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Toward Globalization of the Forest Products Industry

Some Trends

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Toward Globalization of the Forest Products Industry: Some Trends

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Abstract

This paper examines the hypothesis that changes have been brought about in the forest industry that allow it to participate fully in globalization. The forest industry has undergone profound changes in recent years in large part by new technologies. Whereas traditionally it was primarily an extractive industry that relied on local sources for its basic resource—raw, industrial wood—today, intensively managed planted forests are replacing natural forests as the basic source of the wood resource, and modern biotechnology is being applied to create trees that both grow rapidly and have traits desired in industrial wood. These changes eliminate the traditional ties between forest processing and locations with abundant natural forests.

Today, globalization allows investments, capital flows, and emerging technologies to move easily into regions where they are expected to be particularly productive. It also provides for the ready utilization of the human resources of foreign countries. Thus, offshore outsourcing is closely associated with globalization. The easy flow of productive factors results in the production of goods and services based on a mix of in-country and external contributions to production. In forestry, this process takes on an additional dimension in which the basic resource itself, the forest, can be relocated to capitalize on the cost advantages of particular regions. Additional changes have been driven by modern biotechnology, which has dramatically increased the variety of areas where productive forests can be grown, as well as overall forest productivity.

We find that there is substantial evidence in this country-level forestry data to support our hypotheses of how globalization has begun to reshape the forest products industry. However, the evidence suggests that the changes have been more prominent in the pulp industry than in the structural wood sector.

Key Words: forests, globalization, forest products, international, comparative advantage, technology

JEL Classification Numbers: F00, F2, L73, O30, Q23

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Introduction

Like many other industries, the forest industry has undergone profound changes in recent years. Traditionally, it was primarily an extractive industry that relied on local sources for its basic resource: raw, industrial wood. Wood typically was logged from natural forests, giving forest-rich regions a comparative advantage in wood production. When forest production was exclusively dependent on harvesting natural timber stands—and given that wood is a low-value, high-volume resource that requires substantial transportation costs—initial processing, including the production of pulp, lumber, and panels, usually was undertaken close to the forest resource and the processed products transported to the regions of demand. This model of forest production, however, has become somewhat obsolete. Today, the forest industry is experiencing seismic changes. Intensively managed, planted forests are replacing natural forests as the basic source of the wood resource, and modern biotechnology is being applied to create trees that both grow rapidly and have traits desired in industrial wood. These changes eliminate the traditional ties between forest processing and locations with abundant natural forests. This is evidenced by the dramatic shifts in forestland ownership and production locations experienced in the past decade. U.S. forest corporations have divested themselves of almost 50 percent of their forestland holdings in the past 25 years—half of that in the past decade—even as they are purchasing forestland offshore. At the same time, the industry is planting almost one million acres of trees annually in the United States, with another one million acres being planted by non-industrial forest ownerships, often on sites that were not forested recently.

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This paper examines the hypothesis that these changes have been brought about in large part by new technologies, which in turn allow the forest industry to participate fully in globalization. Globalization allows investments, capital flows, and emerging technologies to move easily into regions where they are expected to be particularly productive. It also provides for the ready utilization of the human resources of foreign countries. Thus, offshore outsourcing is closely associated with globalization. The easy flow of productive factors results in the production of goods and services based on a mix of in-country and external contributions to production. In forestry, this process takes on an additional dimension in which the basic resource itself, the forest, can be relocated to capitalize on the cost advantages of particular regions. Additional changes have been driven by modern biotechnology, which has dramatically increased the variety of areas where productive forests can be grown and overall forest productivity (Sedjo 1999; Sedjo 2005).

Background

Fifty years ago, almost all industrial wood was harvested from natural forests. Today, about one-third of industrial wood comes from plantation forests, and it is estimated that this percentage will grow to about 75 percent by 2050 (Sohngen et al. 2003). While many of these planted forests simply replaced the natural forests that had been harvested, others involved the establishment of new forests in new locations.

Initially, the transition from a regional resource-processing model to a more diverse production pattern was facilitated by the availability of low-cost transportation, which allowed for the substantial transport of raw wood from resource-rich regions to resource-poor regions. The quintessential example is the flow of logs and wood chips from North America to Japan from the late 1960s to the early 1990s. During this period, the raw material was in many cases transported to the final market, where processing took place. However, this was limited in scope and resulted from the unique combination of low-cost offshore wood for the Japanese, specifications unique to Japan that required unique milling dimensions, and the low cost of labor in early post-World War II Japan, which made the country suitable for the labor-intensive nature of the specializing milling. In this case, the capital and labor associated with logging and local transport was North American, while the intermediate and final processing was undertaken with Japanese capital and labor.

However, globalization has allowed not only for the relocation of processing facilities but subsequently for the relocation of the forest itself (Sedjo 1981; Bowyer 2004). Innovations in tree growing have rendered reliance on existing natural forests increasingly unnecessary. This change is the outgrowth of a growing concern about the adequacy of future

sources of timber supplies from natural forests, especially in light of the forest protection set-asides that are occurring due to environmental concerns. A second factor was the "discovery" that intensive forest management on chosen sites could substantially increase biological growth rates, while planted forestry was economically profitable under the appropriate set of conditions. Additionally, it was discovered that certain trees grew much more rapidly as exotics in foreign environments than in their natural conditions. Thus, a broader array of tree species could be considered. Finally, in the context of large-scale tree planting, the application of tree breeding and modern biotechnology to forestry increased tree growth and yields even further.

In essence, there has been a shift in comparative advantage from regions that are abundant in forest resources, which have typically been temperate, generally industrialized regions, to regions that have an abundance of the cheaper factors of production (labor, land, and capital) and more favorable growing conditions for planned forest plantations. These typically are tropical, generally developing regions. Thus, just as globalization has been associated with off-shoring production from developed regions to developing regions endowed with cheaper factors of production, forestry has seen a similar shift in comparative advantage from temperate developed countries to tropical developing countries.

These factors led to the realization that forests and forest management could be customized to a site. However, a certain set of conditions needed to be present for forest productivity to increase dramatically. For example, forests need to be established in locations that are favorable from both a biological and an economic perspective. These locations need not have been forested previously, although many have been. Some of these locations favor exotics over indigenous tree species. New and foreign locations are often set up on low-cost sites—many of which previously were agricultural lands in marginal use or grassland areas—that can generate high-yield forestry. With the decline of agriculture on some sites (for example, the cotton and tobacco fields of the U.S. South in the post-World War II period), lands became open to forestry. Until the late 1970s, the center of American timber production was the old-growth forests of the Pacific Northwest. During the 1980s, the center of U.S. industrial wood production shifted to the South. This was due in part to changes in the use of timber from the National Forest System but more importantly due to the substantial reforestation that had taken place in the South through natural regeneration of abandoned agricultural lands and subsequently through intensive planting efforts that began in earnest the 1960s and accelerated in the 1980s. More recently, planted forestry has succeeded in a variety of offshore settings. These include abandoned pastures in New Zealand and Australia;

marginal croplands in Brazil, Chile, and other parts of South America; grasslands in parts of South Africa and Argentina; and lands in China and Indonesia.

Associated with the advent of plantation forestry have been changes in employment levels and patterns. According to the past model of regional resource processing, labor utilized in the logging and processing of wood typically was drawn from local populations. Regions with limited supplies of raw, industrial wood usually found it necessary to import wood products—most commonly in the form of processed or semi-processed intermediate products such as paper or lumber—that would then be utilized locally to produce the final goods desired by that society. Thus, the location of the natural forest to a large extent determined the location of the processing and the associated employment. However, the forest products industry is moving from a foraging operation, which uses the bounty of natural forests, to a cropping mode, which involves planting, tending, and harvesting. One implication is that a wholesale restructuring of processing and employment is likely.

Additionally, with the emergence of planted forests has come tree improvement. As with any crop, there is incentive to plant an improved tree. Forestry first approached this task through the collection of superior trees and programs of tree improvement through traditional breeding approaches. As part of this process, forestry research has moved into the broad area of biotechnology, including tissue culture, genetic marking, and genetic transformation (Strauss and Bradshaw 2004). New employment will be generated in sophisticated plant-breeding and tree nursery activities, as well as in direct planting, intensive management, harvesting, and subsequent wood processing.

Over the past decade, the process of globalization has dramatically changed the forest products industry itself. In the United States, the industry has been divesting its ownership of forestlands. In the past 25 years, industry lands have been reduced by 50 percent, with nearly half of that decline in the past decade. Simultaneously, the industry has increased its ownership of offshore forestlands (Wilent 2004). These changes also are reflected in the trade balance. During the 1990s, the U.S. forest products trade balance deteriorated markedly from modest surpluses in the early 1990s to substantial deficits by the late 1990s (NRSF 2004).

Such changes also are consistent with the notion of industry globalization. Indeed, in recent years, the distinction between domestic and foreign firms has blurred as both groups have acquired forest holdings and processing operations outside their original countries and regions. This trend is not unique to the United States, as Lonnstedt (2004) has found the same trend among Nordic forest products companies. This shift is consistent with the hypothesis

that globalization has shifted the comparative advantage in industrial wood production from the temperate forests of the world to elsewhere. Thus, in the context of the fluidity associated with changing technologies, economic openness, and globalization, it has become feasible for national firms to move beyond their traditional boundaries and to become multinational through land and forest acquisitions or partnerships developed with foreign firms.

Methodology

To test the hypotheses of the effects of globalization on the forest products industry, this analysis examines the industry throughout the world from three different perspectives:

1. **Forest products production**. Where are forest products being produced and how have production patterns shifted over the past few decades? Our expectation is that generally forest products production has decreased in industrialized temperate regions, with an accompanying increase in production in developing tropical regions where factors of production are cheap and abundant and where there tends to be more favorable growing conditions for planned forests. How have these patterns differed depending on which forest products are examined?
2. **Plantations**. We would expect an overall increase in forest plantations throughout the world as forestry has shifted from a foraging industry to a cropping industry. In particular, we would expect disproportionate increases in plantations in tropical developing regions, again due to both favorable economic and biological conditions in these areas.
3. **Employment**. Just as other industries have offshored both production and services to regions endowed with cheap and abundant supplies of labor, we expect that forestry has followed a similar course. Thus, we expect employment in the forest products industry to have increased in tropical developing (labor rich) regions and diminished in industrialized temperate (labor poor) regions.

To examine these three areas, two data sources were consulted. The *Global Forest Resources Assessment 2005*, by the United Nations Food and Agriculture Organization (FAO), contains forestry-related data for 229 countries and territories throughout the world for 1990, 2000 and 2005. Data gleaned from this report include total forest wood product removals, productive plantation area, and forestry sector employment. The FAO also maintains a forest products database (http://faostat.fao.org/faostat/collections?version =ext&hasbulk=0&subset=forestry) with more detailed information on production and consumption of several different forest products, including industrial roundwood, sawnwood,

pulpwood, and wood pulp. This database has data on 230 countries and territories through 2004. This database was consulted for more specific production data for particular forest products. Because this database is not limited to the three data points (1990, 2000, 2005) that the *Global Forest Resources Assessment* includes, forest products production was considered over the continuous period 1980–2004. We believe that looking at forest production over this time frame will reveal the impact of globalization on the industry.

Results

Forest Timber Products Production

When looking at the productive functions of forests, the most primary distinction to be made in forest wood products is fuelwood and roundwood.[1] Global wood removals in 2005 amounted to 2.8 billion m^3, of which about 40 percent was fuelwood (1.2 billion m^3) (FAO 2006). Because fuelwood generally is foraged for local consumption, often for subsistence purposes, and is thus likely to be beyond the reach of the effects of globalization, it is not considered in this analysis. Roundwood, on the other hand, is logged for industrial purposes and is a commodity that is traded internationally; its production is a primary focus of this analysis.

The FAO *Global Forest Resources Assessment 2005* provides data for industrial roundwood removals (i.e., production) for 1990, 2000, and 2005. Of the 229 countries and territories surveyed in this report, there are 153 for which industrial roundwood removals data (in cubic meters) are available for all three years. This data was compiled for this analysis and aggregated into 13 regions:

- Eastern and Southern Africa
- Northern, Western and Central Africa
- East Asia

[1] Non-wood forest products consist of plant and animal products used for food, fodder, medicines, and other purposes and are not considered in this analysis. As is the case with fuelwood, they generally are harvested or foraged for local consumption (often for subsistence purposes) and thus are less likely to reflect the impact of globalization.

- South and Southeast Asia
- Western and Central Asia
- Europe (Excluding Nordic countries and former Soviet countries)
- Nordic Europe
- USSR/Former USSR
- Central America and Caribbean
- United States
- Canada
- Oceania
- South America

Collectively, these 13 regions encompass all of the countries and territories in the world for which there is data available. The delineations of these regions were chosen to attempt to separate tropical areas from temperate areas and developed regions from developing regions. The United States and Canada were each considered regions in themselves because of the large volume of production in each country. (See Appendix A for complete list of countries and territories by region.) These data are summarized in Appendix A and Figures 1 and 2. Figure 1 depicts total roundwood removals for each region for each of the three years, while Figure 2 shows the proportions of total world production for each of the regions for each of the three survey years.

Industrial Roundwood Production

Industrial roundwood is the most all-encompassing forest wood product. It includes sawlogs and veneer logs; pulpwood, round and split; and other industrial roundwood (FAO Yearbook 2002). Essentially, it encompasses all the wood products harvested from forests that are not fuelwood.

To obtain more detailed data than can be gleaned from looking at the three survey years presented in the FAO *Global Forest Resources Assessment* (See Figures 1 and 2), we consulted the FAO Forest Products Database. There are 173 countries and territories for which there is industrial roundwood production data (in cubic meters) available. Country-level data was aggregated up to the 13 regions listed above and production data was considered going back to 1980. Overall, world industrial roundwood production fluctuated somewhat between 1980 and 2004, with a net increase of 14 percent from 1980 to 2004.

Figure 3 summarizes this data. Figure 4 presents the same information in an area graph to give a sense of total world production over this period and how each region's proportions of that total have changed over time. Figure 5 depicts the same information in percentages of world production. The data show that most regions have increased industrial roundwood production over this time frame. The one glaring exception is the former Soviet nations. At the time of the breakup of the Soviet Union in 1991 and in the ensuing transition years, production in these nations diminished significantly from a high of over 300 million m^3 in 1988–1990 to less than 100 million m^3 by 1994.

The data also show that the more industrialized and developed regions of the world (almost entirely in temperate zones)—the United States, Canada and Europe—are the largest producers of industrial roundwood. The more subtle changes in production in the smaller producing regions are swamped by the larger producing regions and can be hard to see in the graphs. Thus, to attempt to depict the dynamics in developing tropical regions, an additional set of graphs was generated that excludes the United States, Canada, and Europe (Nordic, non-Nordic, and all of the former Soviet bloc, even though much of Russia and some other former Soviet states are actually in Asia). Figures 6 and 7 present the industrial roundwood production data for the remaining eight regions in terms of absolute production levels and in terms of percentage of total world production, respectively.

Of these smaller producing regions, South America shows the most notable increase in industrial roundwood production, going from 85 million m^3 (or 5.9 percent of world production) in 1980 to 164 million m^3 (9.9 percent of world production) in 2004. This upward trend for South America has been fairly consistent over the entire 25-year time span. No other region showed as marked an increase or decrease over this time frame. East Asia (which includes China) showed a minor increase throughout the 1980s but declined after 1988 to a near zero net change over the entire time frame. South and Southeast Asia showed a similar pattern, with production levels in 2004 very close to what they had been in 1980. Oceania also showed a steady upward trend (although not nearly as dramatic as South America) from 28 million m^3 (1.9 percent of world production) in 1980 to just under 50 million m^3 (2.9 percent of world production) in 2004. The two African regions showed only slight (but steady) increases over this time frame, while Central America/Caribbean and North/West/Central Asia remained relatively constant.

Sawnwood Production

Sawnwood is a more specific forest product and further along in the production chain than industrial roundwood. While industrial roundwood production represents the direct

harvesting of forests for wood, sawnwood is wood that has been produced from either domestic or imported roundwood by sawing lengthwise or by a profile-chipping process (FAO Yearbook 2002). As described in the introduction, when looking at the dynamics of timber harvesting/logging and processing of the resource into wood products, the processing may not be as close in proximity to the harvesting/logging sites as was the case a few decades ago.

The FAO Forest Products Database has sawnwood production data available for 163 countries over the period 1980–2004. Again, this data was aggregated to the 13 regions listed above and the results are depicted in Figures 8–10. Figure 8 shows sawnwood production levels in absolute terms, while Figures 9 and 10 present the data in percentages of total world production. Total world production has fluctuated over this period. From a level of 420 million m^3 in 1980, production increased to a high of just over 470 million m^3 in 1988 before declining steadily throughout the 1990s before seeing a slight resurgence since 2001. Overall, from 1980 to 2004, world production of sawnwood decreased by 1.3 percent.

Again, the data show a precipitous decline in production in the Soviet countries at the time of their transition in the early 1990s. The USSR was by far the largest producer of sawnwood throughout the 1980s, but by the late 1990s the former Soviet countries collectively were only the sixth largest producing region of sawnwood. Since 1991, the United States has been the largest producing region of sawnwood, and since the mid-1990s, Europe (excluding Nordic countries and former Soviet countries) has been the second largest producer and Canada the third largest producer.

Again, to capture the changes in the smaller producing developing regions, the temperate industrialized regions, which are also the largest sawnwood producing regions (United States, Canada, and Europe) were excluded in Figures 11 and 12. Figure 11 shows absolute levels of sawnwood production for these eight regions, while Figure 12 shows the same data in percentages of world production. The most dramatic trend seen in these data for sawnwood production is in East Asia, which declined from a peak value of nearly 64 million m^3 (nearly 15 percent of world production) in the mid-1980s to about 30 million m^3 (7.4 percent of world production) in 2004. Steep declines in both China's and Japan's production over this time frame account for the bulk of this change. No other region shows nearly as dramatic a change over this period. South America showed a steady increase over the entire time frame, although not nearly as dramatic as its industrial roundwood production increases. South America increased sawnwood production from 22 million m^3 (5.2 percent of world production) in 1980 to 35 million m^3 (8.5 percent of world production) in 2004. South/Southeast Asia showed steady increases throughout the 1980s, going from 27 million

m^3 (6.5 percent of world production) in 1980 to its peak of 41 million m^3 (8.8 percent of world production) in 1990. In the 1990s, however, production declined to a low of 25 million m^3 (6.5 percent of world production) in 2001, before climbing back up slightly in recent years. Oceania again showed steady but only slight increases over this time frame, while all other regions remained relatively constant.

Pulpwood Production

Pulpwood constitutes the portion of roundwood that will be used for the production of pulp, particleboard, or fireboard. Again, it is a wood product that is further along in the production chain than raw industrial roundwood (FAO Yearbook 2002). Traditionally, pulpwood production has been much more prevalent in industrialized countries, but the effects of globalization are likely to be seen as pulpwood production is separated from industrial roundwood production.

The FAO Forest Products Database has pulpwood production data available for 99 countries over the period 1980–2004.[2] Again, this data was aggregated to the 13 regions listed above and the results are depicted in Figures 13–15. Figure 13 shows pulpwood production levels in absolute terms, while Figures 14 and 15 present the data in percentages of total world production. Total world production has steadily increased throughout this period from 370 million m^3 in 1980 to 522 million m^3 in 2004, an increase of 41 percent. Pulpwood production in the United States has accounted for about a third of total world production and dwarfs production levels in many other regions. U.S. production increased slowly but steadily throughout the evaluation period. The Soviet bloc again showed a sharp decline in the early 1990s, but unlike the other forest timber products considered, pulpwood production has shown a dramatic resurgence since the late 1990s to levels that are significantly above the period prior to the dissolution of the Soviet Union. Since the late 1990s in fact, Russia has been one of the largest single country producers of pulpwood, second only to the United States.

[2] In 1998, the FAO Forest Products Database changed its term for pulpwood from “Pulpwood and Particles” to “Pulpwood, Round & Split.”

Again, to capture the changes in the smaller producing developing regions, the largest sawnwood producing regions (United States, Canada, and Europe) were excluded in Figures 16 and 17. Figure 16 shows absolute levels of pulpwood production for these eight regions, while Figure 17 shows the same data in percentages of world production. Similar to the trends for industrial roundwood, South America showed the most dramatic trends in pulpwood production. Its production increased from just over 26 million m^3 (7.2 percent of world production) in 1980 to over 71 million m^3 (13.7 percent of world production) in 2004. This increase was relatively consistent over the entire time frame. Again similar to industrial roundwood production, East Asia showed slight increases in pulpwood production throughout the 1980s and declines ever since. Oceania showed slow but steady increases throughout the time frame to become the second largest producing region (out of these 8 regions) by the early 2000s (most of this is due to Australian production). Eastern/Southern Africa also showed moderate increases throughout this time frame from 6.8 million m^3 (1.8 percent of world production) in 1980 to 15.5 million m^3 (3 percent of world production) in 2004. South/Southeast Asia showed steady increases throughout the 1980s and early 1990s (ranging from 3.2 million m^3, or 0.9 percent of world production in 1980, to 13.9 million m^3, or 3.3 percent of world production, in 1996) but then fell rather precipitously throughout the late 1990s (possibly due to the 1997–1998 Asian financial crisis). Other regions showed very little change and remained very low-level producers throughout this time frame.

Wood Pulp Production

Wood pulp includes fibrous material prepared from pulpwood, wood chips, particles, residues, or recovered paper for further manufacture into paper, paperboard, or other cellulose products (FAO Yearbook 2002). Pulp production also has traditionally been far more prevalent in industrialized countries. The FAO Forest Products Database has wood pulp production data available for 85 countries over the period 1980–2004. These data are summarized in Figures 18 and 19. Total world production of world pulp increased by 39 percent from 1980 to 2004, from 126 million metric tons in 1980 to 175 million metric tons in 2004. As Figure 18 shows, the United States has been by far the biggest producer of wood pulp over this time frame, more than doubling each of the regions with the next largest volumes of wood pulp production (Nordic Europe and Canada). Pulp production in the United States, however, has not increased consistently over this period. Throughout the 1980s and early 1990s, U.S. pulp production did increase steadily, reaching a peak of almost 66 million metric tons in 1994. Since 1994, however, U.S. pulp production has diminished in both absolute (Figure 18) and relative (Figure 19) terms. Meanwhile, almost all other regions have stepped up their pulp production since 1994.

Again to more easily see the changes in the smaller producing regions, wood pulp production was examined with the largest producing regions (United States, Canada, Europe, and Russia) excluded. These results can be seen in Figures 20 and 21. Of the eight remaining regions, East Asia is the largest producer of wood pulp, although its share of world production has remained relatively constant at about 9 percent over this time frame. In contrast, South American pulp production increased steadily and dramatically over the entire time frame from just over 4 million metric tons (or 3.4 percent of world production) in 1980 to over 14 million metric tons (8.1 percent of world production) in 2004. During this time frame, East Asian pulp production only increased from around 11 million metric tons to just over 15 million metric tons. South/Southeast Asia also showed sharp increases during this time, predominantly from 1990 on. In 1980, its pulpwood production was only 724 thousand metric tons (0.6 percent of world production), but by 2004, its production had increased to nearly 9 million metric tons (5.1 percent of world production). Again, the bulk of this increase took place from 1990 on. A more than 100-fold increases in pulp production in Indonesia from 1980–2004 accounts for a substantial share of this increase. All other regions showed relatively constant pulp production levels over this time frame.

Productive Forest Plantations

Forest plantations are defined as forests of introduced species, and in some cases native species, established through planting or seeding, with few species, even spacing and/or even-aged stands (FAO 2006). There are two general types of forest plantations: productive and protective. Productive forest plantations are defined as forest plantations that are predominantly intended for the provision of wood, fiber, and non-wood forest products (FAO 2006). Protective forest plantations are not intended for production but rather for conservation and/or for the ecosystem services that forests provide (i.e., biodiversity preservation, carbon sequestration). While undoubtedly important, protective forest plantations are not considered in this analysis since they are not a component of the forest products industry. Our hypothesis is that productive plantations have more than proportionately increased in subtropical and tropical developing regions where labor is cheap and abundant and where growing conditions lead to more abundant and efficient tree growth. Meanwhile, we expect that productive plantations in industrialized temperate regions, where labor is more scarce and expensive and growing conditions lead to less efficient tree growth, have proportionately decreased.The FAO *Global Forest Resources Assessment 2005* contains productive forest plantations data (in hectares) for the years 1990, 2000, and 2005. Of the 229 countries and territories surveyed in the report, there are 168 for which data are available

for all three survey years.[3] The total world productive forest plantation area was more than 109 million hectares in 2005, more than a 44 percent increase over the 76 million hectares of global productive forest plantations in 1990. We again aggregated the data into the same 13 regions listed above; however, because there is no data on forest plantations available for Canada, the number of regions has been reduced to 12. The data are summarized in Figures 22–24. All 12 regions showed a net increase in productive forest plantations over the 15 years, but some regions showed significantly larger forest plantation growth than others.[4]

Figure 22 shows that total productive forest plantation area throughout the world increased from 76 million hectares in 1990 to 109 million hectares in 2005, with all regions showing positive growth. East Asia had the largest productive forest plantation area in each of the three years. As can be seen in Figure 23, this region also showed one of the higher growth rates in productive forest plantation area over this period. The region with the highest growth rate of productive forest plantation area over this period, however, was Central America/Caribbean. Compared to the overall average annual growth rate in productive forest plantations of 2.95 percent for the entire world, Central America/Caribbean saw an average annual growth rate of 9.79 percent over this 15-year period.

Much of this growth, however, can be attributed to the relatively small area of forest plantation in this region, and even at the end of this period, this region only had 0.5 percent of the world's productive forest plantations (see Figure 24).

The region that showed the largest increase in proportion of total world productive forest plantation area was actually the United States, which somewhat contradicts our hypothesis. In 1990, the United States had 10.1 percent of overall world productive forest plantations, but by 2005, the United States had 15.6 percent. However, it should be noted that the data examined begins in 1990, by which time many regions had substantial plantation

[3] The FAO Forest Products Database does not include data on forest plantations and there is no other data source with continuous time series data for forest plantations over the time frame considered in this analysis.

[4] The productive forest plantation regional totals for 1990 and 2000 for the three regions that comprise Europe (Europe, excluding Nordic countries and former Soviet countries; Nordic Europe; and USSR/Former USSR) have been extrapolated based on the proportions of the European total that these regions comprised in 2005. This is because for 1990 and 2000, the FAO report only includes totals for Europe as a whole and does not differentiate between these three regions.

area, while other had virtually none. In addition, growth rates were often quite different between 1990 and 2000 then from 2000 to 2005. Thus, for example, the U.S. total world share increased between 1990 and 2005 despite a modest growth rate after 2000.

Meanwhile, many of the other regions with vast areas of forest plantations, including East Asia, the Soviet Union, South/Southeast Asia, and Northern/Western/Central Africa, all showed a decline in their shares, although not absolute amounts, of total productive forest plantations.

As can be seen in Figure 24, however, many of these regions showed a decline in their share of total world forest plantations between 1990 and 2000 but an upsurge between 2000 and 2005. For example, East Asia, which had 29.1 percent of world productive forest plantations in 1990, showed a decline to 24.1 percent, but more rapid growth thereafter back up to 27.5 percent by 2005. Meanwhile, the United States showed the opposite trend. Its share of world productive forest plantations increased from 1990 to 2000, from 10.1 percent to 17.1 percent, but then declined between 2000 and 2005 to 15.6 percent. This suggests that the impact of globalization on the location of productive forest plantations may be a more recent phenomenon. From 2000 to 2005, many of the more tropical developing regions showed an increase in their share of world productive forest plantations, including East Asia and Northern/Western/Central Africa. Meanwhile, over this same five-year period, most of the more industrialized temperate regions showed a decline in their share of world productive forest plantations, including the United States, Europe, Nordic Europe, and the former Soviet Union.

Interestingly, South America, which has been shown to have one of the more rapid growth rates for much of the forest industry outputs, does not show rapid increases in forest plantation areas since 1990. However, it did experience substantial plantation establishment before 1990, as reflected in the relatively large 1990 number, and has continue to add to that plantation stock. Forest Industry Employment

Based on our hypotheses of how globalization has reshaped the global forest products industry, as forestry production has been “off-shored” we would expect increases in forestry sector employment in developing countries where labor tends to be cheap and abundant with concurrent employment decreases in industrialized countries where labor is relatively scarce and expensive. These employment increases also would reflect increased investments and new technologies introduced in regions with characteristics favorable to forestry. Unfortunately, the available data on forestry employment is not extensive and is muddled with inconsistencies from country to country in what is considered to be employment in this

sector. The FAO *Global Forest Resources Assessment 2005* reports country-level forestry employment data for only 1990 and 2000; there is no available forestry sector employment data for 2005. There are 139 countries reporting employment data for 2000, but only 116 countries for 1990.

In this context, the FAO defines employment is defined as: "Any type of work performed or services rendered under a contract of hire, written or oral, in exchange for wage or salary, in cash or in kind" (FAO 2006). This is based on definitions by the International Labor Organization and the Employment Security Commission. However, most of the employment data presented in the FAO report relates to work done in the primary production of forest goods and related services; work done in the processing of wood and non-wood forest products is excluded (FAO 2006). Yet, this standard varies somewhat from country to country. For example, the United States included employment in sawmilling (thus resulting in a higher employment figure than employment in roundwood production alone), while other countries reported employment in the public forest administration where these administrations also own and manage forest processing facilities (again leading to overestimation of forest sector employment involved in primary production). Other countries (notably India) may also have overestimated forestry sector employment due to the inclusion of part-time workers without conversion to full-time equivalents. Finally, a last possible problem is that some of the forestry sector employment figures may include people that collect fuelwood and non-wood forest products for subsistence purposes, whereas the guidelines for reporting forestry employment stipulated that only paid employment should be included. These data limitations in forestry employment data are brought up not to completely discount the results reported here but rather to suggest that it is hard to draw robust conclusions about global forestry employment and that further research (hopefully with better data) would be needed to more fully characterize global forestry employment trends.

As was the case for forest timber production and productive forest plantations, the available data was aggregated into the thirteen regions listed above. Table 1 presents the distribution by region of forestry sector employment in 2000. Of the 11 million workers employed worldwide in forestry, the vast majority were in Asia, where more than 8 million workers were employed. (India alone accounted for over 5 million of these, while China accounted for nearly 2 million.)

Table 1. Worldwide Employment in Forestry in 2000

Region	**Number Employed (*1,000 person-years*)**
South and Southeast Asia	5,681
East Asia	2,122
Europe, excluding Nordic countries	504
Western and Central Asia	474
Northern, Western and Central Africa	447
Eastern and Southern Africa	426
USSR/Former USSR	420
United States	281
South America	245
Central America/Caribbean	234
Canada	89
Europe, Nordic	50
Oceania	37
World Total	***11,010***

To examine the regional trends in forestry employment between 1990 and 2000, only countries reporting data for both years were considered. These results are summarized in Table 2 and in Figure 25.

Globally, reported employment in forestry declined slightly from 1990 to 2000, by about 1 million (or 10 percent). This may be attributed in large part to increases in labor productivity that have accompanied technological improvements throughout the world. Inspection of the results reveals that while there have been employment declines in Asia and Europe, many of the other regions, particularly the developing regions of Africa and South America, have shown increases in forest sector employment. Not surprisingly, regions such as South America, which have had large increases in production of most forest products, also have seen substantial employment increases in the forest sector.

Table 2. Trends in Number of People Employed in Forestry 1990–2000

Region	**Number Employed (*1,000 person-years*)**		**1990-2000 Percentage Change**
	1990	**2000**	
South and Southeast Asia	5,991	5,519	-7.9%
East Asia	2,647	2,122	-19.8%
Europe, excluding Nordic countries	614	365	-40.6%
Western and Central Asia	468	474	+1.3%
USSR/Former USSR	330	374	+13.3%
United States	311	281	-9.6%
Northern, Western and Central Africa	255	367	+43.9%
Europe, Nordic	84	50	-40.5%
Central America/Caribbean	83	145	+74.7%
Canada	74	89	+20.3%
South America	66	100	+51.5%
Eastern and Southern Africa	47	57	+21.3%
Oceania	35	37	+5.7%
World Total	***11,005***	***9,980***	***-9.3%***

In Europe, some of the decline in employment can be explained by productivity gains resulting from the restructuring of formerly centrally planned economies and the general privatization of forestry activities. The employment increases throughout much of the developing world likely reflect roundwood production that has increased faster than increases in labor productivity. This supports our hypothesis of the impact of globalization on the forestry sector.

Discussion and Conclusions

We find that there is substantial evidence in this country-level forestry data to support our hypotheses of how globalization has begun to reshape the forest products industry. However, the evidence suggests that the changes have been more prominent in the pulp industry than in the structural wood sector. We claim that technological innovations, reduced costs of transport, and greater mobility of labor and capital have propelled a shift in comparative advantage from developed countries in temperate regions to developing countries in subtropical regions. In the latter, not only are the economic conditions becoming more favorable to cheaper and more efficient production, but biological conditions also tend to support faster growth and higher yields. This is especially significant given the transition of forestry from a foraging activity of natural forests to the cropping and harvesting of planted forests along the lines suggested by Sedjo and Lyon (1983). While there is no doubt

that natural forests are still being cut and depleted in many parts of the world, there is clear evidence that productive forest plantation area is increasing throughout the world and that more and more wood products are being derived from them.

To tell the story of globalization in the forest products industry, we first looked at country-level data for wood products production, starting with the raw materials directly harvested from forests (industrial roundwood) and also including more refined and processed wood products that are derived from these raw materials (sawnwood, pulpwood, wood pulp). While worldwide industrial roundwood production has not changed all that much since 1990, the data does reveal shifts in where the production is happening. South America, in particular, has shown the most dramatic production increases. When the focus is limited to sawnwood, our globalization hypotheses are somewhat less apparent, as North America and Europe have shown the more dramatic sawnwood production increases, although South America has shown steady increases in sawnwood production as well. Pulpwood production also has continued to thrive in industrialized regions, particularly in the United States. But here we see production increases throughout the developing world, particularly subtropical regions in South America, and also in other developing regions such as Eastern and Southern Africa. Finally, when we turn our attention to wood pulp production, the globalization picture comes into sharper focus. Wood pulp production, which traditionally has been far more prevalent in industrialized regions, has actually been declining or staying flat in the pulp producing strongholds (United States, Canada, and Europe), while it has increased dramatically in South America as well as in both East Asia and South/Southeast Asia.

We then turned our attention to productive forest plantations and found data that reveals their overall increase throughout the world, as well as some interesting trends in varying growth rates from region to region. Particularly since 2000, there has been dramatic upsurges in productive plantations in much of Asia and in parts of Africa and Central/Caribbean America compared to more modest increases in the industrialized centers of North America and Europe. The increases also are modest in South America but on a relatively large base established pre-1990.

Finally, we examined forestry sector employment. We found that while overall forestry employment seems to be decreasing due to increases in labor productivity, in many of the more subtropical and tropical areas, forestry sector employment is increasing substantially.

We expect that while many industries already have been significantly reshaped by globalization (through off-shoring, out-sourcing, etc.), the forestry industry may be at a more

nascent stage of globalization, with much of the reshaping of the industry yet to come. Particularly as economic development progresses in the furthest reaches of the world, the forestry industry will continue to evolve and follow in the path that other industries have taken as they have adapted to a more globalized world and taken advantage of the features that can generate comparative advantages. Therefore, it is important to keep an eye on trends in the forest products industry as globalization continues to change our world.

Appendix A: Country List

(Note: not all of the following have data for all of the indicators considered in this report. Each of the countries listed below, however, has available data for at least one of the indicators in this report.)

Eastern and Southern Africa
- Angola
- Botswana
- Comoros
- Kenya
- Lesotho
- Madagascar
- Malawi
- Mauritius
- Mozambique
- Reunion
- Seychelles
- South Africa
- Swaziland
- Tanzania (United Republic of)
- Uganda
- Zambia
- Zimbabwe

Northern, Western and Central Africa
- Algeria
- Benin
- Burkina Faso
- Burundi
- Cameroon
- Central African Republic
- Chad
- Congo
- Cote d'Ivoire
- Democratic Republic of the Congo
- Djibouti
- Egypt
- Equatorial Guinea
- Eritrea
- Ethiopia
- Gabon
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Liberia
- Libyan Arab Jamahiriya
- Mali
- Mauritania
- Morocco
- Niger
- Nigeria
- Rwanda
- Sao Tome and Principe
- Senegal
- Sierra Leone
- Somalia
- Sudan
- Togo
- Tunisia

East Asia
- China
- Democratic People's Republic of Korea
- Japan
- Mongolia
- Republic of Korea

South and Southeast Asia
- Bangladesh
- Bhutan
- Brunei Darussalam
- Cambodia
- India
- Indonesia
- Laos
- Malaysia
- Myanmar
- Nepal
- Pakistan
- Philippines
- Singapore
- Sri Lanka
- Thailand
- Vietnam

Western and Central Asia
- Afghanistan

Cyprus
Iran
Iraq
Israel
Jordan
Lebanon
Saudi Arabia
Syrian Arab Republic
Turkey
United Arab Emirates

Europe, excluding Nordic and Soviet countries

Albania
Austria
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Czech Republic
France
Germany
Greece
Hungary
Iceland
Ireland
Italy
Liechtenstein
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
San Marino
Serbia and Montenegro
Slovakia
Slovenia
Spain
Switzerland
The Former Yugoslav Rep. of Macedonia
United Kingdom

Europe, Nordic

Denmark
Finland
Norway
Sweden

USSR/Former USSR

Armenia
Azerbaijan
Belarus
Estonia
Georgia
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Republic of Moldova
Russian Federation
Tajikistan
Turkmenistan
Ukraine
Uzbekistan

Central America and Caribbean

Bahamas
Barbados
Belize
Costa Rica
Cuba
Dominica
Dominican Republic
El Salvador
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Martinique
Mexico
Nicaragua
Panama
Trinidad and Tobago

North America – USA

United States of America

North America – Canada

Canada

Oceania

Australia
Cook Islands
Fiji
New Caledonia
New Zealand

Niue
Papua New Guinea
Samoa
Solomon Islands
Tonga
Vanuatu

South America

Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
French Guiana
Guyana
Paraguay
Peru
Suriname
Uruguay
Venezuela (Bolivian Republic of)

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Figures

Figure 1: Industrial Roundwood Removals by Region, 1990-2005

(Source: FAO Country Profiles, http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=5081&sitetreeId=18927&langId=1&geoId=0)

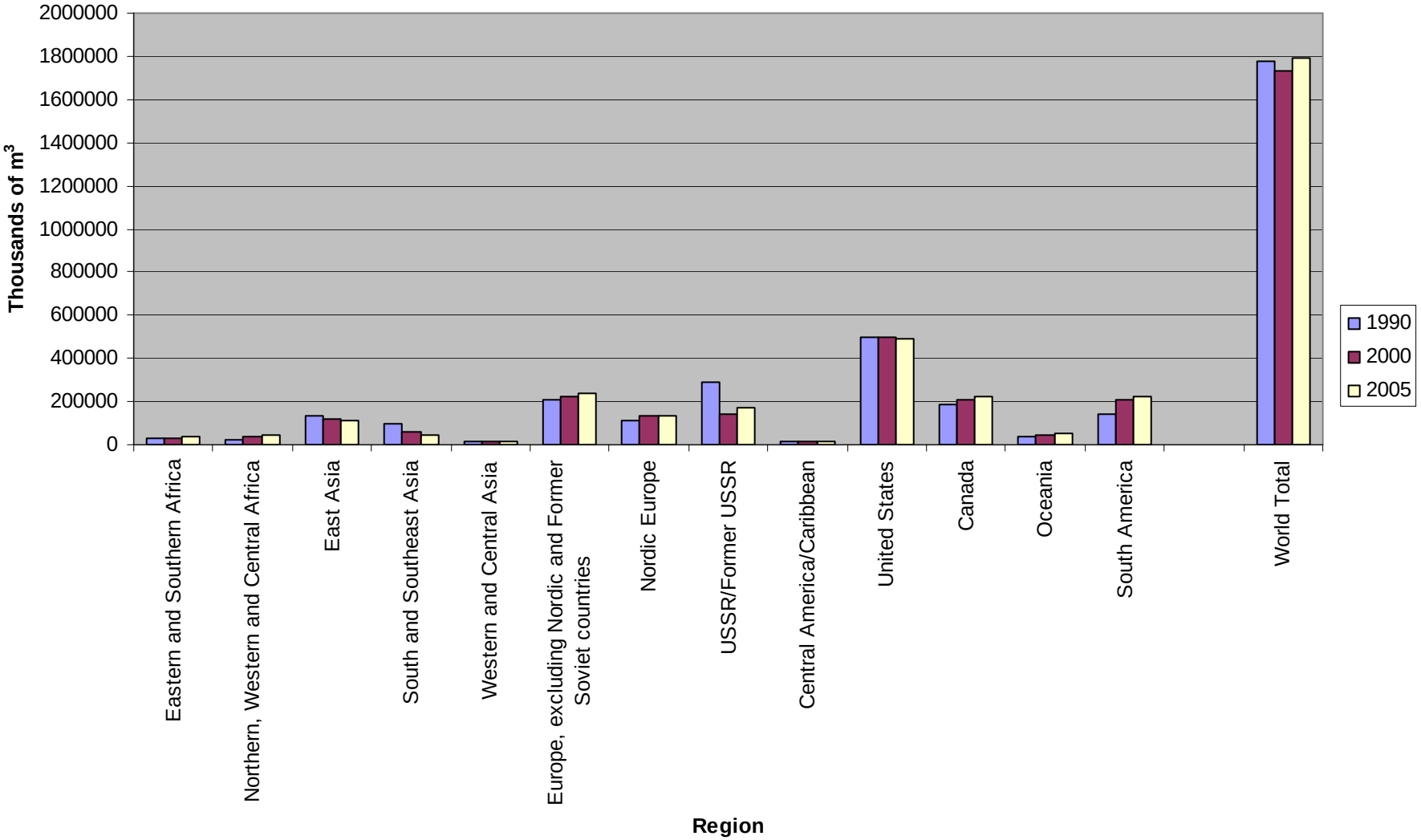


Figure 2: Industrial Roundwood Removals, % of World Total by Region 1990-2005

(Source: FAO Country Profiles, http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=5081&sitetreeId=18927&langId=1&geoId=0)

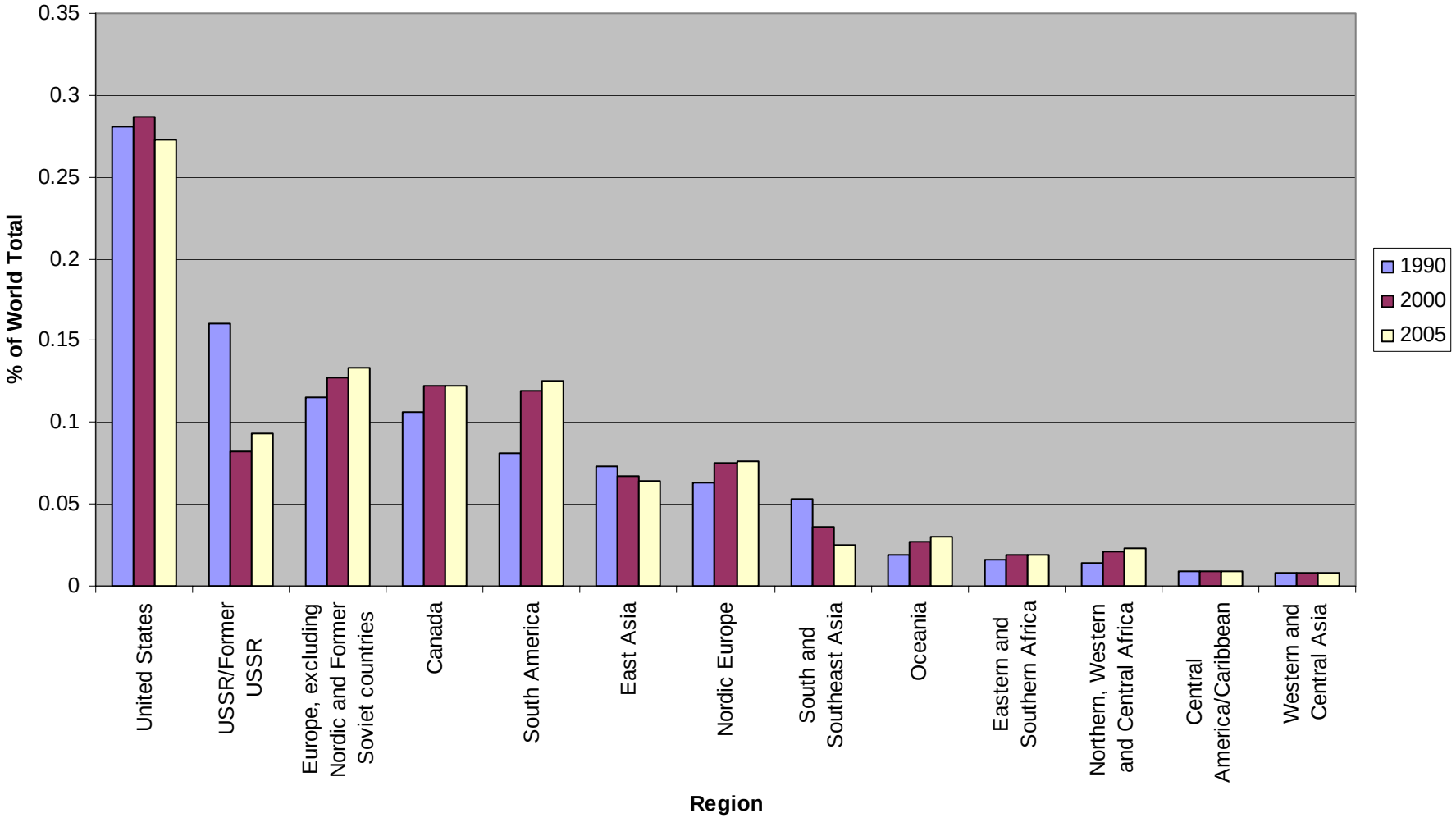


Figure 3: Industrial Roundwood Production by Region, 1980-2004
(Source: FAOStat Forest Products Database)

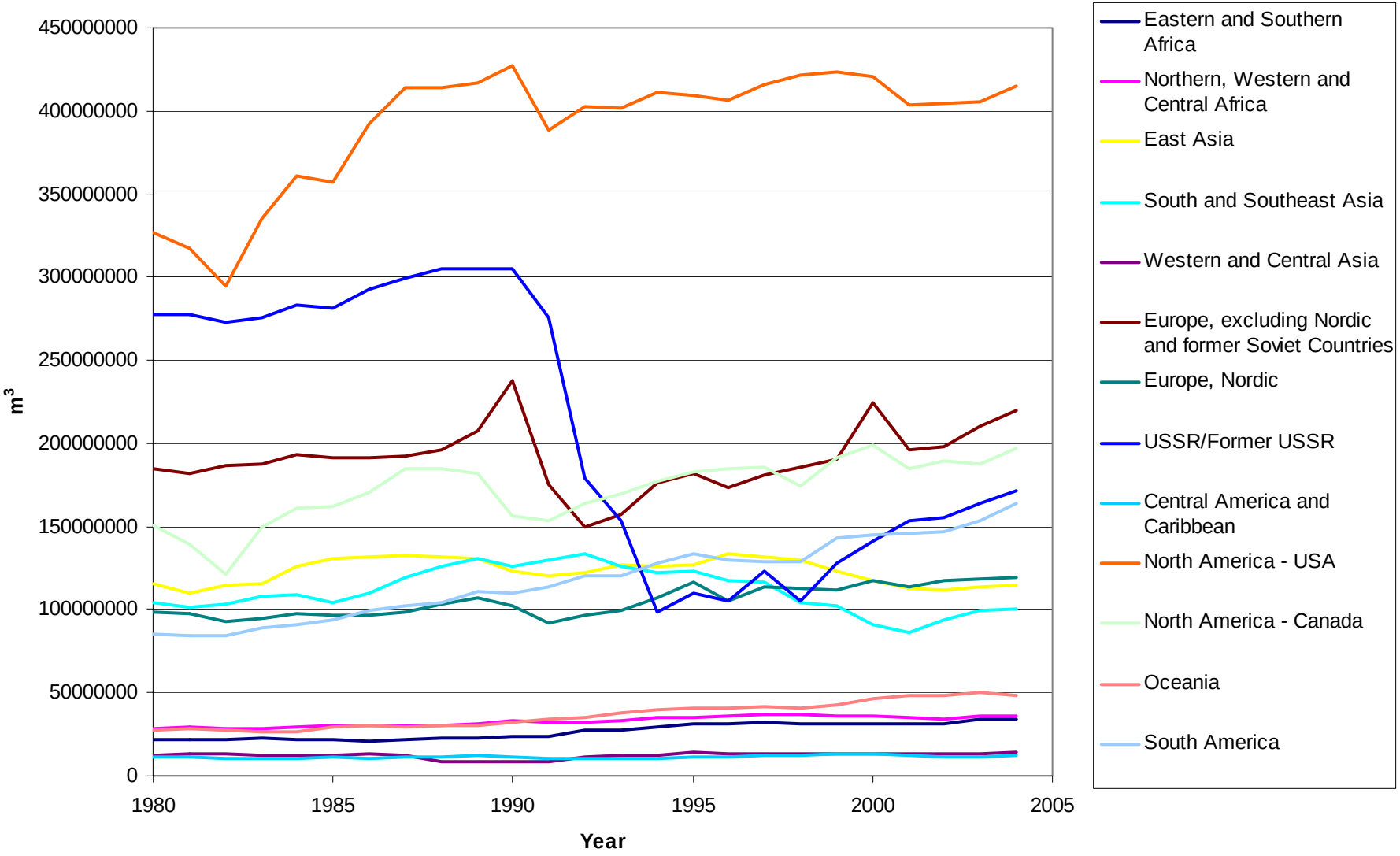


Figure 4: Total Industrial Roundwood Production, 1980-2004
(Source: FAOStat Forest Products Database)

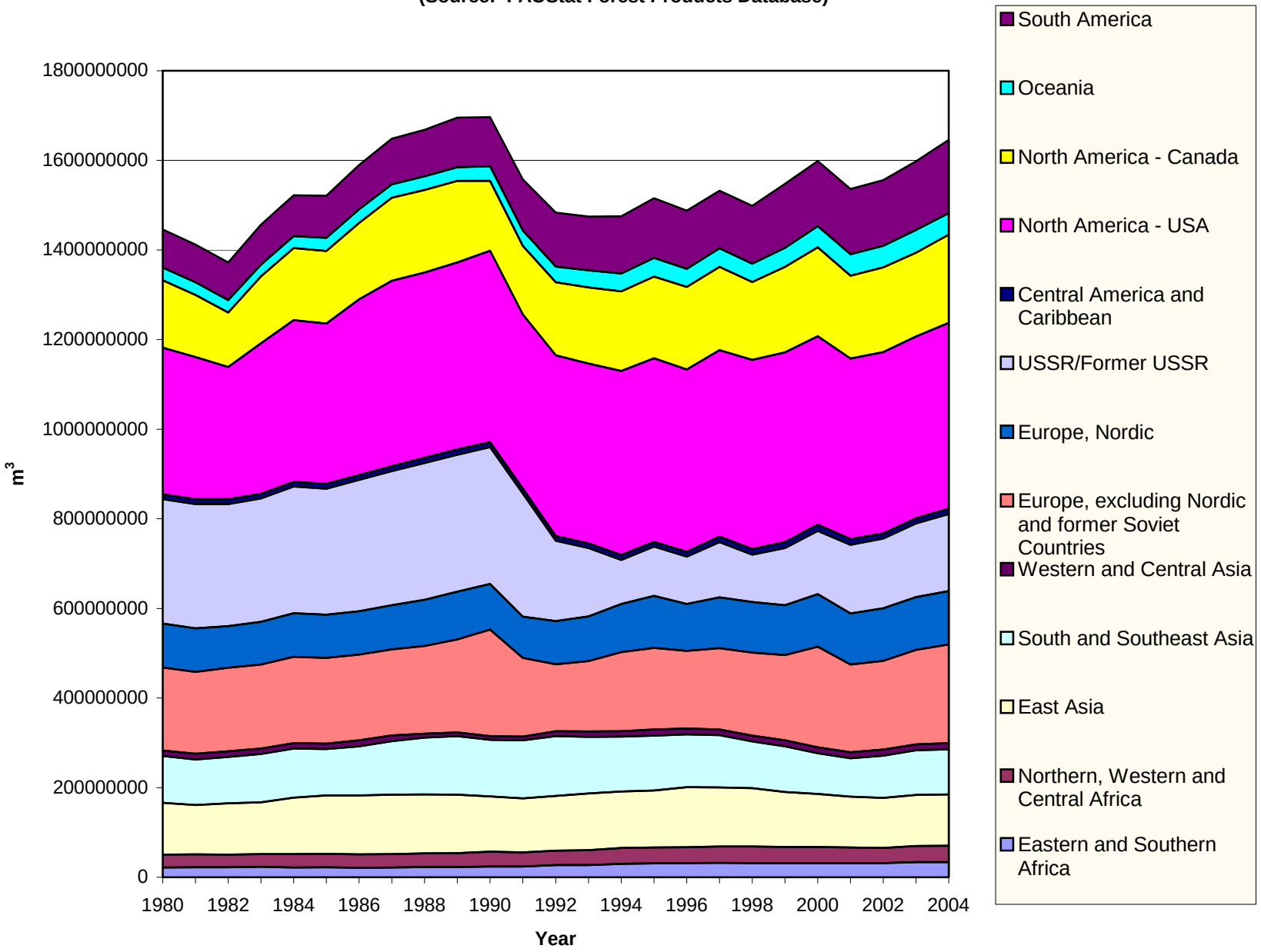


Figure 5: Industrial Roundwood Production - Regional % of Total World Production, 1980-2004
(Source: FAOStat Forest Products Database)

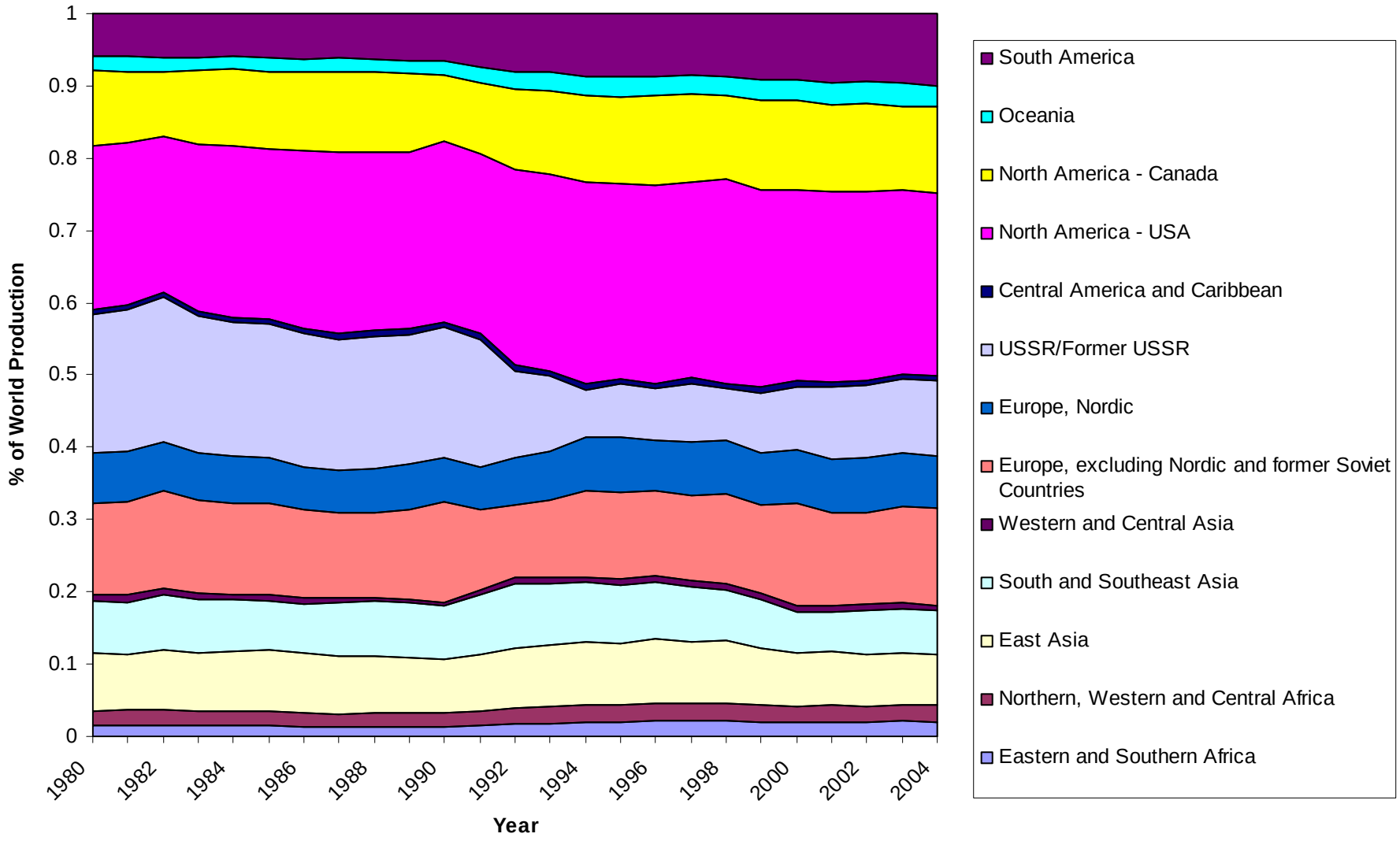


Figure 6: Regional Industrial Roundwood Production, 1980-2004 (Largest Producing Regions Excluded)

(Source: FAOStat Forest Products Database)

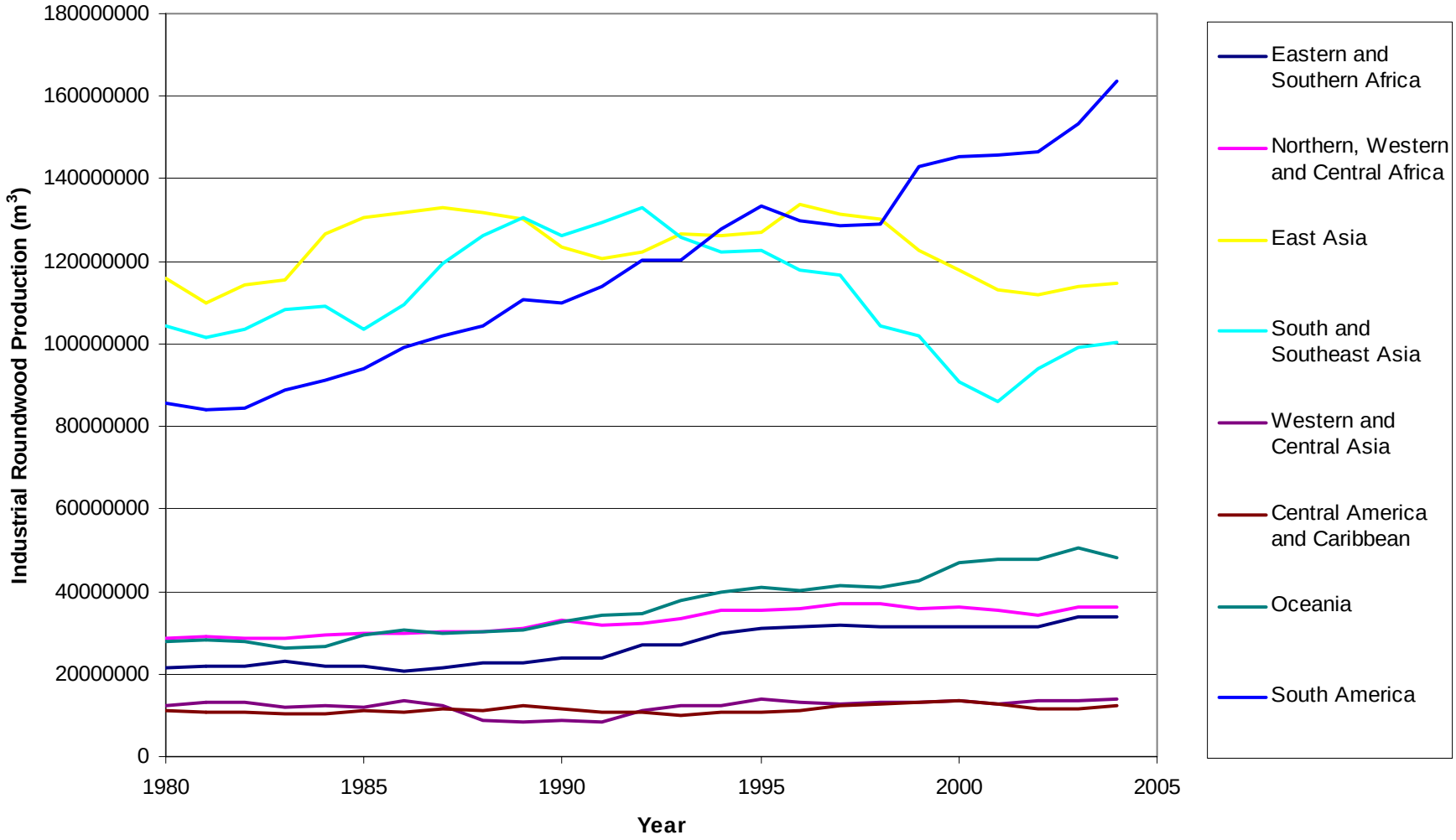


Figure 7: Industrial Roundwood Production Percentage of World Production, 1980-2004
(Largest Producing Regions Excluded)
(Source: FAOStat Forest Products Database)

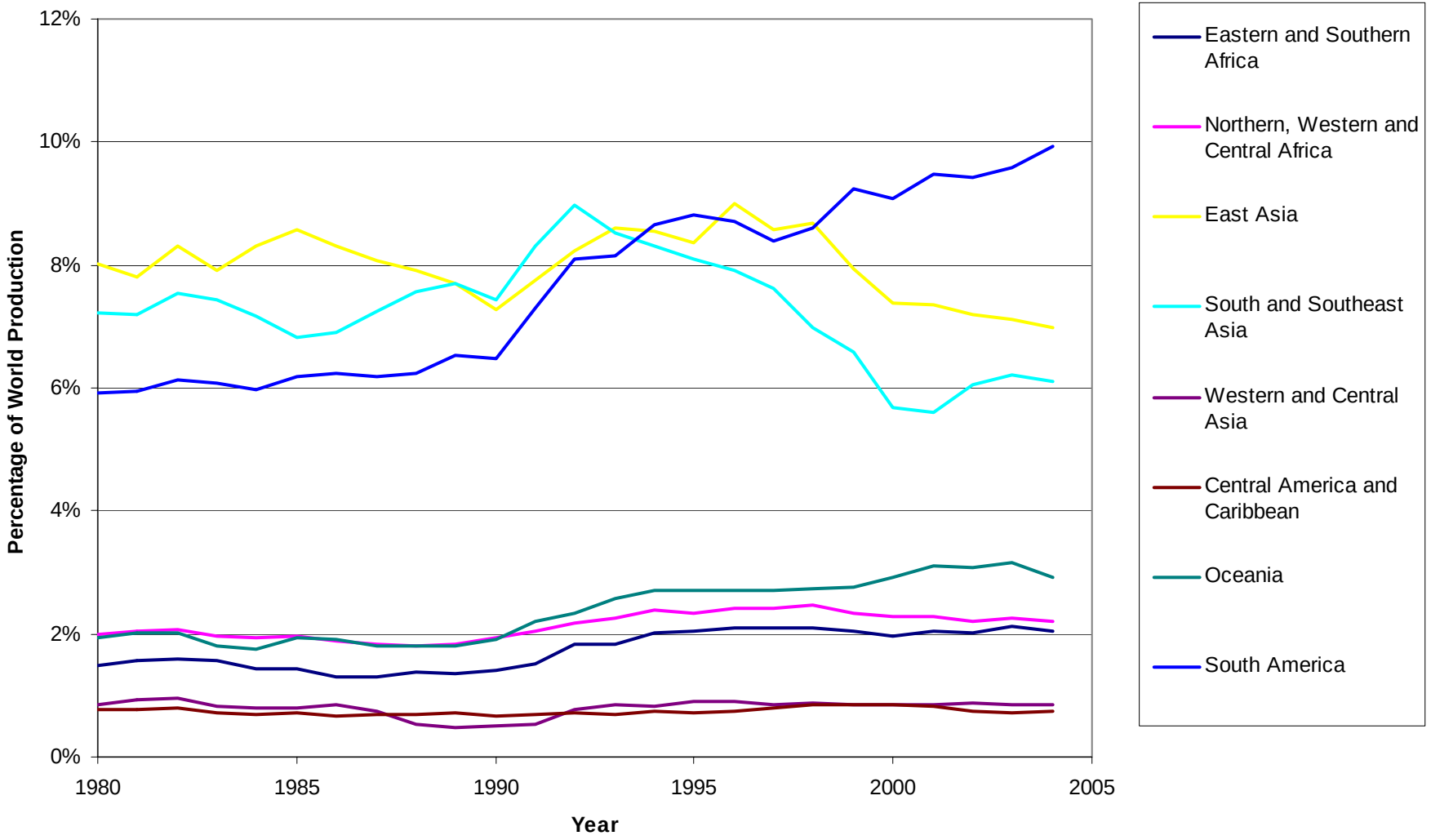


Figure 8: Regional Sawnwood Production, 1980-2004
(Source: FAOStat Forest Products Database)

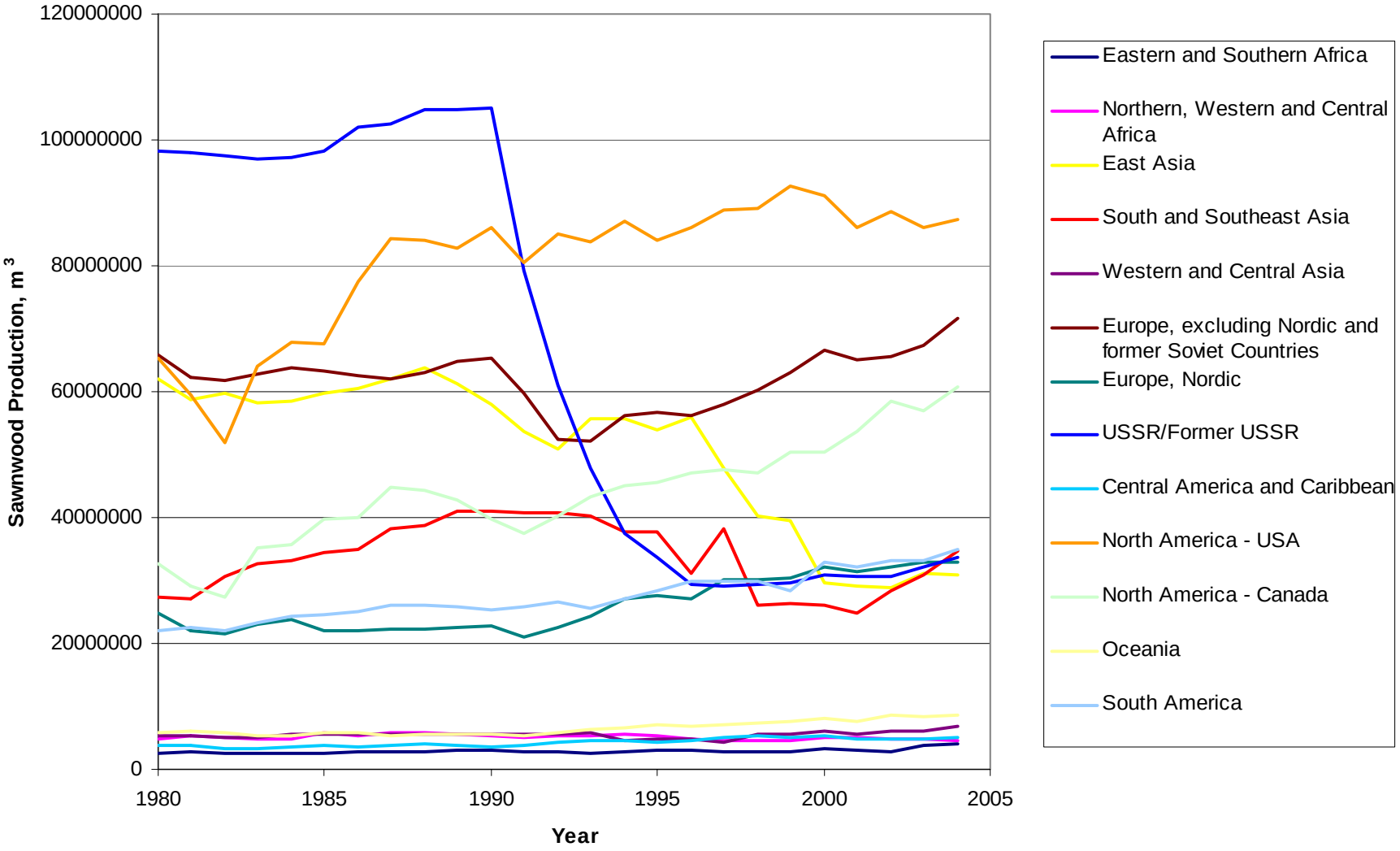


Figure 9: Regional Sawnwood Production, Proportion of World Production, 1980-2004
(Source: FAOStat Forest Products Database)

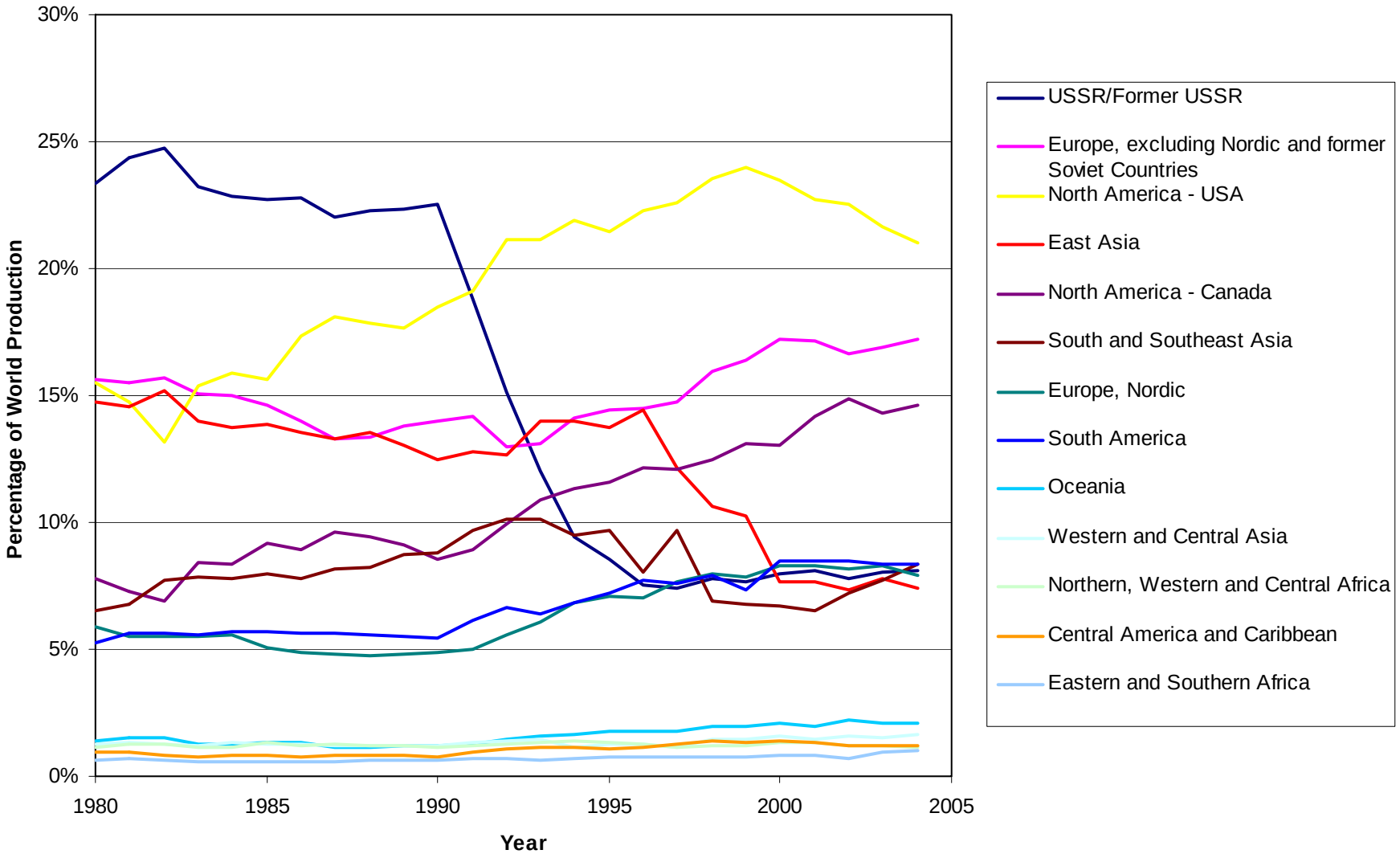


Figure 10: Regional Sawnwood Production, Proportion of World Production, 1980-2004
(Source: FAOStat Forest Products Database)

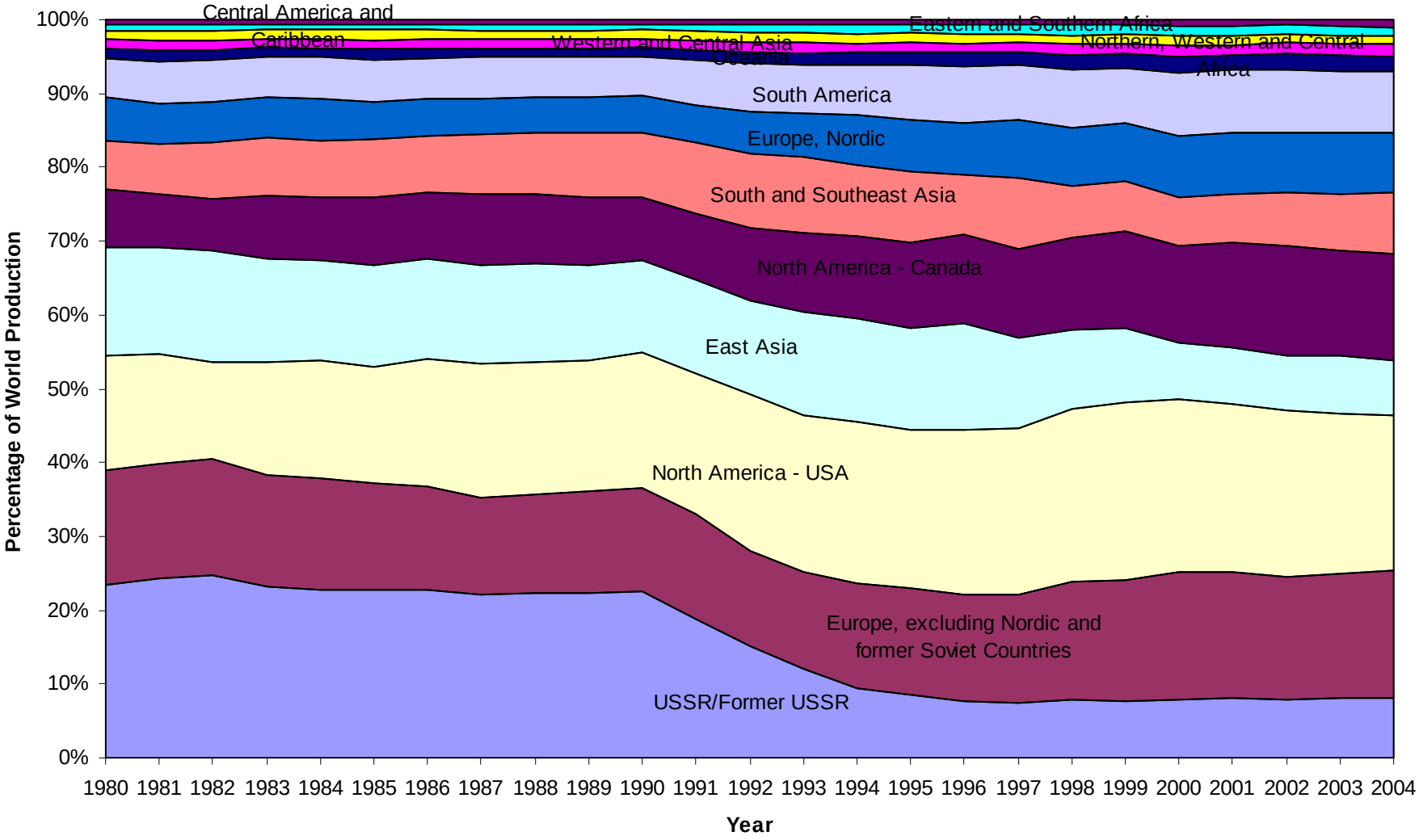


Figure 11: Regional Sawnwood Production, 1980-2004 (Largest Producing Regions Excluded
(Source: FAOStat Forest Products Database)

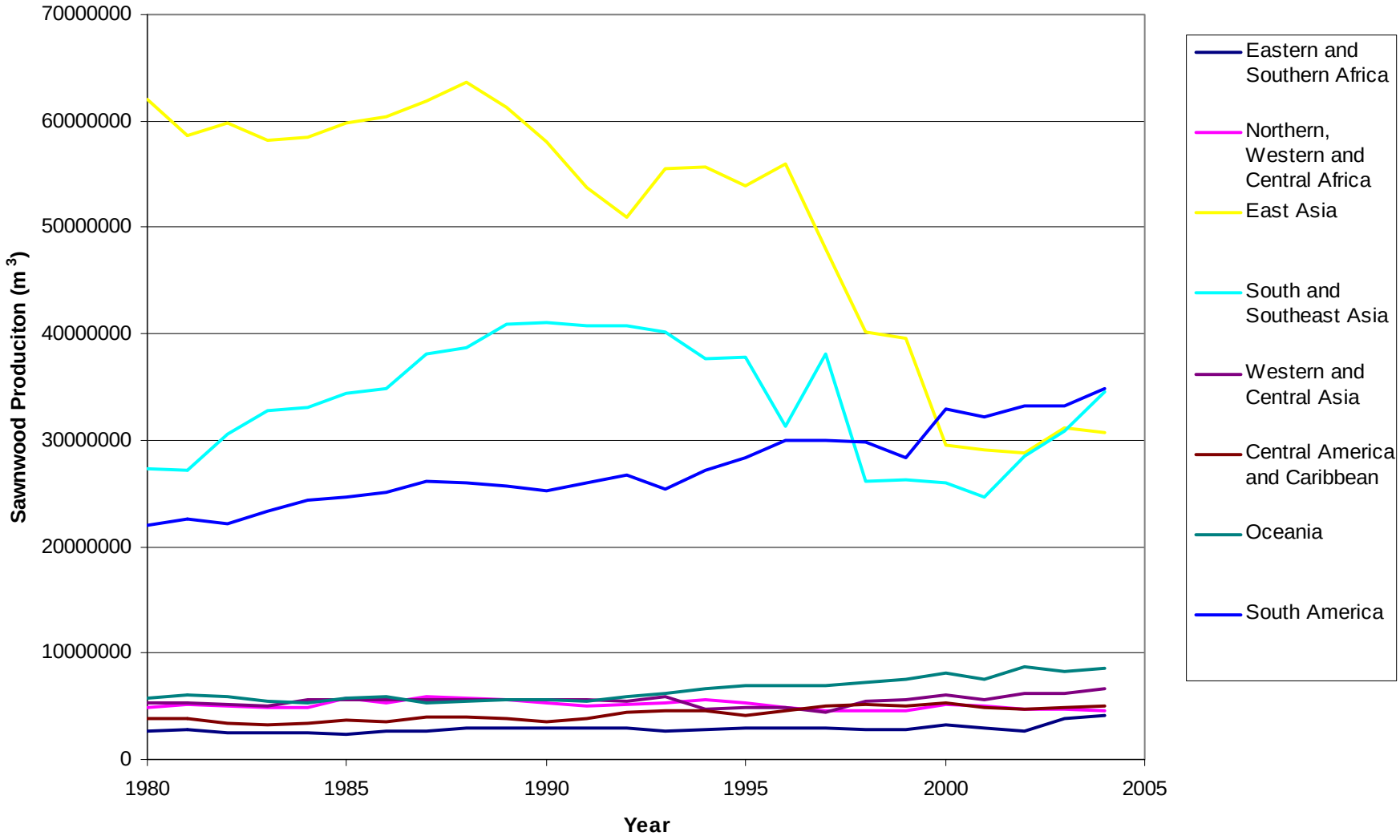


Figure 12: Regional Sawnwood Production Percentage of World Production, 1980-2004
(Largest Producing Regions Excluded)
(Source: FAOStat Forest Products Database)

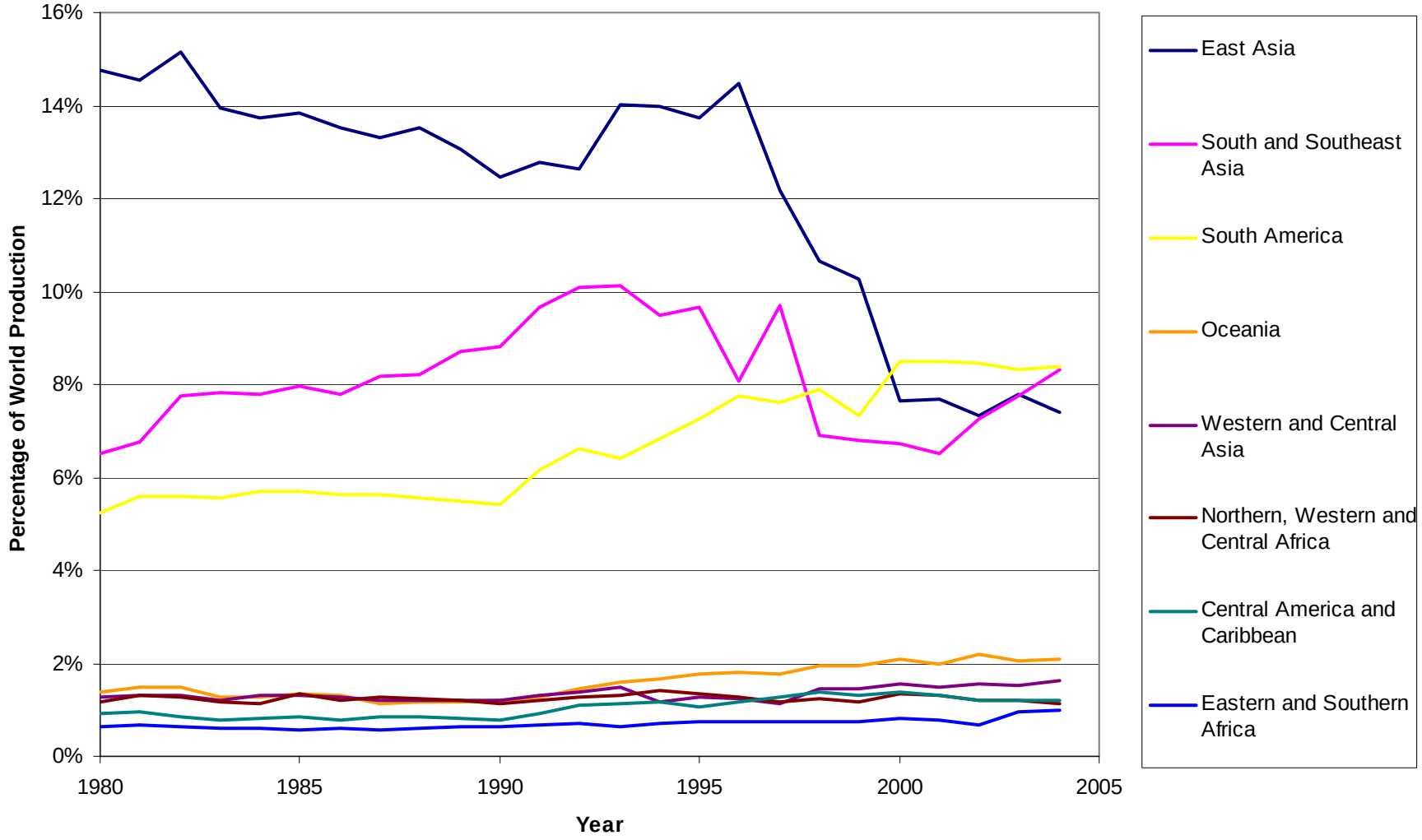


Figure 13: Regional Pulpwood Production, 1980-2004
(Source: FAOStat Forest Products Database)

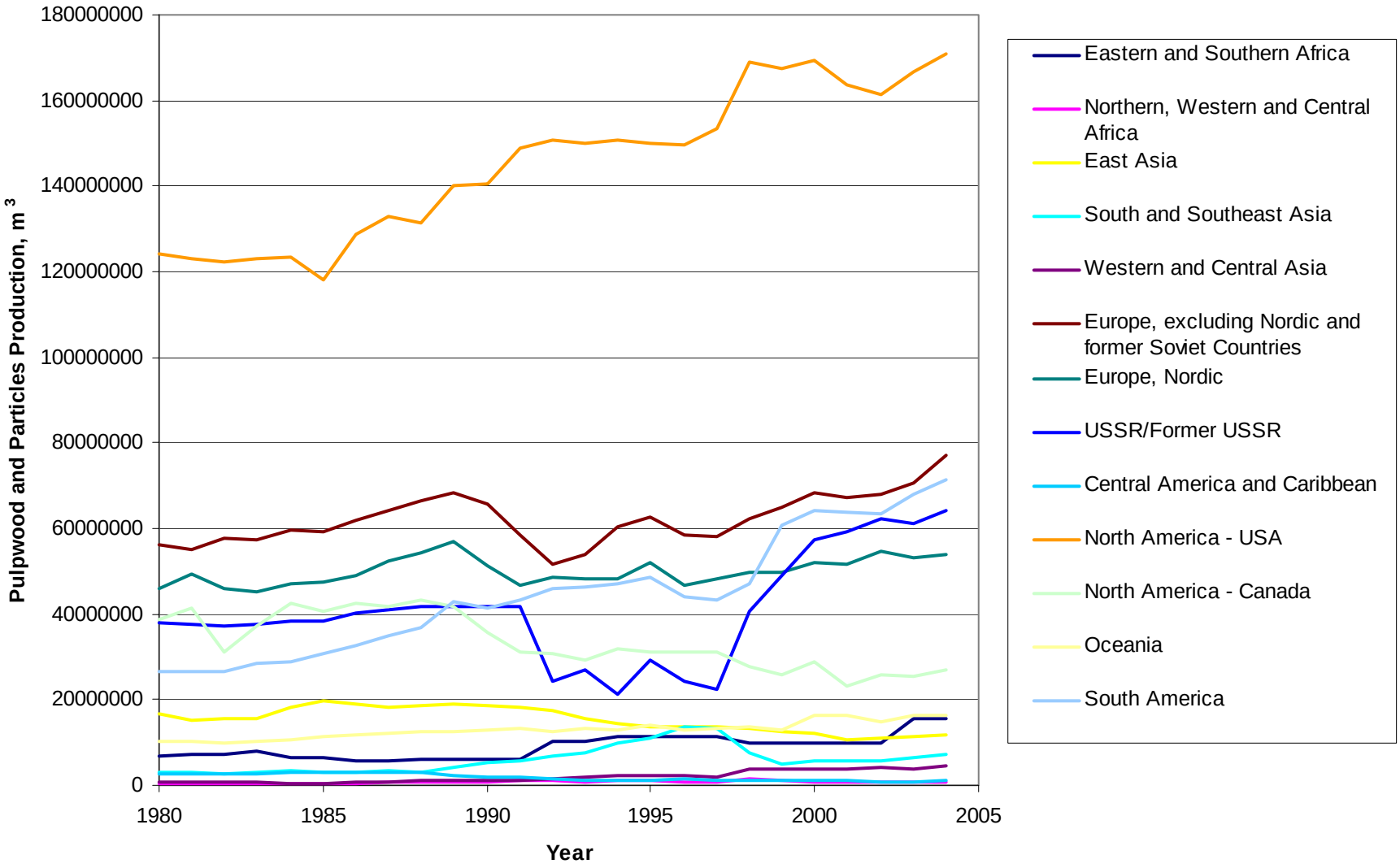


Figure 14: Regional Pulpwood Production, Proportion of World Total, 1980-2004
(Source: FAOStat Forest Products Database)

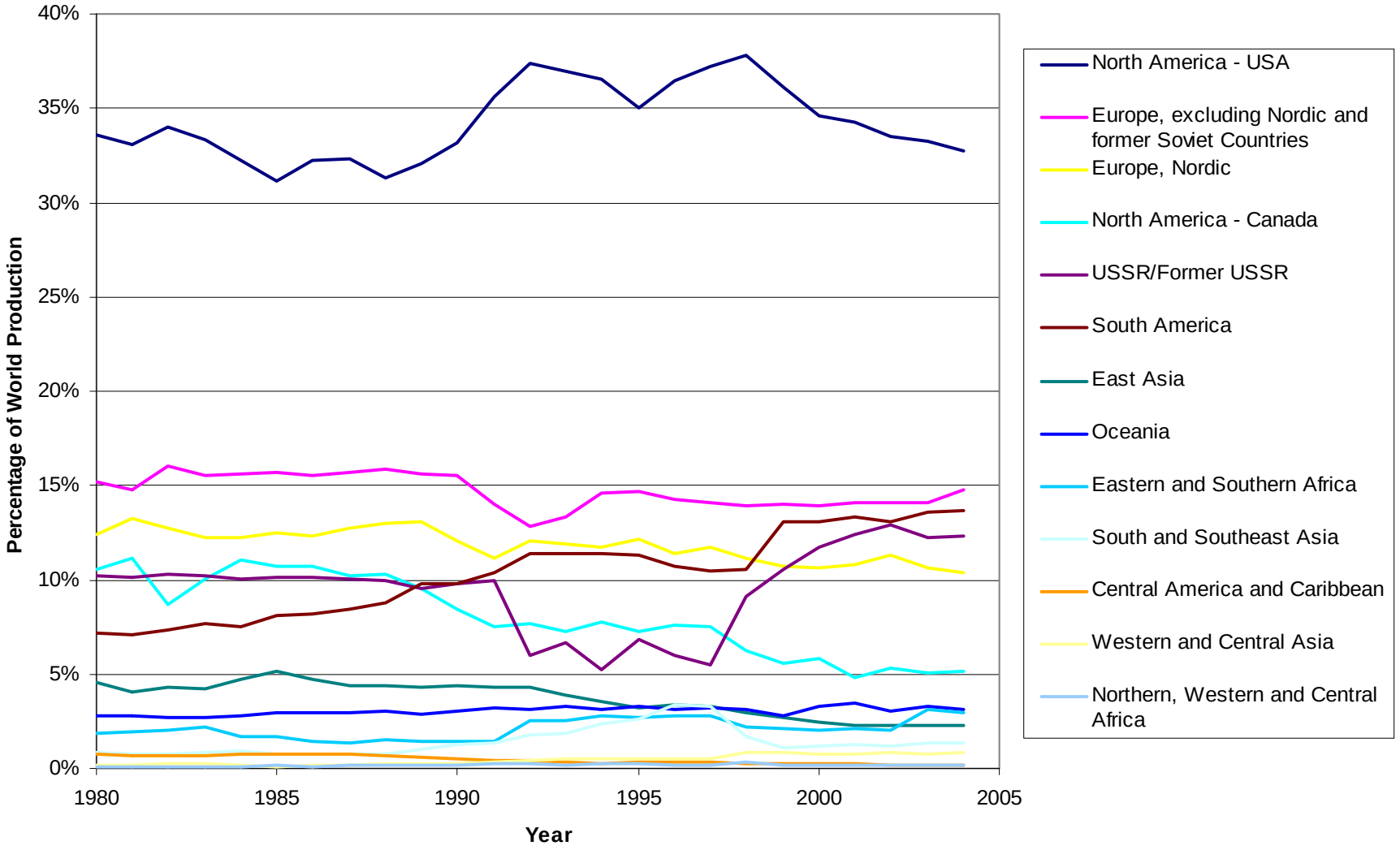


Figure 15: Regional Pulpwood Production, Proportion of World Production, 1980-2004
(Source: FAOStat Forest Products Database)

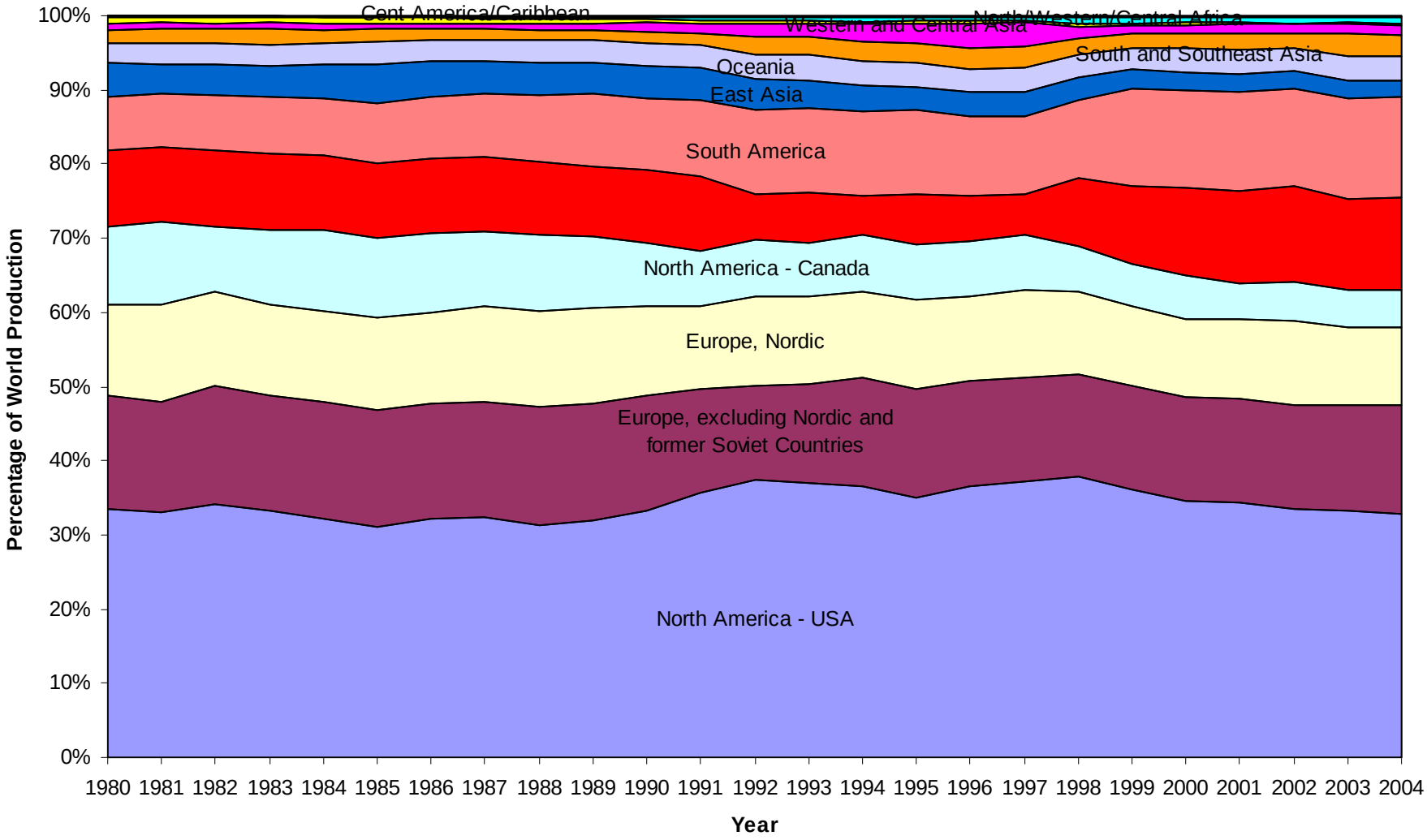


Figure 16: Regional Pulpwood Production, 1980-2004 (Largest Producing Regions Excluded)
(Source: FAOStat Forest Products Database)

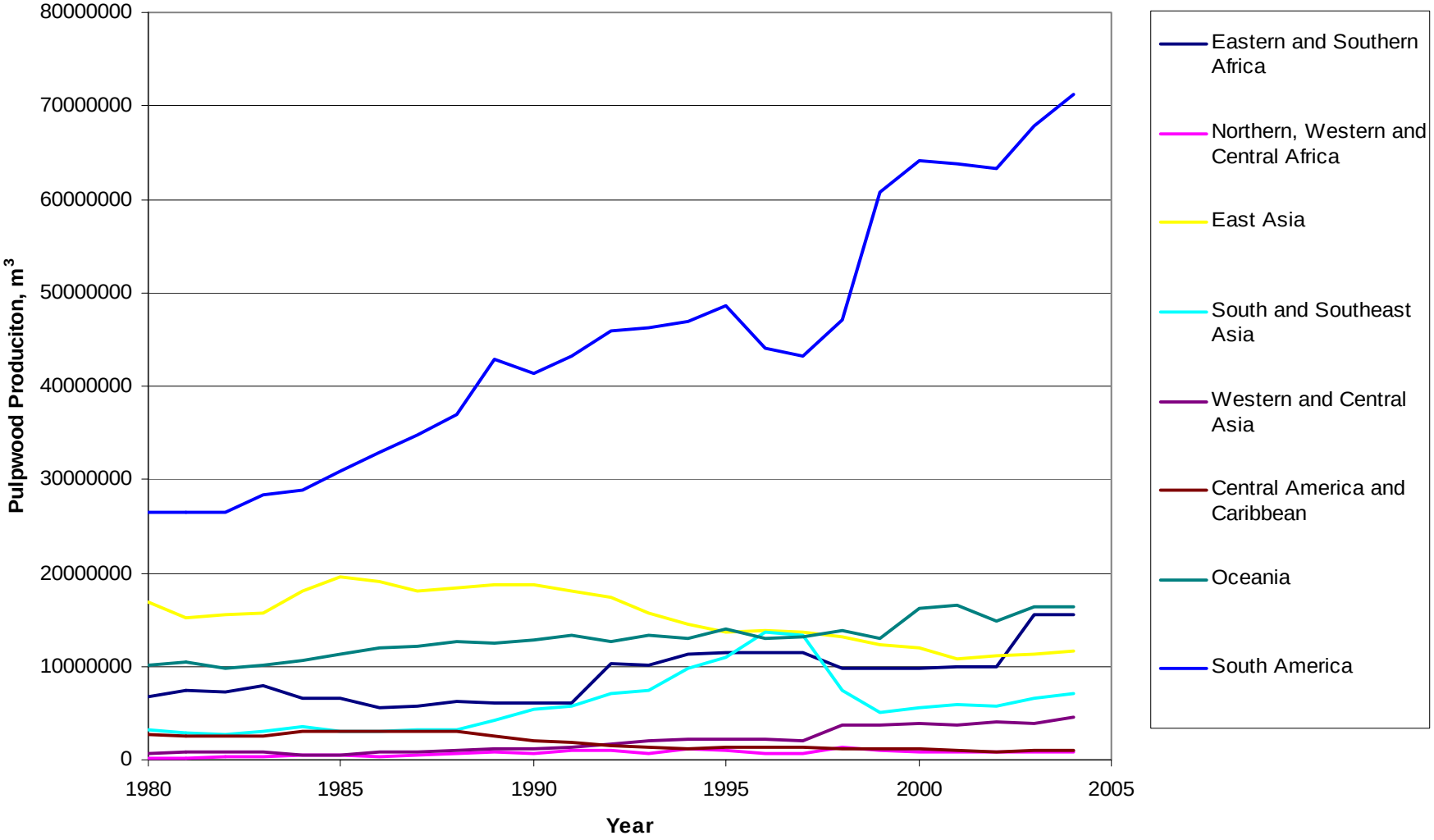


Figure 17: Regional Pulpwood Production Percentage of World Production, 1980-2004
(Largest Producing Regions Excluded)
(Source: FAOStat Forest Products Database)

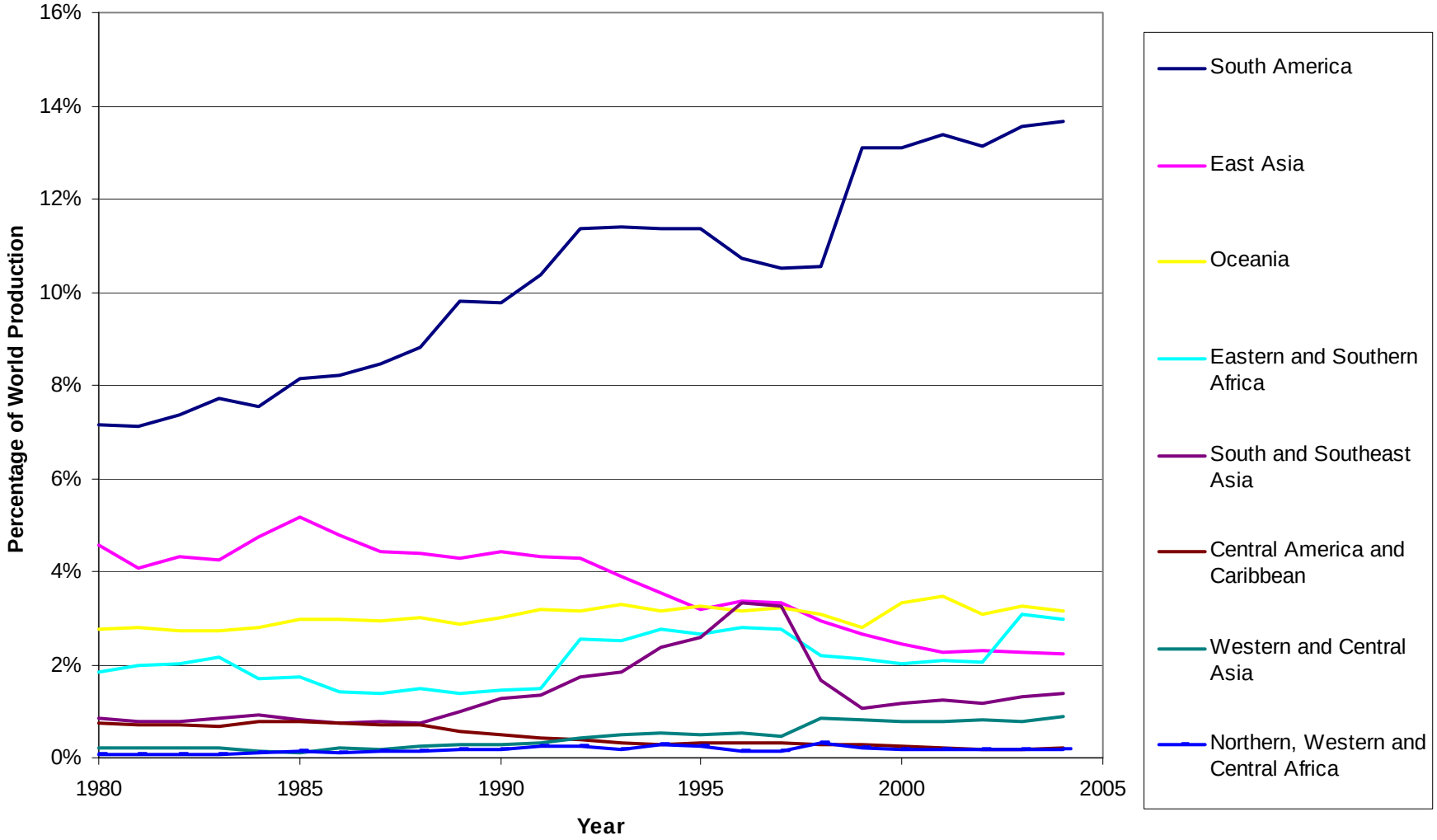


Figure 18: Regional Pulp Production, 1980-2004
(Source: FAOStat Forest Products Database)

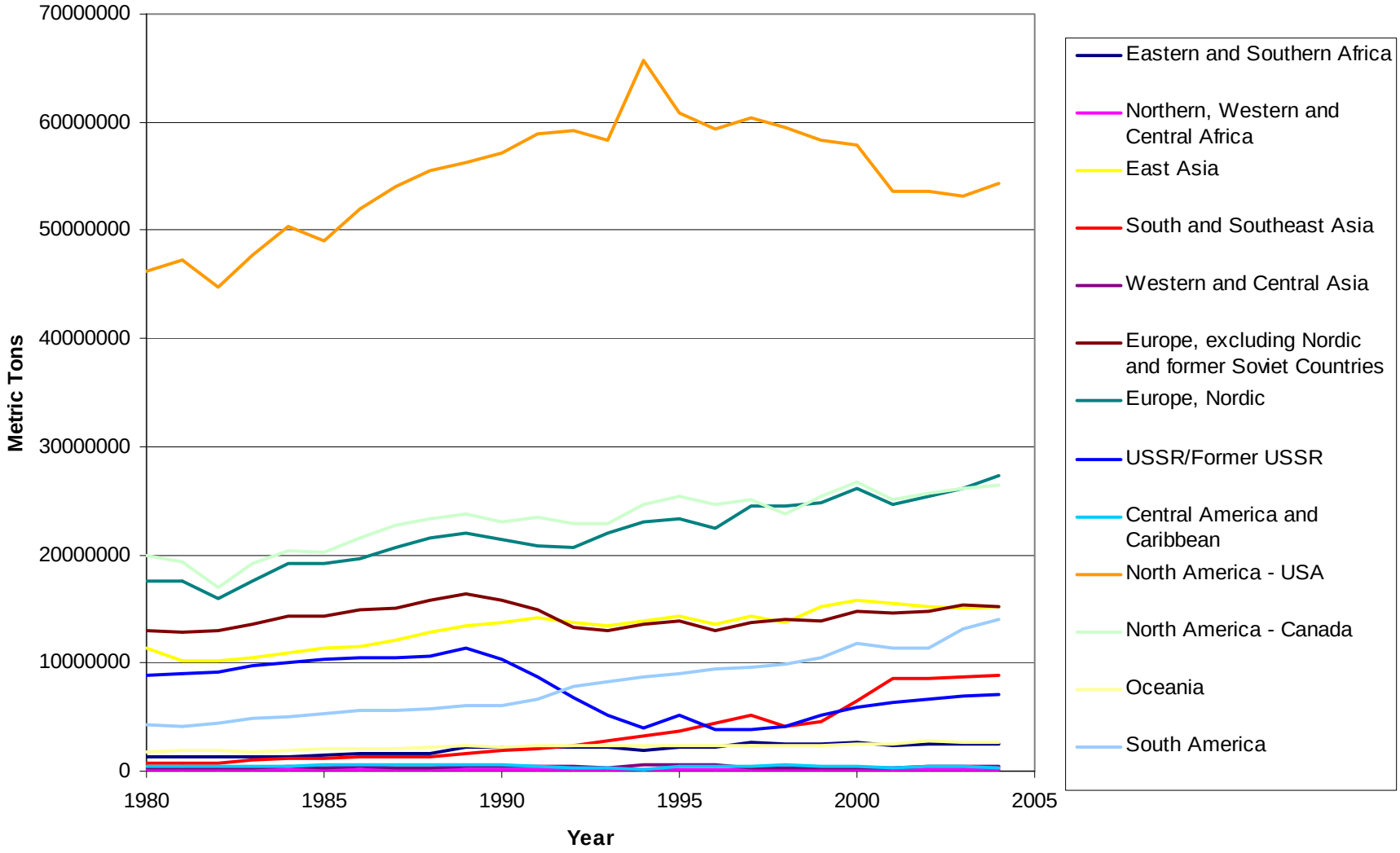


Figure 19: Regional Pulp Production, Proportion of World Total, 1980-2004
(Source: FAOStat Forest Products Database)

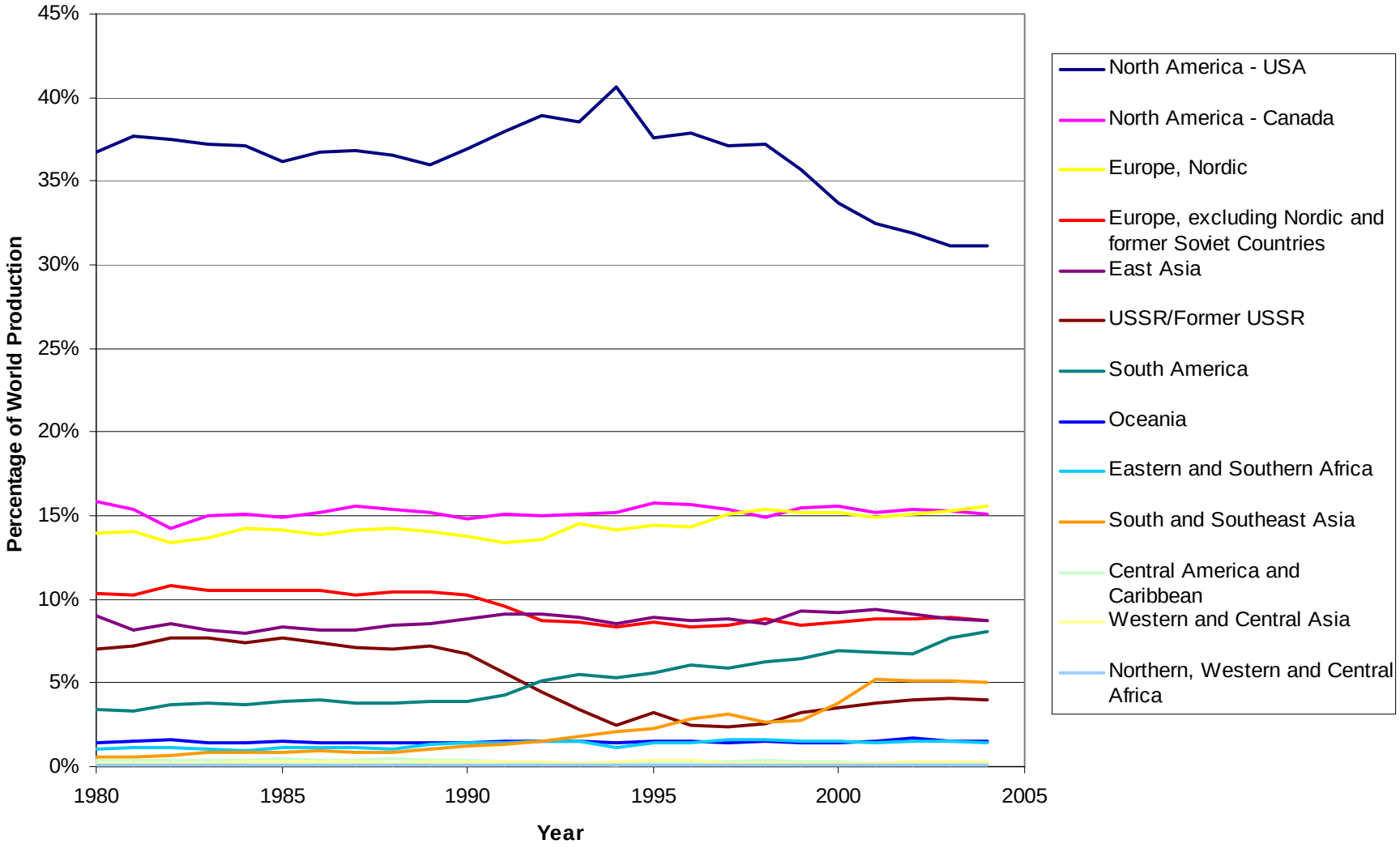


Figure 20: Regional Pulp Production, 1980-2004 (Largest producing regions excluded)
(Source: FAOStat Forest Products Database)

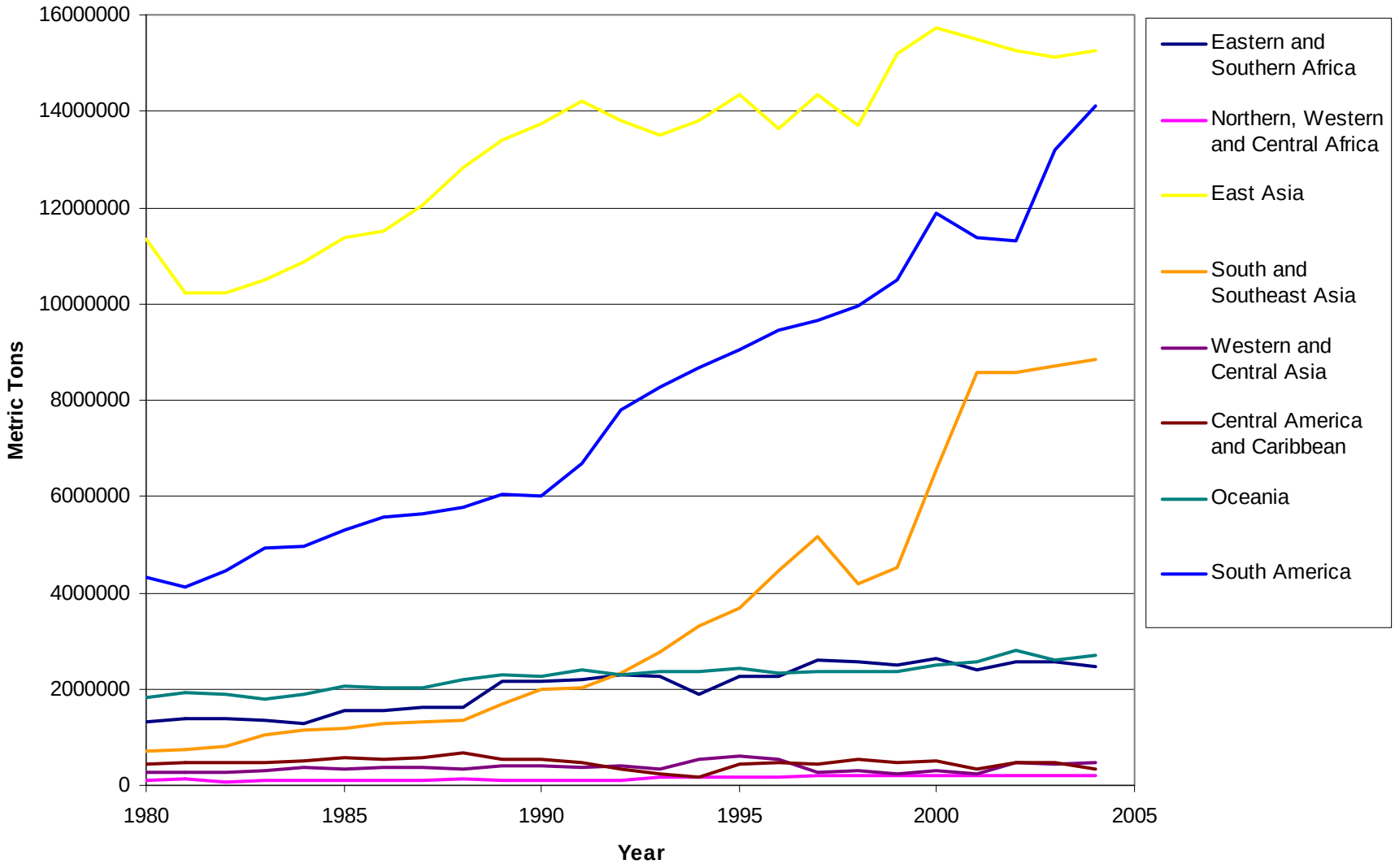


Figure 21: Regional Pulp Production Percentage of World Production, 1980-2004 (Largest Producing Regions Excluded)
(Source: FAOStat Forest Products Database)

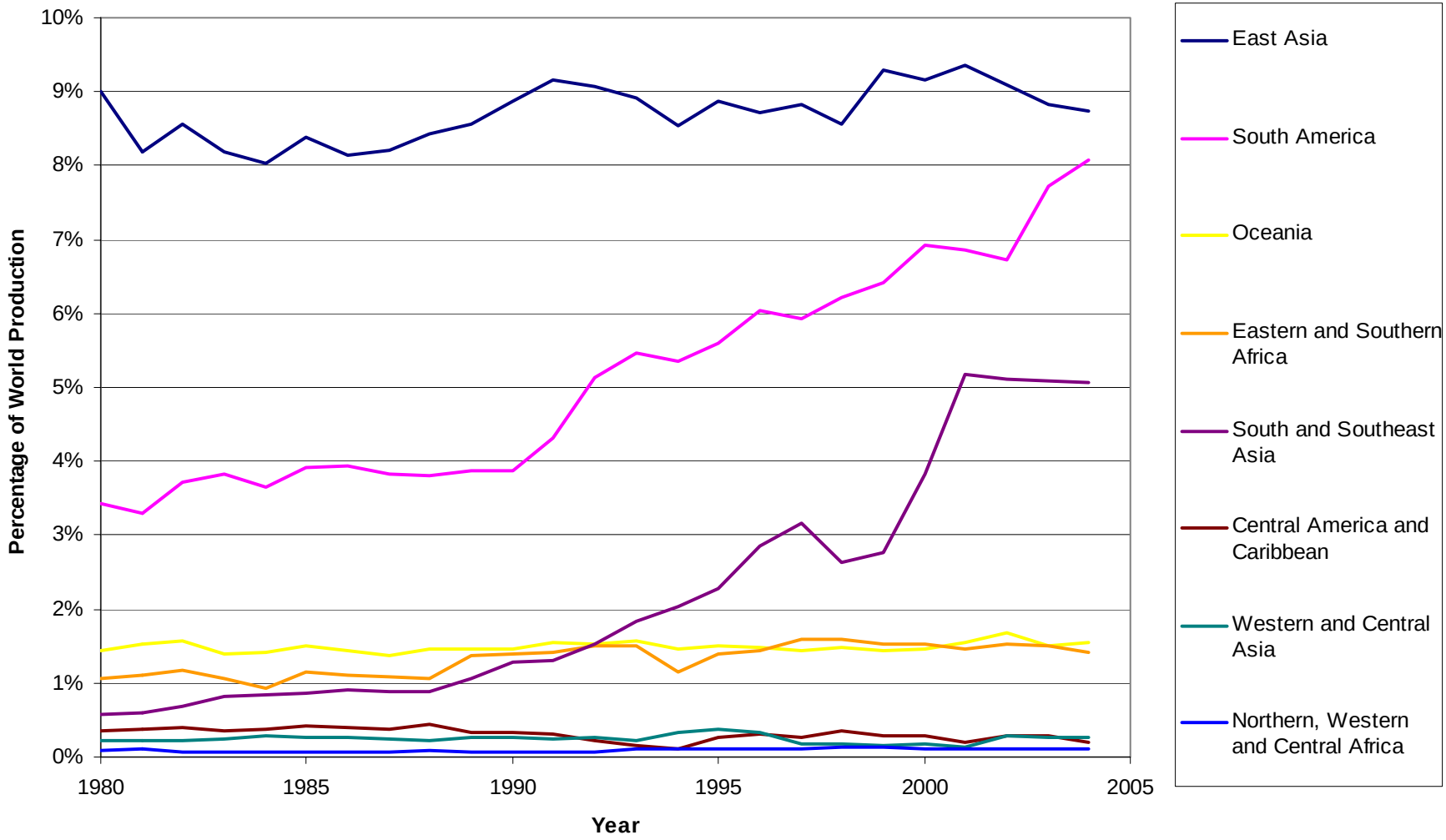
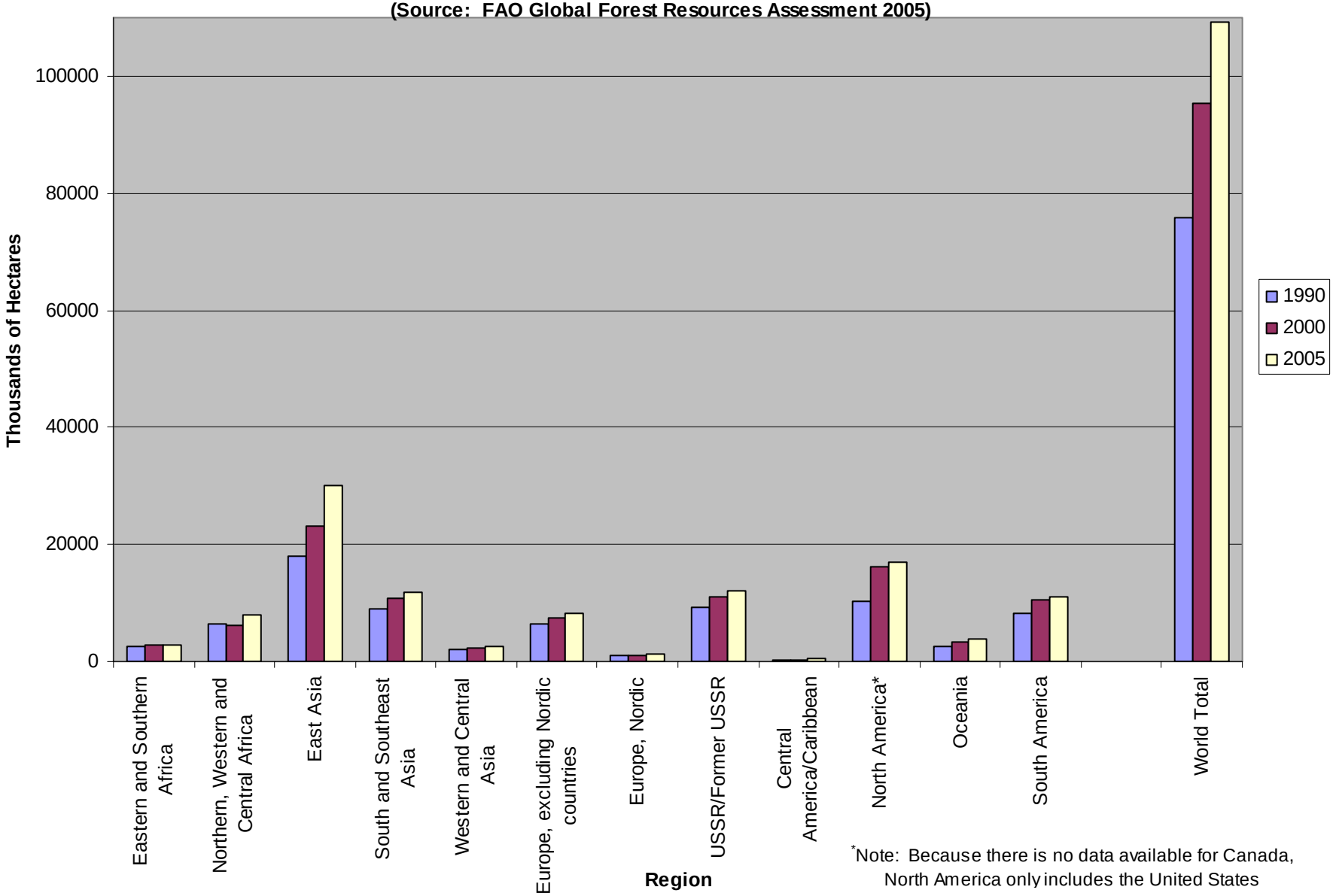
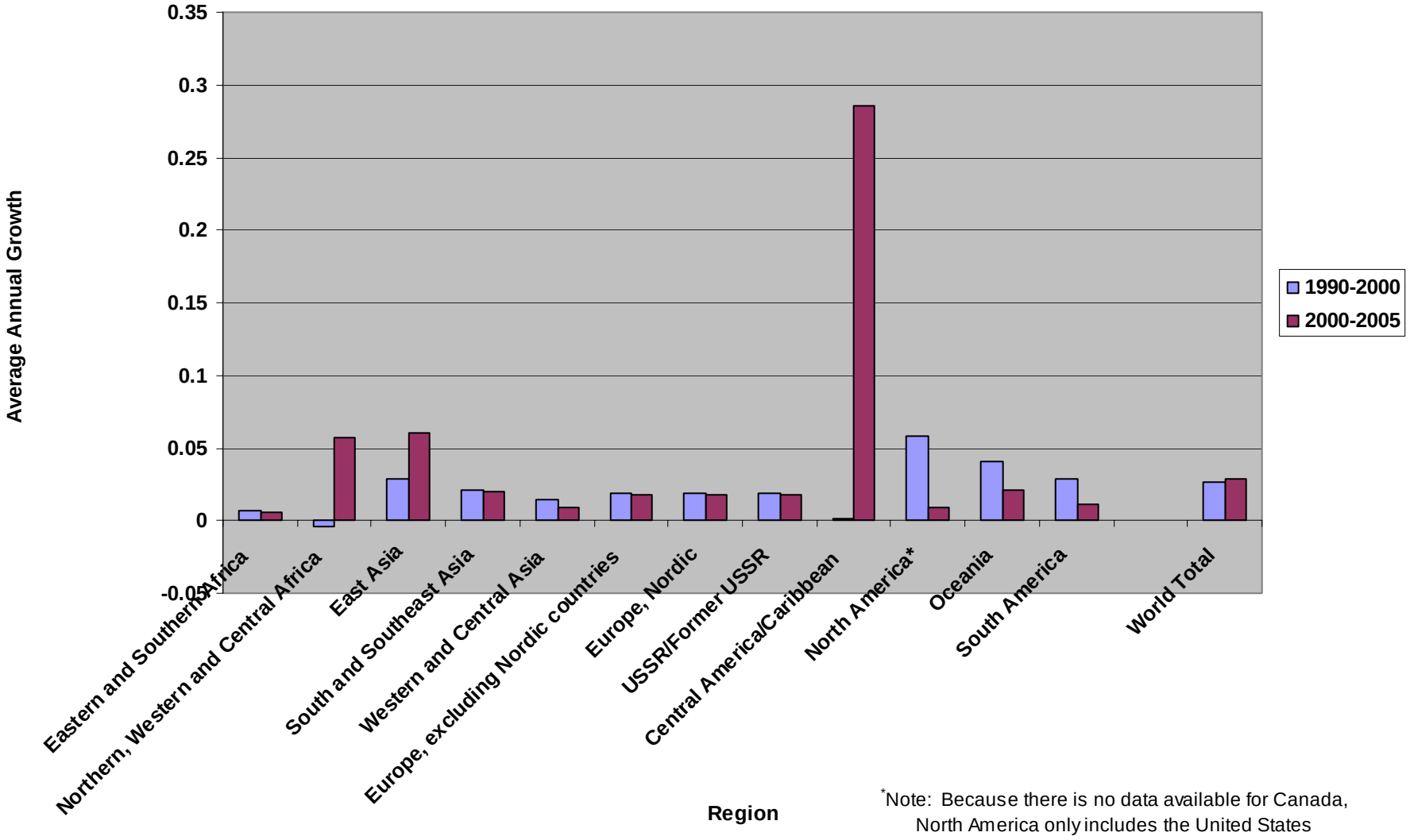


Figure 22: Forest Productive Plantation Area by Region 1990-2005
(Source: FAO Global Forest Resources Assessment 2005)



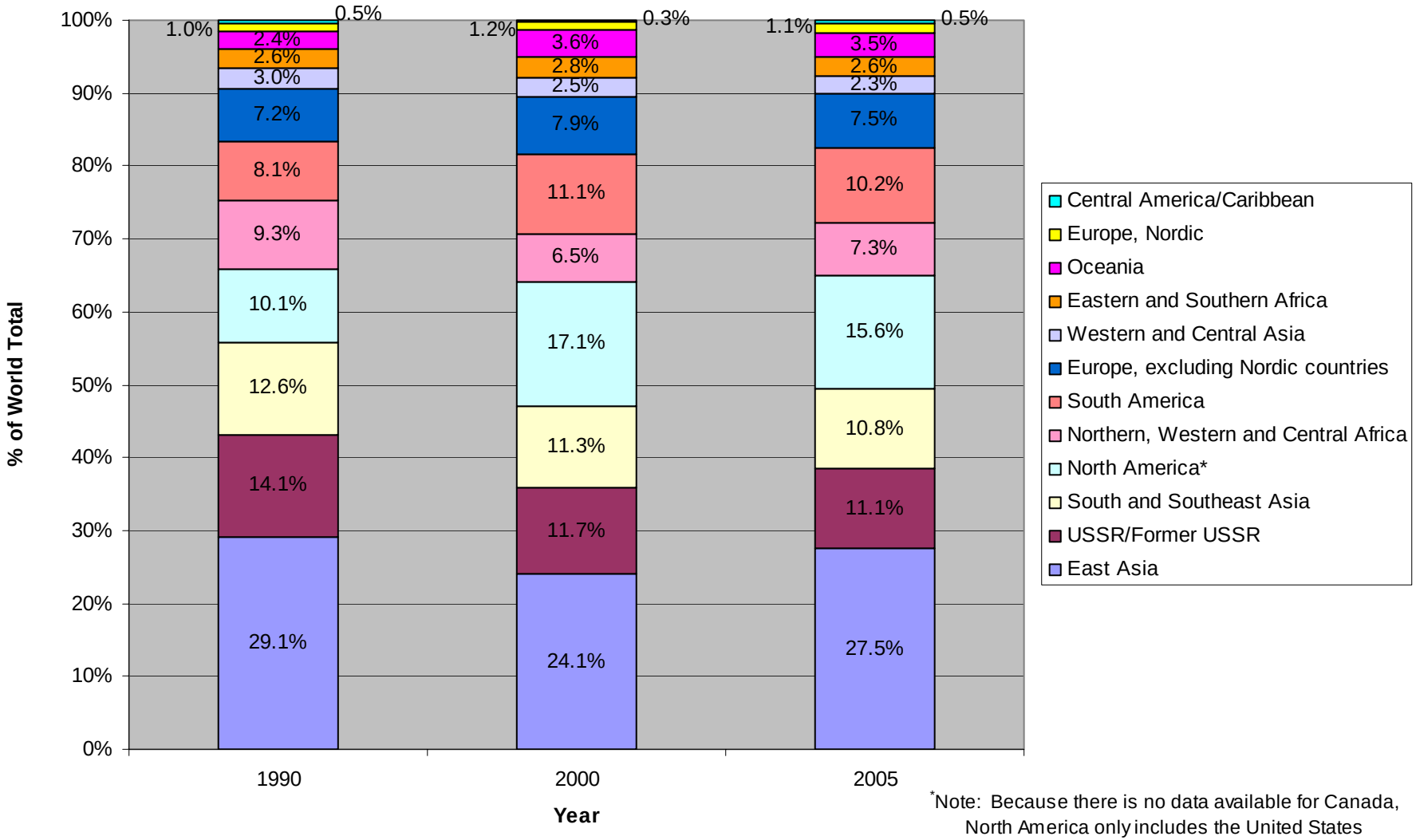
*Note: Because there is no data available for Canada, North America only includes the United States

Figure 23: Average Annual Growth in Plantations, 1990-2005
(Source: FAO Global Forest Resources Assessment 2005)



*Note: Because there is no data available for Canada, North America only includes the United States

Figure 24: Forest Plantations by Region, % of World Total, 1990-2005
(Source: FAO Global Forest Resources Assessment 2005)



*Note: Because there is no data available for Canada, North America only includes the United States

Figure 25: Number of People Employed in Forestry by Region, 1990 - 2000
(Source: FAO Global Forest Resources Assessment 2005)