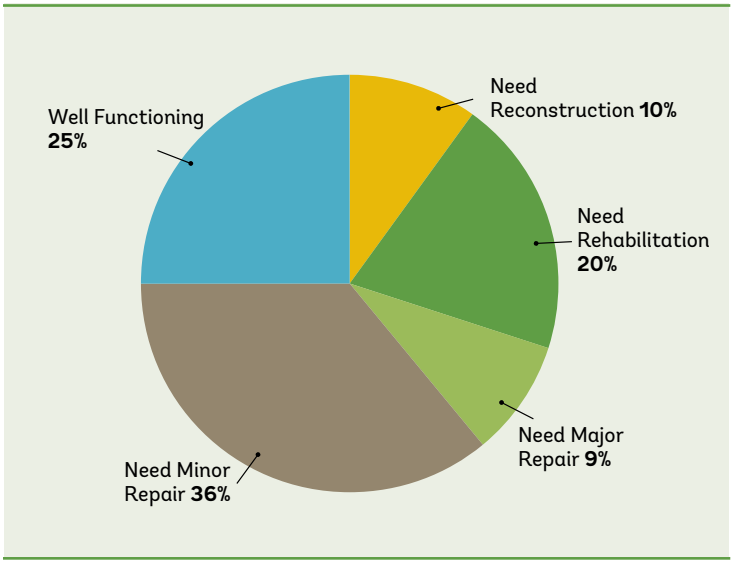
Figure 3.5. Trends in Water and Sanitation Indicators in Nepal, 1996–2016



Sources: Compiled using data from JMP (2017) in World Bank (2018), and Nepal, MWSS (2016b).
Note: Safely managed water is a stricter definition than basic water; hence, the proportion covered is lower. Basic sanitation as defined by JMP (2017) does not include shared facilities.

40 "Bagmati River to Be Sewage-Free by 2020," Himalayan Times, June 6, 2017, https://thehimalayantimes.com/kathmandu/bagmati-river-sewage-free-2020/.

Figure 3.6. Functional Status of Water Supply Systems, 2014



Source: Compiled using data in Nepal, MWSS (2016a).

ceed the national guideline value of 0.05 mg/l (Nepal, MOPE 2017b). In most cases, careful selection of appropriate aquifer depth can avoid serious arsenic contamination.

In Nepal, water pollution and water scarcity affect women's health, nutrition, workload, and, consequently, their opportunities to overcome poverty. Around one-fifth of schools lack basic WASH facilities, mainly affecting the health and education opportunities of girls and women. Around one-third of government schools lack separate toilets for girls and boys and menstrual hygiene facilities (UNICEF 2018).

3.1.1.3. Heavy Metals and Other Pollution Hazards

Nepal does not have heavy industry sources of metal pollution such as mining; however, secondary and consumer goods contribute to heavy metal exposure. These sources include paints, transport emissions, leaded water pipes, cosmetics and traditional remedies, improperly disposed batteries, consumer products, and contaminated groundwater. While concentrations in the population are similar or lower on key heavy metals than those in neighboring countries, they remain a cause for concern. Over 24.7 percent of children in one study from the Kathmandu Valley were found to have a blood lead level above 10 µg/dl (Dhimal et al. 2017).[41]

Proactive policy action has reduced lead exposure in Nepal over the past 20 years. Lead was phased out of fuel in 2000, and the government of Nepal introduced strict controls (less than 90 ppm) on lead concentrations in paint in 2015. However, remaining important sources of lead include lead-acid batteries and imported toys. Lead-acid batteries are common in Nepal, particularly following recent efforts to expand energy access through solar photovoltaic systems. Lead from these systems' batteries enters the environment at end of life given that Nepal does not have a hazardous waste collection system and batter-

Box 3.3. Heavy Metals, Occupational Hazards, and Related Health Impacts

A range of heavy metals are toxic to humans; most important among them is lead, for which no safe limit is known. Lead increases incidence of cardiovascular disease, miscarriage, premature birth, cognitive disability, and antisocial behavior. Young children are particularly vulnerable to the toxic effects of lead due to their exploratory "hand-to-mouth" behavior and their bodies' higher absorptive capacity. Many impacts are irreversible and affect life outcomes (WHO 2018).

Pollutants within workplaces also cause a wide array of diseases, notably cancers and chronic respiratory diseases. Occupational carcinogens include asbestos, polycyclic aromatic hydrocarbons, silica, sulfuric acid, trichloroethylene, arsenic, benzene, beryllium, cadmium, chromium, diesel exhaust, secondhand smoke, formaldehyde, and nickel. Chronic respiratory diseases are caused by occupational particulate matter, gases and fumes, and occupational asthmagens.

41 It should be noted that there is no known safe level of lead. In 2012, the U.S. Environmental Protection Agency lowered their guideline, defining "elevated" lead levels from 10 to 5 µg/dl.

ies are sometimes dumped improperly. Some exhausted batteries are exported to India for recycling, and the dumping of remnant non-exported battery components adds to lead exposure.

The government has also been proactive in reducing imports of carcinogenic asbestos; however, further provisions are required for the safe disposal of the existing asbestos stock. Asbestos is used in roofing, boilers, insulating materials, ceramics, and brake shoes. While asbestos for construction purposes is generally not harmful unless disturbed, it becomes fragile over time and is eventually disturbed during demolition or building renovation. An asbestos ban was introduced for most product categories in 2015, cutting imports from over 23,000 tons in 2014/15, to 87 tons in 2016/17.

3.1.1.4. Solid Waste

Solid waste collection and disposal remains deficient in Nepal's urban and rural municipalities. This includes in and around protected areas, adversely affecting livability, attractiveness to tourists, and ecological integrity. A study by ADB (2013) found that in 2012, the then existing 58 municipalities generated about 1,435 tons of solid waste per day (0.32 kg per capita) and estimated that the entire country generated about 4,735 tons of solid waste per day.[42] The same study found that about 62 percent of municipal solid waste was collected, although with substantial variation across municipalities (from 70 percent to 90 percent in major towns, and to below 50 percent in several smaller municipalities). A 2018 study carried out in nine secondary cities as part of the World Bank–supported Urban Governance Infrastructure Project corroborated this finding, showing that the door-to-door collection rate varies from 30 percent (Shuklagandaki) to 80 percent (Sundar Haraicha and Pokhara-Lekhnath) (White and Masaki 2019). Regarding disposal, ABD (2013) reported that in 2012, six of the 58 municipalities it surveyed used sanitary landfill sites for final disposal, while 45 practiced open dumping, including riverside and roadside (see Box 3.4 regarding the cost of improper disposal). The World Bank (2019a) reported that in 2018, none of the nine secondary cities surveyed possessed any sanitary disposal facilities. Source separation is limited and mostly practiced in rural municipalities. Some reuse and recycling programs exist in municipalities and are carried out by small formal and informal enterprises (ADB 2013).

In the Kathmandu Valley, solid waste collection is high compared to other metropolitan cities, but its disposal adversely affects the livability of the area. In Kathmandu City, an estimated 405 tons (nearly 87 percent of the waste generated daily) is collected, but it is either dumped informally along the Bagmati and Bishnumati riverbanks or taken to riverside municipal transfer stations, which are all overloaded and pollute the nearby environment. A landfill is being built in Banchare Danda to replace the Sisdol landfill—Kathmandu City's only landfill for solid waste, which is at overcapacity and in need of "formal and environmentally responsive closure" (White and Masaki 2019, 24)—but it is not known when this landfill will become operational.

Box 3.4. Cost of Improper Solid Waste Management

On average, the 58 municipalities that existed in 2012 spent about US$30 per ton of waste for collection to disposal in fiscal year 2012 (ADB 2013). This cost compares favorably with the costs of not collecting solid waste. A study of emerging Asian economies by Engel, Stuchtey, and Vanthournout (2016) calculated that burning, dumping, or discharging rubbish into waterways cost around US$375 per ton through pollution and disease, against the US$50–$100 that would cover costs of a system to dispose of that same ton appropriately.

42 As the study focused on households, institutions, and commercial businesses, waste generated by trekkers in protected areas were likely not included in these estimates.

Solid waste presents a particular challenge for the landscapes and biodiversity in the tourist regions, including national parks and conservation areas and corridors of Nepal's hilly and mountainous regions, potentially impacting tourism growth. The large influx of tourists, trekkers, and mountaineers in these areas generate large quantities of solid waste, which in some areas is dumped indiscriminately. Common types of wastes include discarded tents, cylinders, food packaging, plastic bottles, and wrappers. For example, in the Sagarmatha National Park an estimated 4.6 tons of waste is generated every day during the peak season and 2 tons of waste per day at other times. Similarly, about 12 tons of solid waste is dumped every year at Gorak Shep, the dumping point for waste collected at Everest Base Camp (UNEP 2016). Overall, an estimated 140 tons of waste had accumulated in the Mount Everest region during the 60 years of expeditions from 1964 to 2014 (Kelliher 2014). Similarly, issues of solid waste pollution and degradation of fragile landscapes are observed in the ACA, Lantang National Park, and the Kailash Sacred Landscape in far western Nepal (which includes the Khatpad and Rara National Parks and Api-Nampa Conservation Area). However, systematic waste collection and adequate disposal infrastructure of waste remain absent in most mountainous tourism areas, impacting the local environment as well as, to the extent waste finds its way to rivers, all the way to the Indian Ocean, in which the Nepali rivers ultimately empty.

Mountainous areas present unique challenges in terms of designing waste management systems. These include (i) sudden spikes in the quantity of waste generated during the tourist season; (ii) widely varying waste characteristics, including large volumes of plastic and specialist wastes; and (iii) constraints of land availability for waste treatment and disposal, especially due to the environmental sensitivities in these areas. Therefore, specific strategies and models of solid waste management are required for mountainous regions. It is also important to note that the tourists do not pay for waste management services, although tourist numbers in the high season are often multiples of the local population.

3.1.2. Calculating the Cost of Pollution

The analysis in this section quantifies impacts of key pollutants on humans, for which cause-effect linkages have been well established, estimation methods have been developed, and data are available in Nepal. These are: (1) diseases caused by ambient and indoor $PM_{2.5}$ air pollution; (2) diseases directly and indirectly caused by inadequate WASH; (3) diseases caused by occupational carcinogens, particulate matter, and asthmagens; and (4) reduced intellectual ability caused by children's exposure to lead. Consequently, many types of environmental degradation are excluded from this analysis for tractability.[43] The fact that we do not estimate these costs does not mean they equal zero; instead, our costs

Figure 3.7. Summary of 2030 Scenarios

See annex 1 for all scenario parameters		Pollution levels and WASH coverage: High $PM_{2.5}$ pollution, moderate WASH coverage	Pollution levels and WASH coverage: Moderate $PM_{2.5}$ pollution, high WASH coverage
2030 economic growth and GDP	Moderate growth (3.2 pct./yr/per cap.), GDP of US$32.9 billion	2030 BAU (BAU growth)	2030 SDG (BAU growth)
	High growth (7 pct./yr/per cap.) and GDP of US$72.0 billion	2030 BAU (SDG growth)	2030 SDG (SDG growth)

43 Specifically, we do not consider changes in natural resource values (that is, the degradation of natural capital); these topics—forestry, tourism, and water—are considered elsewhere in the ESD. We do not consider potential losses of biodiversity. While a range of methods exist for the quantification of biodiversity value (see, for example, Laurila-Pant et al. 2015; TEEB 2009), usually in the form of ecosystem services value, these are better suited to systems or local-level analysis rather than the national level that this study strives for. We do not quantify the loss of recreational and amenity values from changes in air and water conditions, again given the typically site-specific nature of such values. We also do not consider natural disaster related-costs, such as increased landslide and flood risk from deforestation and soil erosion, because of data limitations.

Box 3.5. Analytical Approach

Calculating the attributable burden involves taking estimates of the total health burden in terms of deaths from each disease (by age group) due to all risk factors (environmental or not), and then determining the contribution made by exposure to the risk factor of interest. We use published estimates of relative risk, which quantify the relationship between a risk factor (for example, the $PM_{2.5}$ concentration) and the likelihood of developing a particular disease (Prüss-Ustün et al. 2014; Burnett et al. 2014). These are combined with Nepal-specific statistics on disease incidence and pollution exposure levels to determine the total attributable burden. Because many diseases are caused by multiple risk factors, an adjustment step is then performed to prevent over-attribution.

The economic (monetary) value of the total attributable burden is estimated in terms of (1) forgone labor output, and (2) lost welfare. The forgone labor output value is an estimate of the cost of premature mortality, calculated as the present value of forgone lifetime earnings (Narain and Sall 2016). The present value of earnings is approximated by multiplying per capita consumption expenditure over the period of lost years (life expectancy minus the average age of death for the disease in question). Consumption is adjusted to grow over time in line with per capita income growth. Estimates are adjusted by the likelihood of participating in the labor market.

By contrast, our lost welfare measure does not account for the length of life lost; instead, it values all lives equally regardless of age of death. It is calculated by multiplying the estimated number of premature deaths with the value of statistical life, a measure of "an aggregate of individuals' willingness to pay (WTP) for marginal reductions in their mortality risks. It is not the value of any single person's life or death, nor does it represent a society's judgment as to what that value should be" (Narain and Sall 2016). We adjust published estimates for Nepal based on income differences in purchasing power parity (PPP) terms. The resulting values are US$18,800–$70,700 for 2006, US$20,900–$74,200 for 2015, US$31,100–$98,800 for 2030, all under BAU growth rates, and US$93,100–$215,900 for 2030 under SDG growth rates.

For 2030 scenarios, mortality rates are predicted using fixed effects panel regression analysis, which captures the experience of other countries at similar stages of economic development. Full method details are presented in the companion paper.

represent lower bounds on total environmental degradation.

We quantify impacts at three points in time: 2006, 2015, and 2030.[44] For 2030, we quantify impacts under different scenarios: a BAU scenario is based on household incomes and pollution concentrations trends of the past 10 years, while a SDG scenario represents the achievement of key environmental pollution-related SDG goals (Nepal, NPC 2017). We estimate both scenarios under two growth rates: BAU growth and SDG target growth (Figure 3.7).[45]

The process of estimating the cost of the health burden of pollution has two main steps: (1) calculating the health burden in terms of premature deaths (mortality) attributable to an environmental risk factor (the "attributable burden"), and (2) estimating the economic value of the attributable burden in monetary terms (see Box 3.5).

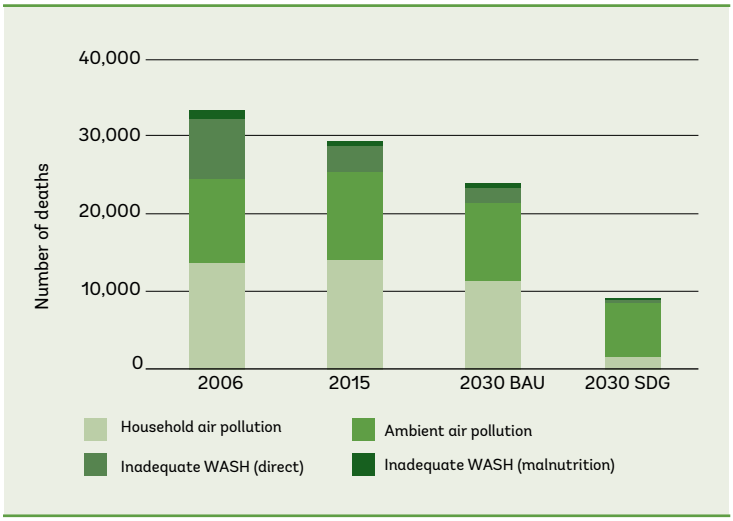
3.1.3. Health Burden

It is estimated that Nepal faces an annual mortality burden from pollution of at least 33,500 deaths, a death toll greater than the devastating 2015 earthquake. This is slightly down from the last time the World Bank calculated the mortality burden of pollution for Nepal, in 2006, when premature deaths were around 36,700 (and the population was around 10 percent smaller). Both

44 Our choice of 2015 reflects "the present" to the best extent that data permit, and the baseline year for the SDGs. Our choice of 2006 aligns with the last time the World Bank undertook a cost of environmental degradation study and is used to examine temporal trends in costs. Our choice of 2030 aligns with key policy goals set by the government of Nepal as part of its commitment to the SDGs (Nepal, NPC 2017).

45 Which growth outcome is most likely is a judgement for the reader. It may be unlikely that SDG levels of pollution can be achieved with BAU rates of growth, especially if (relatively expensive) electricity is required to provide clean cooking, for instance. Alternatively, the SDG rates of growth may be considered unlikely in themselves. We make no judgement about the relatively likelihood of these outcomes and instead present a range of estimates based on these scenarios.

Figure 3.8. Estimated Number of Air Pollution- and WASH-Related Deaths by Year



Note: Occupational related deaths are not projected for 2030 because of a lack of data; hence, they are not shown on this graph.

then and now, these deaths are attributable in largest part to air pollution, with household air pollution the largest single cause (approximately 43 percent). Direct deaths attributable to inadequate WASH (diarrhea and typhoid) are a smaller but still significant component, accounting for approximately 11 percent of pollution-related deaths. While deaths attributable to air pollution held roughly constant between 2006 and 2015, WASH-related mortality decreased rapidly in line with improvements in sanitation and access to safe water. In 2006, by contrast, inadequate WASH was responsible for an estimated 24 percent of that year's pollution-related mortality burden (Figure 3.8).

While these estimates concern mortality, air pollution and inadequate WASH also have large impacts on morbidity. While air pollution morbidity is beyond the scope of this analysis, we examine trends in diarrheal cases. The incidence rate in the under-five age category (measured over a two-week period) fell from 11. 9 percent in 2006 to 7.6 percent in 2015 (Nepal, MOHP 2007; Nepal, MOH 2017), and it is projected to fall below 1 percent in 2030 (in line with the government's SDG target). We conservatively estimate that 28–44 percent of these can be attributed to inadequate WASH infrastructure, representing 1.2–2.0 million cases of (usually nonfatal) diarrhea each year in the 0–4 age bracket.

By 2030, the overall pollution-related mortality is expected to be around 23,800 deaths under BAU, and a much lower 8,800 if SDG targets are reached (Figure 3.8). In the latter scenario, mortality rates fall almost to zero for inadequate WASH and fall to around a third of their 2015 level for PM2.5. Most of this improvement can be attributed to better access to clean cooking: The Nepal government's target is for 90 percent access to cleaner cooking by 2030, up from 19 percent in 2015. It should be noted that these 2030 estimates represent complete SDG target achievement. Partial achievement (for example, representing a scenario based on significant use of biomass improved cookstoves, which are cleaner, but not completely clean) will lead to more modest reductions in mortality.

3.1.4. Economic Costs of Environmental Pollution

3.1.4.1. Economic Cost of Air Pollution

$PM_{2.5}$ is the greatest contributor to Nepal's overall pollution burden, with a total forgone output cost in 2015 of US$130 million per year, and a total welfare loss of US$1,362 in 2015. These costs represent around 0.6 and 6.4 percent of annual economic activity (GDP equivalent), respectively. Relative to the total, $PM_{2.5}$ contributes around 50 percent of forgone outcome losses, and 83 percent of welfare losses in 2015. $PM_{2.5}$ costs are roughly evenly split between household sources and ambient sources and are slightly higher (relative to population) in rural areas.

Air pollution costs continue to grow to 2030 under BAU conditions but fall under SDG conditions. BAU conditions assume current rates of change in pollution, while SDG conditions assume lower pollution in

line with stronger policy action (see section 3.1.2 for a description of scenario assumptions). Under BAU, costs grow from around US$130 million in 2015 to US$136–$256 million in 2030 in terms of forgone output and from US$1,363 million to US$1,655–$3,885 million in terms of lost welfare (depending on growth rates assumptions; see Figure 3.9). These trends are driven by worsening ambient air pollution in urban areas and increasing urbanization that will bring a greater share of the population into contact with these elevated concentrations. In addition, the use of biomass for cooking in rural areas falls only marginally under the BAU scenario, from 87.8 percent to 80 percent, not enough to outweigh the impact of increased ambient $PM_{2.5}$. By contrast, SDG conditions see total $PM_{2.5}$ costs fall to US$48–$91 million in 2030 in terms of forgone output, and to US$591–$1,386 million in lost welfare terms.

3.1.4.2. Economic Cost of Inadequate WASH

Inadequate WASH is the second largest driver of environmental health costs. In 2015, forgone output was an estimated US$76.8 million directly and US$2.1 million through malnutrition impacts. Equivalent welfare losses are an estimated US$249 million directly (mortality and morbidity) and US$20.8 million indirectly, respectively. Relative to the total economic burden of pollution quantified in this study, inadequate WASH contributes around 38 percent of forgone outcome losses and 16 percent of welfare losses in 2015. In total, the forgone output and welfare loss estimates are equivalent to around 0.4 and 1.4 percent of GDP, respectively.

These costs are substantially less than in 2006, for which comparable lost welfare costs were US$447 and US$54 million for direct impacts and malnutrition impacts, respectively (annex 3). The proportional cost of GDP was also much higher in 2006, at around 2.7 percent GDP equivalent (lost welfare) and 0.7 percent (forgone output). Improvements since 2006 are a result of improvement in the coverage and quality of infrastructure: The proportion of Nepal's population with improved drinking water increased by 5 percentage points between 2006 and 2015. Nepal further achieved a 15 percentage point increase in improved sanitation as defined by JMP (2017), and around a 35 percentage point increase as defined by Nepal, MWSS (2016b). There was a 60 percentage point increase in improved hygiene facilities.

Under SDG conditions, total inadequate WASH costs fall to US$1.8–$2.7 million in 2030 in terms of forgone output, and US$15.9–$37.7 million in lost welfare terms. The economic costs under BAU could fall further or increase to 2030, depending on economic conditions. Under BAU improvements in WASH coverage, costs are predicted to shrink to a total of US$20.5 million annually in forgone output and US$159 million annually in welfare terms, given moderate economic growth similar to 2015. Under higher SDG levels of growth, the ongoing deficiencies in WASH infrastructure see costs increase to US$37 million in forgone output and US$375 in welfare terms (annex 3). This highlights the importance of economic conditions on costs. **A wealthier Nepal stands to lose more from pollution as the cost of the health burden becomes higher along with wage rates.**

Table 3.3. Estimated Annual Mortality and Economic Cost of Occupational Pollutants, 2015–2016

Year	Occupational hazard associated disease	Est. mortality	Lost welfare (US$, millions)	Forgone output (US$, millions)
2006	Neoplasms	166	129.1	8.6
	Chronic respiratory diseases	2,461		
2015	Neoplasms	241	170.7	15.7
	Chronic respiratory diseases	3,034		

Note: Estimates are in 2014 U.S. dollars.

3.1.4.3. Economic Cost of Heavy Metals and Occupational Hazards

We estimate an average IQ loss due to childhood lead expoure of 1.44 points. Given existing estimates of a 1.4–1.9 percent decline in lifetime earnings per IQ point lost, we estimate a loss in potential earnings of 2.0–2.7 percent. Given the size of the Kathmandu Valley population children under five, this causes an estimated forgone output of US$34–$46 million per year.

We estimate an increase in mortality from deaths from occupational pollutants from 2,622 in 2006 to 3,264 in 2015. This is associated with forgone output in 2015 of US$15.7 million per year and a welfare loss of US$170 million, substantially higher than in 2006 (Table 3.3). While the amount of heavy industry in Nepal is low compared with neighboring Bangladesh and India, micro and small enterprises such as workshops and metalworkers using hazardous materials still contribute to negative health impacts.

3.1.4.4. Aggregate Cost of Pollution

In aggregate, these costs sum to around US$259 million per year in terms of forgone output (Table 3.4), which is approximately equivalent to 1.22 percent of Nepal's 2015 GDP. In welfare terms, overall costs are substantially higher, representing the implicit value placed by individuals on their own lives—those beyond simply lost earnings—that is captured in value of statistical life estimations. The estimated 33,558 premature deaths that occur in Nepal represent economic welfare costs of US$1,803 million in total, equivalent to around 8.5 percent of GDP per year. These estimates are conservative: The damage from many types of pollution and environmental degradation are not included due to limitations in data or in valuation methods.

The overall economic burden has fallen slightly since 2006. The drop, from an estimated US$266 million to US$208 million in 2015 forgone output terms, represents a fall from 1.45 percent to 0.98 percent in GDP equivalent (see Table 3.5 and Figure 3.9). Out to 2030, costs rise or fall depending on economic assumptions: The higher SDG rate of growth dramatically increases overall costs relative to BAU rates of growth. A larger economy entails more productive workers and higher demand for both environmental and quality of life. The opportunity cost of pollution increases substantially. While this superficially suggests that the SDG outcome is not desirable, the appropriate comparison is BAU levels of pollution combined with SDG levels of growth, which has even greater costs.

3.1.5. Policy Options for Reducing Pollution

This analysis has shown sizable economic costs associated with air pollution, inad-

Table 3.4. Estimated Cost of Environmental Degradation in Nepal, 2015

	Premature mortality	Welfare loss		Forgone output	
		US$, millions	GDP equiv.	US$, millions	GDP equiv.
$PM_{2.5}$ Air pollution	26,063	1,362.9	6.41%	129.6	0.61%
Ambient	11,975	626.2	2.94%	59.6	0.28%
Household	14,088	736.7	3.46%	70.0	0.33%
WASH	4,230	269.7	1.27%	79.3	0.37%
Direct	3,832	248.9	1.17%	76.8	0.36%
Malnutrition	398	20.8	0.10%	2.5	0.01%
Occupational pollutants	3,264	170.7	0.80%	15.7	0.07%
Lead (Kathmandu Valley only)	N/A	0.0	0.00%	34.4	0.16%
Total	33,558	1,803.3	8.48%	259.0	1.22%

Note: Author estimations are in 2014 U.S. dollars.

Table 3.5. Total Cost of Pollution and GDP Equivalent by Scenario/Year

Scenario/Year	Lost welfare		Forgone output	
	US$, millions	GDP equiv.	US$, millions	GDP equiv.
2006	1,738.6	9.48%	266.0	1.45%
2015	1,632.6	7.68%	208.8	0.98%
2030 BAU (BAU growth)	1,813.7	5.51%	156.5	0.48%
2030 BAU (SDG growth)	4,260.0	5.92%	293.1	0.41%
2030 SDG (BAU growth)	607.6	1.85%	49.7	0.15%
2030 SDG (SDG growth)	1,424.0	1.98%	93.7	0.13%

Note: Author estimates are lower and thus a more partial measure than those presented for 2015 alone as lead and occupational costs are excluded due to a lack of data. These estimates are intended to indicate time trends rather than overall levels, which can be assumed to be slightly higher. Estimates are in 2014 U.S. dollars.

equate WASH, metals, and occupational hazards. Reducing these costs requires concerted action, from developing sector policies and strategies, to greater (or smarter) enforcement of existing regulations, to investments in institutions and infrastructure. The broad policy framework required for such actions is already in place. The 2015 constitution enshrines the right to a clean and healthy environment, and legislation such as the Environment Protection Act 1997 and Environment Protection Rules 1997 support pollution reduction efforts.

This section focuses on interventions to improve air quality, given that air pollution is the largest driver of health and economic costs in Nepal, and given that BAU scenarios show a worsening problem in the absence of policy action. Interventions focus on policies and institutions, first concerning the overall air quality management (AQM) framework, followed by interventions to address three key air pollution sources: brick kilns, transportation, and household air pollution. A similar discussion on WASH, solid and hazardous waste, and heavy metals contamination is presented in annex 4.

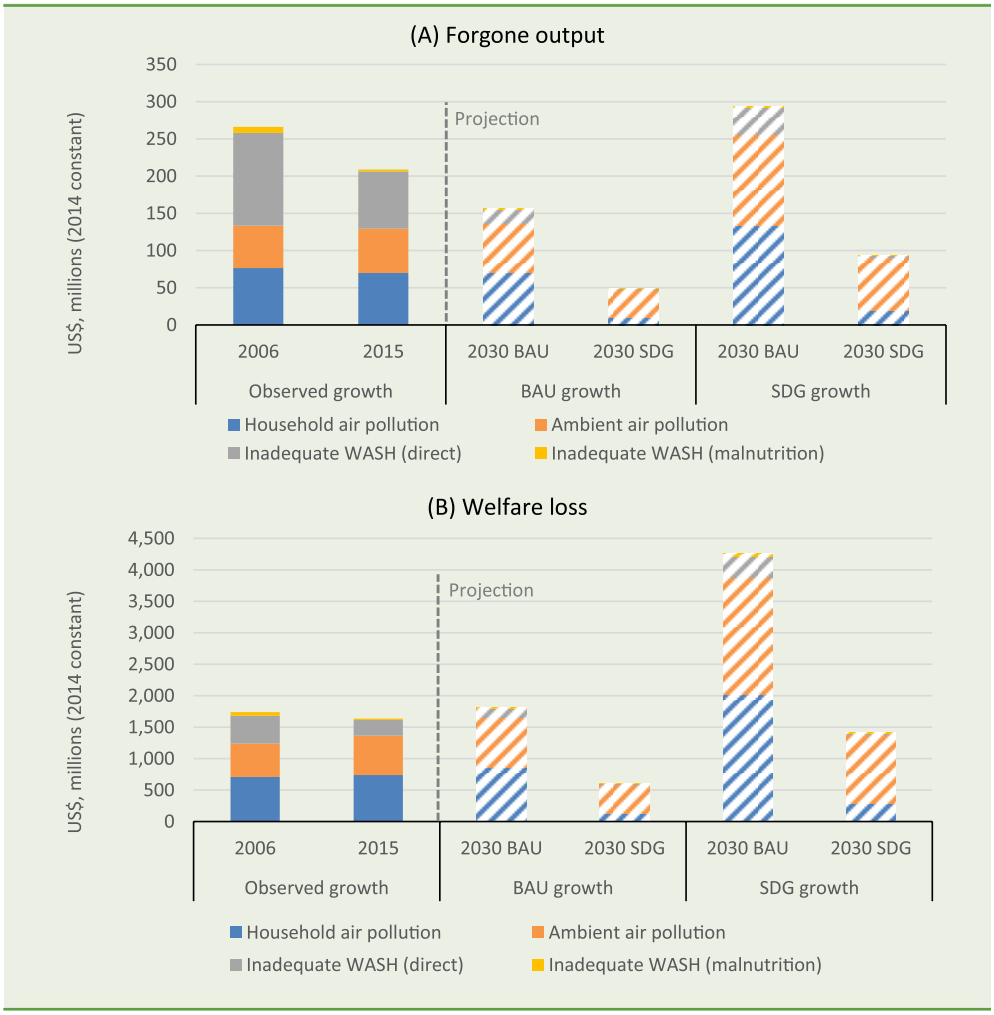
3.1.5.1. Current Regulatory and Institutional Framework for Ambient Air Quality Management

Nepal's National Ambient Air Quality Standards (NAAQS) define 24-hour concentration limits for PM_{10} and $PM_{2.5}$ of 120 µg/m^3 and 40 µg/m^3, respectively, which are approximately two times higher than the WHO guidelines (Table 3.7). Monitoring of ambient air quality is the responsibility of the Department of Environment (DOE) under MOFE, which may change under federalism (see chapter 4). Continuous monitoring occurs at 19 stations, of which 7 are in Kathmandu, 3 in Pokhara, 4 in the Terai (Jhumka, Simara, Nepalgunj, and Dang), 2 in Lumbini and Chitwan, and 2 inside the U.S. embassy in Kathmandu (which shares data with the DOE). Twelve monitoring stations are operated by the DOE, three by ICIMOD, one by the US Embassy, and three jointly by the U.S. embassy and DOE. These stations provide real-time data that are made publicly available online. However, the DOE lacks the capacity to process and analyze the data in ways that could support adaptive regulatory action. Emission standards exist for the two key $PM_{2.5}$ sources, namely brick kilns and vehicles, as well as quarries.

3.1.5.2. Policy Options for Reducing Air Pollution

To improve the air quality in the Kathmandu Valley and other hot spot areas, Nepal should develop an AQM plan and clarify the institutional responsibilities for AQM at the three levels of government. AQM is a continuous and circular process of monitoring air quality, identifying sources, developing and adjusting policies, and implementing

Figure 3.9. Total Cost of Pollution by Year/Scenario and Cause



priority investments for pollutant reduction. This process should aim to adapt to changing circumstances and pollution levels, as recorded by frequent data collection.

Strengthen the AQM decision support system. There is a need to upgrade the quality and accessibility of air quality data, by investing in monitoring stations and systems for real-time data processing. The current network of monitoring stations should be expanded, with greater monitoring in key urban areas outside of the Kathmandu Valley. The DOE plans to add seven more monitoring stations in 2019 and 2020, but further increases in monitoring stations will be required. The scope of pollutants detected should also be increased: While particulate matter monitoring should receive the broadest spatial coverage, the capacity to monitor less prevalent but more toxic pollutants such as benzene is required in key areas. Data should continue to be made publicly available online in close to real time, and daily reporting of the air quality index should be made through popular media. This information is particularly important for people with heightened health sensitivity to pollution levels and can support avoidance behaviors.

Use of richer data requires upgraded capacity for analysis and input into decision making. Investment in capacity for emissions in-

Box 3.6. Pollution Costs in the Kathmandu Valley

The Kathmandu Valley, home to about 10 percent of Nepal's population, is a focal point for important industries, government, cultural attractions, and tourists. With some of the country's highest population densities, it is also the home of some of the best-known pollution problems, including water pollution in the Bagmati River and high levels of air pollution. For the Kathmandu Valley alone, pollution costs in 2015 were approximately US$18 million in forgone output, and US$120 million in lost welfare.

The Kathmandu Valley faces a growing proportion of Nepal's pollution costs, from 6.8 percent in forgone output terms in 2006 to around 15 percent in 2030. This is partly because incomes are higher in the Kathmandu Valley than elsewhere, implying a higher opportunity cost of damage because of higher lost wages. Second, the valley is substantially urbanized (and becoming more so), increasing the total population along with growing ambient air pollution. Third, migration is putting pressure on urban WASH infrastructure. A third of Nepal's districts, for instance, shrank in terms of population between 2001 and 2011 as people migrated to urban areas in search of economic opportunity and amenities.

Table 3.6. Cost of Environmental Degradation in the Kathmandu Valley by Scenario/Year

Scenario/Year	Lost welfare (US$, millions)	Percent of country total	Forgone output (US$, millions)	Percent of country total
2006	86.6	4.98%	18.1	6.80%
2015	120.4	7.37%	18.0	8.62%
2030 BAU (BAU growth)	210.2	11.59%	23.7	15.18%
2030 BAU (SDG growth)	461.6	10.84%	42.2	14.39%
2030 SDG (BAU growth)	82.2	13.53%	7.5	15.10%
2030 SDG (SDG growth)	192.3	13.50%	14.2	15.16%

Note: Estimates are in 2014 U.S. dollars. Percent of country total means percent of cost of environmental degradation estimated from the sources analyzed in this study, nationally.

ventory analysis and dispersion modeling will help inform sector-specific regulations and target monitoring efforts. Current pollution source research is concentrated in the Kathmandu Valley (with some exceptions; see, for example, Sadavarte et al. 2019); this should be extended to other parts of Nepal. There is also a need to better understand cross-border pollution flows given the influence of activities in Bangladesh and India on Nepal's air quality. Ambitions for air pollution reduction must be cognizant of cross-border pollution that cannot be reduced by domestic actions alone. The DOE should expand partnership with academic and meteorological institutions to support analysis and research efforts.

In line with the findings from these expanded research efforts, the National Ambient Air Quality Standard of Nepal should be revised periodically. Sector-specific regulations should be upgraded based on new evidence. However, enforcement of sector regulations is arguably more important than changes to the ambient standard, as no one firm can be held legally responsible for ambient pollution levels. Enforcement is required for sector-specific technology and regulatory requirements and should be a DOE priority.

The DOE needs to be further capacitated in terms of staff numbers, expertise, and number of service outlets. Currently, the DOE has only 56 staff members, of which 35 are technical, including 16 environmental inspectors. The number of environmental inspectors is insufficient. Recruitment, in the medium term, of at least one environmental inspector in each of the 753 local governments, and some in all seven provincial ministries, and their two-way communication linkages with the DOE is recommended. The monitoring

Table 3.7. National Ambient Air Quality Standards, 2012

Parameter	Time-weighted average	Maximum concentration (µg/m^3)	World Health Organization guideline (µg/m^3)
TSP	Annual	-	-
	24-hour	230	-
PM_{10}	Annual	-	20
	24-hour	120	50
$PM_{2.5}$	Annual	-	10
	24-hour	40	25
SO2	Annual	50	-
	24-hour	70	20
NO2	Annual	40	40
	24-hour	80	-
CO	8-hour	10,000	-
Lead	Annual	0.5	-
Benzene	Annual	5	-
Ozone	8-hour	157	100

system of the DOE needs to be strengthened considering the changing contexts of federalism, infrastructure development, and increasing environmental impacts including pollutions across the country.

3.1.5.2.1. Options for Reducing Air Pollution From Brick Kilns

Construction of a brick kiln requires an initial environmental examination or an environmental impact assessment, in addition to permission from local government. The DOE is responsible for issuing emissions standards and monitoring compliance. Upon repeated noncompliance, MOFE has the authority to suspend an enterprise's activities. It is not yet clear under the new federal system how much of these inspection and enforcement prerogatives the DOE will delegate to provincial and local counterparts.

Several regulatory decisions have already been made to reduce pollution from kilns. The least efficient and most polluting technologies, clamp kilns and movable chimney Bull's trench kilns, were banned nationwide in 2009. Kilns are already prohibited from using firewood, rubber tires, or plastic as fuel. To incentivize more efficient "vertical shaft" kilns, some restrictions have been waived on this type of kiln construction (for example, the need to obtain permission to locate a kiln within 2 kilometers of forest areas). Tax deductions are also available for more efficient kilns, and emissions standards were tightened in 2018. As per the updated standards, the maximum limit of suspended particulate matter (TSP) and the minimum limit for the height of stack of brick kilns varies depending on the kiln types.[48] Actions based on the following recommendations can build on this progress.

Strengthen monitoring and enforcement of standards within the brick kiln industry: While the 2018 standards are an important improvement, increased monitoring to ensure compliance is required. There is limited monitoring at present, and clamp kilns and movable chimney Bull's trench kilns still operate in the country despite the ban (Eil et al. 2018). Bringing all kilns into the registration (and thus monitoring) system is an initial necessary step. Registration should be an

48 "New Emission Standards Set for Brick Kilns," Himalayan Times, February 8, 2018, https://thehimalayantimes.com/kathmandu/new-emission-standards-set-for-brick-kilns/.

ongoing event rather than a one-time event, with kilns required to maintain "certification" based on pollution checks. Currently, registered kilns face competition from nonregistered kilns, which avoid tax and regulatory liabilities. Fines for noncompliance are low and reportedly rarely applied (MinErgy and FNBI 2017). Improved pollution monitoring could be combined with checks on workplace conditions and child protection measures (Nepal, MOPE 2017d).

Monitoring results could be linked to future registration, with noncompliant kilns given a time-bound opportunity to take corrective action. Similarly, registration should be denied to kilns not using zigzag or other improved firing processes (see Box 3.7). In the process, simplifications to the registration system could help reduce the burden of these new requirements on industry.

Harmonize standards to incentivize cleaner technology: Regulation that does not make allowances for older technologies would hasten conversion to cleaner kiln types. Currently, less efficient kilns are held to a more lenient standard, providing little incentive for their upgrade (MinErgy and FNBI 2017). Gradual, fully anticipated moves toward a consistent, stricter standard, over a time frame that allows for the required capital investment, are recommended. Assistance in accessing financing for these upgrades should be considered.

Explore opportunities to use economic incentives: Regulation is not the only tool at the disposal of policy makers. Taxes, credits, and trading programs can be used to lower the economic cost of regulation relative to firm emissions, input, or technology requirements. Potential options could include a coal tax: Almost all of Nepal's coal imports are used in brick kilns, providing an opportunity to incentivize efficiency improvements by industry. Alternatively, firms could be required to purchase emissions permits as part of their operating certification, with revenues used to cover concessionary finance or other subsidies for efficiency improvements within the sector. It is important to note, however, that for economic incentives to be effective, the basic elements of a sound regulatory system must be in place, including notably monitoring. Additional factors to consider in exploring various economic incentives include the cost and capacity to design and administer such programs.

Utilize spatial planning when approving new construction: Registration and development approvals should consider "airshed" conditions (the local wind patterns), mapped and made publicly available, and use financial instruments (fees or subsidies), or regulation (for example, construction approvals) to encourage the siting of kilns in less pollution-sensitive areas. Similarly, differentiated air quality standards could be used for more sensitive locations such as urban areas, valleys, and heritage and conservation sites.

Coordinate actions and signal intent to industry by implementing a comprehensive sector strategy: There is currently no clear policy and strategy to guide the modernization and regulation of the sector, causing uncertainty among investors. The uncertainly has been nominated by the industry as a major brake on investment (MinErgy and FNBI 2017), which includes emissions reducing investments. All regulatory changes should be flagged as far in advance as possible to allow for changes to capital investments.

Nepal's government has already banned the two most traditional (and very polluting) kiln types, namely the clamp kiln and the movable chimney Bull's trench kiln. The industry has also responded by rebuilding a small number of kilns with a zigzag design after the 2015 earthquake, which damaged over a third of the nation's kilns. These operators have found the improved efficiencies to outweigh the higher capital costs (around US$150,000), with a payback period averaging two years (Lo-

Box 3.7. Options for Upgrading Nepal's Brick Kilns

Nepal produces around 5 billion bricks per year (0.4 percent of Asia's total). Brick production is an important part of the national economy. However, Nepal's estimated 1,600 brick kilns contribute substantially to degraded air quality: Around 19 percent of total particulate matter emissions in the Kathmandu Valley, for instance, comes from brick kilns (even though fewer than 10 percent of Nepal's kilns are located here). Around 70 percent of Nepal's kilns are fixed-chimney Bull's trench kilns (BTKs), which have relatively low energy efficiency (Nepal et al. 2019).

Switching from BTKs to other designs can reduce emissions dramatically. Zigzag designs maintain the fundamental structure of the BTK but arrange bricks so that they are more efficiently heated. The zigzag design reduces emissions by 20–40 percent (Panday 2016), as demonstrated in a recent comparative study from across central and western Nepal (Nepal et al. 2019). More capital intensive but even more efficient designs include the hybrid Hoffman kiln (HHK) and the vertical shaft brick kiln (VSBK). The HHK employs a mix of pulverized coal and clay to improve firing conditions. Waste heat from the kiln is collected and reused to dry the green bricks before they enter the kiln. HHKs use around half the coal of fixed chimney kilns, and they trap coal particles inside the brick to prevent them from becoming airborne. VSBK stacks bricks vertically for firing to take advantage of the upward movement of heat.

pez et al. 2012). While cleaner kilns are more expensive, they are also more productive and can attract carbon-emissions reduction financing. However, they must be operated correctly to achieve emissions reductions, necessitating technical training. It is also possible to improve the resource efficiency of brick production without changing kiln type. Partially hollow bricks require up to 20 percent less energy and are lighter, yet they retain their compressive strength. However, they require an electricity supply and expensive equipment, putting them out of reach of some small enterprises (Sharma 2017).

3.1.5.2.2. Options for Reducing Air Pollution From Vehicle-Based Sources

The government of Nepal has recently taken positive steps to reduce traffic-sourced air pollution. In an effort to reduce the numbers of the most polluting vehicles, in 2018 the Department of Transportation banned public vehicles (taxis and buses) older than 20 years from Nepal's roads, affecting around 5,500 vehicles (Bajracharya and Bhattarai 2016). Furthermore, in metropolitan cities and in all other areas of Nepal where there is a Transport Management Office or a transport Management Service Office, vehicles are required to undergo an emissions test; vehicles that fail the test must undergo maintenance and retake the test until they pass it. The extent to which these measures are enforced will be key, as initial attempts at similar measures were not well enforced. Actions based on the following recommendations can build on this progress.

Improve vehicle standards: Imported vehicles to Nepal must currently meet Euro III emissions standards, with a move to Euro IV standards currently under consideration by the government. This upgrade would bring Nepal in line with India, the source of 90 percent of vehicles. India is further considering an upgrade to Euro VI standards nationwide by 2020, which Nepal should follow. Without consistency between markets, it is likely that India's noncompliant used vehicles will be sold to buyers in Nepal, shifting the problem there. The extent of market integration makes a harmonization of standards logical.

Fuel standards can also play a role: Nepal has already improved standards, with a switch to Euro IV standards in 2017. This switch is ahead of India, which plans to achieve nationwide Euro IV standards by 2020. Imports of fuel should be tested to ensure that standards are being met.

Improve the efficiency of the transport fleet: Nepal's total fuel consumption is expected to triple between 2010 and 2030, with a concordant 30 percent increase in particulate matter (among other pollutants) (Bajracharya and Bhattarai 2016). Motorbikes are estimated to become the largest contributor to this demand (44 percent), followed by light duty vehicles (24 percent), by the year 2030. Both fuel efficiency measures and changes to the mix of vehicles can substantively reduce the pollution load associated with these trends. These policies also help reduce Nepal's dependence on sometimes unreliable imported sources of fossil fuels.

A 30 percent increase in overall vehicle efficiency between 2016 and 2030 is predicted to reduce fuel consumption by around 9 percent, with a similar reduction in particulate matter emissions. Greater efficiency also avoids fuel costs estimated at US$363 million over this period, partially offsetting the higher costs of more modern, more efficient vehicles (Bajracharya and Bhattarai 2016). The Ministry of Physical Infrastructure and Transport is currently working on a baseline survey of fuel economy in Nepal, which will provide a basis for an appropriate fuel policy incorporating increasing efficiency guidelines (and associated policy measures, such as traffic control) over time.

The government of Nepal also has a strategy to introduce electric and hybrid vehicles, which is expected to have large impacts on emissions. A scenario in which hybrid cars account for 75 percent of car sales by 2030 is estimated to reduce particulate matter pollution by around 10 percent, relative to business as usual. Similarly, a scenario in which electric motorbikes account for 75 percent of sales (with a corresponding reduction in petrol motorbikes) is estimated to reduce vehicle-based particulate matter pollution by around 20 percent (World Bank and AEPC 2017).

Reduce road-based sources of dust pollution: While resuspended dust comprises mainly PM_{10} and larger size particles (rather than the particularly dangerous $PM_{2.5}$ particles), it nevertheless impacts health, and has a significant amenity cost. Dust is sourced mainly from construction sites and unpaved roads. Construction in the Kathmandu Valley is particularly extensive, thanks to ongoing post-earthquake reconstruction efforts. Unpaved roads make up around 40 percent of feeder roads (both primary and secondary), although most national highways and strategic urban roads are paved. Dust comes from both road construction and vehicle use of unpaved roads. Greater water spraying at construction sites and a construction schedule that prioritizes sealing of earth roads are rec-

Box 3.8. Clean Cooking Solutions for All: A Nepali Initiative

As part of Nepal's commitment to the Sustainable Energy for All partnership, a global initiative aiming to make energy universally accessible, cleaner and more efficient, the government of Nepal has committed to achieving Clean Cooking for All by 2030 (CCS4All). Nepal's efforts toward this goal so far have been supported by the governments of Denmark, Germany, Nepal, Norway, and the United Kingdom, multilateral banks, and the United Nations with US$184 million in commitments between 2012 and 2017. As part of this program, the government through the Alternative Energy Promotion Center has disseminated more than 1.3 million cookstoves and facilitated the construction of over 360,000 biogas plants throughout the country (World Bank and AEPC 2017).

The World Bank is supporting Nepal's efforts toward CCS4All through the Developing Improved Solutions for Cooking (DISC) Initiative. This technical assistance program has funded outreach, pilots, and knowledge exchanges to raise grassroots awareness about the benefits of clean cooking. Further, through "learning-by-doing" approaches developed in collaboration with the government of Nepal, DISC has helped catalyze an appropriate roadmap, framework, and benchmarks for achieving universal clean cooking by 2030.

ommended. Overtime, higher-quality roads will also improve vehicle fuel efficiencies.

These approaches have vastly different costs that require further quantification in the Nepal context. Interventions requiring substantial capital investments (public or private) such as vehicle replacement, are much more expensive than upgrades such as greater use of diesel particulate filters (DPFs). Selected recommendations should be guided by analysis to determine the relative contributions from different types of vehicles and reveal opportunities to cut emissions in the most cost-effective manner. This may mean focusing on heavy-duty vehicles or public buses first, for example.

3.1.5.2.3. Policy Options for Reducing Household Air Pollution

Biomass use is predicted to remain widespread in Nepal for some time because of the unreliability and relatively high cost of electricity, relatively high cost of liquefied petroleum gas (LPG), and a limited number of cattle for biogas production. Cooking is driven by cost, tradition, and a lack of reliable alternatives. Biomass is predicted to remain the primary energy source, but with the right mix of investments, it is predicted that traditional cookstoves can be largely displaced with improved cookstoves (ICSs), biogas, and LPG by 2030 (Leaders 2018; Nepal, MOPE 2017a).[49] While improved cookstoves are not "clean," they are "cleaner," with a fuel conversion efficiency of around 25 percent up from 10 percent for traditional stoves, and $PM_{2.5}$ emissions that are 60 to 80 percent lower in the right conditions (World Bank and AEPC 2017).[50] The following recommendations can support efforts to promote use of both cleaner biomass and non-biomass stoves.

Public promotion of cleaner cooking and awareness raising: While awareness-raising activities by the Alternative Energy Promotion Center (AEPC) and others appear to have successfully socialized public understanding of the health, fuelwood use, and cooking time benefits of cleaner stoves in urban areas, more needs to be done in rural areas. A national media campaign could help, but it is likely more peer-orientated and direct messaging approaches are needed in more remote areas. This could include try-before-you-buy approaches for clusters of households. Education should consider stove issues broadly, advocating for proper installation (for example, dedicated vents), operation, and awareness of health impacts and safety issues.

Capacity building is required on the supply side: Actions that strengthen supply chains are needed. Training courses and business development events for manufacturers, suppliers, and retailers, highlighting investment opportunities and new technologies, are recommended. These may include opportunities around cleaner-burning wood pellets. Capacity building that promotes local operations and maintenance networks would also be valuable, as a lack of technicians in rural areas who can service and repair the stoves has previously been a barrier to continued ICS use in Nepal.

Expanded subsidy support through the Renewable Energy Subsidy Policy 2016 in line with the Cleaner Cooking for All initiative (see Box 3.8): Demand is presently too low for ICSs, and prices for liquified petroleum gas too high, for a purely market-based approach. A range of subsidies already exist. For example, the Renewable Energy Subsidy Policy 2016 provides roughly 40 percent of

49 This prediction is the high-growth scenario in World Bank and AEPC (2017). Specifically, they predict a mix of 32 percent in situ ICS, 21 percent factory-produced ICS, 14 percent biogas, 30 percent LPG stoves, and negligible electricity, kerosene, and traditional biomass stoves, nationwide in 2030.

50 This statistic (Leaders 2018) is based on field tests in Nepal of forced draft tier three stoves as part of the Developing Improved Solutions for Cooking (DISC) Project by the World Bank. Health benefits are not proportional to emissions reductions; they are less than proportional at high concentrations due to non-linearity in the dose-response function.

the cost of improved biomass and biogas stoves. The cleanest biomass stoves (tier III and tier IV) currently have almost no market penetration without subsidies. A tier III stove, Nepal's target tier of stove, costs around US$90, an up-front cost beyond reach for most households.

Refine subsidy support to increase its effectiveness: Support could be paired with enhanced certification and quality control schemes in which only those stoves demonstrated to be suitable for Nepali conditions and assured of quality via a standardized process are eligible. Subsidies could also be linked to the use of the stove rather than its purchase, through monitoring devices built into the stove (the "green card" program). This helps encourage not only the initial purchase but also continued use, which is otherwise a major barrier to ICS penetration. Achieving the above use projections is expected to have a total cost of US$389 million out to 2023, of which around 60 percent would need to be public expenditure (World Bank and AEPC 2017). Financial support such as loan guarantees may also be appropriate for suppliers and manufacturers.

In the long term, cleaner cooking requires stronger electricity networks: Electricity, like LPG, is not more widely used because of limited supply, relatively high cost, and in some areas, unreliability. The government is strongly committed to new hydropower construction, which will gradually alleviate the supply gap and load-shedding. In addition to base capacity, widespread use of electrical stoves will also require building a more robust grid that can handle higher and more variable power use. Increasing electricity use for cooking is a long-term necessity and it is ultimately preferable to LPG as it is cheaper at scale and does not rely on sometimes unreliable fossil fuel imports. However, LPG and ICSs are complementary measures that are required in the short and medium terms to promote cleaner cooking while electricity capacity improves. This reality is addressed by the government's Biomass Energy Strategy 2017 (Nepal, MOPE 2017a).

3.2. Building and Maintaining Green and Resilient Roads

Road development is key to local and national economic development through improved access to markets, securing higher prices for produce and lower costs of inputs, better access to services like health and education, and for developing new tourism destinations. The two main components of Nepal's road network are the strategic road network (SRN), which includes national highways, feeder roads and a few urban roads of national importance, and the local road network (LRN), which comprises urban roads and local roads, including agricultural roads and roads in urban and rural municipalities. The government of Nepal plans to expand the SRN and LRN significantly beyond their current lengths of about 13,000 kilometers and 58,000 kilometers (Nepal, DOLIDAR 2016), respectively. Under Sustainable Development Goal 9, the government plans to increase the road density from 0.44 km/km^2 in 2015 to a target of 1.5 km/km^2 in 2030 (Nepal, NPC 2017), which

Table 3.8. SDG Target 9.1 on Road Development

	2015	2019	2022	2025	2030
Target 9.1. Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all					
9.1.1 Road density (km/km^2)	0.44	1.3	1.35	1.41	1.5
Corresponding total road network (km)	64,759	191,334	198,693	207,524	220,770
9.1.2 Paved road density (km/km^2)	0.01	0.07	0.12	0.17	0.25
Corresponding total paved road network (km)	1,472	10,303	17,662	25,021	36,795

Source: Nepal, NPC 2017; authors' calculations.

is roughly equivalent to 220,000 kilometers. A related target is increasing the paved road density from 0.01 km/km^2 in 2015 to 0.25 km/km^2, or 37,000 kilometers in 2030 (Table 3.8).

Nepal's topography, geology, and climatic conditions pose significant challenges to road construction and maintenance, and must be taken into account fully to ensure resiliency and sustainability. In the hills and mountains, the key hazard is landslides; in the Terai, it is floods. Road design, construction, and maintenance must consider the possibility of landslides, slope failures, flooding, and other hazards, and prevent, minimize, or mitigate any adverse impacts on the environment and local communities. In addition, many of the roads in the SRN pass through forest areas, national parks, protected areas, and important wildlife corridors for which wildlife mobility and transboundary migration will need to be taken into account in the planning and design. Furthermore, the planning and design stage needs to integrate the fact that roads often lead to encroachment as people tend to concentrate along roads and at crossroads because improved transportation of goods and people generates economic opportunities. This influx, if not managed, is the cause of natural resources irreversible destruction (deforestation for building houses and clearing for agriculture, water consumption, generation of wastewater, and so on).

The 2015 constitution lays out the road-related division of powers among the three tiers of government… In the federal system, national highways and national transport policy are placed under the federal government's responsibility. Provincial governments manage provincial highways and provincial-level transport, while local governments are responsible for local-level roads in urban and rural municipalities, including agricultural roads.

…but institutional alignments are still evolving. For roads under the purview of the federal government, the Ministry of Physical Infrastructure and Transport (MOPIT) is the apex body for the preparation of plans, policies, and programs. Under MOPIT's aegis, the Department of Roads (DOR) oversees the development, maintenance, and management of the SRN. Regarding the LRN, prior to federalism, districts were formally at the center of planning and implementation of all activities related to the LRN, with substantive support from the Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR). With federalism, the frontline responsibility for planning and implementation of the LRN has shifted to the provincial and local governments. The federal government will be assuming a guiding and thoughtful leadership role. The role of the Department of Local Infrastructure (DOLI) under the Ministry of Federal Affairs and General Administration (MOFAGA) in this context is still evolving.

3.2.1. Strategic Road Network

Roads in the SRN are generally constructed following engineering design standards, but there is a lack of consideration of climate risks and room for improvement in terms of enhancing and greening the design and maintenance. There is also a clear lack of strategic land use and investment planning to manage climate risks. The DOR has been applying some measures for greening roads and making them more climate resilient, but these are done on a project-by-project basis. Building and operating climate-resilient, disaster-resistant, and green roads has not been yet mainstreamed into its policies, planning, and operations. Specific greening measures include bioengineering in newly cut slopes and in unstable and landslide-prone areas, combining engineering and biological measures such as the use of rock netting with iron nails, drainage, terracing, gabions, stone masonry and revegetation and forestation. Recently, the construction of wildlife passes has been piloted in a World Bank–financed project to ensure connectivity in wildlife corridor areas.

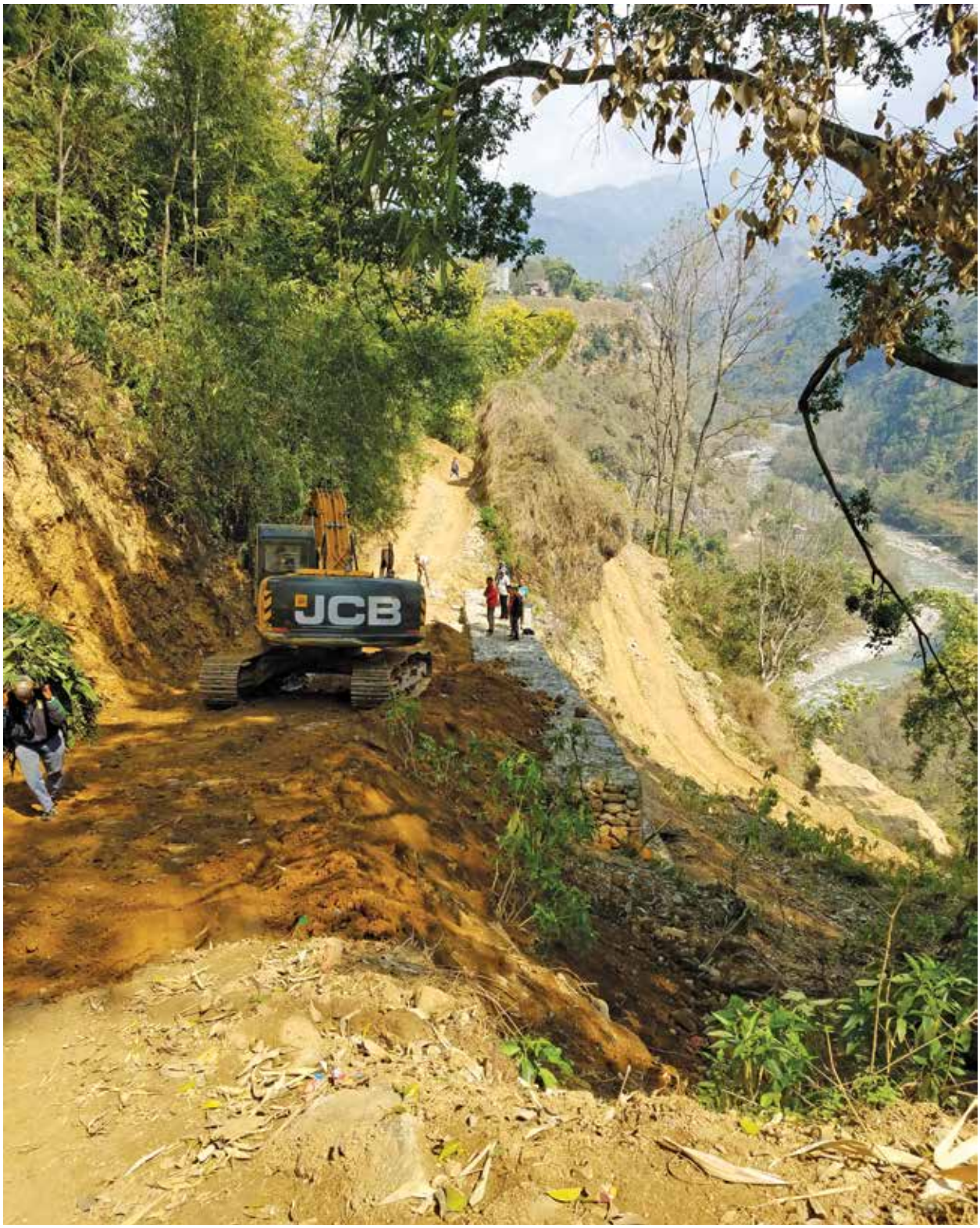
The DOR established the Geo-Environment and Social Unit (GESU) in 2005 and maintained it to provide environmental and social risk management services for its projects. As road construction often produces adverse effects on the biophysical, social, economic, and cultural environments, the role of GESU is very important not only in social analysis and ensuring stakeholders' participation in the planning and implementation process, but also for improved efficiency, effectiveness, and sustainability of the projects (HURDEC 2013). GESU has been the lead/home unit for bioengineering solutions for unstable road slopes and, over the years, has published various guidelines and handbooks on environmental and social risk management (see annex 5). The unit's relevance has been eroded, however, by the lack of independence, the inability to directly interact with other branches, and the tendency of donors to ring-fence their projects at the project management unit. There is clearly high awareness of the need for and expertise on incorporation of slope stabilization in road design in various units of the DOR and demonstrated in donor-funded projects. There has been no indication that GESU is leading or getting involved in the design or in the procurement of design consultants on geo-technical/bioengineering solutions for roadside slope stabilization problems.

The following recommendations may be provided for widening the SRN in a sustainable manner:

- An important recommendation is that the DOR mainstream sustainability aspects and green approaches throughout the project cycle from upstream planning, construction, operation and maintenance, and closure/decommissioning. Experiences and lessons learned from India, China (such as Yiba Highway) and Latin America (such as Cienaga-Barranquilla Highway in Colombia) (Quintero 2015) on green techniques and innovative technologies would be very relevant and useful for DOR during construction, operation and maintenance, and closure.
- In terms of policy, strategic environmental and social assessment (SESA), including cumulative impact assessment (CIA), combined with upstream planning, would be recommended as a useful tool. The SESA can be done alongside land use planning. Development of environmental and social impact assessment (ESIA) guidelines in the road sector would also be useful. On pre-design/design, the DOR could apply adaptive planning and mitigation hierarchy. The application of mitigation hierarchy in the ESIA and design should be able to inform and influence decision makers on whether to go for improving existing two-lane roads or expanding them to four lanes, as the tendencies of the DOR suggest, keeping in mind the environmental and social risks, impacts, and costs.
- Climate change also needs to be considered in the pre-design and design stages rather than retroactively when roads are already damaged.
- Institutionally, mainstreaming resilient and green approaches in the project cycle will require that the DOR's Design Unit, Construction Unit, and GESU all work closely together from pre-design though closure and decommissioning. In this collaboration, GESU should play a significant role and have credibility among the other units within the DOR.

3.2.2. Local Road Network

The LRN comprises the district road and village roads, which include agricultural roads. These roads, particularly village roads, are being constructed by local communities in a haphazard manner, without following technical standards or environmental risk mitigation measures. In hilly and mountainous areas, local roads, especially village roads, are often constructed with poor alignment using heavy equipment like bulldozers and excavators, which triggers environmental



Non-engineered road construction using heavy equipment. Photo: © Annu Rajbhandari / World Bank.

degradation at the beginning of the construction itself. The rural roads are nonengineered roads without any geometric design, using cut-and-throw methods that destroy downhill vegetation and trigger landslides, especially during the monsoon. Poorly engineered roads are also vulnerable to monsoon rains and become impassable after the first monsoon rains (Hearn and Shakya 2017). The World Bank (2013) estimated that half of the LRN or some 30,000 kilometers were impassable.

Research increasingly links haphazard road construction in the hills and mountains to higher incidence of landslides, some fatal, causing significant economic losses (Leibundgut et al. 2016; Petley et al. 2007; Petley 2017). One study found that the impact associated with landslides related to road construction exceeded the impacts of the 2015 earthquake in one area (Durham University et al. 2019). Landslides and uncontrolled release of construction debris block and cause sedimentation of the local water source; damage drinking water and irrigation infrastructure, agricultural land, forests, and physical property; and cause loss of lives (Devkota et al. 2014; Leibundgut et al. 2016; World Bank 2019b). Roads in mountainous areas also influence the landslide risk by leading "to the expansion of settlements into hazard zones. Weighing increased landslide risk against economic opportunities, inhabitants of adjacent areas acquire land along road corridors and build shops and houses" (Lennartz 2013, 364).

The trend started in the early 1990s and accelerated after the Decentralization Act 2008 as district and village authorities identified road construction as the top priority for the use of the grant funds for local infrastructure provided by the central government. The trend was aided by the rapid proliferation of heavy equipment in rural areas after a favorable change in the import tax regime, and the outmigration of young males from villages in the middle hills and hills. These developments together with a shortage of local technical capacity rendered the concept of labor-intensive road construction unfeasible.

The 2015 constitution mandates local governments with local road construction, where funding is provided by the federal government and provincial governments (see section 4.6); however, they face a severe lack of technical capacity. Prior to federalism, DOLIDAR was responsible for approving LRN plans by village development committees and providing technical assistance to them, but it faced technical capacity constraints, as did the committees (UNDP 2011). After a reconfiguration of institutions, the Department of Local Infrastructure is mandated to provide local governments with technical assistance, but its capacity is also limited. Limited technical capacity and oversight explains the frequent lack of technical designs and the construction of roads even when the number of users is low. An economic assessment of roads is not required for grant funding, although ex post analysis has shown that some roads lead to low economic returns (UNDP 2011). Environmental sustainability is a criterion for a grant award; however, it is not enforced.

Policies, guidelines, and standards for proper rural road construction are in place, but enforcement is a key constraint, caused by a variety of factors related to funding availability, incentives, and technical capacity shortages. It will be important that a systematic approach for rural road construction be adopted, including preparing a master plan for connectivity network, conducting a SESA, and developing and enforcing the use of manuals and guidelines for selection, design, construction and maintenance. The financing constraint may be partly overcome by designing the roads consistent with the expected vehicles per day.

Google Earth image of the environmental impacts of poorly constructed mountain roads in Nepal.

The following recommendations would contribute to sustainable LRN development:

- Prepare watershed or province-level master plans for LRN development based on cost-effectiveness and environmental, disaster, and climate risk considerations. SESAs should be carried out to provide the basis for environmental, disaster and climate risk considerations.
- Develop a manual to guide the selection, design, construction, and maintenance of rural roads, which should consider the physical environment to avoid areas prone to erosion and deforestation.
- Dimension local roads appropriately. Rather than aiming at standard widths, roads should be dimensioned according to the level of transportation needs of a community, as measured by vehicles per day (VPD), while meeting technical standards and environmental requirements and taking into account disaster and climate risks. This would be cost-effective and allow communities to make more with the funding obtained from federal and provincial sources. Guidelines encompassing all these elements should be developed for local governments.
- Institute long-term programs to raise awareness among citizens and political leaders in local and provincial governments on environmental, disaster, and climate risks and cost to the economy associated with local road development and to build technical capacity for design, planning, and evaluation commensurate with mandates.
- Make federal and provincial infrastructure grant-funding conditional on designs that optimize road dimensions, minimize environmental damage, and consider climate and disaster risks. Along the same vein, make performance in maintenance of existing roads one of the criteria for allocation of grants for infrastructure (see chapter 4).
- Use hazard maps to inform disaster- and climate-resilient road construction. However, lack of high-resolution topographical maps would limit this endeavor. Therefore,

it is important that Nepal prepare high-resolution topographical maps.

- Strengthen the EIA/IEE implementation mechanism and monitoring system and internalize environmental aspects into technical planning and design.
- Provide the possibility of recourse to the judicial system to ensure that local governments are accountable.
- Further analytical work on resilient rural roads with a focus on obtaining robust cost estimates of required measures for environmental sustainability and resilience in different topographical and climatic conditions. Such a study could build on and learn from Department of Soil Conservation and Watershed Management initiatives to promote "community-based bio-engineering for eco-safe roadsides" (Devkota et al. 2014).

4. STRENGTHENING GOVERNANCE FOR SUSTAINABLE GROWTH UNDER FEDERALISM

Good governance with robust regulations and institutions is a primary condition for sustainably reaping the benefits of more productive natural resource use for greater economic growth and prosperity as discussed in chapter 2 and mitigating the costly adverse impacts on ENR of economic growth as elaborated in chapter 3. This would be a challenging target even without the transition to federalism, given the existing limitations in Nepal's ENR governance system (World Bank 2008). However, in the context of Nepal's swift and comprehensive shift to federalism, the shift of natural resource management to newly elected local entities constitutes a major risk. The main concern is the inability to deliver prosperity in the absence of ENR management capacity and accountability mechanisms because subnational governments unsustainably use natural resources, such as overharvesting of forests or developing unsustainable tourism infrastructure to maximize visitor numbers; undertake infrastructure projects that lead to degradation of natural resources, such as substandard road construction; or fail to enforce national standards on polluters, such as brick kilns, cottage industries, or intensive farming practices.

The transition to federalism must be managed in a way that reduces this risk. While the devolution of powers was comprehensive, the 2015 constitution is ambiguous on the division of power among the federal, provincial, and local governments regarding the so-called concurrent powers, leaving it to the political process to reach compromises in due time. The governments, under the leadership of the federal government, are taking steps to overcome the uncertainty, notably by updating laws or promulgating new ones that define the roles and responsibilities of the three tiers of government, and instituting intergovernmental fiscal transfer and revenue sharing mechanisms. It is an evolving and fluid process, and it may be expected to continue well into the 2020s—and likely won't be unidirectional.

To manage this process, it is important that a timed and prioritized action plan be put in place with periodic status checks and possibility to adjust course. The proposed planning approach would build, albeit in a narrower ENR-focused manner, on the Federalism Implementation Facilitation Action Plan that was developed at the First Inter-Provincial Council Meeting on December 9, 2018, and listed priority laws clarifying the rights of all three levels of government in key thematic areas.

This chapter presents a snapshot of the status of the governance arrangements and the risks to ENR and provides recommendations on short-, medium-, and long-term actions. This chapter also focuses on institutional capacity goals at the subnational government levels and recommends an approach to capacity building, recognizing the impact of the fluidity of the federalism process. Capacity-building efforts should be informed by and synchronized with the status reviews and made part of the prioritized action plans. This chapter also reviews availability an access to information and accountability of authorities regarding ENR management decisions, two key elements in ENR governance. Finally, the chapter reviews existing and potential intergovernmental financing mechanisms from the point of view of incentivizing good ENR management by the subnational governments. The analysis is informed by international experience (see Box 4.1).

Box 4.1. Key Principles for Natural Resource Governance Under Federalism

A review of the power devolution experiences in several countries, including Burkina Faso, Canada, Indonesia, and Peru, revealed several key principles for natural resource governance under federalism.

- **Set a timeline that is stepwise but timely.** There is a trade-off between a "shock decentralization" and a decades-long process to devolve power. If the process is completed too quickly, subnational institutions may not have the capacity to properly manage the new responsibilities they have been granted. Furthermore, coordination problems between newly empowered regions can lead to fiscal and economic instability. On the other hand, a process that takes too long risks stalling over inertia or political changes. It seems that the ideal situation would be a stepwise process that matches the transfer of powers with the proper capacity building and resources and commits to doing so within a defined time period—perhaps within one government mandate.

- **Invest in building local capacity.** The successful transfer of power from central to subnational institutions requires a significant effort to build capacity among potentially new institutions and government officials. Depending on the types of powers transferred, these capacities can range from managing a multimillion-dollar budget to mediating diverse stakeholder interests. Additionally, strong political and legal institutions are needed to ensure that the process is not stymied or weakened by self-interested political calculations among government leaders. In most cases, capacity-building efforts will likely take longer than the formal transfer of powers. International donors (including multilateral development banks) can play a key role in supporting a long-term commitment to local capacity building.

- **Develop a flexible framework to share natural resource revenues.** In countries that have the potential for significant natural resource development, federalism/decentralization provides an opportunity for efficient local governance, but also risks exacerbating regional imbalances and inequalities. At the outset of the process, the central and regional governments should agree on an overall framework for how resource revenues will be distributed between the central and local governments, as well as between wealthy and poor regions. This framework may need to remain flexible to future revisions, based on unanticipated resource discoveries or commodity boom-bust cycles. However, it is important that all actors are clear on the broad division of powers to collect revenue and promote regional equality, before regional governments become too vested in maintaining the status quo.

- **TimberAuctions is a round timber marketing service for buyers and sellers throughout the United Kingdom.** TimberAuctions' monthly electronic timber sales have been operating nonstop since 1995, selling over £16 million worth of hardwood and softwood timber from both private and state woodlands. Timber sellers can enter parcels of standing or felled timber into forthcoming sales using the online entry form and then watch live timber auctions on their own computer at home or office. Timber buyers can download catalogues containing details of all currently available timber parcels and all users have free access to the latest timber price information, including the annual electronic sales event calendar, newsletters, and press releases. The monthly sales are operated in accordance with an industry-wide agreed practice standard. The standard sets out how electronic timber sales should be conducted in the United Kingdom. http://www.timberauctions.co.uk/about.html

4.1. Division of ENR-Related Powers According to the 2015 Constitution

The 2015 constitution restructures Nepal's political system from a unitary government with some permitted powers accorded to 75 district governments and 3,400 district suboffices, including village development committees, to a nonhierarchical three-tier system of a federal government, 7 provincial governments, and 753 local governments. The comprehensiveness of the shift of power in a single step is nearly unapparelled globally. Under federalism, all three tiers of government can make their own laws and formulate budgets and raise tax and royalty revenues. At the central level, the House of Representatives and the National Assembly exist to pass laws centrally, to be implemented by federal minis-

Table 4.1. Division of Specific Powers and Concurrent Powers According to the 2015 Constitution by Tier of Government

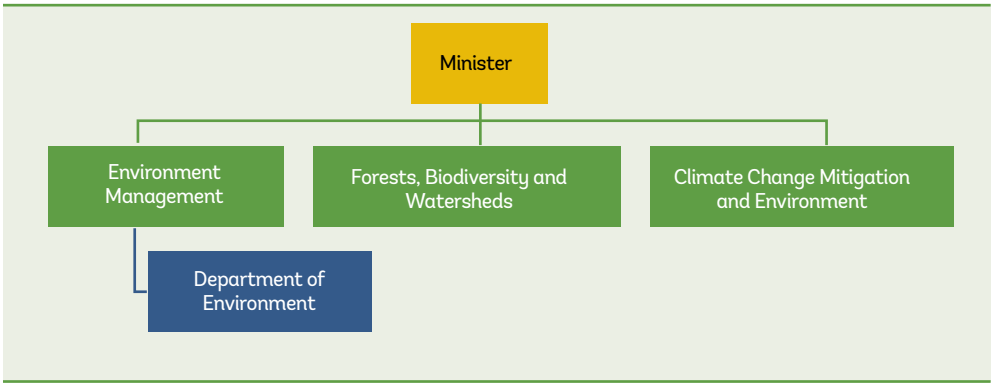
Natural resource use	**Federal government (Schedule 5)** • National and international environment management • National parks • Wildlife reserves and wetlands • National forest policy • Carbon services • Land use policy • Tourism policy • Central-level large electricity, irrigation, and other projects	**Provincial government (Schedule 6)** • Land management, record-keeping of the land • Management of national forest, water resources, and ecology • Agriculture and livestock development • Exploration and management of mines • Provincial-level electricity, irrigation projects	**Local government (Schedule 8)** • Conservation of watershed, wetlands, wildlife • Mines and minerals • Small electricity projects, alternative energy
	Concurrent: Federal and provincial (Schedule 7) • Province border rivers, waterways, biodiversity • Tourism • Inter-provincial forest, wildlife, birds, mountains, national parks, and water uses • Land policy and related legal provisions		
	Concurrent: Federal, provincial, and local (Schedule 9) • Royalty received from natural resources • Mines and minerals • Forest, wildlife, birds, water use, ecology, and biodiversity • Service fee, registration fee, fine, tourism fee and royalty received from natural resources • Services like electricity, irrigation		
Environmental management	Federal government (Schedule 5) • National transport policy, national highways	Provincial government (Schedule 6) • Provincial highways • Factories, industrialization, business, transportation • Provincial-level drinking water, transport	Local government (Schedule 8) • Management of local markets, environment conservation, and biodiversity • Local roads, rural roads, agriculture roads, irrigation • Management, operation, and control of agriculture extension • Water supply
	Concurrent: Federal and provincial (Schedule 7) • Province border environment and biodiversity protection • Medicine and pesticides • Industries, minerals, and infrastructure • Drinking water and sanitation		
	Concurrent: Federal, provincial, and local (Schedule 9) • Environment • Drinking water		

Source: Nepal 2015 Constitution.

tries. Each province has a provincial assembly to pass state laws, which are implemented by provincial ministries. Each local government has a municipal or village council to pass local laws and regulations, implemented by the executive board or office of the mayor. Federal laws must be based on the constitution, provincial laws may not contradict federal laws, and local laws must be consistent with both state and federal laws.

The 2015 constitution devolves many ENR-related powers, but it also introduces concurrent powers... Table 4.1 presents the distribution of powers related to natural resource use, environmental management, and disaster management among the three tiers of government as listed in the constitution. While some powers are clearly assigned to a single tier of government, it may be concluded that, in general, the federal government retains national-level policy making, notably regarding natural resource management and uses such as biodiversity, wetlands, forests, and land, and the local governments are entrusted with the delivery of basic public services such as water supply, roads, small power generation, irrigation, and agricultural extension at the

Figure 4.1. Ministry of Forests and Environment Main Divisions



Source: Based on http://mofe.gov.np/content/11/2018/33330673/.

local level. Several other powers are listed under two or more tiers of government as concurrent powers, which should be interpreted consistent with the principle of subsidiarity,[51] where the role and responsibility of each level of government will be in accordance with its jurisdictional influence. For example, in environmental management, the federal government will be responsible for setting overall policies and standards and cross-provincial environmental impacts, while a provincial government will concern itself with environmental issues whose geographical footprint goes beyond the jurisdiction of a single local government within the province. Local governments will be responsible for issues that can be addressed most efficiently at the local level, such as enforcement of standards.[52]

…leaving clarification to be done subsequently through sectoral laws and secondary regulations. The constitution does not precisely assign the concurrent mandates among the three tiers of government; instead, it leaves it to the political process to achieve a final understanding, which will then be codified in the relevant laws and regulations. The status of the revision of the regulatory framework is discussed in the next section.

The process of setting up institutions to carry out the roles and responsibilities set forth by the constitution has begun. Prior to federalism, the ministry in charge of environmental protection, including the Department of Environment, formulated environmental policies and strategies, provided technical advice on environmental issues, implemented programs on environmental protection, enforced the laws and regulations for pollution control and resource management, and conducted compliance monitoring. District offices carried out activities delegated to them by the DOE. Under federalism, MOFE continues to house the DOE (Figure 4.1), but its mandate has lessened because provincial units now have the mandate to carry out monitoring of industrial air emission and effluent discharges and compliance monitoring of MOFE-approved EIA conditions. The provincial unit handling these issues is a dedicated environmental unit under the Science, Environment and Climate Change Division of the provincial Ministry of Industry, Tourism, Forest, and Environment. For the provincial gov-

51 The principle of subsidiarity is defined as "the idea that a central authority should have a subsidiary function, performing only those tasks which cannot be performed effectively at a more immediate or local level" (Democracia Participativa, accessed May 21, 2019, http://democraciaparticipativa.net/documentos/Principle_of_Subsidiarity.htm).

52 Interestingly, the constitution does not specify any powers regarding climate change mitigation and adaptation, except for specifying that carbon services are a federal mandate (see Table 4.1). One explanation for this seeming omittance may be an underlying presumption that climate change mitigation and adaptation are embedded in the design of sectoral policies, including notably forest management, agriculture, disaster risk management, transport, and electricity generation.

ernments, standard indicative organigrams issued by the Ministry of Federal Affairs and General Administration include units with environmental functions. These units vary by size of the municipality and by whether the municipality is urban or rural. It is noteworthy that the current institutional structures for environmental management do not appear to separate monitoring and inspections functions from permitting and enforcement, which would avoid conflicts of interest.

4.2. Status of ENR-Related Regulations to Implement the 2015 Constitution

This section reviews the status of clarity on the division of ENR management powers

Table 4.2. Status and Gaps in the Policy and Regulatory Framework, as of June 2019

ENR theme	Existing policies and regulations			Status of revisions and amendments	Recommended actions and timing (Short, Medium, and Long term)[a]
	Name	Do they adequately address thematic challenges?	Do they clarify division of powers under federalism?		
EIA/IEE	Environment Protection Act (EPA) 1997 Environment Protection Rules (EPR) 1997	Lack of incentives for integrity and quality in EIA/IEE Weak requirements for public participation	No	Draft EPA 2019: • Clarifies intergovernmental division of responsibilities • Introduces climate change mitigation/ adaptation requirements • Encourages application of indigenous practices for environmental protection • Introduces the concept of strategic environmental analysis • Prohibits implementation of proposal without EIA/ IEE approval • Introduces quality standards and punitive measures for EIA/ IEE professionals for noncompliance • Assigns EIA review of all national priority projects to MOFE (federal government)	Amend EPR 1997 accordingly to operationalize EPA 2019 EPA **(S)** EPR 1997 to strengthen public participation **(S)** Introduce vetting and certification of EIA professionals **(S)**
Emission standards, compliance monitoring, inspection and enforcement – pollution sources	EPA 1997 EPR 1997	EPA assigns responsibilities but EPR is weak on inspection requirements and contains limited number of emission standards	No	Draft EPA 2019 assigns responsibilities regarding EIA/IEE and the corresponding responsibilities for monitoring/inspection and enforcement	Introduce strong public information requirements related to environment performance of public and private actors **(M)** Introduce taxes as a tool that government may use for incentivizing reduced pollution and other good environmental management **(M)**
Ambient pollution standards, monitoring	National Ambient Air Quality Standards 2012	Standards higher than WHO guidelines	No		Adjust ambient air quality standards periodically as more evidence on linkages between sources and air pollution levels becomes available **(L)**

ENR theme	Existing policies and regulations			Status of revisions and amendments	Recommended actions and timing (Short, Medium, and Long term)[a]
	Name	Do they adequately address thematic challenges?	Do they clarify division of powers under federalism?		
Waste management	Solid Waste Management Act 2011 Solid Waste Management Rules 2013	Weak communication and public consultation leading to instances on NIMBY (not in my backyard) syndrome Hazardous waste management not covered Does not address specific requirements of solid waste management (SWM) in mountainous areas	Solid waste management is inherently a local government mandate so it should not be affected by federalism, but hazardous waste management responsibility unclear	Public Health Act 2019 addressing health care waste management under development Health care waste management regulation currently under development	Develop hazardous waste policy **(S)** Develop hazardous waste management act **(S)** Establish deposit-refund system for hazardous waste **(L)** Develop guidelines for SWM in mountainous areas **(M)**
Resilient and Green Roads	Road Standards 2013	Do not consider climate and geo-hazards	N/A		Update Road Standards 2013 to incorporate climate and geo-hazards **(M)**
		No EIA, CIA and strategic regional or sectoral assessments (SESA) guidelines for road sector in place	N/A		Adopt EIA and SEA guidelines for roads **(M)**
		Piecemeal approach to EIA in SRN	N/A		Carry out SESA (regional or sectoral assessments), CIA for SRN **(M)**
Sustainable forest management	Forest Act 2018		No	Draft Forest Act 2019 to clarify division of powers	Enactment of Forest Act 2019 **(S)**
Forest/ biodiversity clearance and offsets	Forest Use Guidelines 2017[b]	Cash payment option for developers not operational due to missing standards	N/A	Revision of Forest Use Guidelines 2017 cum standard for developers' cash payment in progress, approval by MOFE expected by end of current fiscal year	
	Forest Act 2018	Established Forest Development Fund (FDF), but governance arrangements not in place	N/A	Preparation of guidelines defining governance of the FDF initiated	
	Protected Area Working Policy 2008[c]		N/A	Revision of Protected Area Working Policy initiated	
Nature-based tourism	PA working procedures on concessions in national parks	Restrictive in terms of concessions in PAs	N/A	Revised procedure in draft ("Procedure Relating to Operation and Regulation of Tourism Service in Protected Areas 2019") in draft	Adopt revised procedure **(S)**
Sustainable agricultural intensification	Pesticide Act 1991 Pesticide Regulation 1993		No	Pesticide management act under development	

a. Short term (S): 0–12 months; medium term (M): 12–36 months; long term (L): 36–60 months.
b. Formal title: Procedure Relating to the Use of National Forest Area for National Priority Projects 2017.
c. Formal title: Working Policy on Constructing and Operating Physical Infrastructures in Protected Areas 2008.

among the three tiers of government as of June 2019, identifies remaining gaps and associated risks, and recommends a prioritized action plan. Chapter 2 discusses some of these issues and presents recommendations regarding natural resource management, so this section only summarizes relevant findings and recommendations. The discussion includes changes intended by the government, as shared with the ESD team. It is understood that by the time this report is published, some of the analyses and recommendations may already be out of date. But, in fact, the main goal of this section is to provide an example for a risk-based prioritization exercise that is recommended for periodic replication during the process of strengthening the federalism system.

Table 4.2 summarizes the findings of this study on the status and gaps in the policy and regulatory framework regarding environmental and natural resource management.

4.2.1. Environmental Impact Assessment

The Environment Protection Act (EPA) 1997 lays out the mandated processes for environmental protection, including notably EIA/IEE, pollution prevention and control, environmental inspections, and the governance of the Environmental Protection Fund. The Environment Protection Rules (EPR) 1997 (amended in 1999, 2007, 2009, and 2010) and the National Environmental Impact Assessment Guidelines 1993 detail the procedures associated with these processes. A draft revision of EPA 1997—EPA 2019—has been prepared and is at the final stage of approval.[53]

Nepal plans to undertake a large number of infrastructure projects to promote industrial development; hence, EPA-mandated EIAs/IEEs are particularly important. The EPA/EPR empower MOFE with the review and approval of the EIA reports, while IEEs are approved by the concerned sectoral ministry. The EPR detail the process of preparation and approval of projects requiring an EIA or an IEE, with annexes detailing the projects that require an EIA or IEE. The National Environmental Impact Assessment Guidelines 1993 provide methodology on project screening, scoping, impact identification, prediction, report reviewing, monitoring and evaluation, and impact auditing. The guidelines also contain procedures for ensuring public participation during the preparation of the EIA report and identification of impact mitigation measures in the EIA/IEE report. In addition, sectoral EIA guidelines exist for forestry, industry (1995), and hydropower development (2018).[54]

Although the EIA/IEE procedures have been integrated in development project preparation, the process has been largely perfunctory and thus ineffective in mitigating negative environmental impacts. The main reasons for this include lack of consultation and coordination with line ministries in charge of impacted resources, such as MOFE and the Ministry of Agriculture and Livestock Development; a limited cadre of technical specialists capable of producing high-quality assessments; and inadequate trained manpower and inadequate allocation by project proponents of resources for the environmental mitigation measures specified in the approved EIA/IEE documents. Often, the EIAs/IEEs are treated as a formality and the reports are of poor quality. Once the EIA is approved, mitigation measures are rarely implemented as outlined in EIA report. Importantly, monitoring of EIA implementation by MOFE and of IEE implementation by sectoral ministries

53 Revision of EPA 1997 was one of the priority acts identified in the Federalism Implementation Facilitation Action Plan developed at the First Inter-Provincial Council Meeting on December 9, 2018.

54 EPR 1997 provides a holistic framework for the protection and improvement to the environment during the project/proposal implementation. Section 3 of the act requires the proponent to conduct an IEE and EIA in relation to the prescribed proposals. The proposals (that is, the proposed project) requiring IEE/EIA studies are broadly listed in Schedule 1 and Schedule 2 under Rule 3 of the EPR enforced under the provisions of the EPA. The EIA approval was the responsibility of MOFE, and the IEE that of sector ministries. The EPA/EPR 1997 prohibits the performance of any act inside the environment conservation zones; however, Schedule 2 of the EPR also states that any proposals inside the conservation area/zones can be implemented after undergoing an EIA procedure irrespective of the size of the project and will need approval from the concerned ministry.

are seldomly adequately executed. As the regulatory and institutional structure for EIA/IEE evolves, there is a crucial need to strengthen the capacity of three tiers of government for implementation purposes.

The quality of most EIA reports produced by consulting firms and sectoral government entities is lacking. Specifically, the methodologies and scientific tools used for data analysis are inadequate; alternatives analyses are absent, inadequate, or aimed at justifying a choice already made based on non-environmental criteria; and EIA documents often contain passages with unrelated information copied and pasted from other EIA documents. This points to a lack of integrity and below-par experience and technical qualifications of the EIA authors. Therefore, to improve the quality and consistency of EIA reports certification, accreditation and vetting should be kept as a federal-level responsibility. The role of EIA practitioners is critical in determining the overall efficiency of an EIA system. The requirement of certification can be included in EIA regulations, at least for large projects, which means that the EIAs submitted to an environmental authority must be conducted by an accredited party. The requirements for accreditation and certification could be defined in a flexible manner cognizant of the specific circumstances of the country and its institutional and regulatory setup.

To enhance the accountability and responsibility of the EIA preparers and reviewers, environmental information disclosure could be an efficient tool. This would require investing in proper database systems and related communication procedures. In addition, proper focus on the appropriateness of technical mitigation measures and their formulation could facilitate their inclusion in the goods and works procurement processes. Currently this process often remains just a legal formality.

A comparison of Nepal's EIA system and the World Bank's Environmental and Social Framework (ESF) (Box 4.2) shows similarities as well as differences. They both classify projects according to their risks, change the risk rating throughout the project implementation, require stakeholder engagement during the EIA study, and undertake monitoring activities. Required activities in the ESF such as submitting monitoring reports regularly and facilitating stakeholder engagement throughout the project life cycle are also recommended per the National Environmental Impact Assessment Guidelines 1993 of

Box 4.2. World Bank Environmental and Social Framework – Principles

The World Bank Environmental and Social Framework (ESF), effective since October 1, 2018, is a comprehensive set of policy statements and standards that consolidates a consensual set of principles and rules destined at ensuring that development activities are designed and implemented in a manner that addresses environmental and social issues in as systematic, modern, and harmonized way.

Systematic:

- Applies 10 standards with explicit objectives
- Assesses a broad set of environmental and social risks and impacts consistently
- Involves ongoing stakeholder engagement

Modern:

- Responds to challenges that have arisen over time
- Adapts to need in a timely way
- Integrates environment and social risks

Harmonized:

- Brings environmental and social protections into closer harmony with other institutions
- Applies good international industry practice

The ESF is based on assessing the risks and impacts of a project in a way that is adaptive and according to a systematic mitigation hierarchy (avoid, minimize, mitigate, and compensate).

Nepal. However, the Nepali EIA system lacks reference to a mitigation hierarchy, differentiated measures for the vulnerable groups, assessment of the possible impacts caused by associated facilities of the proposed project, consideration of possible impacts associated with the primary suppliers of the project, and consideration of transboundary and global impacts caused by the project. These issues will be of importance given Nepal's large hydropower and infrastructure development agenda, the likely transboundary impacts of some of these projects, and Nepal's commitment to gender equality and social inclusion. The draft EPA 2019 shares many principles that are core to the ESF; however, it still lacks adequate attention to climate change, cumulative impacts, and public consultation and participation.

Recent revisions to umbrella legislation aim to strengthen management of environmental impacts of development in addition to reflecting the new division of powers and responsibilities under federalism and further clarifying concurrent powers. The draft EPA 2019 introduces several substantially stronger provisions on the EIA process. For example, the EIA of all national priority projects and those promoted by the Foreign Investment Board, regardless of initially envisaged environmental impact, would be reviewed by MOFE. The draft EPA 2019 also defines the level of environmental assessment, assigning the local and provincial governments appropriate mandates in line with the constitutional division of power, mainstreaming climate change into sectoral policies, in-depth alternative analysis, strategies and action plans to manage the effect of climate change through federal, provincial and local governments and the private sector. The adoption of EPA 2019 should be followed by an amendment of EPR 1997 to operationalize EPA 2019. Sectoral guidelines and manuals for EIA/IEE studies also need to be developed in parallel to support the local governments in ensuring that consultants prepare quality reports and mainstream environmental concerns in development activities.

Current and proposed practices of public participation and consultation fall short of good international practice. Under the current system, publication of notifications in national newspapers to elicit public opinion and suggestions is required during scoping, IEE review, and proposal approval. Public hearings are required during EIA preparation, but not for IEE preparation, depriving the local communities of a formal opportunity to voice their feedback on a proposed project. It is recommended that the revision of EPA 1997 make public hearings mandatory for both types of assessments. Furthermore, in cases where the ethnic communities in a project location speak a different language or dialect than the national language, they may be at a disadvantage in comprehending the draft EIA/IEE documents or expressing their views. Nepal may pave the way for more meaningful consultations by following the example of Peru, where translations of the executive summaries of EIA reports are made available in the predominant language of the locality of the project site (Peru, MOE 2009). Another relevant example is Canada, where the government facilitates public participation through the Participant Funding Program, which provides limited financial assistance to the public, especially vulnerable people, to participate in key stages of environmental assessments (Canada, MOJ 2012). Furthermore, there is no explicit mention of indigenous peoples throughout the current EIA-related regulations and guidelines of Nepal. On the other hand, the draft EPA 2019 requires that the project proponent incorporate traditional and local practices for environment protection in the formulation of an environmental protection plan.

4.2.2. Compliance Monitoring, Inspection and Enforcement

Nepal's environmental management system does not have permits but relies on approved EIA and IEE documents to prescribe the

environmental management parameters related to pollutant discharges and emissions, waste management, and other types of environmental impacts of an enterprise or a project, based on relevant regulations and standards. In the current system, monitoring of compliance and inspection functions have been carried out by the DOE under MOFE and by sectoral ministries such as the Ministry of Transport for vehicular emissions (see section 3.1). The DOE could delegate these functions to district offices where the scope of the task is commensurate with their technical capacity. The DOE and sectoral ministries share the responsibility for enforcement, but the mechanism needs to be more effective (see subsection 3.1.5). The draft EPA 2019 stipulates that some of these responsibilities will now have to be shared or transferred to the provincial and local governments. However, the revision of EPR 1997 as well as a specific body of secondary regulations will be necessary to define clearly and provide the tools for the said devolution to be effective.

A strong recommendation stemming from a widely applied practice is the preparation of a comprehensive registry of polluting facilities, ranging from large industrial enterprises or estates to medium, small, and micro enterprises. The registry would classify the facilities according to their size and the nature of the pollution they cause, which together will provide a proxy for the importance of the pollution they generate. The registry would also indicate for different thresholds which level is in charge of monitoring, inspection, and enforcement. Setting up this registry will involve significant capacity strengthening of the DOE and likely require two to three years to be developed and implemented. The European Pollutant Emission Register may serve as a good model.

4.3. Institutional Capacity in Provincial and Local Governments

4.3.1. Overall Institutional Capacity

In 2018/2019, the World Bank in association with the government of Nepal and development partners carried out a Federalism Capacity Needs Assessment (FCNA), "whose goal [was] to identify the gap between the needs

Table 4.3. Departments and Professional Staff Numbers by Size of Urban Municipality, as Prescribed by MOFAGA

Type of municipality	25,000< Pop. <50,000	50,000< Pop. <75,000	Pop. >75,000	Sub-metro	Metropolitan
Planning & Administration	7	9	9	10	16
Physical Infrastructure & Environment	9	10	12	16	
Physical Infrastructure					17
Health & Social	3	6	6	9	13
Law & Justice	2	2	3	9	
Education, Youth & Sports	2	2	2	10	7
Economic Development	2	4	4	10	11
Financial Administration	3	3	3	6	8
Revenue					10
Internal Audit	1	2	2	2	3
CAO				1	
Chief Administrative Officer	1	1	1	21	1
General Administration					33
Environment & Disaster Management					8
Total	**30**	**39**	**42**	**84**	**127**

Source: World Bank 2019a, 43.
Note: Figures represent senior and mid-level administrative officials only.

and the capacity of provincial and local governments to manage and deliver services under the new system, and to evaluate the progress with putting in place the necessary legal, institutional, and organizational structures" (World Bank 2019b). The FCNA methodology consisted of structured interviews with officials from the seven provinces and a survey targeting a stratified random sample of 115 metropolitan, municipal, and rural local governments. The report identified the priority issues facing the provincial and local governments and concluded that the main next step should be to *"develop and put into effect an implementation plan (roadmap), which features a sequenced federal and subnational government action plan, an implementation calendar and a well-defined and realistic timeline."* Other actions were also recommended to operationalize the capacity-building efforts.

4.3.2. Subnational Institutional Capacity for ENR Management

Stakeholders consulted during the ESD development commonly emphasized the lack of institutional capacity at provincial and local governments as a major constraint for carrying out environmental management functions. MOFAGA prescribed key departments and associated staff numbers by type and size of municipality (Table 4.3). According to a recent World Bank study on urbanization in the context of federalism (White and Masaki 2019), a review of 15 urban municipalities found that the number of sanctioned staff positions in all 15 exceeded the prescribed figures but did not elaborate on the specialization of those staff. A systematic analysis of staff capacity at the local or provincial government level was not carried out as part of this ESD; however, consultations with officials from select municipalities suggest that the number of technical or managerial staff with environmental management responsibilities is extremely limited even in some metropolitan municipalities (Box 4.3).

The FCNA (World Bank 2019b) confirmed that the federalism process has left many provincial and local governments struggling with implementing their environmental protection mandate (the proportion runs from 50 percent to 73 percent). The proportion of local governments that have incorporated selected environmental functions into their organizational structure lies between 27 percent and 77 percent, depending on the environment sector considered. About a third of local governments report having an environment and biodiversity conservation plan. Local governments use equalization grants most often (76 percent of local governments) for funding the environment sector, followed by own source (56 percent), conditional grants (50 percent), revenue sharing (39 percent), and complementary grants (17 percent). Sev-

Box 4.3. Observations of a Metropolitan Municipality Official

"[T]he new constitution of Nepal has significantly empowered the local bodies and as a result, we are suddenly loaded with new roles and tasks from diverse sector of socio-economic development. It is evident to you that we have recently been graduated into full-blown local government, whereby we are not only added with new responsibilities but also raised expectation and ambition of local people and communities. If we fail to deliver in our reformed role, it will only create new political pressure and tensions in the society. … We are expected to adapt quickly and swiftly to this new situation and perform our duties at different scales involving different partners and stakeholders.

"… The present capacity of local governments in terms of their attention, understanding and knowledge, preparation, know-how and seriousness toward environment-related issues is very limited and ordinary. In this changed context, we, the local bodies, are in the driving seat and we require strong backing of additional resources, appropriate orientation, and technical knowledge …."

Source: A metropolitan municipality liaison officer, email message to T. Arin, May 8, 2019.

Table 4.4. Portion of Local Governments With "Adequate" and "No Capacity" for Monitoring Performance in the Environment Sector

Personnel/skills		Resources		Knowledge		Physical infrastructure	
Adequate	None	Adequate	None	Adequate	None	Adequate	None
6%	34%	w5%	24%	16%	15%	6%	31%

Source: World Bank 2019b.
Note: Estimated by the FCNA study team based on a representative survey of local governments.

enty percent of local governments include environmental services in their annual operation and maintenance budgets, and 46 percent of local governments have a capital investment plan for the environment. Three-quarters of local governments include capital spending for the environment in their budgets, while 40 percent of local governments monitor performance and outcomes in the environment sector. It should be noted, however, that the FCNA had a broad definition of environment and did not explore in detail the amount or subcategories of environmental spending. Table 4.4 illustrates the fact that gaps, as perceived by local government officials, are still important in terms of capacity.

Annex A of the FCNA report presents the Federalism Implementation Facilitation Action Plan agreed upon during the First Inter-Provincial Council Meeting, December 9, 2018. This plan contains actions pertaining to environmental protection, forestry, and natural resource management. It is to be noted that the present ESD is consistent with the findings of the FCNA and draws similar conclusions on the gaps regarding environment and natural resource management in the current transition to federalism context.

4.3.3. Recommendations on Institutional Capacity Strengthening

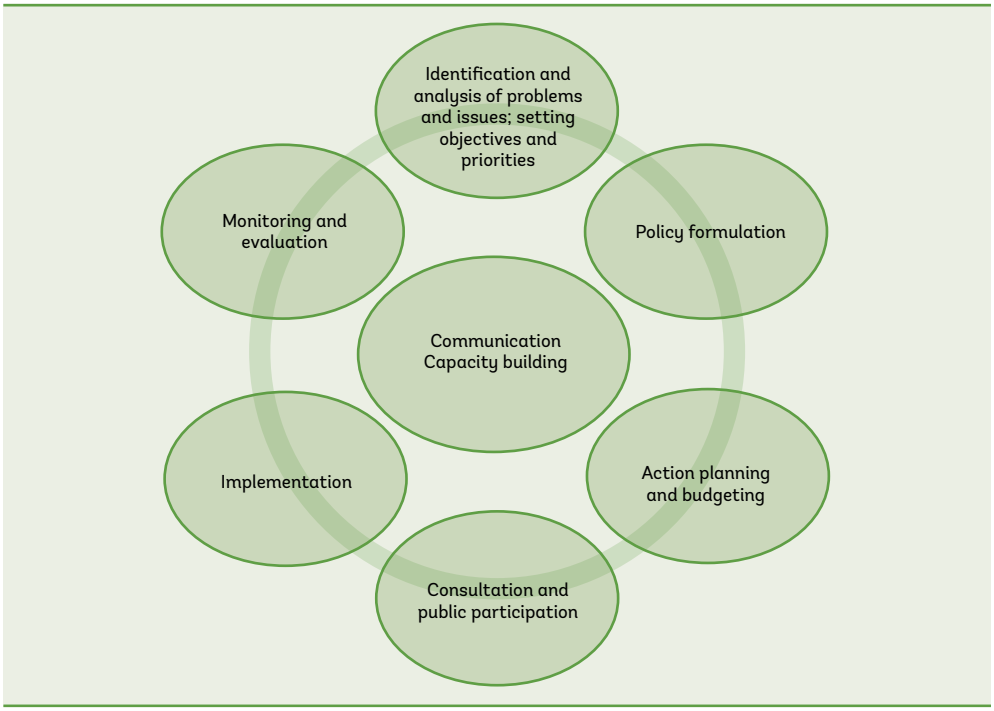
A multifaceted and long-term institutional capacity-building effort will be key for making growth under federalism sustainable. It should include ensuring that all subnational units tasked with ENR management are adequately staffed; all staff have the skills required for their positions; and ENR data and analyses are available for policy making, standard setting, environmental approvals, and enforcement. Such a capacity-building effort would be best informed by functional analyses of subnational governments in different parts of the country to account for the diversity ENR management needs.

4.3.3.1. Capacity Building at the Provincial and Local Levels

Skills enhancement of staff at provincial and local governments is key for ensuring the efficient and effective execution of ENR management functions. A no-regret set of actions at this stage should focus on capacity strengthening especially at the local and the provincial levels (Box 4.4 considers two possible approaches for addressing in a meaningful manner the capacity gap discussed above). The earlier these strengthening efforts start, the earlier each level of government will be able to tackle its responsibilities. The conceptual framework under which local ENR management would be best addressed is presented in Figure 4.3. Capacity strengthening ought to address all six components of the framework in addition to communication.

It is important that training activities start as soon as possible and be continuous long term rather than be one-time events. While the complete clarification of mandates may take some time, there are several fundamental functions that are critical for local ENR management, involving a recurrent cycle of monitoring and evaluation, identification and analysis of issues, and setting objectives and priorities, policy formulation, action planning and budgeting, consultation and public participation, and implementation (see Figure 4.2). Training for these functions would

Figure 4.2. Fundamental Government Functions Relevant to ENR Management



Source: Adapted from Cistulli 2002.

be a no-regret intervention in the short run. Provinces and local municipalities vary in their ENR issues and therefore their capacity needs. Thus, as mandates are clarified, it would be advisable to carry out functional reviews of current staffing, technical skills, and resources at different provincial and local government levels to identify staff enhancement, training, and other resource needs for adequate implementation of their functions.

Meanwhile, there is a critical need to introduce strategic mechanisms to address ENR issues in the development interventions at the local level, particularly regarding infrastructure projects. A transparent monitoring and tracking system can be established to provide information to all stakeholders on major projects and activities impacting the environment and natural resources, noting that present arrangements have been designed to respond quickly and address the ENR aspects.

The design of the capacity-building program should reflect the broad mandates accorded by the constitution to each tier of government. The federal level should be strengthened in the formulation of policies and defining and enforcing rules for issues of national importance. In addition, the federal government should be able to give direction to the provincial and local governments for integrating environmental concerns in planning and formulating of policies at their respective levels. Research, development, and dissemination of results to stakeholders for evidence-based decision making call for a holistic planning approach. This would empower provincial and local agencies, which is critical for addressing environmental problems at the source level. The capacity-building program for provincial and local governments should focus on using environment instruments and tools like the strategic environmental assessment and regional assessment for integrating environmental issues in project planning for greening structure and sustainable development. In addition, the skills and understanding of subnational environmental officials in scientific approaches, tools, and best practices

Box 4.4. Two Approaches to Institutional Capacity Strengthening

Capacity strengthening could be approached in practice from either a bottom-up or top-down perspective.

The bottom-up perspective

Since the Nepali decentralized system takes the devolution of power to a quite extreme point, it would make sense to initiate the capacity-strengthening process at the most local level. For instance, the identification of priorities would be essentially based on local considerations in line with the underlying subsidiarity principle. Same for the other aspect mentioned in Figure 4.3 above. Building the capacity from the bottom up would require the following steps:

- Identifying priorities with local stakeholders
- Establishing a structure in charge of training staff and candidate staff for ENR management functions
- Preparing curricula based on priorities
- Delivering training
- Awarding certificates
- Preparing supporting material and provide training documents

The main issue with this approach is that it is expensive and complex to set up and will depend a lot on the local political commitment. The overall success of this approach is contingent on the replicability of the model and the incentives for other local governments to adopt the approach.

The top-down perspective

This approach would be more pragmatic and benefit from economy of scale. A capacity-building entity could be established under MOFE and provide training services to local and provincial governments as well as public and private companies. The curricula would be flexible enough to accommodate different types of capacity baseline and trainees' background. Such an entity could certainly more easily attract financing from international bilateral or multilateral donors and would be overall more cost-effective than the bottom-up approach described above. Moreover, this approach would ensure a certain level of consistency in working methodologies and standards regardless of where the trainee would be coming from or would be assigned to. However, it might not be tailored to the level that may be required in some instances at the local level.

used for evaluating environmental impacts should be strengthened. This would enable them to build robust permitting and monitoring mechanisms, as needed.

In addition, considerable infrastructure investments by the local governments, like rural roads, require immediate attention and support for protection of environment. Hence, adequate capacity development investments in training and capacity building is a crucial factor for mainstreaming conservation into local development planning and implementation. They should understand the environmental issues and exercise their duties and use their powers for decisions that have repercussions for the environment. For example, the capacity building for local governments should be designed to include awareness of environmental conservation, sector-specific environmental issues and design of mitigation measures related with the project cycle, environmental legislation, monitoring approaches and procedures, and tool kits. Overall, the number and capability of civil servants in environmental protection needs to be commensurate with the responsibilities of a government.

4.3.4. Data Generation and Analysis

There is limited availability of reliable data on the state of environmental media and natural resources and the sources of pollution and other types of degradation constraints. One example of the needs at the federal level relates to the collection of data and their analysis for sound policy making. In 2018, the Ministry of Population and Environment (now the Ministry of Forests and Environment) published a report entitled Strengthening National Capacity in Environment Data Sharing and Reporting (Nepal, MOPE 2018). This report mentions the role of the Central Bureau of Statistics (CBS), established through the Statistics Act 1958 and the Statistics Rule 1984. The CBS's

mandate is to conduct social, economic, and demographic statistical surveys, censuses, and research; record statistics; and provide advice to the government on statistical matters. According to this report, the CBS "published a compendium on Environment Statistics for the first time in 1994, followed by a second publication in 1998, with an analysis of data related to different aspects of environment issues. Realizing the importance of environmental statistics, CBS continues to publish 'Environment Statistics' in a biannually basis from 2000." These statistics also enable Nepal to meet its data reporting and analysis obligations under several multilateral conventions that the country has ratified.

The main hurdle the CBS faces is the lack of formal indicators to measure the performance of environmental actors,[55] and the general lack of awareness of the importance of reliable statistical data for policy making and enforcement. The CBS recognizes, however, that important gaps still exist regarding environmental issues; therefore, it struggles to produce quality assessment regarding the state of the environment. The ministry in charge of the environment last produced a "state of the environment" report in 2000 for lack of resources and capacity. The report presents a useful summary of the different data sets available through the internet pages of main ministries and agencies; however, there are still limitations in the use of geospatial and remote sensing data except for forestry, land, meteorology and hydrology, and mines and geology.

4.3.4.1. Creating a Knowledge/ Database Platform (Excellence Center) at the Federal Level

Environmental problems are location-specific; therefore, area-specific environmental data is required at various geographical levels. For easy access of geographical environmental data and sharing of knowledge for planning purposes, a platform can be established. This platform will seek to create networks among stakeholders (local government, private sector) to share data. This center can hold and disseminate online data on pollution, standards, critical habitat, biodiversity, and hazard maps that are required for desk work and upstream planning process. One of the roles of the National Planning Commission is the coordination of inter-sectoral activities and monitoring environment-related actions; therefore, it would be well-suited to house this platform.

4.4. Availability and Access to Information

Although the constitution guarantees the population of Nepal the right to a clean environment and also access to information, much remains to be done in that respect. Policies and plans—sectoral or otherwise—are not systemically submitted to public consultation and disclosure. However, the environmental impact regulation and recent amendments and revisions (see section 4.2) include provisions for public consultation and disclosure, which civil society has been demanding for a long time.

Practices of consultation and disclosure will take time to mainstream in Nepal. When it does, approaches based on disclosure of environmental performance could be tested. These approaches have been tested in several countries (China, Egypt, Indonesia, Vietnam) in various ways and the lessons learned are that they are cost-effective but need good basic governance to reach their potential.

4.5. Accountability of Decision Makers for ENR Management

Accountability is a notion closely related to governance. Good political governance depends on the integrity of the political process and the ability to elect the best people to public offices. Under the new federal system, elected people at the three levels of

55 Notwithstanding the fact that in 2017 the National Planning Commission issued "Nepal's Sustainable Development Goals" (Nepal, NPC 2017).

government will be rewarded or penalized by voters based on their success in delivering on their promises. The current process is promising as it resulted from a long and sometimes tragic series of events and struggles; checks and balances are likely to be built as the structure of the federal system coalesces.

To promote the virtue of accountability, incentives will have to be built into the system; access to information as mentioned above will be one, but an independent judiciary would be critical.

4.6. Intergovernmental Financing as Incentive for Improved ENR Management

The 2015 constitution provides for intergovernmental revenue sharing and fiscal transfers to ensure that subnational governments have enough resources to carry out programs within their own mandate and "their part" of federal and provincial programs. The constitution assigns most tax and non-tax revenues to the federal government,[56] notably VAT and excise tax, with a lesser number and volume assigned to provincial and local governments.[57] The federal government may also collect royalties from natural resources.[58] Mechanisms for sharing the VAT, excise taxes, and natural resource royalties as well as four categories of fiscal transfer have been instituted to enable provincial and local governments to carry out their constitutionally mandated programs and participate in the implementation of federal (and provincial) programs, as defined in the Intergovernmental Fiscal Arrangement Act 2017. Specifically, as summarized in Table 4.5, sharing of revenues from VAT and excise taxes aims to cover administrative expenditures by provincial and local governments. Among fiscal transfers:

- Equalization grants are unconditional and aim to enable provincial and local governments to carry out their responsibilities specified in the constitution—Schedules 6, 7, and 9 (provincial governments) and Schedules 8 and 9 (local governments) (see Table 4.1).
- Conditional grants may be given by the federal government to provincial and local governments so they can implement national policies, programs, and standards, and develop infrastructure, and by provincial and local governments so they can implement provincial policies, programs, and standards, and develop infrastructure. Examples are the national target of maintaining the forest cover at 40 percent or more of the land area or the SDGs, for which provincial and local level cooperation is essential. The federal and provincial governments may impose additional conditions when providing conditional grants.
- Complementary grants are given by the federal government to provincial and local governments and by a provincial government to local governments within their jurisdictions and aim to complement the recipients' funds for implementing specific infrastructure projects, subject to preset criteria. These criteria may include conditions related to ENR management.
- Special grants may be provided by the federal government to provincial and local governments and by a provincial government to local governments, for the development and delivery of basic services like education, health, and drinking water, achievement of inter- and intra-provincial balanced development, and mitigation of discrimination.[59]

The National Natural Resources and Fiscal Commission has been tasked to recommend formula for revenue distributions and fiscal

56 Taxes assigned to the federal government include customs duty, excise duty, VAT, corporate income tax, individual income tax, remuneration tax, and passport fee, visa fee, tourism fee, service charge/fee, gambling lottery, casino, penalties and fines.

57 Taxes assigned to provincial governments include house and land registration fee, motor vehicle tax, entertainment tax, advertisement tax, agro-income tax, and service charges/fees, tourism fee, penalties and fines. Taxes assigned to local governments include wealth tax, house rent tax, house land registration tax, motor vehicle tax, land tax (land revenue), entertainment tax, advertisement tax, business tax and service charges/fees, tourism fee, penalties and fines.

58 Namely, mountaineering, electricity, forest, mines and minerals, water, and other natural resources.

59 Intergovernmental Fiscal Arrangement Act 2017, Nepal. See also Nepal, NNRFC (2018a, 2018b).

transfers to subnational governments. The percentage distributions of tax revenues and royalties between accounts for the provincial and local governments are prescribed by the constitution, while the NNRFC was established in 2017 to devise formulas for distribution from each account among provincial and local governments. The NNRFC established various indexes—including a human development index, an underdevelopment index, a multidimensional poverty index for the provinces, a human poverty index for local levels, a social and economic discrimination/disparity index, and an infrastructure index—and has recommended distribution formulas applying them for fiscal years 2017/18 and 2018/19 (Table 4.5). **The NNRFC is also tasked "to provide necessary suggestions relating to the conservation and use of natural resources to the Government of Nepal, the State or Local level."**[60]

Revenue sharing and fiscal transfers to lower tiers of government offer an opportunity for providing incentives for public-good environmental services or reducing environmental externalities, but they currently are not used to their full potential. Currently, access to safe drinking water supply is considered as one of the indicators for social discrimination in the socioeconomic discrimination (dispar-

Table 4.5. Revenue Sharing and Fiscal Transfers Between the Federal, Provincial, and Local Governments

Category	Purpose	Formula for Distribution / Conditions for Allocation
Revenue sharing (VAT, excise tax)	Administrative expenditures	Initial division: FG: 70%, PG: 15%, LG: 15% Allocation among PGs and LGs: Population and demographic factors: 70%, Area: 15%, Human development index: 5%, Underdevelopment index: 0% Minimum for each LG: NPR 30 million in fiscal year 2018/19; NPR 35 million in fiscal year 2019/20
Natural resource royalty sharing	None specified	Initial division: FG: 50%, PG: 25%, LG: 25% Allocation among PGs and LGs: In proportionate ratio to PGs and LGs as affected by their use of natural resources
Fiscal transfers		
Equalization grants	For carrying out responsibilities specified in the constitution **PGs:** Schedules 6, 7, and 9 **LGs:** Schedules 8 and 9	**From FG to PGs and LGs:** Allocation among PGs: Service delivery cost: 60%, Multidimensional poverty index: 15%, Social and economic discrimination/disparity index: 15%, Infrastructure index: 10% Allocation among LGs: Gap between revenue capacity and expenditure needs: 70%, Human poverty index: 10%, Social and economic discrimination/disparity index, 5%, Infrastructure index: 10% **From PGs to LGs:** Allocation among LGs: same as above
Conditional grants	**FG to PGs and LGs:** For implementing national policies, programs, and standards, and for infrastructure development **PG to LGs:** For implementing provincial policies, programs, and standards, and for infrastructure development FG/PGs may impose additional conditions	Based on annual budget proposals submitted by PGs and LGs to FG, and by LGs to PG
Complementary grants	**FG to PGs and LGs:** For infrastructure projects **PG to LGs:** For infrastructure projects	**Criteria for funding:** Project's feasibility, cost, outputs/benefits, financial and physical capacity or human resource availability, priority/need Allocation on basis of ratio to total cost
Special grants	**FG to PGs and LGs, and PG to LGs for:** Basic services Balanced development among provincial or local jurisdictions Mitigating social, economic, and other discrimination	

Source: Based on GON 2017a; Nepal, NNRFC 2018a, 2018b.
Note: FG = federal government; LG = local government; PG = provincial government.

60 National Natural Resources and Fiscal Commission Act 2017, Nepal.

ity) index, which influences the allocation of the equalization grant. Climate change vulnerability is given a weight of 5 percent in the same index (Nepal, NNRFC 2018a, 2018b). These weights are not only limited; they also do not address environmental externalities that affect other, often downstream communities, such as dumping of waste and wastewater in rivers (see chapter 3), forest degradation affecting downstream hydropower generation or irrigation infrastructure (see chapter 2), and road-induced landslide damage on lives, infrastructure, and property (see chapter 3). White and Masaki (2019) show that, while Nepal has become the most fiscally devolved country in South Asia, the largest share of the revenues and fiscal transfers are unconditional. Specifically, fiscal equalization grants and shared revenues accounted for 54 percent of all transfers received by local governments. Yet, international experience and Nepal's own experience with grants to local governments show that the preferences of local stakeholders involved in decisions on the use of unconditional grants will be for infrastructure with direct economic or health benefits and rarely for investments that avoid environmental externalities, especially when they impact other communities. **Increasing the share of conditional grants dedicated to environmental externalities may be explored as a more effective mechanism to support sustainable growth under federalism.**

Elements of competitive federalism may also be applied to further incentivize sustainable growth. Conditional and complementary grants may be best suited for this purpose as their main objective is to provide resources for national (and provincial) policies and programs, which tend to address public goods that go beyond provincial and local interests (see Table 4.5). Conditional grants may be allocated competitively among provinces and among local governments to further key national ENR management priorities. Box 4.5 presents an example for this practice in India. In a similar vein, conditional grants may be used to promote greening infrastructure, notably roads. For example, states that allocate conditional grants to local governments for local road development may make the allocation dependent on the level of compliance with engineering standards in construction and level of maintenance.

4.7. Offsetting Forest and Biodiversity Loss due to National Priority Projects

Where the options of "avoiding," "minimizing," and "mitigating" the potential adverse impacts of large development projects on forests have been exhausted, and there is no other option but to clear forests, an "offset" is the last resort to compensate a society for the ecosystem services that would be lost.[61] Nepal's national priority projects,[62] notably hydropower-related structures, roads, and airports, may indeed necessitate the clearance of forests in national forests areas and protected areas, as well

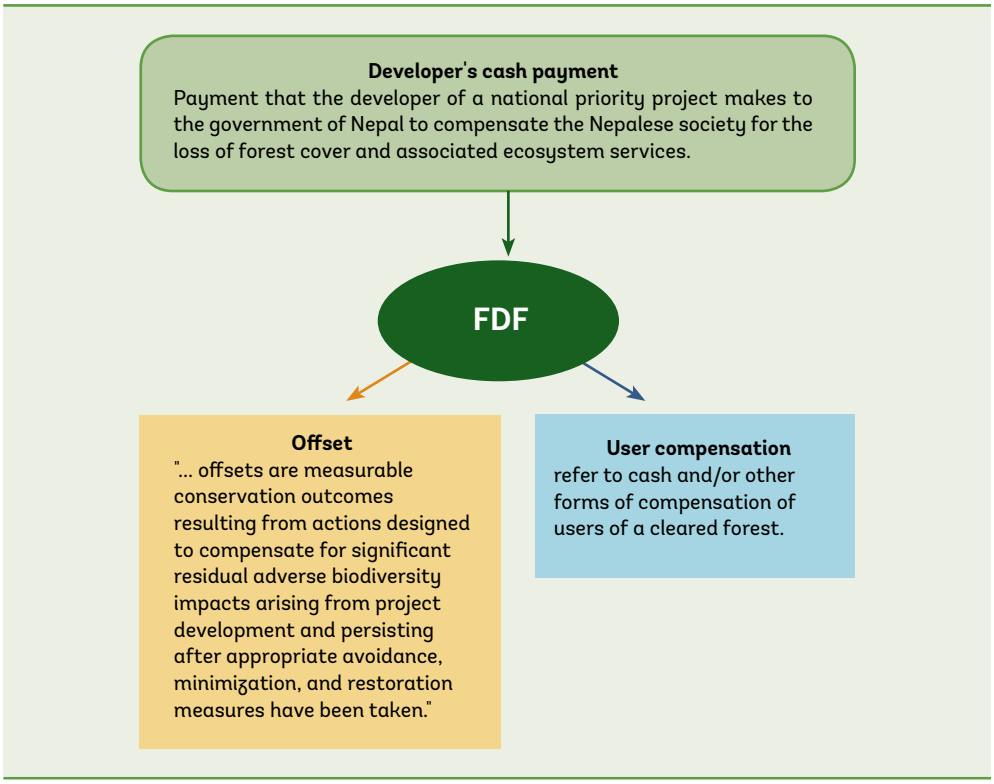
Box 4.5. Competitive Federalism Incentivizing Forest Quality Improvements in India

In India, the 14th Fiscal Commission adopted a formula for the transfer of tax revenues to states that applies a 7.5 percent weight to forest quality, besides income distance, baseline population, population change, and area.* Forest quality is defined in terms of area of very dense and dense forests. Thus, the larger a state's total area of very dense and dense forests, the bigger the share it receives from the "forest quality bucket" of the revenue transfer.† States compete for a higher share of the revenue transfer by investing in the quality of their forests, which then provides not only local benefits, such as recreational benefits and tourism revenues, but also national and global benefits, such as carbon sequestration and biodiversity conservation.

* Respectively, 50 percent, 17.5 percent, 10 percent, and 15 percent.
† In this calculation, an adjustment is made in accounting for Himalayan states' high-elevation land areas.

61 A more detailed discussion on this topic may be found in the ESD background paper "Review of Policy Proposals for Forest Clearance for National Priority Projects" (Arin, Kaczan, and Kutter 2019), which is available upon request.
62 Also known as "national pride projects." As of June 12, 2019, the National Planning Commission website listed 21 such projects. https://www.npc.gov.np/en/page/74/visualing_development/data/national_pride_projects.

Figure 4.3. Compensation/Offset Framework



as, to a limited extent, nonforest habitats. The extent of forest clearance under a national priority project will vary; run-of-the-river hydropower plants will likely cause limited clearance, while transportation infrastructure projects may involve extensive clearance. A good example is the proposed Nijgadh International Airport, which would require the clearance of approximately 8,000 hectares of natural forests.

A comprehensive compensation and offset mechanism is needed to handle potentially extensive or cumulative forest/habitat clearance activities in an environmentally sound and socially acceptable manner while avoiding undue burden on investors. Such a mechanism would collect cash payments from developers ("developer's cash payment") and use them to (a) establish and maintain physical offsets ("offsets"); and (b) compensate users of the cleared forest for the loss of productive and other benefits they derive from it ("user compensation"). If no feasible alternative options are available, the compensation/offset mechanism should follow the following principles:

1. Offsets should result in no net loss and preferably a net gain of forest biodiversity.
2. Offsets and user compensation should be socially acceptable.
3. The developer's cash payment should be enough to cover the costs to establish and manage the offset.
4. The developer's cash payments should be economically efficient, reflecting the value of lost ecosystem services.
5. The developer's cash payment should be determined in a way that is fair, simple, and transparent.
6. The compensation/offset framework should be governed according to good international practices.
7. The compensation/offset framework should be monitored and evaluated regularly.

The government of Nepal has put in place some of the building blocks for a compensation/offset mechanism. First, the Forest Use

Box 4.6. Liberia Biodiversity Offset Roadmap

The Liberia Biodiversity Offset Roadmap, National Biodiversity Offset Scheme: A Roadmap for Liberia's Mining Sector, emphasizes industrial-scale mining because of its prevalence in the country and the successful offset pilot in the country. Since adequate funding for Liberia's protected areas remains a challenge, biodiversity offsets offer potential for improved financial sustainability. In that context, a network of proposed protected areas provides excellent potential offset sites for future mining projects. The roadmap outlines a series of steps for scaling up biodiversity offsets in Liberia; among the most important is the establishment of a national Conservation Trust Fund (CTF) to enable the reliable and transparent transfer of funds from extractive firms to priority PAs. The World Bank and the government of Norway are supporting the government of Liberia with implementing the roadmap's key recommendations. This support includes technical assistance for designing the CTF, as well as biodiversity offset facilitation activities such as (i) developing metrics; (ii) convening a Stakeholder Advisory Committee; (iii) promoting new offset pilots; (iv) establishing thresholds for possible future mandatory participation by large mining firms; and (v) proposing adjustments to Liberia's environmental and social impact assessment regulations and other legal requirements regarding offsets.

Source: World Bank 2016.

Guidelines 2017[63] now allow developers the option of cash payments to the government in addition to that of undertaking afforestation/reforestation activities in equivalent degraded forest areas. The latter option was the only one available under the previous version of the guidelines and proved to be cumbersome to developers; as such, it became widely regarded as a bottleneck to hydropower investments (Sharma 2017, 2018). To operationalize the cash option, MOFE is preparing a standard norm that will determine the amount of the cash payment that will reflect the present value of the economic value of lost ecosystem services.[64] Second, the Forest Act 2019 established the Forest Development Fund (FDF), which would be capitalized, among others, through the developer's cash payments sanctioned by the Forest Use Guidelines 2017. Funds that accumulate in the FDF would be used to establish and manage the offsets and provide user compensation (Figure 4.3).

The identification of land in Nepal feasible for re- and afforestation as well as for increased forest protection is recommended. A basic condition for establishing successful offsets is the identification of areas that can be re- or afforested or otherwise rehabilitated (for example, degraded lands) or with habitats that should be protected (World Bank 2016). Pre-identifying and prioritizing potential offset areas in Nepal would help accelerate the process of implementing the offsets necessary for projects that come at the cost of forests. The pre-identification and prioritization of potential offset areas should be part of a national- and/or provincial-level land use planning exercise as it would allow for a comprehensive analysis of current and potential land uses. The offset activities should preferably be implemented in the province where the forest clearance takes place; if that province cannot offer an appropriate compensation area within its own boundaries, the FDF should facilitate the identification of an appropriate offset area in another province.

In the middle to long term, the government of Nepal should consider developing an aggregate forest/biodiversity offset. An "aggregated forest/biodiversity offset" refers to a system in which forest offsets are planned and implemented in a systematic manner, more than just a one-off single offset area to compensate for a single original development project. This can mean, for example, (a) planning one or more relatively large offset sites that would compensate for multiple original projects, or (b) preselecting offset areas to facilitate support from development

63 Formally, "Procedure Relating to the Use of National Forest Area for National Priority Projects 2017"

64 An equivalent policy document for protected areas, namely the Working Policy for Construction and Operation of Physical Infrastructure in Protected Areas 2008, already provides for cash compensation, but this compensation covers only the cost of establishing and maintaining a plantation in an equivalent area and protection for up to five years. This policy is also being revised, which provides an opportunity to broaden the compensation to include other lost system services.

Box 4.7. Conceptual Framework for Developers' Cash Payments (Standard Norms)

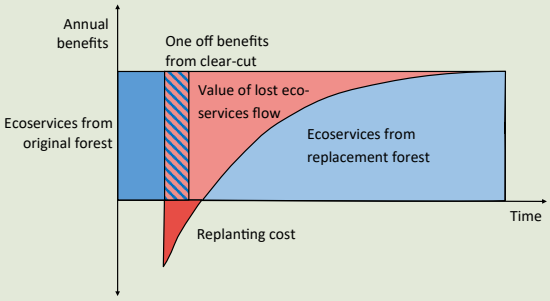
The compensation/offset mechanism has seven principles it should follow. The third and fourth principles imply that a sound cash payment should cover both the costs of replacing the lost forest and the temporary costs of lost ecosystem services. There is also a benefit of the clear-cut: the one-time timber windfall that goes to the government.

The developer's cash payment should be the resulting net cost:

This conceptual framework for forest compensation recognizes that forests both have standing value (by providing of timber, fuelwood and NTFPs) and produce other ecosystem services.* Ecosystem services are a flow of benefits, and include both tangible values (such as timber production) and intangible values (such as cultural significance). From an economic perspective, these benefits are the dividend that society receives from its stock of natural resource assets, such as forests. Maintaining these assets, and ensuring they are replaced when their loss is unavoidable, ensures a sustained provision of ecosystem services and thus the maintenance of human well-being.

In practical terms, the ecosystem services provided by forests typically include timber, fuelwood, fodder, NTFPs, carbon storage and sequestration, recreation and tourism, water filtration and recharge, soil conservation, biodiversity, and pollination and seed dispersal (Verma et al. 2013). Accounting for both tangible (monetary) and intangible (nonmonetary, existence and option) services values, where possible, helps to provide a more complete picture of the true value of an environmental asset (a concept known as total economic value).

The flow of these benefits is lost when a forest is cleared, justifying cash payment as compensation both to society for the temporary loss of services flow and to cover the cost of replacement forest. The cash payment should reflect ecological damages as completely as possible (principle 5) and cover the full costs of replacement (principle 4). It should be noted that it is difficult to estimate



the complete value of services lost, particularly the value of intangible services. The cash payment determined by the standard norms thus is likely to be an underestimate.

It is also important to note that the developer's cash payment does not substitute for replacement forest; on the contrary, the cash payment is determined on the specific assumption that an equivalent forest ecosystem will be established and maintained to provide replacement ecosystem services. The compensation is simply for the production "gap" between when the original forest is cleared and when the replacement forest is producing equivalent ecosystem services. Failure to plant and maintain this forest, or ensure its equivalency, will cause a social loss to Nepal. Equivalency requires that reforestation occurs in the same ecozone (that is, it will have similar biophysical characteristics), at a similar distance from human populations (that is, it is comparably accessible), in a similar watershed (that is, it provides comparable hydrological services). It should also be recognized, even the most similarly replanted forests will still be unable to fully replicate the original (especially the biodiversity).

Finally, estimation of the total economic value lost due to forest clearance also informs policy makers and the general public on the damage sustained by its natural capital to generate economic growth through the creation of an alternative form of capital (produced capital) and which section of society stands to lose from it, so it can be compensated and/or measures to mitigate the damage to natural can be taken.

* For more background on ecosystem services, see TEEB (2010) The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

project sponsors (which they may want to use for communicating on their corporate social responsibility). An example of an offset roadmap in Liberia is provided in Box 4.3.

The recommended next key steps are (a) define the governance for FDF; (b) finalize the standards and norms for determining the cash compensation amount to be paid by developers (see Box 4.4); (c) pre-identify and prioritize feasible offset areas in Nepal through a land use planning exercise at national and provincial levels; and (d) prepare the guidelines for user compensation. These building blocks are important for the development of the aggregate forest/biodiversity offset mechanism to be managed by MOFE in collaboration with the provincial governments.

5. CONCLUSIONS AND SUMMARY OF RECOMMENDATIONS

This chapter concludes the ESD report by summarizing in tabular form (Table 5.1) the recommendations of the paper together with an indication of the main stakeholder(s) who would carry them out, and an indication of priority. Short term (S) indicates that the recommended action is considered high priority and therefore recommended to be carried out within two years from now. Medium term (M) is defined as recommended being carried out within six years from now, and long term (L) as within 10 years from now.

Table 5.1. Recommendations Made in the EDS

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Better harnessing natural resources for sustainable growth			
Sustainable forest management (SFM)	Carry out functional review of the divisional and subdivisional forest units	MOFE, PG	S
	Initiate training program for divisional and subdivisional forest officers and community forest user groups in SFM	MOFE	S
	Empower the Forest Research and Training Center to carry out annual partial updates of forest resource assessment	MOFE	M - L
	Separate functions of managing forests and supervision Institute an appropriate framework of incentives and sanctions to minimize chances of corruption	MOFE	M
	Pilot online auctioning	MOFE, PGs	M - L
Nature-based tourism (NBT)	Develop participatory integrated destination plans for protected areas, surroundings, and gateway cities	PGs, MOFE	S - L
	Enhance connectivity to protected areas with high NBT potential	MOFE, PGs, LGs	M - L
	Simplify regulations concerning activities and concessions within protected areas	MOFE	S
	Upgrade environmental protection and safety measures in protected areas	MOFE	S - M
	Provide advice to businesses on value chain integration, access to finance, marketing, and improving service standards	MOFE, PGs, LGs	S - M - L
Hydropower development	Enact a comprehensive nationwide integrated water management policy as well as relevant technical guidelines	MEWRI	M
	Systematize the use of strategic environment assessments (regional or sectoral), cumulative impact assessment to capture sectoral, regional, or national environmental and social considerations	MOFE, MEWRI	M
	Clarify mandates of the three tiers of government regarding hydropower development and management	Government	S
Environmentally friendly agriculture	Clarify the distribution of powers and responsibilities with regard to pest, pesticide, and soil nutrient management and build subnational staff capacity accordingly	Government, MALD	S
	Resume broad-based training of trainers and farmer training on integrated pest management, in particular in areas in irrigated areas	MALD, MLMACs	S
	Introduce farm nutrient management supported by affordable farm-level soil testing, advice, and farmer training, and train-the-trainers' programs especially in irrigated areas	MALD, MLMACs	M
	Target fertilizer subsidy to poor farmers and link it to nutrient management	MALD, MLMACs	M
	Issue guidelines for efficient irrigation	MEWRI	M

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Sustainable river quarrying	Consolidate and revise regulatory provision scattered around multiple regulations	MICS, MOFE	M
	Clarify the powers and responsibilities of the three tiers of government	Government	S
	Issue guidelines for small-scale sustainable river quarrying	MICS, MOFE, LGs	M
	Clarify principles for exporting aggregates from river quarrying	Government	S
	Strengthen the planning and technical capacities of the relevant agencies and introduce a system of licensing based on assessment of annual yields, appropriateness of sites, and environmental and social impacts	MICS, MOFE, Government	M
	Introduce a robust and reliable monitoring and enforcement mechanism	DOE, MICS, LGs	S
Mitigating adverse impacts of growth on the environment and natural resources			
Air pollution	Issue point source air emission standards and update those for brick kilns	DOE, MOI	M
	Update ambient air quality standards	DOE	L
	Increase density and management of air monitoring networks	DOE	M
	Improve and enforce vehicle (and fuel) emission standards	DOE, MOPIT	M - L
	Incentivize use of electric vehicles in the administration and public transportation fleet	MOF, MOPIT, MOFE	M
	Enforce measures to reduce road-based sources of dust pollution	PGs, LGs	M
	Promote cleaner cooking methodologies, including electric cooking, to reduce indoor air pollution	DOE, NGOs	S
Water, sanitation, and hygiene (WASH)	Carry out thorough diagnostic of WASH infrastructure and develop a nationwide maintenance and rehabilitation plan	MWS	M
	Define responsibility of three tiers of government with regard to construction and maintenance of WASH infrastructure and strengthen capacity	Government	S
	Carry out investments and maintenance in line with the 2016 National Water and Sanitation Strategy	MWS	M - L
	Carry out a nationwide assessment of contamination by agrochemicals from agricultural runoffs	DOE, MALD	M
	Carry out a nationwide heavy metal contamination survey of surface and ground water	DOE, MWS	M
	Undertake spatial planning to protect watersheds	MEWRI, MOFE	M
Solid and hazardous waste management	Develop hazardous waste management policy and act	MOFE	S
	Carry out a survey of survey of sources of soil contamination attributable to inappropriate elimination of hazardous waste (batteries, asbestos products, etc.)	DOE, MOFAGA	M
	Introduce a deposit-refund system to incentivize recycling	NPC, NNRFC, DOE	M
	Improve waste collection in mountainous areas and protected areas	MOFE	S

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Resilient and green roads	Expand application of guidelines for construction of more climate- and disaster-resilient roads, particularly for the local road network	DOR	S
	Mainstream disaster and climate risks, sustainability aspects, and green approaches throughout the project cycle from upstream planning, construction, operation and maintenance, and closure/decommissioning	DOR	M
	Clarify roles of three tiers of government regarding construction and maintenance of the road network	Government	S
	Ensure Geo-Environment and Social Unit within DOR has sufficient resources and clear mandate	DOR	S
	Develop local road network (LRN) development guidelines including cost-effective appropriate scaling, technical standards, environmental risk mitigation measures, and climate and disaster proofing elements	MOFAGA	S - M
	Develop master plans for LRN based on cost-effectiveness and environmental, disaster, and climate risk considerations. Strategic environmental and social assessments should be carried out to provide the basis for environmental, disaster, and climate risk considerations	PGs	M
	Institute long-term programs to raise awareness in local and provincial governments on environmental, disaster, and climate risks and cost to the economy associated with local road development and to build technical capacity for design, planning, and evaluation commensurate with mandates	MOFAGA	M
	Make allocation of intergovernmental grants for infrastructure development contingent on design that optimizes road dimensions based on vehicles per day and minimizes environmental damage and takes into account climate and disaster risks Make performance in maintenance of existing roads one of the criteria for deciding on funding allocation by federal and provincial governments for new infrastructure	NNRFC, FG, PGs	M
	Develop high-resolution topographical maps followed by hazard maps for rural areas	MLMCPA	M - L
	Carry out analytical work to identify requirements for more environmentally resilient rural roads, particularly focusing on the optimizing budget/cost aspects	DOLI	S
	Organize capacity strengthening programs/activities to reinforce the implementation efficiency and monitoring system in road design, construction, and maintenance	DOLI, provincial ministry in charge of transportation	S
	Issue guidelines defining the process for internalizing environmental considerations into technical planning and design of roads	MOPIT, MOFAGA	S
Governance for sustainable growth under federalism			
Devolution of powers	Pass regulations detailing rights and responsibilities of the three tiers of government regarding environmental management	Government	S
Regulatory framework	Finalize and enact the revised Environment Protection Act and the corresponding Environment Protection Rules as well as impact assessment guidelines	MOFE	S
	Strengthen requirements for ensuring appropriate quality of environmental impact assessment/initial environmental evaluation	DOE	S
	Introduce strengthened public consultation and environmental disclosure requirements	DOE	S
	Establish a registry of polluting activities, including level of taxation based on importance of pollution and nuisance generated	DOE	M

Theme/Issue	Recommendations	Key stakeholders[a]	Priority[b] Short, Medium, Long term
Use of offset mechanism	Amend the Forest Use Guidelines 2017 defining the standard for developer's cash payment	MOFE	S
	Define and regulate the governance mechanism for the Forest Development Fund	MOFE	S
	Identify and prioritize areas feasible for re- and afforestation and rehabilitation (especially degraded lands) and increased habitat protection	MOFE	S - M
	Define guidelines for user compensation	MOFE	S - M
	Develop aggregate forest offset mechanism	MOFE	M
Capacity strengthening	Develop and deploy urgent capacity strengthening program for enhancing the environmental management capacity of province and local governments	MOFE, sectoral ministries	S
	Conduct a large consultation for defining the most appropriate approach (top-down or bottom-up) to fill the capacity gap in provincial and local governments	MOFE, NGOs	M
	Develop a comprehensive mechanism for collecting environmental data and information to improve management and ensure Nepal fulfills its international commitments	DOE, sectoral ministries, CBS	S - M
Access to information	Promote public access to environmental information	DOE	S
	Introduce an effective grievance-redress mechanism to allow citizens to dispute decisions that may affect the environment	DOE, MOFAGA	S - M
Accountability	Promote transparency of the decision-making process to ensure accountability	Government	S
Financing mechanisms	Adopt an explicit formula for competitive fund transfer to incentivize good environmental and natural resource stewardship by provincial and local governments	NNRFC	M

Note: CBS = Central Bureau of Statistics; DOE = Department of Environment; DOLI = Department of Local Infrastructure; DOR = Department of Roads; FG = federal government; Forest Use Guidelines 2017 = Procedure Relating to the Use of National Forest Area for National Priority Projects 2017; LG = local government; MALD = Ministry of Agriculture and Livestock Development; MEWRI = Ministry of Energy, Water Resources, and Irrigation; MICS = Ministry of Industry, Commerce and Supplies; MLMAC = (provincial) Ministry of Land Management, Agriculture and Cooperation; MLMCPA = Ministry of Land Management, Cooperatives and Poverty Alleviation; MOFAGA = Ministry of Federal Affairs and General Administration; MOF = Ministry of Finance; MOFE = Ministry of Forests and Environment; MOI = Ministry of Irrigation; MOPIT = Ministry of Physical Infrastructure and Transportation; MWS = Ministry of Water Supply; NGO = nongovernmental organization; NNRFC = National Natural Resources and Fiscal Commission; PG = provincial government.
a. The stakeholders listed here are meant to be those in leading role. Undoubtedly, there will be a need for the cooperation of stakeholders from within and outside the concerned sector, to realize synergies and mitigate externalities.
b. Short term (S): up to two years; medium term (M): up to six years; long term (L): up to 10 years.

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ANNEXES

Annex 1. Timber Model Parameters and Calculations

Table A1.1. Observed Values/Assumptions for Key Forest Management Model Parameters

Parameter	Baseline	BAU (2030)	SFM (2030)
Mean annual increment (m^3/ha)			
Terai and valleys	1.5	Reduced through degradation (see below)	
Middle hills and Chure	1		
Yield factor in potential production (SFM) forest areas			
CBFUGs in Chure, Terai / Valley	0.15, 0.15	0.15, 0.15	0.60, 0.60
Government-managed in Chure, Terai / Valley	0.10, 0.15	0.10, 0.15	
CFUGs in middle hills	0.20	0.20	0.60
Government-managed in middle hills	0.05	0.05	
Annual deforestation* in potential SFM forest areas			
CBFUGs in Chure, Terai / Valley	0.18%, 0.20%		0.05%
Government-managed in Chure, Terai / Valley	0.18%, 0.60%		
CFUGs in middle hills	0%		0%
Government-managed in middle hills	0%		
Forest degradation in potential SFM forest areas**			
CBFUGs in Chure, Terai / Valley	0.02%, 0.05%	0.02%, 0.05%	0.02%, 0.05%
Government-managed in Chure, Terai / Valley	0.10%, 0.20%	0.10%, 0.20%	
CFUGs in middle hills	0%	0%	0%
Government-managed in middle hills	0.10%	0.10%	
Yield factor in potential protection forest areas			
CBFUGs in Chure/Terai	0.15		0.10
Government-managed in Chure/Terai	0.10		0.05
CFUGs in middle hills	0.10		0.20
Government-managed in middle hills	0.05		0.05
Annual deforestation* in potential protection forest areas			
CBFUGs in Chure/Terai	0.10%		0.10%
Government-managed in Chure/Terai	0.20%		0.20%
CFUGs in middle hills	0%		0%
Government-managed in middle hills	0%		0%
Private timber producers:			
Increase in production from 2018 to 2030		30%	30%
Ratio of harvested/traded timber	1.2	1.2	1.2
Aggregate composition of species (sal, sissoo, asna, pine, eucalyptus, uttis) in sales (%) from:			
Government-managed forests	42%, 8%, 50%, 0%, 0%, 0%		
CBFUGs	42%, 8%, 30%, 20%, 0%, 0%,		
Private producers	0%, 10%, 0%, 30%, 10%, 50%		

Parameter	Baseline	BAU (2030)	SFM (2030)
Market (M) / Farmgate (FG) price (NPR/m³*)**			
Sal (M)	60,035		
Sissoo (M)	63,567		
Asna (M)	24,720		
Pine (FG)	10,593		
Eucalyptus (FG)	17,657		
Uttis (FG)	7,063		
Stumpage value (NPR/m³)			
Sal	35,310		
Sissoo	24,717		
Asna	14,124		
Pine	8,474		
Eucalyptus	17,128		
Uttis	6,357		
Royalty rate (NPR/cf) – sal, sissoo, asna, pine, eucalyptus, uttis	700, 400, 250, 150, 75, 100		
VAT (%) (levied on FG/M**)**	13%		
Tax on sal (%) (levied on market price)	15%		

Note: BAU = business as usual; CBFUG = community-based forest user group; CFUG = community forest user group; SFM = sustainable forest management.
* Reduces forest area.
** Impacts mean annual increment.
*** Market price data based on personal communication with timber merchants in the Terai and mid-hills in April 2019.
****For private producers, royalty rates, which are required floor prices in auctions, are taken as a proxy for market prices for assessing value added tax.

Table A1.2. Estimates of Potential Production and Protection Forest Areas in the Terai/Chure and Middle Hills (ha)

Baseline		Potential production (SFM) forest areas (size >100 ha for CFUGs* and <19-degree slope in Terai/Chure**)			Potential protection forest areas (size <100 ha and slope >19 degrees)			Total		
		BAU (2030)	SFM (2030)	Baseline	BAU (2030)	SFM (2030)	Baseline	BAU (2030)	SFM (2030)	
Terai/ Chure	CBFUGs	289,775	282,699	780,176	293,057	289,270	289,270	582,832	571,969	1,069,446
	Govt.- managed	495,490	473,693	0	293,841	286,292	286,292	789,331	759,985	286,292
	Total	785,265	756,392	780,176	586,898	575,562	575,562	1,372,163	1,331,954	1,355,738
Middle hills	CFUGs	353,557	353,557	665,814	859,395	859,395	859,395	1,212,952	1,212,952	1,525,209
	Govt.-managed	312,257	312,257	0	728,599	728,599	728,599	1,040,856	1,040,856	728,599
	Total	665,814	665,814	665,814	1,587,994	1,587,994	1,587,994	2,253,808	2,253,808	2,253,808
Total CBFUGs		643,332	636,256	1,445,990	1,152,452	1,148,665	1,148,665	1,795,784	1,784,921	2,594,655
Total Govt.-managed		807,747	785,950	0	1,022,440	1,014,891	1,014,891	1,830,187	1,800,841	1,014,891
Total		**1,451,079**	**1,422,206**	**1,445,990**	**2,174,892**	**2,163,556**	**2,163,556**	**3,625,971**	**3,585,762**	**3,609,546**

Source: Compiled using data from the CFUG database (2017) and FRA (DFRS 2015).
Note: BAU = business as usual; CBFUG = community-based forest user group; CFUG = community forest user group; Govt. = government; FM = sustainable forest management.
* According to SFM Guidelines; ** According to Chure masterplan.

Table A1.3. Estimates of Timber Production From Production and Protection Forest in the Terai/Chure and Middle Hills (m3)

Baseline		Potential production (SFM) forest areas (size >100 ha for CFUGs* and <19-degree slope in Terai/Chure**)			Potential protection forest areas (size <100 ha and slope >19 degrees)			Total		
		BAU (2030)	SFM (2030)	Baseline	BAU (2030)	SFM (2030)	Baseline	BAU (2030)	SFM (2030)	
Terai/ Chure	CBFUGs	54,333	52,731	1,140,727	43,959	43,391	28,927	98,291	96,122	1,169,654
	Govt.-managed	74,323	68,845	0	44,076	42,944	21,472	118,400	111,789	21,472
	Total	128,656	121,576	1,140,727	88,035	86,334	50,399	216,691	207,910	1,191,126
Middle hills	CFUGs	70,711	70,711	798,977	85,940	85,940	171,879	156,651	156,651	970,856
	Govt.-managed	15,613	15,411	0	36,430	36,430	36,430	52,043	51,841	36,430
	Total	86,324	86,122	798,977	122,369	122,369	208,309	208,694	208,492	1,007,286
Total CBFM		125,044	123,443	1,939,704	129,898	129,330	200,806	254,942	252,773	2,140,510
Total Govt.-managed		89,936	84,256	0	80,506	79,374	57,902	170,442	163,630	57,902
Total		**214,981**	**207,698**	**1,939,704**	**210,404**	**208,704**	**258,708**	**425,385**	**416,402**	**2,198,412**

Source: Compiled using data from the CFUG database (2017) and FRA (DFRS 2015).
Note: BAU = business as usual; CBFM = community-based forest management; CFUG = community forest user group; Govt. = government; SFM = sustainable forest management.
* According to SFM Guidelines; ** According to Chure masterplan.

Table A1.4. Estimates of Timber Harvest and Trade (cubic meters)

Party trading timber	BASELINE			BAU 2030			SFM 2030		
	DOF records on traded timber	Estimated total trade	Estimated harvest	Estimated recorded trade	Estimated total trade	Estimated harvest	Estimated recorded trade	Estimated total trade	Estimated harvest
Private producers	371,302	445,562	534,675	482,693	579,231	695,077	482,693	579,231	695,077
Government-managed forests	25,700	57,818	170,442	24,6737	54,464	163,630	0	0*	57,902
TCN sold timber in market	3,898	3,898		3,742	3,742		0		
DFO sold timber in market	13,804	13,804		13,252	13,252		0		
DFPSC (sold on subsidy)	7,999	7,999		7,679	7,679		0		
Estimated unrecorded sales		32,118			29,791		0		
CFUGs	41,854	41,854	254,942**	19,902	19,902	252,773**	1,650,783	1,650,783	2,140,510**
Collaborative forests	17,689	17,689		17,538	17,538		274,394	274,394	
Total	**456,545**	**562,923**	**960,060**	**544,806**	**671,136**	**1,111,480**	**2,407,870**	**2,504,409**	**2,893,489**

Note: BAU = business as usual; CFUG = community forest user group; DFPSC = District Forest Product Supply Committee; DOF = Department of Forests; SFM = sustainable forest management; TCN = Timber Corporation of Nepal.
* Given the large difference between actually produced on government-managed forests and traded by TCN, DFO, and DFPSC in the baseline, for the SFM scenario it is assumed that none of the amount harvested from government-managed forests is traded in the SFM 2030 scenario.
** The amount distributed among CFUGs for own use is estimated at 195,400 cubic meters in the baseline, 215,332 cubic meters in the BAU scenario, and 215,332 cubic meters in the SFM scenario.

Annex 2. Detailed Empirical Approach for Cost of Environmental Degradation Estimations

The process of estimating the cost of the health burden of pollution may be broken into two main steps: (1) calculating the health burden in terms of premature deaths (mortality) that may be attributed to a pollutant or environmental risk factor of interest (the "attributable burden"), and then (2) estimating the economic value of the attributable burden in monetary terms.

Health Burden Estimation

Calculating the attributable burden involves taking estimates of the total health burden in terms of deaths from each disease (by age group) due to all risk factors (environmental or not), and then determining the contribution made by exposure to the risk factor of interest. This contribution is quantified using epidemiological literature estimates of relative risk (RR), which represents the relationship between the risk factor (for example, pollution concentration) and the likelihood of developing a particular disease.[65]

Relative risks are used to calculate the "population attributable fraction," PAF, across exposure levels *i*:

$$PAF = \frac{\sum_{i=1}^{n} P_i RR_i - \sum_{i=1}^{n} P_i' RR_i}{\sum_{i=1}^{n} P_i RR_i} \quad \text{Eq. 1}$$

Where P_i is the proportion of population at exposure level I (current exposure), P_i' is the proportion of the population at the counterfactual or ideal level of exposure, and n is the number of exposure levels.[66] PAF represents the proportion of the disease burden attributable to that risk factor. PAFs are calculated for each relevant disease, and where necessary, for different age categories.

Because many diseases are caused by multiple risk factors, an adjustment step is then performed to prevent over-attribution ("double counting"). Both poor quality water and inadequate sanitation, for instance, are risk factors for diarrhea. To "isolate" the attributable fraction of the specific risk factor in the form of an "adjusted" PAF, we first calculate the total population attributable fraction *(PAF^T)* of the health burden for the cluster of risk factors under consideration:

$$PAF^T = 1 - \prod_{k=1}^{n}(1 - PAF^k) \quad \text{Eq. 2}$$

where n is the number of environmental risk factors.[67] We derived an adjustment coefficient, C, from the PAF^T:

$$C = PAF^T / \sum_{k=1}^{n} PAF_i^k \quad \text{Eq. 3}$$

Which is then used to proportionally adjust each PAF downward to account for overlapping causes of disease incidence:

$$PAF_i^{k*} = PAF_i^k * C \quad \text{Eq. 4}$$

65 Formally, RR is defined as the ratio of the probability of a health outcome, namely premature death (mortality) or disability from a disease, occurring in an exposed group to the probability of it occurring in a nonexposed group.

66 An integral can be used for continuous exposure distributions. The present study uses discrete categories representing intervals of exposure level, based on the available literature estimates.

67 An important assumption underlying this formula is that the risk factors are independent of each other and do not interact to either exacerbate or mitigate each other's impact on the disease occurrence. This assumption may not be realistic in some cases. Following Prüss-Ustün et al. (2014) and in the absence of prior hypotheses for relationships between our risk factors, we consider this assumption acceptable.

The adjusted PAF is then multiplied by the relevant population segment to determine the attributable disease burden for both age and disease specific categories, and across the population, B:

$$B = \sum_{k=1}^{t} \sum_{l=1}^{s} D_{kl} PAF_{kl}^{*} \quad \text{Eq. 5}$$

where D_{kl} is the total annual number of cases of disease, *k,* in age group, *l,* and PAF_{kl} is the attributable fraction of these cases of disease, *k,* in age group, *l,* due to exposure.

Cost Estimation

The economic (monetary) value of the total attributable burden is estimated in terms of (1) forgone labor output, and (2) lost welfare. The forgone labor output value is an estimate of the cost of premature mortality, calculated as the present value (PV) of forgone lifetime earnings (Narain and Sall 2016). The present value of earnings at time *t, PV(Y)*$_t$, are approximated by the present value of per capita consumption expenditure,[68] *Y,* over the period of lost years. The period of lost years, *L,* is equal to life expectancy, AD_t minus the average age of death, $AD_{t,k}$ for the disease in question, *k.* Consumption is adjusted to grow over time in line with expected future per capita income growth, *y.* The discount rate is *r.*[69]

$$PV(Y)_t = \sum_{t=0}^{L} \frac{Y_0}{(1+r-y)^t} \quad \text{Eq. 6}$$

Deriving forgone lifetime earnings, $FE_{t,k,}$ from the present value of earnings requires two further adjustments. We multiply by the labor force participation rate specific for the period of life lost, *LF(.),* based on observed labor force participation rates for Nepal at five-year intervals[70] Labor force participation is considered zero before age 15, in line with the ILO Minimum Age Convention. We additionally multiply by the survival rate *S(.)*, the probability that a person of age $AD_{t,k}$ will survive until the average life expectancy AD_t:

$$FE_{t,k} = PV(Y)_t * LF\left(AD_{t,k}, AD_t\right) * S\left(AD_{t,k}, AD_t\right) \quad \text{Eq. 7}$$

An alternative approach to estimating the economic cost of the health burden is based on welfare loss. This does not take into account the length of life ("life-years") lost, and instead values all lives equally regardless of age of death.[71] It is calculated by multiplying the estimated number of premature deaths with the value of statistical life (VSL). The VSL measures "an aggregate of individuals' willingness to pay (WTP) for marginal reductions in their mortality risks. It is not the value of any single person's life or death, nor does it represent a society's judgment as to what that value should be" (Narain and Sall 2016). We use a VSL base value of US$3.2–$3.8 million (2011 US$ PPP), encompassing the mean and median VSL calculated by stated preference studies[72] from OECD countries that passed a test of internal and external validity (Narain and Sall 2016). We transferred this range to Nepal using an adjustment for the difference in GDP per capita

68 Per capita consumption expenditure is used to approximate wage income, for which there is no reliable data to our knowledge.

69 Real average per capita growth rates were 2.2 percent from 1997 to 2006, and 3.2 percent from 2006 to 2015. Our discount rate is twice the long-term (10-year) GDP per capita growth rate average for the relevant scenario (4.4 percent for 2006 and 6.4 percent for 2015) (see World Bank 2016). Under SDG growth conditions for 2030, the higher per capita growth of 7 percent implies a higher discount rate (14 percent). These different discount rates more accurately reflect true social preferences within each scenario than a single discount rate would allow.

70 We use the male labor force participation rate, which is higher than that for women, so as not to implicitly devalue informal work undertaken by women (see Narain and Sall 2016; Viscusi 2010). Labor force participation data is from ILOStat (database), International Labour Organization, Geneva (accessed 2018), http://www.ilo.org/ilostat/.

71 While there is considerable evidence that VSL is heterogenous across age, there is debate about how this heterogeneity should be quantified from both an empirical and an ethical standpoint (Prüss-Ustün et al. 2014). We use a consistent VSL in line with the U.S. Environmental Protection Agency and the OCED.

72 In these studies, surveyed individuals are asked how much they would hypothetically be willing to pay to marginally reduce their mortality risk. As such, VSL is not limited to the value of output that would be lost in case of premature death but covers an array of other values that contribute to an individual's and society's welfare. Therefore, this measure is not directly comparable with GDP.

between Nepal, $Y_{N,}$ and the OECD average, $Y_{OECD,}$ and high and low assumptions regarding the income elasticity of VSL, $\varepsilon \in [1,1.4]$ (Viscusi and Masterman 2017).

$$VSL_{N\ in\ PPP} = VSL_{OECD\ in\ PPP}\left(\frac{Y_{N\ in\ PPP}}{Y_{OECD\ in\ PPP}}\right)^{\varepsilon} \quad \text{Eq. 8}$$

VSL results thus scale with GDP at the relevant time period. The resulting low- and high-end values of the VSL are US$18,800–$70,700 for 2006, US$20,900–$74,200 for 2015, US$31,100–$98,800 for 2030 under BAU growth rates, and US$93,100–$215,900 for 2030 under SDG growth rates.

Scenario Projections

Mortality and economic cost scenarios are estimated for 2030 for air pollution and inadequate WASH. Nepal's mortality rates are predicted based on the experience by other countries at similar stages of economic development. Specifically, we regress the mortality rate, M, for each disease, *k,* for each age category, *l,* using OLS over a panel of all countries, *c,* for the years 2000–2015 (where data are available):

$$Ln(M_{t,k,l,c}) = B_0 + B_1 gdp_{t,c} + B_2 gdp_{t,c}^2 + B_3 edu_{t,c} + B_4 t + u_{k,l,c} + e_{t,k,l,c} \quad \text{Eq. 9}$$

Where $gdp_{t,c}$ is the per capita income in country *c* at time *t,* and $edu_{t,c}$ is the average years of education. We include a linear time trend to account for technological change and country-level fixed effects to control for all time-invariant determinants. The specification is similar to that used to estimate the global burden of disease mortality estimates (Mathers and Loncar 2006). For the WASH regressions (diarrhea and typhoid, in each age group), we further include as determinants the proportion of the population with access to safely managed drinking water and basic sanitation:[73]

$$Ln(M_{t,k,l,c}) = B_0 + B_1 gdp_{t,c} + B_2 gdp_{t,c}^2 + B_3 edu_{t,c} + B_4 t + B_5 sanitation + B_6 water + u_{k,l,c} + e_{t,k,l,c} \quad \text{Eq. 10}$$

To project mortality rates, we use gdp per capita, education, and pollution metrics, predicted for 2030 based on (1) linear projections of current trends (for BAU), and (2) the government of Nepal's SDG targets.

Converting predicted mortality into cost of environmental degradation estimations in 2030 requires a suite of adjustments to other parameters. We use the 2030 medium-variant population age structure (proportion of the population in each age category) predicted by the Central Bureau of Statistics (Nepal, CBS 2014). This source also provides predicted urbanization rates. Urbanization rates do not apply evenly to each age category, however, and in the absence of published predictions we adjust the urbanization rates for each age category in 2030 using their observed 2011 ratios. We linearly predict the (male) labor force participation rate based on its observed trend from 2006 to 2013 (86.1 percent). Consumption expenditure per capita, a proxy for income, is projected for 2030 by scaling the 2015 statistic from the World Bank[74] with estimated GDP (either that predicted under BAU or the SDG target). In combination with the mortality predictions, these parameter estimates allow for calculation of the cost of environmental degradation equivalent to that in our 2006 and 2015 calculations using the approach described above.

73 While data exist to add equivalent determinants of air pollution (ambient pollution concentration and access to clean cooking), multicollinearity prevented satisfactory model estimation. Given that our model is for prediction rather than causal inference, omitting these variables is not a major problem: The economic indicators and time trend capture much of these variables' impact. It is possible that Nepal's SDG goals would see greater pollution reductions than other countries have experienced at equivalent income levels—in which case, our model will overestimate mortality. However, the purpose of this calculation is to determine the benefit of moving from BAU to SDG levels of pollution, which would be rendered more conservative under this type of bias.

74 World Bank Open Data (database), Washington, DC (accessed October 30, 2018), https://data.worldbank.org.

Table A2.1. Key Estimation Parameters for Scenarios

SDG target (Nepal, NPC 2017)	Economic parameters	2006	2015	2030 (BAU)	2030 (SDG)
8.1	GDP (constant US$ 2014) (billion)	18.33	21.27	32.93	71.98
8.1	GDP PPP (constant US$ 2014) (billion)	55.48	70.14	108.61	237.41
N/A	Population (million)	25.94	28.66	33.33	33.33
N/A	Urban population (million)	4.02	5.33	7.51	7.51
8.1	Consumption expenditure per capita (constant US$ 2014)	638	885	1201	2996
SDG target (Nepal, NPC 2017)	**Environmental health parameters**	**2006**	**2015**	**2030 (BAU)**	**2030 (SDG)**
	Air pollution				
11.6	Ambient $PM_{2.5}$ 24-hour exposure ($\mu g/m^3$)	46	51	54	20
7.1	Population using biomass cooking fuel (percent)	84%	81%	79%	10%
	Inadequate WASH				
6.1	Population with safe drinking water (percent)	25%	27%	30%	90%
6.1	Population with improved, piped drinking water (percent)	46%	48%	51%	90%
6.1	Population with improved, non-piped drinking water (percent)	38%	42%	48%	10%
6.2	Population with improved, unshared sanitation facility (percent)	31%	46%	71%	95%
N/A	Population with improved hygiene facility (percent)	13%	73%	100%	100%

Sources: BAU economic data are estimated from current trends (World Bank Open Data (database), accessed October 30, 2018, https://data.worldbank.org). SDG economic data are estimated from the government of Nepal's growth targets and current baselines (Nepal, NPC 2017; World Bank, 2018). Population data and projections are sourced from government of Nepal estimates (Nepal, CBS 2014). SDG environmental parameters are the government of Nepal's targets (Nepal, NPC 2017). Current and past WASH data are sourced from (JMP 2017) (using linear interpolation for 2006 estimate). Consumption expenditure per capita is projected for 2030 by scaling current expenditure (World Bank Open Data (database), accessed October 30, 2018, https://data.worldbank.org) with projected GDP. Ambient air pollution is from Brauer et al. (2016) and adjusted downward by 30 percent to match Kathmandu monitoring stations; clean cooking is from Nepal, MOH (2017) and Nepal, MOHP (2007); these metrics are extrapolated linearly for 2030 estimate.
Note: BAU = business as usual; GDP = gross domestic product; PPP = purchasing power parity; SDG = Sustainable Development Goal.

Annex 3. Detailed Environmental Health and Cost Estimates

Table A3.1. Estimated Number of Pollution-Related Deaths by Year, Pollution Type, and Region

	Total				Urban				Rural				Kathmandu Valley			
	2006	2015	2030 BAU	2030 SDG	2006	2015	2030 BAU	2030 SDG	2006	2015	2030 BAU	2030 SDG	2006	2015	2030 BAU	2030 SDG
$PM_{2.5}$ air pollution	24,530	25,634	21,685	13,355	2,600	3,679	4,268	3,374	21,929	21,955	17,417	9,982	1,256	1,952	2,928	1,228
Household	13,964	14,014	11,376	1,505	819	1,359	1,999	0	13,145	12,655	9,377	1,505	491	809	1,439	37
Ambient	10,566	11,619	10,309	11,851	1,781	2,320	2,269	3,374	8,784	9,299	8,041	8,477	765	1,142	1,489	1,191
WASH	8,609	3,668	2,095	201	1,033	623	433	38	7,576	3,045	1,662	163	433	306	279	11
Direct	7,511	3,269	1,853	82	900	564	389	17	6,611	2,705	1,464	65	433	306	279	11
Malnutrition	1,098	398	241	119	133	58	43	21	965	340	198	98	0	0	0	0
Occupational	2,622	3,264														
Total	35,761	32,565	23,780	13,556	3,634	4,301	4,700	3,412	29,505	25,000	19,079	10,144	1,689	2,258	3,207	1,239

Note: Both BAU and SDG 2030 mortality estimates are calculated under SDG economic growth targets. 2030 BAU pollution levels are linear extrapolations of current pollution trends; SDG pollution levels are the government's 2030 targets (Nepal, NPC 2017). Deaths from occupational pollutants are only estimated at the national level and for 2006 and 2015. Lead is assumed to have morbidity impacts only. While lead can cause mortality through heart disease, it is expected to be negligible compared to the other causes examined here. BAU = business as usual; SDG = Sustainable Development Goal; WASH = water, sanitation, and hygiene.

Table A3.2. Cost of Air Pollution by Year/Scenario, Cause, and Region

		Household air pollution (US$, millions)				Ambient air pollution (US$, millions)			
		Lost welfare			Forgone output	Lost welfare			Forgone output
		Mortality	Morbidity	Total		Mortality	Morbidity	Total	
Total	2006	643.5	64.3	707.8	76.4	481.1	48.1	529.2	56.9
	2015	669.7	67.0	736.7	70.0	569.3	56.9	626.2	59.6
	2030 BAU (BAU growth)	784.5	78.5	863.0	70.8	719.5	72.0	791.5	65.2
	2030 SDG (BAU growth)	111.8	11.2	122.9	10.1	426.1	42.6	468.7	37.8
	2030 BAU (SDG growth)	1,842.4	184.2	2,026.6	133.6	1,689.1	168.9	1,858.0	122.9
	2030 SDG (SDG growth)	262.5	26.2	288.7	19.1	997.8	99.8	1,097.6	72.2
Urban	2006	36.6	3.7	40.3	4.2	79.7	8.0	87.7	9.0
	2015	64.6	6.5	71.1	6.7	110.3	11.0	121.3	11.4
	2030 BAU (BAU growth)	129.9	13.0	142.8	11.7	147.4	14.7	162.1	13.4
	2030 SDG (BAU growth)	304.4	30.4	334.8	22.2	345.4	34.5	379.9	25.2
	2030 BAU (SDG growth)	0.0	0.0	0.0	0.0	128.5	12.9	141.4	11.5
	2030 SDG (SDG growth)	0.0	0.0	0.0	0.0	300.6	30.1	330.7	21.9
Rural	2006	588.1	58.8	647.0	70.4	393.0	39.3	432.4	46.9
	2015	601.6	60.2	661.8	62.6	442.1	44.2	486.3	46.0
	2030 BAU (BAU growth)	609.2	60.9	670.1	55.1	522.4	52.2	574.6	47.3
	2030 SDG (BAU growth)	1,430.2	143.0	1,573.2	103.9	1,226.0	122.6	1,348.6	89.3
	2030 BAU (SDG growth)	109.8	11.0	120.8	10.0	326.9	32.7	359.6	29.1
	2030 SDG (SDG growth)	257.9	25.8	283.7	18.8	765.5	76.5	842.0	55.5
Kathmandu Valley	2006	22.0	2.2	24.2	2.5	34.2	3.4	37.7	3.8
	2015	38.5	3.8	42.3	4.0	54.3	5.4	59.7	5.6
	2030 BAU (BAU growth)	93.5	9.3	102.8	8.5	96.7	9.7	106.4	8.8
	2030 SDG (BAU growth)	219.1	21.9	241.0	16.0	195.2	19.5	214.7	14.2
	2030 BAU (SDG growth)	2.7	0.3	3.0	0.2	78.4	7.8	86.2	7.0
	2030 SDG (SDG growth)	6.4	0.6	7.1	0.5	183.3	18.3	201.6	13.3

Note: Estimates are in US$ 2014. Lead and occupational hazards costs are not presented in this table for consistency across years. BAU = business as usual; SDG = Sustainable Development Goal.

Table A3.3. Cost of Inadequate WASH by Year/Scenario, Cause, and Region

		Direct effect (US$, millions)				Malnutrition (US$, millions)			
		Lost welfare			Forgone output	Lost welfare			Forgone Output
		Mortality	Morbidity	Total		Mortality	Morbidity	Total	
Total	2006	394.9	52.7	447.6	124.8	49.1	4.9	54.0	7.8
	2015	205.5	43.3	248.9	76.8	18.9	1.9	20.8	2.5
	2030 BAU (BAU growth)	138.9	3.1	142.0	18.8	15.7	1.6	17.3	1.7
	2030 SDG (BAU growth)	7.4	0.0	7.4	0.9	7.7	0.8	8.5	0.8
	2030 BAU (SDG growth)	328.3	6.6	334.9	35.1	36.7	3.7	40.4	1.4
	2030 SDG (SDG growth)	17.4	0.0	17.4	1.6	18.4	1.8	20.2	0.7
Urban	2006	48.1	11.9	60.0	28.7	6.0	0.6	6.6	1.8
	2015	30.3	12.6	43.0	22.2	2.8	0.3	3.1	0.7
	2030 BAU (BAU growth)	27.0	4.4	31.5	10.6	2.8	0.3	3.1	0.6
	2030 SDG (BAU growth)	63.8	10.2	74.0	21.4	6.6	0.7	7.3	0.5
	2030 BAU (SDG growth)	1.1	0.0	1.1	0.2	1.4	0.1	1.5	0.3
	2030 SDG (SDG growth)	2.6	0.0	2.6	0.4	3.3	0.3	3.6	0.2
Rural	2006	344.6	40.1	384.8	91.4	43.2	4.3	47.5	5.6
	2015	180.6	33.4	214.0	57.2	16.2	1.6	17.8	1.7
	2030 BAU (BAU growth)	114.6	0.0	114.6	10.5	12.9	1.3	14.2	1.1
	2030 SDG (BAU growth)	271.0	0.0	271.0	19.1	30.1	3.0	33.1	0.9
	2030 BAU (SDG growth)	6.0	0.0	6.0	0.6	6.3	0.6	6.9	0.5
	2030 SDG (SDG growth)	14.1	0.0	14.1	1.1	15.1	1.5	16.6	0.5
Kathmandu Valley	2006	22.5	1.2	23.7	11.4	0.9	0.1	1.0	0.4
	2015	16.2	1.6	17.8	8.3	0.5	0.0	0.5	0.2
	2030 BAU (BAU growth)	19.3	0.6	19.9	6.4	0.7	0.1	0.8	0.2
	2030 SDG (BAU growth)	45.7	1.4	47.0	11.8	1.6	0.2	1.8	0.2
	2030 BAU (SDG growth)	0.7	0.0	0.7	0.2	0.3	0.0	0.4	0.1
	2030 SDG (SDG growth)	1.7	0.0	1.7	0.3	0.8	0.1	0.9	0.1

Note: Estimates are in US$ 2014. Lead and occupational hazards costs are not presented in this table for consistency across years. BAU = business as usual; SDG = Sustainable Development Goal.

Annex 4. Options to Address Inadequate WASH, Solid Waste, and Heavy Metal Contamination

1. WASH

The Ministry of Physical Planning and Works issued the National Drinking Water Quality Standards, 2005, and their implementation directives, that detail the specifications for drinking water as well as the sampling, test methods, and responsible entities. The Ministry of Health and Population is the main implementing and monitoring agency for these regulations. Nepal also issued Water Quality Guidelines for the Protection of Aquatic Ecosystem in 2010, but compliance is probably also problematic, although there is little evidence at this stage to ascertain the fact because of a lack of monitoring and enforcement for the reasons cited above.

Recommendations are focused on actions with the potential to reduce water contamination and increase the use of improved water sources, consistent with Nepal's SDG targets.

a) Investments in WASH Infrastructure

Invest in the reforms outlined in the 2016 National Water and Sanitation Strategy: For many decades, the WASH sector lacked a strategic plan, with priorities being set according to annual budgets and the national (five-year) periodic planning process. This changed in 2016, when a comprehensive WASH sector strategy was introduced, representing a commendable attempt to concentrate efforts on key priorities and determine the necessary institutional and financing changes required to meet the government of Nepal's SDG targets (Nepal, MWSS 2016a). This sector strategy has also been met with increased resources—appropriate given the importance of the sector—with an increase of over 40 percent to the WASH budget in the last three years (Nepal, MWSS 2016a). As outlined in the strategy, further resources are required.

Invest in the upkeep of existing water infrastructure, not only in new infrastructure: A large contribution to poor water quality comes from contamination within the piped water system. Achieving complete coverage is estimated to require 15 percent expenditure in new pipes through unbroken ground (that is, investment on the extensive margin), and 85 percent in repairs of existing pipes (investment on the intensive margin). Many water systems are in disrepair. In 2014, an estimated 39 percent of systems were in need of reconstruction or major repair, and a further 36 percent were in need of minor repair (Herrera et al. 2017). In addition, those systems that are most in need are some of the biggest systems (including Kathmandu), and thus the proportion of the population who faces intermittent or insufficient water supply is greater than these statistics suggest. High-priority users are not immune to these problems, with an estimated 50 percent of hospitals receiving contaminated water. Smaller systems, by contrast, highlight the way forward. Many smaller, rural systems are working well.

Ensure that households have safe alternatives to arsenic contaminated groundwater and ensure that contamination problems are widely recognized: Careful selection of appropriate aquifer depth can avoid serious arsenic contamination. Households at risk of arsenic are those that use shallow wells in the Terai. In many cases, these households either lack access to municipal supplies or use their own supply to avoid the water connection tariff (despite tariffs being relatively low at present). For those households that have access to affordable alternatives but choose not to use them, increased awareness of health risks is required. Public health messaging on this issue and on water quality in general (to improve contamination avoidance behavior) is recommended. The 2016 sector strategy recognizes this and calls for increased sector visibility through media campaigns and dissemination of WASH promotional materials at cultural events.

Undertake river basin planning to protect watersheds: River basin planning helps safeguard water sources and reduce treatment and conveyance costs. A system that can strategically guide infrastructure construction and land use away from hydrologically sensitive areas, such as springs or particularly important catchments that serve large populations, does not currently exist. Such planning would require mapping the hydrological features within each basin, and restricting certain land uses, notably forest clearance and grazing, in those zones where catchment integrity is critical (see Box A4.1). Road construction also impacts catchment integrity through landslides and increased siltation in downstream water sources. Improved road construction techniques that minimize soil disturbance should be used where construction in watersheds is critical. The Water and Energy Commission Secretariat, in partnership with the World Bank, is developing river basin plans for all of Nepal's watersheds with support from the South Asia Water Initiative.

b) Institutional Responses to Inadequate WASH

Implement a publicly accessible national WASH monitoring system: A monitoring system can provide spatially explicit (that is, GIS-based) information on water system functioning, in close to real time, to inform local planning processes (for example, maintenance needs), capital investment decisions, and highlight progress toward Nepal's SDG targets. The government has developed a computerized, spatially enabled monitoring and evaluation application for monitoring WASH schemes in rural areas, with the support of the World Bank. This could be extended to improve data collection beyond the rural water sector and cover all aspects of water monitoring. For instance, there is a need for regular monitoring of surface and ground water quality; these data could be incorporated into the monitoring system.

Facilitate effective local governance for water and sanitation improvements: There is a need for both increased budget (especially for maintenance), and a more even distribution of water management expertise at the local level. Capacity building for provincial governments is also needed. In line with the 2016 sector strategy, local Water Supply Management Boards should lead on operations and management decisions, with policy and guidance, technical inputs, implementation support, and monitoring by the federal government. The federal government should set minimum service and performance standards, and direct resources to those municipalities most in need. The operational capacity and legal position of water boards (and the existing Water Users and Sanitation Committees) require strengthening, in line with their increased responsibilities.

Box A4.1. Value of Healthy Landscapes for Water Provision

Healthy forests, grasslands, wetlands, and other natural ecosystems play an important role in the provision of water. Forests increase groundwater recharge and mitigate erosion, helping supply agricultural irrigators, municipal users, and reduce siltation in dams. While forests usually reduce surface water runoff in total, they mitigate pulses of surface runoff. Downstream flows that are more evenly distributed across time are more predictable, accessible, and useful for water managers (Calder et al. 2008).

Intact forests, grasslands, and wetlands also help filter pollutants and pathogens from surface water supplies, leading to fewer nutrients and other pollutants for downstream users. Conversion of intact systems to human uses introduces new activities and settlements with the potential to add contaminants, increasing water treatment costs downstream.

Globally, a 30 percent increase in tree cover in upper reaches of watersheds has been found to reduce childhood diarrheal disease incidence by 4 percent, an improvement equivalent to the health benefits of improved sanitation infrastructure (Herrera et al. 2015).* Maintaining healthy natural landscapes is thus an important public health investment, particularly in countries like Nepal that face deficiencies in built infrastructure.

* Improved sanitation infrastructure, relative to unimproved sanitation infrastructure, as defined by JMP (2017).

Continue decentralizing WASH sector expertise: A related challenge is that the federal government retains most WASH sector expertise. This problem is widely recognized as affecting many sectors throughout the current early stages of implementation of the new constitution. An enhanced system of secondment may help improve knowledge transfer and could also improve career rewards and pathways for those who relocate to municipalities. The government's proposed Civil Service Adjustment Ordinance, which would make promotions and extra pay grades available for decentralizing staff, may assist. In addition, activities of the National WASH Training Center could prioritize strengthening rural management capacity.

Improve the capacity of local administrators to raise (and reinvest) water supply revenues: In the context of increasingly decentralized budgeting, municipalities will need to cover more costs locally. Higher tariffs, providing they remain affordable and within rural households' willingness to pay, may be required. These should remain below the international norm of 2.5 percent for rural and small-scale water systems. However, pricing schemes that place large up-front burdens on rural communities should be avoided. It is reported that, at present, around 5 percent of capital costs for water infrastructure are covered up front by households in rural communities. A further 25 percent are reportedly covered by community loans. Both present a large barrier for investment. Alternative financing arrangements should be sought, which could include subsidized loans or grants from the federal government, supported by increased collection of water tariffs.

2. Heavy Metals and Solid and Hazardous Wastes

The institutional and regulatory framework for hazardous waste management is fragmented and needs upgrading in the context of federalism. The responsibility to manage hazardous wastes is divided between the Department of Health (medical waste), the DOE (industrial waste), and the Department of Agriculture (pest control waste). The regulation on hazardous waste management has been a focus of MOFE's for several years. This regulation requires completion. Nepal is a signatory to the United Nations Basel Convention but has not developed an overarching hazardous waste policy that would allow for implementation of all convention requirements. In line with the regulation and policy, there is a need to develop a separate hazardous waste stream for toxic materials and hospital waste.

Nepal has taken several successful measures to reduce heavy metal and hazardous waste pollution in recent years. These include a ban on most asbestos imports in 2015, and improved testing capacity of consumer goods imports by the Department of Customs. Controls on the import of paints containing lead (of a concentration above 90 ppm) were introduced in 2015, and controls on the import of toys containing lead were introduced in 2017 (although they are now being reconsidered). The following further measures can build on this progress.

Build asbestos disposal protocols and capacity: While the use of asbestos has been curtailed dramatically in Nepal, safe ways to dispose of the current stock at the end of its life need to be developed. While asbestos is not hazardous once installed, it produces carcinogenic dust when disturbed. There is a need for a protocol for the safe disposal, and a need for certification of technicians capable of safely handling asbestos removal.

Develop a system for the proper disposal and recycling of lead-acid batteries: Following action on gasoline and paint, batteries are likely one of the greatest remaining source of lead contamination in Nepal. Lead-acid batteries are used in vehicles, as sources of power during blackouts, and as a component in small-scale renewable power systems, which have grown considerably in number in recent years thanks to promotion and subsidies. Batteries last three to five years, after which an informal industry extracts their recyclable parts. These are sent to India and the remainder disposed. There is release of lead during this process, improper dis-

Box A4.2. Deposit-Refund Systems to Incentivize Hazardous Waste Collection

An option for at least partially reducing hazardous materials contamination is to incentivize their dedicated collection through a deposit-refund system. A deposit-refund system places a small surcharge on a product when it is purchased and refunds the surcharge when the product is returned. They are widely used for recyclable materials and consumer items that require careful post-use processing or disposal. Such schemes are common for lead-acid batteries worldwide.

A program in India's National Capital Region has operated for almost two decades, and effectively motivates consumers to return batteries to retailers, helping prevent inappropriate waste disposal or dumping (Gupt 2012). A similar program may be suitable for Nepal. Over time, this could potentially be extended to other electronic waste that contains heavy metals. The program should be complemented by broader development of procedures for disposal of hazardous waste to ensure the batteries do not end up in conventional waste streams after collection by retailers. Additional incentives or regulation can be used to ensure that retailers, after collecting the batteries from consumers, correctly recycle or dispose of them.

posal through the conventional waste stream, and exposure of workers to lead. In addition, some lead-acid batteries used in rural areas are disposed of in the local environment. Incentive programs could help improve collection and recycling rates (Box A4.2).

While regulations for solid waste management are in place, capacity of local governments, which are mandated by the constitution to provide environmental services, needs to be enhanced: The Solid Waste Management Rules 2013 define the rules applicable from segregation of waste to operation and closure of landfills. These rules implement the principles for solid waste management set forth in the Solid Waste Management Act 2011. White and Masaki (2019) found that weak institutional capacity rather than availability of funding has been the binding constraint to municipalities in delivering services. (See chapter 4 for more discussion on institutional capacity issues.)

Box A4.3. Output-Based Aid for Municipal Solid Waste Management Project

The World Bank has worked with municipalities in Nepal to improve solid waste collection. A results-based financing project of US$4.3 million in 2013–2017 increased user fee collection and improved waste collection services in five municipalities, benefiting 800,000 residents. Financing covered the initial cost of improving services. As services improved, households' willingness to pay and thus revenues also increased, allowing the financing need to decrease over time.

Invest in improved solid waste collection and disposal systems: Improper solid waste management (SWM) contributes to soil contamination with heavy metals and other hazardous pollutants, water pollution from leaching of landfill sites and litter, and air pollution from garbage burning. Improved SWM collection would reduce in-street burning, which currently is a substantial contributor to air pollution (estimated around 4–6 percent for the Kathmandu Valley). A good precedent for improving collection services in Nepal is the 2013 Output-Based Aid for Municipal Solid Waste Management Project, undertaken in partnership with the World Bank (Box A4.3). Additionally, improved landfill sites would prevent soil and water contamination that increases water treatment costs downstream.

Design and refine mechanisms for applying and financing SWM in mountainous areas: There is a particular need to address SWM issues in mountainous areas, where the cost of waste removal and recycling are higher, and the impacts on local ecology, downstream communities, and the tourism economy are high. Mechanisms include tourism fees that direct revenues toward SWM, and "carry out" policies for sensitive natural areas. Education of tourists (and guides) through sustainable tourism guidelines can also help green the tourism sector in mountainous areas.

Annex 5. Guidelines and Handbooks on Environmental and Social Risk Management Related to Roads

Table A5.1. Guidelines and Handbooks on Environmental and Social Risk Management Developed and Published by GESU, DOR

Document title	Year	Description
Environmental Management Guidelines	1997	These guidelines were developed under the World Bank–funded Road Maintenance and Rehabilitation Project and approved at the ministry level. Intended for use by the DOR regional offices, divisions, and project managers. The guidelines provide common environmental mitigation measures in road construction and design, procedures for public participation and coordination with other agencies, and social considerations in project planning, design and implementation. The guidelines also provide for the integration of the EIA process and requirements into the project cycle.
Environmental Guidelines for Roads and Bridges	1999	These guidelines ensure that environmental considerations are integrated into the project survey and design, tender document, contract document, and project supervision and monitoring. The guidelines intend to minimize environmental impacts resulting from road and bridge construction, operation, maintenance, and rehabilitation. The guidelines intend to improve road performance and reliability, increase benefits to local residents, and maximize cost-effectiveness.
Roadside Bio-Engineering Reference Manual	1999	This reference manual on roadside bioengineering works gives comprehensive information on the use of vegetation in engineering. In addition to covering the principles underlying techniques of slope stabilization, the manual outlines relevant aspects of the ecology, geology, geography, and law of Nepal. The manual provides standard specifications for bioengineering works, profiles of the main bioengineering species, and rate analysis norms of bioengineering approved by the government. It also provides the information needed to design, plan, implement, and maintain roadside bioengineering works and is intended for use in the site.
Public Road Maintenance and Land Acquisition Directives	2002	This directive specifies two categories of affected families, "project-affected family" (PAF) and "seriously project-affected family" (SPAF). A PAF consists of the members of a household, including elderly dependents and minor children (under 18 years), residing under one roof and operating as a single economic unit, who are adversely affected by the project. SPAF is defined as a family who loses over 25% of its total land holdings or whose land is reduced to an uneconomic holding (less than 5 katha) or who is being displaced. Under this directive, the concerned officials, with the assistance of the project team, are to carry out assessments of PAFs to identify their standard of living and types of assets. Valuation of land and asset lost are to be based on comparative market values of similar assets in the vicinity. The directive also includes arrangements for rehabilitation of PAFs. For PAFs, the compensation package includes cash for assets acquired or damaged by the project and a rehabilitation grant (assistance allowance) to cover any suffering and hardship. For SPAFs, the compensation additionally includes employment for one family member and provision of skill training.
Manual for Environmental and Social Aspects of Integrated Road Development	2003	This manual is designed to help integrate social and environmental considerations, including public involvement strategies, with technical road construction practices. It suggests a stepwise process of addressing environmental and social issues alongside the technical, financial, and others. The manual is suggestive, and not exhaustive; it advises and recommends various environmental and social approaches, actions, and strategies to assist developers in following mandatory requirements of the law and improving public involvement. The manual is based on the experiences of Nepal and incorporates national (EPA 1996; EPR 1997/1999) and international "best practices." It suggests an environmental and social assessment process, the roles and responsibilities of stakeholders at various stages of the project, advice on impact mitigation action plans, and a process for involving the public.

Document title	Year	Description
Environmental and Social Management Framework (ESMF)	2007	This ESMF report provides technical and managerial inputs and guidance into the design of the strategic roads (both designated for rehabilitation and, to a lesser extent, to new construction), through identification of key environmental and social issues, mitigation of potential impacts and concerns, and enhancing the benefits. The framework integrates in a stepwise approach the most important environmental and social considerations into all stages of project preparation, implementation, monitoring, and operation and is applicable to all future projects.
Roadside Geotechnical Problems: A Practical Guide to Their Solution	2007	This document is part of the outputs of the Institutional Strengthening Component of the Road Maintenance and Development Project for strengthening of GESU. The guide aimed to bring uniformity in the assessment, investigation, design, and implementation of geotechnical solutions in Nepal, which had up to then depended standards and codes used by specialist from other countries. In addition, the DOR purchased two comprehensive software packages—SLIDE for soil slop stability analysis and SWEDGE for rock slope stability—to support the application of these guidelines.
ESMF: A Guide to Environmental and Social Issues Associated With New Road and Bridges Construction and Upgrading/ Maintenance	2013	The update to the ESMF was made as part of the recommendations of the World Bank Environmental and Social System Analysis (ESSA) to include the Bridge Program. GESU prepared the addendum to the ESMF; it was approved on 2069/12/5 (March 18, 2013) and the DOR decided on 2069/12/27 (April 19, 2013) to circulate the addendum to all the stakeholders for effective implementation along with the main ESMF document. The ESSA also included recommendations to strengthen GESU in terms of human and financial resources.

Note: Some of these titles were published by GESU's predecessor, the Geo-Environment Unit (GEU), which was established in 1994.

Annex 6. Consultations

The ESD benefited from stakeholder inputs and comments at the following consultation meetings:

- Discussion on major environmental pollutants and cost of degradation in the context of the World Bank's Environment Sector Diagnostic for Nepal, Kathmandu, April 3, 2019
- Discussion on greening road development, Kathmandu, April 12, 2019
- Technical discussion on sustainable forest management, Godawari, April 2, 2019
- Discussion on sustainable forest management, MOFE, Singha Durbar, April 4, 2019
- Discussion on interim ESD findings, MOFE, Singha Durbar, May 5, 2019

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