Chapter 2
Introduction

U.S. Department of Agriculture, Forest Service. 2023. Introduction. In: U.S. Department of Agriculture, Forest Service. 2023. Future of America's Forest and Rangelands: Forest Service 2020 Resources Planning Act Assessment. Gen. Tech. Rep. WO-102. Washington, DC: 2-1–2-7. Chapter 2. https://doi.org/10.2737/WO-GTR-102-Chap2.

The 2020 Resources Planning Act (RPA) Assessment is the sixth report prepared in response to the mandate in the 1974 Forest and Rangeland Renewable Resources Planning Act (P.L. 93-378, 88 Stat 475, as amended), which requires the Secretary of Agriculture to assess the Nation's renewable resources every 10 years. The RPA Assessment is intended to provide reliable information on the status, trends, and projected future of the Nation's renewable natural resources on all forests and rangelands on a 10-year cycle. While not required by the authorizing legislation, the U.S. Department of Agriculture, Forest Service also prepares mid-cycle updates to decadal RPA Assessments. The 2020 RPA Assessment focuses on past, current, and projected future availability and condition of forests, forest product markets, rangelands, water, biodiversity, and outdoor recreation, as well as the effects of socioeconomic and climatic change upon these resources.

The RPA legislation recognizes the importance of our forests and rangelands in contributing to the American public's well-being and quality of life. The American public continues to depend on our forests and rangelands to provide a variety of ecosystem services. Maintaining productive forests and rangelands requires continual monitoring and analysis of the effects of changing social expectations and a changing climate on these resources. The RPA Assessment improves our understanding of the multiple and interacting factors that we expect to affect renewable natural resources in the future. This focus is a unique contribution that provides important information to policymakers and resource managers as they develop strategies for sustaining the Nation's renewable natural resources. This chapter provides an overview of the 2020 RPA Assessment, describing the scope of RPA analysis, the document organization, and the framing context for the Assessment.

Scope of the Analysis

The RPA Assessment reports on a body of targeted research funded by the USDA Forest Service to address the RPA legislative mandate, providing both historical trends and projecting plausible futures of forest and rangeland resources. Based on an understanding of the historical trends, our research focuses on analyzing the influences of multiple drivers of change on renewable natural resources 50 years into the future, with the goal of informing and enabling planning to prevent future resource degradation and shortage. The analyses in the RPA Assessment respond to the mandated national all-lands focus and include renewable natural resources and related economic sectors for which the USDA Forest Service has management responsibilities: forests, forest products, rangelands, water, biodiversity, and outdoor recreation. We examine potential direct and indirect effects of socioeconomic and climatic change on future resource trends by incorporating demographic, economic, and climatic variables into our models. We continue to target our research to improve understanding of the multiple and interacting factors that we expect to affect renewable natural resources through a coherent and integrated view of the future.

We capitalize on areas where the USDA Forest Service has research capacity. The RPA Assessment draws upon the expertise of other Federal agencies that have responsibilities for national analyses by using their data and incorporating their reports by reference. For example, we rely on information from the U.S. Environmental Protection Agency about water quality. Likewise, we do not analyze renewable energy, with the exception of wood-based bioenergy, because the U.S. Department of Energy conducts comprehensive analyses of the energy sector. We also draw upon the work of our research and technology partners in the university sector, who are acknowledged and heavily cited throughout the Assessment.

Our analyses typically have a national focus, which requires either nationally consistent data or data that can be consistently compiled to the national level. The national focus often creates data constraints that limit analyses in some resource areas and often restrict analyses to the conterminous United States. For some resource areas, analyses are conducted at a subnational geographic extent to reflect the geographic extent of the resource. For example, our rangeland analyses focus on the Western United States, where most rangeland is found. The results of the analyses throughout the subsequent chapters often will be presented for both the entire United States and for the four RPA Assessment regions (figure 2-1). Other regional definitions are used for specific resource analyses and are described in the resource chapters.

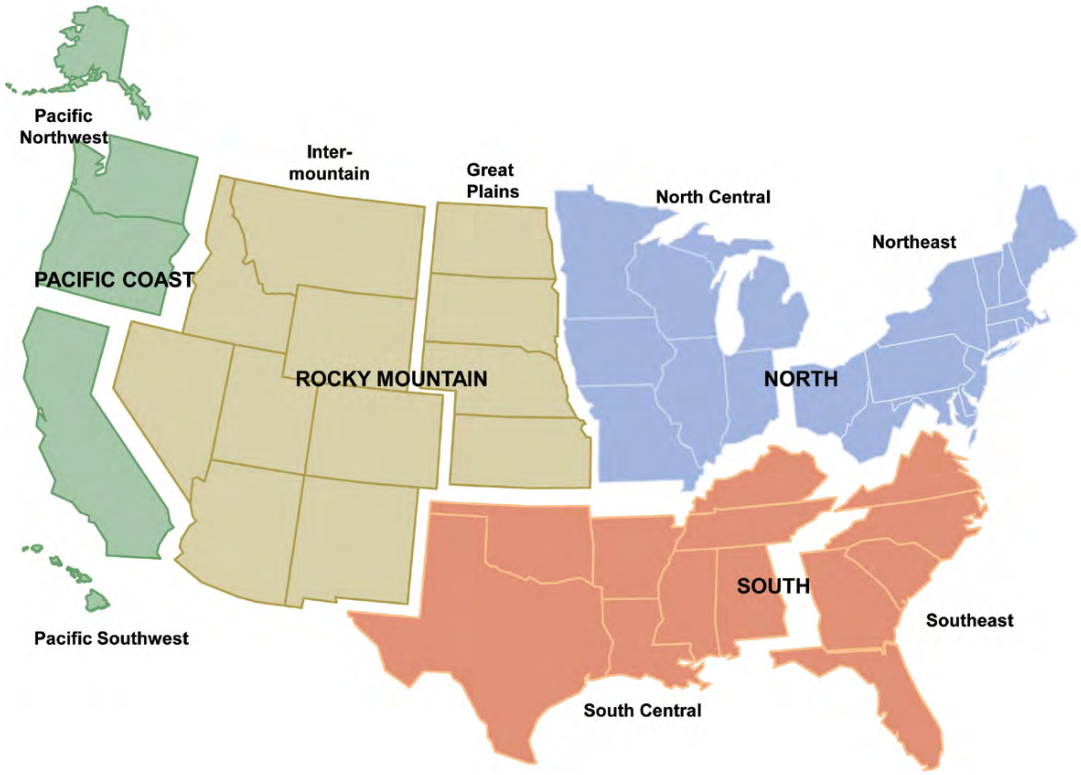
While the RPA Assessment focuses primarily on national analyses, the data supporting these analyses are available at varying spatial resolutions, and, therefore, the geographic scale of our results also varies. As a result, terminology about the "scale" of the analyses can be confusing, especially because scale is defined differently across disciplines. In the absence of a universal definition, we have tried to clearly define the context for scale in these analyses by specifying when we are referring to extent, resolution, or some other characteristic of scale.

The selection of English versus metric units in reporting RPA results continues to be challenging. While scientific outlets are primarily in metric units, English units are still commonly used in U.S. discussions and analyses. As a result, we have taken a hybrid approach in this Assessment to follow standard conventions. Metric units are used in many chapters because metric has become the predominant unit in both technical and policy discussions (i.e., Disturbance, Forest Products, Rangeland Resources, Biodiversity), while other chapters provide English units because of common usage in the United States (i.e., Land Resources, Outdoor Recreation). Both sets of units are used in the Forest Resources and Water Resources Chapters: English units are used for forest area and volume reporting and water use due to common usage among U.S. audiences, while metric units are used for carbon accounting and water yield to maintain consistency with the scientific community and international reporting. We have provided results in both English and metric units in the Conclusions section of each chapter to meet the needs of all audiences.

Document Organization

Preceding this introduction, the 2020 RPA Assessment key findings are presented by individual resource topic (the Key Findings of the 2020 RPA Assessment Chapter). Following this introduction, we describe the future scenarios used as

Figure 2-1. RPA Assessment regions and subregions.



the basis for the 2020 RPA Assessment projections (the Scenarios Chapter). The remaining chapters present results by resource area or resource sector and include both chapter and section key findings.

The information presented in these chapters begins with historical information that is tracked across RPA Assessment reporting cycles. Changes in historical trends are of particular interest because future projections are influenced by historical trends. Future resource conditions, demand, and supply are projected for 50 years (2020 to 2070 in this RPA Assessment cycle) for those resources for which sufficient data were available. The RPA analyses typically assume that policies affecting resource conditions remain consistent over the projection period. This assumption is more challenging in the scenario framework used for the 2020 RPA Assessment, especially given international efforts to address climate change effects. As described in the Scenarios Chapter, jointly achieving climate and socioeconomic futures may require policy or technology changes, although the means may vary widely across local, national, and global scales. Individual resource analyses will address whether significant changes in socioeconomic and climatic drivers are likely to shift resource trajectories.

This document summarizes the results of analyses that are documented in more detail in a series of technical supporting documents referenced throughout the chapters that follow. These supporting documents provide more details on data, methods, and results. RPA Assessment supporting technical documents are available on the USDA Forest Service's RPA Assessment web page as they become available: https://www.fs.usda.gov/research/inventory/rpaa.

Framing Context

Population, income, and climatic factors are all key drivers of resource demands that affect the future status of forests and rangelands—increasing population and per capita income have been shown to increase demand for goods and services, as have changing climatic factors including increasing temperatures. Changes in climate can also affect the future condition and supply of resources, with profound and highly variable impacts on forest and rangeland resources. Not only is the effect of climate change on temperature and precipitation projected to be variable across the United States, but individual resources are projected to respond differently to changes in climate. The changing climate will likely benefit some ecosystems, species, and associated goods and services at the expense of others.

It is therefore important to compare the plausible future condition and availability of forest and rangelands resources under the changing climate with plausible future demand to identify potential future shortages of important forest and rangeland resources. Following the precedent established in the 2010 RPA Assessment, the current Assessment uses a scenario approach to project resource futures based on the anticipated effects of changes in population and income (available at the county scale) and climate (available at a 4-km^2 scale) on forests and rangelands. We construct a range of scenarios by combining assumptions about our key drivers (see the Scenarios Chapter) and provide guidance on their application (see the Scenarios Chapter, the sidebar Using Scenarios and Projections in Resource Management Planning). For context, the following provides a brief overview of recent global and national population, economic, and climatic trends, as well as global trends in forest and rangeland area—national trends in forest and rangeland area are covered in depth in the Land Resources, Forest Resources, and Rangeland Resources Chapters.

Population Growth

Global population grew from 6.9 billion in 2010 to 7.7 billion in 2019 and is projected to reach approximately 10.5 billion by 2070 (United Nations 2019a). The percentage of the global population living in urban areas was 55 percent in 2018, up from 30 percent in 1950 (United Nations 2019b). Estimates and projections of global urbanization indicate that the growing number of city dwellers may account for almost the entire future growth of the human population. The United Nations projects that 68 percent of the world's population will be living in urban areas by 2050 (United Nations 2019b).

Unlike many high-income (per capita) countries where population is declining, the U.S. population continues to increase. The 2020 Census indicated that the U.S. population increased 6.3 percent between 2010 and 2020 (slower than the almost 10-percent increase between 2000 and 2010), exceeding 328 million in 2019. Although the U.S. population continues to grow, it did so at the slowest rate since the 1930s; the U.S. annual rate of population growth dropped from 0.73 percent in 2011 to 0.50 percent in 2020 (USCB 2021a), rates consistent with low net-immigration (USCB 2021b). Regional population growth was faster in the South and West than in the Midwest and Northeast. Overall, the South and West accounted for more than 80 percent of the U.S. population increase. The States with the highest numeric increases were, in descending order, Texas, Florida, California, Georgia, Washington, and North Carolina. These six States accounted for approximately half of the overall increase in the last decade.

Eighty-six percent of the U.S. population in 2020 lived in a metropolitan statistical area, and population in these areas grew at a faster rate (9 percent) than the overall U.S. rate (USCB 2021c). The 2020 Census data on urban areas were not yet available; however, the growth in population in metropolitan statistical areas will likely be mirrored by growth in urban areas.

Although the South and West had the largest increases in population, the U.S. population is still concentrated on the two coasts. And while only three States—Illinois, Mississippi, and West Virginia—lost population in the last decade, depopulation occurred in more than half of U.S. counties, continuing decades of population loss in areas such as Appalachian counties in eastern Kentucky and West Virginia, many Great Plains counties, and a group of counties around the Mississippi Delta. Many counties along the Great Lakes and the Northern U.S. border either lost population or grew at very low rates (USCB 2021c).

Economic Outlook

The global economy has gone through considerable change during the last several decades. The 1970s saw oil price shocks; the 1980s were a time of general deflation of commodity prices; the 1990s saw many high-income (per capita) countries, including the United States, shifting from industrial to service sectors; and the 2000s included a global recession that had major effects on the global and U.S. economy, especially in the real estate and housing construction sectors. The decade of 2010 to 2020 saw gradual economic growth from the nadir of the 2007 to 2009 recession, with increasing global sovereign debt and consistently low inflation, as well as rising income inequality within most high-income countries occurring alongside decreasing inequality between countries (United Nations 2020; World Bank 2016).

Global gross domestic product (GDP) increased 24 percent between 2010 and 2020, from $66.2 to $81.9 trillion (constant 2010 USD) (World Bank 2021). The rate of GDP growth in high-income countries was outpaced by the rate observed in emerging markets, led by but not limited to China. Global commodity trade held steady as a share of global GDP until the end of the decade, when several countries enacted higher tariffs, withdrew from existing and proposed new trade agreements, and otherwise took steps to limit cross-border flows of selected commodities. The arrival of COVID-19 at the end of the first quarter of 2020 in the United States and many other nations brought about a sharp contraction of the global economy. While this contraction was worse than the 2007 to 2009 financial crisis, growth returned more quickly due to fiscal support in a few large economies and the development and distribution of vaccines (International Monetary Fund 2021). Central bank actions to fight inflation in the United States and other economies, geopolitical uncertainty, and continued supply-chain disruptions make it difficult to project the future global economic trajectory.

The U.S. economy in the 2010s, growing out of the recession that began at the end of 2007, experienced the first recession-free decade since record-keeping began in the 1850s and ended the decade with historic lows in unemployment. Wage growth was slow for most of the decade, leading to a rise in wealth inequality as the stock market continued to rise. The arrival of COVID-19 in 2020 brought about the sharpest economic shock to the U.S. economy since the Great Depression. The recession was the shortest on record, at 2 months, and U.S. real GDP exceeded its pre-COVID level by the second quarter of 2021 (USDC Bureau of Economic Analysis 2021). Unemployment, which peaked at almost 15 percent in April 2020, proceeded to steadily fall, reaching pre-COVID-19 levels again in April 2022 (USBLS 2022). The arrival of COVID-19 variants, ongoing product supply chain disruptions, and the need for global vaccine deployment to bring an end to the pandemic produce, at the timing of this writing, an uncertain short-run future for the United States and the world.

Climate

Globally, each decade since 1980 has been successively warmer than the preceding decade, with the most recent decade (2010s) being around 0.36 degrees Fahrenheit (0.2 degrees Celsius) warmer than the previous decade (2000s) (Blunden and Arndt 2020). The 2010s was the warmest decade on record for the planet, with a surface global temperature of +1.48 °F (0.82 °C) above the 20th-century average. The combined land and ocean temperature has increased at an average rate of 0.13 °F (0.08 °C) per decade since 1880; however, the average rate of increase since 1981 has been more than twice that rate (0.32 °F / 0.18 °C) (NOAA 2021a). The 10 warmest years in the 1880 to 2020 record have all occurred since 2005, with 7 of the warmest years occurring since 2014. In addition, hot extreme events such as heatwaves have increased in frequency and intensity over most land area since the 1950s. Although warming has not been uniform across the planet, the upward trend in the globally averaged temperature shows that more areas are warming than cooling. Global impacts of this warming include shrinking arctic summer sea ice, thawing permafrost, increasing sea level rise, and the alteration of geographical ranges and lifecycles of many plant and animal species. Total annual precipitation over land areas worldwide has increased at an average rate of 0.1 inches per decade since 1901 (Blunden and Arndt 2020) and heavy precipitation events have become more frequent and intensified over the global land area where data are available (IPCC 2021); however, because higher temperatures lead to more evaporation, increased water stress on plants, and higher water use by people, increased precipitation will often not increase the amount of available water, especially at critical times (Blunden and Arndt 2020). As with warming trends, precipitation trends have also not been uniform across the planet. For example, agricultural and ecological drought in western North America has increased since the 1950s (IPCC 2021).

Based on a 126-year record, the average annual temperature for the conterminous United States is increasing at an average rate of 0.16 °F (0.09 °C) per decade—the increase rises to an average rate of 0.48 °F (0.27 °C) per decade when examining temperatures since 1970 (Blunden and Boyer 2020). The average annual temperature for Alaska has increased at a higher average rate of 0.31 °F (0.17 °C) per decade over the 96-year record—with the increase rising to an average rate of 0.90 °F (0.50 °C) per decade since 1970. Nine of North America's 10 warmest years have occurred since 2001, with the year 2016 being warmest year on record with a temperature departure of +3.46 °F (1.92 °C). For the conterminous United States, 2021 ranked as the fourth-warmest year in average annual temperature in the 127-year record, with the six warmest years having all occurred since 2012 (NOAA 2022). Maine and New Hampshire had their second-warmest year on record in 2021 (NOAA 2022), while 10 States across the Southwest, Southeast, and East Coast had their second-warmest year on record in 2020. No areas observed below-average annual temperatures (NOAA 2021b). Annual average precipitation has increased by 4 percent across the United States since 1901, with strong regional differences, including increases over the Northeast, Midwest, and Great Plains and decreases over parts of the Southwest and Southeast (Easterling et al. 2017). Alaska shows little change in annual precipitation (+1.5 percent), while Hawaii shows a decline in annual precipitation of more than 15 percent (Easterling et al. 2017). In any given year between 1895 and 2010, around 14 percent of the Nation experienced moderate to severe drought, on average (Hayes et al. 2012). The three longest drought episodes in the United States occurred in the 1930s, the 1950s, and the early 21st century. The most recent drought, during the early 21st century, started in individual regions across the conterminous United States. By September 2012, two-thirds of the conterminous United States was in drought, with the drought not breaking until 2014 (Heim 2017). Across most of the country, heavy precipitation extreme events have increased in both intensity and frequency since 1901, with the largest increases occurring in the Northeast (Easterling et al. 2017).

Forests and Rangelands

The Food and Agriculture Organization (FAO) estimates global forest area to be about 10 billion acres, covering 31 percent of the total global land area (FAO 2020). The FAO forest area estimate is primarily related to land use, meaning that an area without trees may be considered forest, while agricultural and urban areas with tree cover may be considered as land uses other than forest. The five most forest-rich countries, in descending order, are the Russian Federation, Brazil, Canada, the United States, and China. These countries account for more than half (54 percent) of the total global forest area. U.S. forest land accounts for 7.6 percent of the world's forest area.

The rate of global deforestation remains substantial but continues to show signs of decreasing, from 12.8 million acres of forest lost per year during the 2000s to 11.6 million acres per year during the 2010s. The largest net losses occurred in Africa, where the rate of loss increased from the previous decade, followed by South America, where the rate of loss in the 2010s declined by 50 percent. Deforestation results in the loss of ecosystem services provided by forests, including the provision of food, fuel, and fiber; carbon storage; flood and erosion control; and opportunities for recreation and cultural enrichment. Large-scale planting of trees is significantly reducing the net loss of forest area globally, through a combination of afforestation and natural expansion of forest. Asia had the highest net gain of forest area from 2010 to 2020, although the rate of gain declined from the previous decade. The area of planted forest continues to increase, albeit at a decreasing rate, accounting for 7 percent of total global forest area (FAO 2020).

Rangelands—defined in the *Rangelands Atlas* as land on which the vegetation is predominantly grasses, grass-like plants, and forbs or shrubs that are grazed or have the potential to be grazed by livestock and wildlife—cover 54 percent of the world's land surface (ILRI 2021). Rangelands are found in every region of the world and provide a variety of services including providing wildlife habitat, storing carbon, and supporting large rivers and wetlands. Rangelands around the world are currently experiencing threats from both development and climate change (ILRI 2021).

The United Nations has projected that 70 percent more food needs to be grown by 2050 to support the growing world population (FAO 2011). This growing demand will continue to put pressure on forest and rangelands, both domestically and globally.

Uncertainty and the Case for Scenarios

In the chapters that follow, we describe historical trends in resource conditions and use. As we look to the future, uncertainties in demography, economics, and climate—and the potentially wide-ranging effects on natural resources—underpin the need to project alternative plausible futures using a scenario-based structure. Here, we review the sources of these uncertainties and outline the justification for our use of scenarios in projecting the future availability and condition of the Nation's renewable resources.

Before the 2010 RPA Assessment, the United States and the world had been experiencing growing trade liberalization as a result of repeated rounds of General Agreement on Tariffs and Trade/World Trade Organization agreements. The United States and the world then experienced two global recessions: 2007 to 2009 and 2020. Growing trade frictions among the world's largest trading nations and blocs occurred in the 2010s, and collections of countries had incomplete

success establishing inclusive plurilateral agreements such as the Trans-Pacific Partnership. World investors altered their behavior in the last decade, reducing foreign direct investment, with implications for trade and manufacturing. In contrast, the United States experienced increased foreign investment in the wood products sector over the past decade, notably in the U.S. South, for the production of lumber and wood pellets for energy.

Layered over the uncertain national and global environments and declining trade growth over the past 10 years are the increasing effects of climate change. The 2016 Paris Agreement—a legally binding international treaty that sets out a framework to avoid global climate change, including the role of forests—affects how policymakers and other decisionmakers see and manage forests (United Nations Framework Convention on Climate Change 2015). In discussions and negotiations following the 2016 Paris Agreement, forest-sector actors are considering how forests can mitigate climate change through both active management and the use of wood to produce energy and substitutes for more carbon-intensive building materials, as well as how forests are directly affected by climate-change processes. In the latter category, forests are increasingly threatened by altered rates and intensities of catastrophic disturbances. These deleterious effects of climate change carry with them possible impacts on the provision of many ecosystem goods and services (including water quality and quantity, recreation opportunities, wildlife habitat provision), the costs of managing forest-based insect and disease epidemics, and the challenges of maintaining and growing healthy urban forests. Climate change may also be contributing to accelerated net growth of timber, which can benefit timber growers and wood product manufacturers, potentially improve the relative comparative advantage of the U.S. forest products sector and raise the attractiveness of forests as a land use.

Given the recent variability in economic and climatic variables and the uncertainties surrounding their future development, we use a set of scenarios to project alternative plausible futures (see the Scenarios Chapter); those futures are strongly influenced by population and economic assumptions, along with projections of future climate change. Scenarios are not assigned likelihoods, nor are any scenarios intended to be "accurate" per se. Rather, these constructed scenarios provide a means of qualitatively and quantitatively understanding how a range of socioeconomic and climate conditions interact through time to create different natural resource futures. Global and, in most scenarios, U.S. populations are projected to continue increasing in the future. The outlook for economic growth is more uncertain, particularly in the short term, but the longer term growth trend is expected to be positive, although generally slower than in recent decades. Inequality—which has been linked to rapid technological change, urbanization and migration, and climate change—can either rise with these trends or fall if they are harnessed to foster a more sustainable world (United Nations 2020). The RPA Assessment outlook for U.S. resources is based on scenarios with varying assumptions about global economic growth, global wood energy consumption, forest products trade, domestic population and economic growth, and global climate change. Our analyses indicate the importance of these factors in assessing the alternative resource futures and likely challenges for future renewable resource management. Managers and policymakers can therefore apply our findings to evaluate potential ways of reducing the likelihood of unwanted futures and increasing the chances for desired futures.

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