

## 2. UEMOA Member Country Overviews

An overview of UEMOA member countries, highlighting each country's geography, demographics, economics, key crops, energy situation, and bioenergy status is provided as country background for the remainder of this report.<sup>1</sup>

### BENIN AT A GLANCE:



**Population:** 8,294,941 (2008)

**Urban population:** 46.1%

**Rural population:** 53.9%

**Human Development Index:**<sup>2</sup> 0.437 (2005)

**Electricity Access:** 23%

**GDP per capita:** \$1,500 (2007)

**Major Agricultural Crops:** Cotton, maize, cassava (tapioca), yams, beans, palm oil, peanuts, cashews; livestock

**% of Land under Cultivation:** 2.3% (2005)

**Oil production:** 0 bbl/day (2007)

**Oil consumption:** 9,232 bbl/day (2007)

**Oil imports:** 16,830 bbl/day (2007)

### 2.1 BENIN

#### 2.1.1 COUNTRY OVERVIEW

Benin comprises a narrow strip of 110,620 square kilometers (km<sup>2</sup>) of land area between Togo and Niger, of which about 24% is arable land. Permanent crops account for only a little over 27% of this land use. The area of irrigated land was 120 km<sup>2</sup> in 2003 and total renewable water resources 26 cubic kilometers (km<sup>3</sup>) in 2001. The total population is 8.2 million people, with a growth rate of 2.6% (2008 est.) and 37% of its population living below the poverty line (2007 est.).

<sup>1</sup> Data sources for this chapter are primarily CIA, 2008 and UEMOA Country Studies (to be published).

<sup>2</sup> The Human Development Index combines normalized measures of life expectancy, literacy, educational attainment, and per capita GDP for countries worldwide, on a scale of 0 to 1.

The country is endowed with small offshore oil deposits, limestone, marble, and timber. Benin's main agricultural products include cotton, maize, cassava, yams, beans, palm oil, peanuts, and cashews. Its main industries are textiles, food processing, construction materials, and cement. Agriculture accounts for one-third of the country's GDP, with industry accounting for 15%, and services over half of GDP. Growth in GDP has averaged 5% over the past seven years, with a per capita GDP of US\$1,500 (2007 est.). Benin remains underdeveloped and dependent on subsistence agriculture, cotton production, and regional trade. Export commodities include cotton, cashews, shea butter, textiles, palm products, and seafood. Imports include foodstuffs, capital goods, and petroleum products. Benin's largest trading partner is China, accounting for one-fifth of export earnings and 47% of imports. Insufficient electrical supply continues to adversely affect Benin's economic growth, though the government has recently taken steps to increase domestic power production. The country consumes 587 kWh of electricity, producing 105 million kWh and importing 595 kWh (2005). Completely dependent on trade for its oil, Benin imports approximately 9,232 bbl/day (2007).

### **2.1.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS**

A number of agricultural crops can serve as feedstocks for bioenergy production. These include cassava, cashew nuts, maize, and sugarcane for ethanol production, and cotton seeds, groundnuts, palm oil, soy, jatropha, and ricin for biodiesel. Overall, the evaluation of the various feedstock options, the potential for production growth, and competing demand for human and animal consumption tend to point to cassava as a significant potential crop for ethanol production. Benin is the largest producer of cassava in the UEMOA region, with approximately 2.5 million tonnes of cassava produced in 2006. Production, though, has been on the decline after peaking in 2003. Using 5% of that potential for ethanol production could generate around 20,000 cubic meters (m<sup>3</sup>) of ethanol. There are small ethanol production units employing cassava as feedstock.

Due to its comparatively limited demand for water and soil quality, sweet sorghum is also a suitable feedstock in Benin. The advantage of sorghum over other crops is that it produces two harvests per year. Estimates indicate that with less than 20,000 ha of production, sweet sorghum delivers similar ethanol yield as cassava—42,000 and 43,923 liters respectively. Currently, annual cashew production is around 40,000 tonnes, with a cashew fruit production of 160,000 tonnes per annum. This fruit is generally just thrown away (considered waste). An ongoing project seeks to assess the technical potential of ethanol production from cashew fruit.

The main oilseeds produced in Benin are cotton, groundnuts, palm trees, and soy. Estimates of current production and consumption do not seem to offer significant potential for non-human/animal use of most of these crops. Recent development of palm oil in the southern part of the country—host to 50% of agricultural production—has given rise to concerns by environmental groups about potential displacement of grain production. On the other hand, there are initiatives for jatropha-based oil and biodiesel produced from other agricultural crops.

## BURKINA FASO AT A GLANCE:



**Population:** 15,264,735 (2008)

**Urban population:** 21.3%

**Rural population:** 78.7%

**Human Development Index:** 0.370 (2005)

**Electricity Access:** 7%

**GDP per capita:** \$1,300 (2007)

**Major Agricultural Crops:** cotton, peanuts, shea nuts, sesame, sorghum, millet, maize, rice; livestock

**% of Land under Cultivation:** 0.22% (2005)

**Oil production:** 0 bbl/day (2007)

**Oil consumption:** 8,300 bbl/day (2005)

**Oil imports:** 8,158 bbl/day

## 2.2 BURKINA FASO

### 2.2.1 COUNTRY OVERVIEW

This landlocked country has 273,800 km<sup>2</sup> of total land area, of which about 18% is arable land and 0.22% is employed for permanent crops. The irrigated areas cover 250 km<sup>2</sup> (2003) and total renewable water resources are 17.5 km<sup>3</sup> (2001). Though 90% of Burkina Faso's 15 million citizens are farmers, agriculture accounts for only 30% of GDP, with industry accounting for 19%, and services 51%. Approximately 46% of the population is below the poverty line.

Cotton is the main cash crop, but the susceptibility of cotton to severe weather patterns such as drought amplifies farmers' plight. GDP growth in 2007 is estimated to be 4%, well below the 10-year average of 6%. This is due mainly to higher energy costs, imported foodstuffs, and low cotton prices. Beyond cotton, agricultural products include peanuts, shea nuts, sesame, sorghum, millet, maize, rice, and livestock. Industries include cotton lint, beverages, agricultural processing, soap, cigarettes, textiles, and gold. Burkina Faso's largest trading partner is China, accounting for 41% of exports. Imports come primarily from Côte d'Ivoire (26%), France (23%), and Togo (7%).

Burkina Faso relies on imported petroleum for most of its electricity needs, estimated at 8,158 bbl/day.

### 2.2.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS

Woody biomass accounts for 95% of biomass energy consumption. Petroleum products constitute 13% and electricity 2% of final energy consumption. Local bioenergy development could improve the diversity of energy supply. Certain initiatives are already underway. Nevertheless, at present, there is no national bioenergy policy.

While several agricultural crops appear to be potential feedstocks for ethanol and biodiesel production, only a few have been assessed from a technical and economic perspective. Sugarcane appears to be the most suitable crop for ethanol production. The national sugar company (SN SOSUCO) has approximately 5,000 ha that could be used for this purpose. Theoretically, this land could produce 20,000 m<sup>3</sup> of ethanol each year. Since 2003, cotton production has increased after a long period of decline. Total production ranges from 500,000 to 700,000 tonnes of cotton seeds. Further, there is an ongoing project to produce cotton oil with the national company SN SOSUCO in collaboration with the group DAGRIS. The unit is expected to have a productive capacity of 10,000 tonnes of oilseeds. In 2006, the Ministry of Trade and Enterprise Development started a collaborative effort with the national oil company (SONABHY) to produce biodiesel from cotton oilseeds. *Jatropha* plantations have been initiated in several parts of the country and are likely to expand following interest generated by research on high-yield seeds from institutions such as the French Agricultural Research Center for International Development (CIRAD) and national agricultural research institutions.

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## CÔTE D'IVOIRE AT A GLANCE:

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**Population:** 18,373,060 (2008)

**Urban population:** 49.5%

**Rural population:** 50.5%

**Human Development Index:** 0.432 (2005)

**Electricity Access:** 51%

**GDP per capita:** \$1,700 (2007)

**Major Agricultural Crops:** coffee, cocoa beans, bananas, palm kernels, maize, rice, cassava (tapioca), sweet potatoes, sugar, cotton, rubber; timber

**% of Land under Cultivation:** 11% (2005)

**Oil production:** 57,700 bbl/day (2005)

**Oil consumption:** 27,000 bbl/day (2005)

**Oil imports:** 76,730 bbl/day (Côte d'Ivoire is a major refiner) (2004)

**Oil exports:** 85,780 bbl/day (2004)

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## 2.3 CÔTE D'IVOIRE

### 2.3.1 COUNTRY OVERVIEW

Bordering the North Atlantic Ocean between Ghana and Liberia, Côte d'Ivoire has a total land area of 318,000 km<sup>2</sup>. Ten percent of that land is arable; 11% is comprised of permanent crops. Irrigated areas cover 730 km<sup>2</sup> (2003) and total renewable water resources are 81 km<sup>3</sup> (2001).

The total population exceeds 18 million, with an annual growth rate of approximately 2% (2008 est.). Forty-two percent of the population is below the poverty line. The country is the world's largest producer and exporter of cocoa beans and a significant producer and exporter of coffee and palm oil. Côte d'Ivoire is also rich in petroleum, natural gas, diamonds, manganese, iron ore, cobalt, bauxite, copper, gold, nickel, tantalum, silica sand, clay, and hydropower. Other agricultural and forestry products include bananas, maize, rice, cassava, sweet potatoes, sugar, cotton, rubber, and timber. Most of the population (68%) is engaged in the agriculture sector, which accounts for 27% of GDP. Industry accounts for 22% of GDP and services 50%. GDP grew by 1.6% in 2007, but per capita income has declined by 15% since 1999. Major exports include cocoa, coffee, timber, petroleum, cotton, bananas, pineapples, palm oil, and fish. More than half of Côte d'Ivoire's imports (fuel, capital equipment, and food) are supplied by Nigeria and France.

Since 2006, oil and gas production have been one of the most important economic activities as Côte d'Ivoire has one of the largest refineries in the UEMOA region. Earnings from oil and refined products were \$1.3 billion in 2006, while cocoa-related revenues were \$1 billion during the same period. Côte d'Ivoire's offshore oil and gas production has resulted in substantial crude oil exports and provides sufficient natural gas to fuel electricity exports to Ghana, Togo, Benin, Mali, and Burkina Faso. In 2005, Côte d'Ivoire produced 57,700 bbl/day and consumed 27,000 bbl/day. The country is self-sufficient in oil. In 2005, the country produced 5.305 billion kWh, consumed 2.9 billion kWh, and exported 1.397 billion kWh of electricity.

### 2.3.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS

Côte d'Ivoire has the largest percentage of electrification in the UEMOA region—85% in urban areas. The agricultural sector provides several opportunities for bioenergy production. Côte d'Ivoire has the largest potential for palm oil since its production exceeded 300,000 tonnes in 2006. Although the country produced about 2.25 million tonnes of cassava in 2006, no ethanol production from cassava has occurred. Approximately 500,000 tonnes of biomass is produced each year from agro-industrial enterprises, half of which is used to produce electricity.

Sugarcane production, concentrated in the country's northern part, is approximately 1,320,000 tonnes. It involves two major companies: Sucaf (860,861 tonnes) and Sucrivoire (569,322 tonnes). In 2005–2006, total raw sugar production was 147,279 tonnes. There is much interest in industrial-scale production of ethanol from sugarcane, maize, and other crops in Côte d'Ivoire. An American company has committed to investing US\$1 billion to produce 3.5 billion liters of ethanol from sugar and maize over a five-year period.

Although cashew production is important and has potential, no production is underway yet. The total production of 235,000 tonnes of cashew nuts, translating into 2,350,000 tonnes of cashew fruit, could potentially generate 30 liters of ethanol per tonne of cashew fruit, for a total of 70,500 m<sup>3</sup> of ethanol. Jatropa plantations have been initiated only recently.

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## GUINEA BISSAU AT A GLANCE:

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**Population:** 1,503,182 (2008)

**Urban population:** 26.1%

**Rural population:** 73.9%

**Human Development Index:** 0.374 (2005)

**Electricity Access:** 11.5%

**GDP per capita:** \$500 (2007)

**Major Agricultural Crops:** rice, maize, beans, cassava (tapioca), cashew nuts, peanuts, palm kernels, cotton; timber; fish

**% of Land under Cultivation:** 6.9% (2005)

**Oil production:** 0 bbl/day (2005)

**Oil consumption:** 2,480 bbl/day (2005)

**Oil imports:** 2,463 bbl/day (2004)

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## 2.4 GUINEA BISSAU

### 2.4.1 COUNTRY OVERVIEW

Guinea Bissau has a total land area of 36,120 km<sup>2</sup> and borders the North Atlantic Ocean between Guinea and Senegal. It is rich in fish, timber, phosphates, bauxite, clay, granite, limestone, and unexploited deposits of petroleum. The country produces rice, maize, beans, cassava, cashew nuts, peanuts, palm kernels, and cotton. It also has large timber and fisheries industries. Arable land accounts for 8.3% of total land; 6.9% is devoted to permanent crops. Agriculture accounts for 62% of GDP, but employs 82% of the population. Guinea Bissau exports fish and seafood along with small amounts of peanuts, palm kernels, and timber. Imports include foodstuffs, machinery, transport equipment, and petroleum products. Because of high costs, the development of petroleum, phosphate, and other mineral resources is not a prospect for the near future. Since offshore oil prospecting has not yet yielded commercially viable crude deposits, the country remains dependent on oil imports at the rate of 2,463 bbl/day (2004). Electricity production (60 million kWh) fulfills domestic consumption requirements (55.8 million kWh).

### 2.4.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS

Guinea Bissau's energy profile is dominated by traditional biomass, which represents 90% of energy consumption. Petroleum products account for 8% of energy consumption and electricity accounts for the remaining 2%. Recent trends in the energy profile indicate a slight reduction in

the use of woody biomass to its 90% level from 97% in 1990 due to the increased use of natural gas. Development of biomass conversion into modern energy applications is limited.

Agricultural production benefits from suitable conditions with respect to rainfall—1,200 to 2,600 mm more per year than most other UEMOA member countries. Cashew is the most prominent agricultural crop in Guinea Bissau, generating more than US\$60 million of the country's export income from an annual production of 80,000 to 90,000 tonnes. Cashews offer the highest potential for bioenergy production in the form of ethanol from cashew fruits and electricity from cashew nuts. The total annual production is estimated to reach 600,000 tonnes, of which only 30% is transformed into juice to produce wine and spirits. If the remaining 70% (usually lost) were to be employed for the production of ethanol, the potential production of ethanol would be approximately 8,400 to 12,700 m<sup>3</sup> per year. However, a major drawback is that the season lasts only three months each year, from April to June.

Beyond ethanol production, there may be significant potential for electricity generation from cashew nuts. An ongoing initiative with support from the UEMOA Commission seeks to assess that potential.

In addition, timber harvesting yields some 67,000 m<sup>3</sup> of wood residues annually. This resource currently provides 12,000 tonnes of charcoal to meet the demand for cooking fuel. New applications to process these resources (pellets) and burning the cleaner fuel in more efficient stoves could improve the energy balance as outlined in the introduction. These residues could also be used in electricity generation.

In Guinea Bissau, effective forest management will be crucial. One possible policy shift is the reduction of charcoal in favor of more efficient and less polluting fuel options. Such an effort could also improve the quality of life for many rural people and replace charcoal production with alternative cooking fuel production.

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## MALI AT A GLANCE:

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**Population:** 12,324,029 (2008)

**Urban population:** 33.4%

**Rural population:** 66.6%

**Human Development Index:** 0.380 (2005)

**Electricity Access:** 17%

**GDP per capita:** \$1,000 (2007)

**Major Agricultural Crops:** cotton, millet, rice, maize, vegetables, peanuts; cattle, sheep, goats

**% of Land under Cultivation:** 0.33% (2005)

**Oil production:** 0 bbl/day (2007)

**Oil consumption:** 5,600 bbl/day (2006)

**Oil imports:** 5,600 bbl/day (2006)

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## 2.5 MALI

### 2.5.1 COUNTRY OVERVIEW

With 1.22 million km<sup>2</sup> of land, Mali borders southwest Algeria and is among the world's poorest countries. This is because the country is landlocked and approximately 65% of the land area is desert or semi-desert.

Only about 4% of its land is arable, with 0.03% under permanent cultivation. Irrigated areas cover more than 2,360 km<sup>2</sup> (2003), and the total renewable water resources are 100 km<sup>3</sup> (2001). The total population exceeds 12 million (July 2008 est.). The growth rate is 2.7% (2008 est.), and 36% of the population lives below the poverty line (2005 est.). Key environmental problems include deforestation, soil erosion, desertification, inadequate supplies of potable water, and poaching. Economic activity is largely confined to an area irrigated by the Niger. Eighty percent of the labor force either farms or fishes, which accounts for 45% of GDP. Industrial activity is concentrated on processing farm commodities. Mineral resources include gold, phosphates, kaolin, salt, limestone, uranium, gypsum, and granite. Bauxite, iron ore, manganese, tin, and copper deposits have been discovered but have not been exploited. The country is vulnerable to fluctuations in world prices for cotton, its main export, and gold. In terms of electricity production, Mali is producing and consuming 804 million kWh (2006). The country is entirely dependent on oil imports, amounting to 5,600 bbl/day (2006 est.). Mali has a considerable trade deficit, with exports estimated at \$294 million free on board (f.o.b.), and imports of \$2.4 billion f.o.b. (2006).

### 2.5.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS

Mali has adapted its 2006 agriculture legislation with the specific objective of energy production from agricultural crops.

Jatropha has been a centerpiece of the country's experience with bioenergy and a focus of government efforts. Several pilot projects have been initiated over the past several years with jatropha oil being used to run agricultural machinery and for rural electrification. To date, the national potential for jatropha has not been evaluated. However, partial assessments indicate the availability, as do experiments conducted to evaluate potential seed and oil production. It is estimated that Mali has more than 20,000 km of jatropha hedge. Seed production is estimated to be two kilograms per linear meter, resulting in a natural potential of about 34,000 tonnes per year. If jatropha plantations were to be developed on available agricultural land, approximately four million hectares could be utilized. Using one-quarter of this area with a production assumed to be at three kilograms in the fifth year of growth, Mali would obtain a raw production of at least 7.8 million tonnes of seeds, equivalent to 1.95 million liters of diesel in the form of jatropha oil in one year. Furthermore, the potential for jatropha's development remains considerable, since areas not suitable for crops could be planted with jatropha.

Ethanol development is also underway with two sugar-producing units that belong to SUKALA-S.A. (Dougabougou and Siribala). Sugarcane production is 400,000 tonnes per year, and molasses between 8,000 and 10,000 tonnes per year. Approximately 50% of molasses is dedicated to ethanol production; the remainder is sold for animal feed or to the agro-food industry. The company produces 2.3 million liters of ethanol per year. Ethanol is sold to the pharmaceutical industry and to the agro-food and beverage industries in Mali. Large quantities (about one million liters per year) are exported to Burkina Faso. Production of cane could be doubled or tripled with the implementation of new sugar projects on 12,000 ha financed by the American-Brazilian consortium. The vast potential of agricultural residues and forest resources for modern energy generation (e.g., biogas, electricity) remains underutilized. Despite Mali's huge cotton production, the recent surge in the demand for cottonseed oil for human consumption seems to undermine any potential for energy use. Meanwhile, declining world prices have tended to encourage farmers to move to other crops, resulting in a decline in national cotton production. In Mali, the regulatory framework for bioenergy is defined in the national energy policy, the national strategy for renewable energies, and the national strategy for the development of biofuels. These initiatives will be implemented by the National Agency for Bioenergy (BIOCARMA), which is currently being developed and is expected to be operational in the summer of 2008.

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## NIGER AT A GLANCE:

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**Population:** 13,272,679 (2008)

**Urban population:** 23.2%

**Rural population:** 76.8%

**Human Development Index:** 0.374 (2005)

**Electricity Access:** 7%

**GDP per capita:** \$700 (2007)

**Major Agricultural Crops:** cowpeas, cotton, peanuts, millet, sorghum, cassava (tapioca), rice; cattle, sheep, goats, camels, donkeys, horses, poultry

**% of Land under Cultivation:** 0.01% (2005)

**Oil production:** 0 bbl/day (2005)

**Oil consumption:** 5,450 bbl/day (2005)

**Oil imports:** 5,412 bbl/day (2004)

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## 2.6 NIGER

### 2.6.1 COUNTRY OVERVIEW

Niger is landlocked and mostly desert (the northernmost four-fifths). Of its 1.27 million km<sup>2</sup> of land, 11% is arable, 0.01% is used for permanent crops, and only 730 km<sup>2</sup> are irrigated. Niger has renewable water resources of 33.7 km<sup>3</sup> (2003). The total population exceeds 13 million (July 2008 est.), with 63% of the population living below the poverty line (2007 est.). Key environmental challenges include overgrazing, soil erosion, deforestation, desertification, and loss of wildlife populations.

The economy centers on subsistence crops, livestock, and some of the world's largest uranium deposits. The agriculture sector comprises 39% of GDP, but employs 90% of the labor force. Agriculture products include cowpeas, cotton, peanuts, millet, sorghum, cassava, rice, cattle, sheep, goats, camels, donkeys, horses, and poultry. Drought cycles, desertification, and population growth have hit the economy hard.

Niger has a current account deficit of \$321 million (2007 est.), with exports of uranium ore, livestock, cowpeas and onions comprising \$428 million f.o.b., while imports of foodstuffs, machinery, vehicles and parts, petroleum, and cereals comprise \$800 million f.o.b. (2006).

Growth in the future could be sustained by exploitation of oil, gold, coal, and other mineral resources. Electricity consumption is 437.7 million Kwh, with 220 million kWh being supplied through imports (2005). Oil consumption is supplied almost entirely by imports, which amount to 5,412 bbl/day (2004).

### 2.6.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS

Woody biomass remains the primary source of energy, providing 95% of energy needs for the vast majority of the population. There is a significant forest area estimated at 16,000 ha, which represents 2% of total land cover. Valuable forest resources are under threat due to increasing deforestation and the advance of desertification. The national strategy for rural development adopted in 2003 seeks to promote the development of renewable sources of energy, including biogas, vegetable oils, ethanol, and biodiesel.

A dozen agro-forest species have been identified in Niger as potential energy plants and crops, including natural plants such as balanites, jatropha, neem, and ricin. Export crops include cotton, groundnuts, maize, and cassava. However, the country's initiatives have focused on species that seem to be adapted to the Sahel's ecological conditions, in particular the potential to develop jatropha and other oil plants.

Studies of land use have indicated that 953,401 ha could be made available for planting jatropha bushes, taking into account protected zones and forest reserves that total 313,599 ha. The Sahelo-Sudanic zone is considered the most suitable area for jatropha development.

Niger has demonstrated the most interest in neem for biofuels development. In June 2005, a demonstration of the use of neem oil in a diesel motor pump took place at the National Council of the Environment for Sustainable Development (CNEDD). The mix was 0.5 liters of diesel and 0.5 liters of neem oil. As an experiment, a Nigerian NGO—the School Instrument of Peace (EIP)—initiated the use of neem oil to operate some motor pumps and grain mills in their participating villages of Seno, Sounga Dossdo, Wali, and Sawani. The progressive introduction of diesel tractors creates another opportunity for biodiesel use.

Niger seems to offer a high potential for biogas generation, owing to its vast livestock industry. The pastoral area extends over more than 240,000 km<sup>2</sup> and includes more than 7 million head of livestock. There is an ongoing assessment of this potential, with the goal of producing household electricity and cooking fuel from biogas.

## SENEGAL AT A GLANCE:



**Population:** 12,853,259 (2008)

**Urban population:** 51%

**Rural population:** 49%

**Human Development Index:** 0.499 (2005)

**Electricity Access:** 42%

**GDP per capita:** \$1,700 (2007)

**Major Agricultural Crops:** peanuts, millet, maize, sorghum, rice, cotton, tomatoes, green vegetables; cattle, poultry, pigs; fish

**% of Land under Cultivation:** 0.24% (2005)

**Oil production:** 0 bbl/day (2005)

**Oil consumption:** 35,000 bbl/day (2005)

**Oil imports:** 37,180 bbl/day (2004)

## 2.7 SENEGAL

### 2.7.1 COUNTRY OVERVIEW

With 192,000 km<sup>2</sup> of land, Senegal borders the North Atlantic Ocean between Guinea Bissau and Mauritania. The country's principal natural resources are fish, phosphates, and iron ore. Just over 12% of the land is arable and 1,200 km<sup>2</sup> are irrigated, with 0.24% of land devoted to permanent crops. Its total renewable water resources are 39.4 km<sup>3</sup> (1987). Key environmental challenges include wildlife populations threatened by poaching, deforestation, overgrazing, soil erosion, desertification, and overfishing.

Senegal has a total population of almost 13 million (July 2008 est.), and a growth rate of 2.58% (2008 est.), with 54% of the population living below the poverty line (2001 est.). Agriculture products include peanuts, millet, maize, sorghum, rice, cotton, tomatoes, green vegetables, cattle, poultry, pigs, and a sizeable fish industry. Since its economy contracted by 2.1% in 1993, Senegal has made reforms that have resulted in real GDP growth averaging more than 5% annually over the period 1995 to 2007. Major exports include fish, groundnuts (peanuts), petroleum products, phosphates, and cotton; imports include food and beverages, capital goods, and fuels.

Senegal was beset by an energy crisis that caused widespread blackouts in 2006 and 2007. However, today, production of 2.159 million kWh outstrips consumption of 1.859 million kWh. Senegal remains highly dependent on foreign oil, importing 37,180 bbl/day (2004). Senegal has

a substantial current account deficit of \$906 million (2007 est.), compounded by sharply reduced output in the phosphate industry, which has reduced GDP.

### **2.7.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS**

Senegal has adopted a national bioenergy strategy that is largely centered on the development of jatropha for biodiesel and sugarcane for ethanol. The special program for biofuels began in 2006. It is being implemented by a national technical committee under the authority of the Minister of Cooperation that consists of local elected officials—notably the National Association of Rural Councilors (ANCR)—and producer organizations. The Senegalese Institute for Agricultural Research will monitor production. The strategy for the program implementation depends, in part, on the country's plan to Return to Agriculture (REVA). The set objective is the planting of 320,000 ha of jatropha bushes by 2012, providing 1,000 ha per rural community. This program would yield 3.2 million tonnes of seeds by 2012, netting 1.2 billion gallons of straight Jatropha oil, or 1.1 billion liters of refined oil that could be used as biodiesel. Senegal expects jatropha to contribute to a significant reduction in oil imports and make the country a net producer of energy.

Meanwhile, ethanol production has been underway at the Senegalese Sugar Company (CSS). The company produces approximately 35,000 tonnes of molasses with a strong sugar content. It projects that it can transform the molasses into 2,500 m<sup>3</sup> of industrial ethanol and 10,000 tonnes (12,500 m<sup>3</sup>) of anhydrous ethanol as biofuel.

The national oil seeds company (SANACOS) has been employing groundnut shells in cogeneration with a production estimated at 341 kilotonnes. Nonetheless, energy generation from groundnut shells remains limited in comparison to the large volume of groundnut production available within the country.

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## TOGO AT A GLANCE:

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**Population:** 5,858,673 (2008)

**Urban population:** 36.1%

**Rural population:** 63.9%

**Human Development Index:** 0.512 (2005)

**Electricity Access:** 10%

**GDP per capita:** \$800 (2007)

**Major Agricultural Crops:** coffee, cocoa, cotton, yams, cassava (tapioca), maize, beans, rice, millet, sorghum; livestock; fish

**% of Land under Cultivation:** 2.11% (2005)

**Oil production:** 0 bbl/day (2005)

**Oil consumption:** 16,000 bbl/day (2005)

**Oil imports:** 15,130 bbl/day (2004)

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## 2.8 TOGO

### 2.8.1 COUNTRY OVERVIEW

A narrow strip of 54,385 km<sup>2</sup> of land between Ghana and Benin, Togo is rich in phosphates, limestone, and marble.

It also has a considerable amount of arable land, 44%, with 2% of that land devoted to permanent crops. The areas under irrigation extend more than 70 km<sup>2</sup> (2003), and total renewable water resources are 14.7 km<sup>3</sup> (2001). Togo has a total population of more than 5.8 million, an annual growth rate of 2.7% (2008 est.), and has 32% of the population below the poverty line (2007). Key environmental challenges include deforestation due to slash-and-burn agriculture and fuelwood use, water, and air pollution. Togo is heavily dependent on both commercial and subsistence agriculture, which provides employment for 65% of the labor force and comprises the greatest part of GDP, at 40%. Industry makes up 25% of GDP and 5% of the labor force; services account for 35% of GDP and 30% of the labor force. Agriculture products include coffee, cocoa, cotton, yams, cassava, maize, beans, rice, millet, sorghum, livestock, and fish industries. Cocoa, coffee, and cotton generate about 40% of export earnings with cotton being the most important cash crop. The country is the world's fourth-largest producer of phosphate. However, it has a current account deficit of \$160 million (2007). Exports include cotton, phosphates, coffee, and cocoa; imports include machinery and equipment, foodstuffs, and petroleum products.

Togo relies on the import of electricity from neighboring Ghana, which supplies 486 million kWh of the 576 million kWh consumed (2005). Oil imports to meet domestic consumption are 15,130 bbl/day (2004).

### **2.8.2 BIOENERGY FEEDSTOCKS—POLICIES AND PROGRAMS**

Biomass accounts for 76% of final energy consumption in Togo, petroleum products 20%, and electricity 4%. Biomass resources come from agriculture, forests, and associated residues, biofuels, and biogas. The total area of full forest cover is estimated at 449,000 ha. The national consumption of charcoal was around 1.9 million tonnes in 2006, of which 62% was consumed in rural areas and 38% in urban areas. The country satisfies much of its energy needs for cooking and heating from traditional biomass resources. Replacing charcoal production with modern, cleaner biomass fuels should be a top priority for Togo. This effort, combined with an active reforestation and forest management strategy, could significantly improve rural incomes and contribute to sustainable development.

Agricultural crops include several potential feedstocks, including sugarcane, cashew, sorghum, maize, cassava, groundnuts, and palm oil. Sugar production is undertaken on an industrial scale at Anié (200 km north of Lomé, the capital of the country) by a Chinese-owned sugar company. The area exploited—1,250 ha—is relatively small, which limits the production to 8,000 tonnes per year. Most of the molasses produced is used in the pharmaceutical industry; some is exported to Burkina Faso and Ghana. Togo produced approximately 750,000 tonnes of cassava in 2006, making it the third-largest producer of cassava in the region, after Benin and Côte d'Ivoire. Current cassava production is for human consumption; production would need to be significantly increased to generate feedstock for energy beyond food requirements. Both cotton and palm oil production have recorded a decline in production in the past years, with the cotton decline driven largely by low international prices.

While a few pilot projects have been initiated to develop biogas from animal wastes, applications remain limited due to competition from cheap woody biomass. In developing Togo's national development strategy, which was adopted in May 2007, use of jatropha to produce biodiesel was identified as one of the priority action areas to be developed during 2008 to 2010 as part of the poverty reduction program for achieving the MDGs. This could open up new opportunities for future production of biodiesel from jatropha.

## 2.9 SUMMARY

- Approximately 60% of the population is below 25 years of age, and based primarily in rural areas where unemployment levels are high and there is a significant migration to urban areas.
- Agriculture accounts for the bulk of GDP; cotton and groundnuts are key cash crops and both are experiencing significant price declines and susceptibility to weather patterns.
- Most UEMOA member countries have established biofuels production policies and several have attracted investor interest in establishing plantations. The combination of pro-biofuels policies, investor interest, and existing and potential feedstocks offers an opportunity to enhance energy access in the region. Examples of related activities include:
  - » **Benin** has a small operating ethanol plant and initiatives underway for jatropha/biodiesel development.
  - » **Burkina Faso** is producing biodiesel from cotton seeds and is developing jatropha plantations.
  - » **Côte d'Ivoire** has the largest potential for palm oil. Biomass produced from agro-industrial enterprises is used to produce electricity. There is also much interest in industrial-scale production of ethanol from sugarcane, maize, cassava, and other crops. Jatropha plantations have been initiated only recently.
  - » **In Guinea Bissau**, cashew presents the highest potential for bioenergy, potentially using cashew fruit and/or agro-forest residues to generate electricity and produce cleaner cooking fuels. Ethanol production is possible and it could contribute to other energy needs.
  - » **Mali** has adapted its 2006 legislation on agriculture with the specific objective of energy production from agricultural crops. Jatropha has been a centerpiece of Mali's experience with bioenergy. The development of ethanol from sugar is also underway and there is potential to use agricultural residues and forest resources for modern energy generation (biogas, electricity).
  - » **In Niger**, the national strategy for rural development adopted in 2003 seeks to promote the development of renewable sources of energy, including vegetable oils, ethanol, and biodiesel. Niger is also pursuing biogas generation, due to its vast livestock industry.
  - » **Senegal** has adopted a national bioenergy strategy focused on jatropha for biodiesel and large-scale sugarcane for ethanol.
  - » **Togo** has initiated biogas projects and incorporates biodiesel from jatropha in its national development strategy.