

4. Energy and Agriculture

4.1 ENERGY PROFILE OF UEMOA MEMBER COUNTRIES

Final energy consumption in the UEMOA zone is composed of biomass (73%), oil products (23%), and electricity (4%), as shown in Figure 4-1. The region lacks an efficient, effective, and sustainable energy infrastructure, which is a precondition for economic development. Enhancement of this infrastructure, diversification of energy supply and demand, promotion of clean and affordable energy sources and technologies, and decentralization of energy production through development of local energy resources and systems are among the key challenges the UEMOA confronts both collectively as a region and within each of its member countries. "Heavy reliance on the inefficient and unsustainable use of traditional biomass fuels ... are both manifestations and causes of poverty." (OECD, 2007).

- Wood, charcoal, and vegetable wastes constitute the bulk of the biomass resources in UEMOA countries.
- Agriculture has a dual role as an energy user and energy supplier in the form of bioenergy.
- Energy for agricultural practices in the UEMOA member countries continues to be based to a large extent on human and animal energy, and on traditional wood fuels.
- Access to energy to advance development objectives in the agricultural sector in Africa represents a major challenge in the current context of high oil prices.

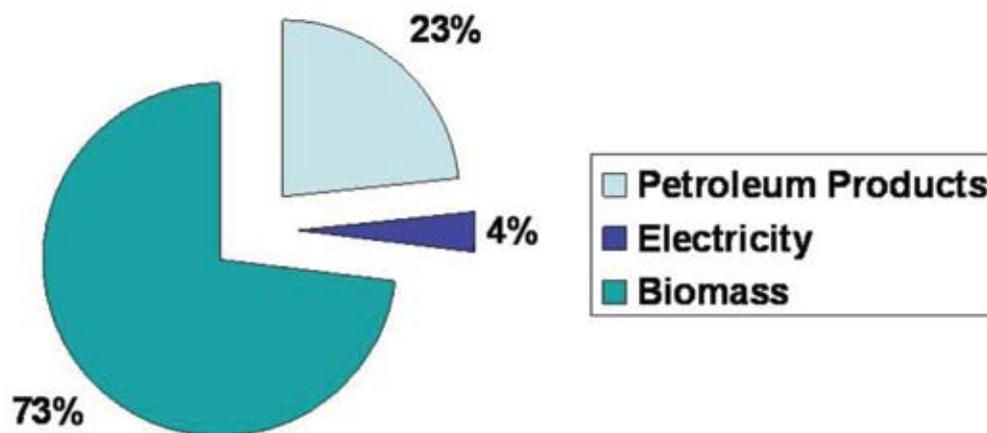
4.1.1 BIOMASS

Wood, charcoal, and agricultural wastes constitute the bulk of the traditional biomass resources in the UEMOA countries, primarily for cooking and heating needs. Figure 4-2 illustrates biomass energy consumption in UEMOA member countries.

Wood. At present, burning wood is the largest use of energy from solid biomass. This practice has enormous human consequences, particularly for women and children, who spend up to one-third of their day in the collection and transport of wood and suffer the effects of indoor air pollution from poorly ventilated cookstoves. Wood collection for cooking applications is also a key cause of deforestation. Traditional woodstoves are highly inefficient, as shown in Figure 4-3.

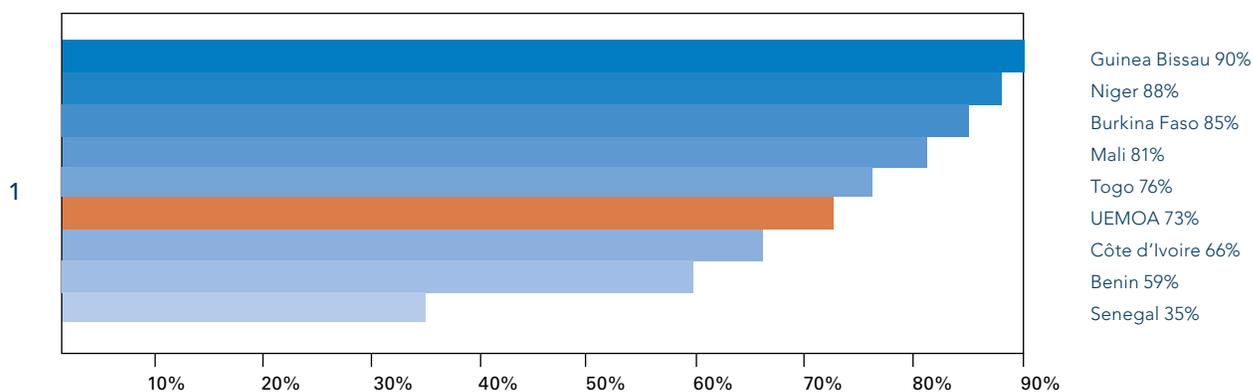
Forests, which are the principal sources of wood, are unequally distributed across the UEMOA. As shown in Table 4-1, the forest cover in UEMOA member countries is estimated to be 44.5 million hectares, which is equivalent to 13% of total land area. West Africa's forests and other wooded lands are diverse and include steppes, tropical forests, mangroves, and wetlands.

Figure 4-1: Distribution of End-Use Energy Consumption in the UEMOA Zone



Source: IEA, 2005 and SIE, 2005 (Senegal, Niger, Togo).

Figure 4-2: Biomass in Energy Consumption, 2005

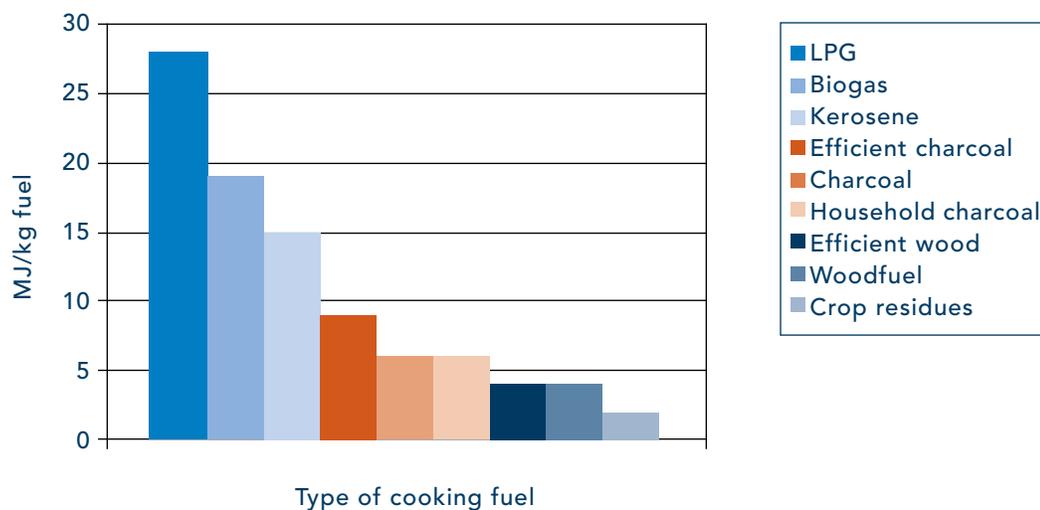


Source: IEA, 2005 and SIE, 2005 (Senegal, Niger and Togo).

A key issue confronting the UEMOA countries is deforestation. The combination of poverty and population growth is taking a toll on the forests in the region, as deforestation is primarily due to human settlement, agricultural expansion, and the use of wood for cooking. Overall, the average deforestation rate³ was 1.25% per year for all UEMOA member countries over the period 2000 to 2005. This is in sharp contrast to the annual deforestation rate for Africa as a whole of 0.62% per year. However, Togo had a much higher annual deforestation rate of 4.5%. At the other extreme is Côte d'Ivoire, which had a 0.1% reforestation rate.

³ The average deforestation rate from 2000 to 2005 is defined as loss in percent of the remaining forest area each year within the given period.

Figure 4-3: Energy Efficiency of Selected Cooking Fuels



Source: FAO, 2000.

Table 4-1: Extent of Forests and Other Wooded Lands in the UEMOA, 2005

UEMOA Countries	Forest Area		Deforestation Rate (Average 2000-2005) ^a	Total Land Area 1000 ha
	1000 ha	% total land area		
Benin	2,351	21.3	2.5	11,062
Burkina Faso	6,794	29.0	0.3	23,400
Côte d'Ivoire	10,405	32.7	-0.1	31,800
Guinea Bissau	2,072	73.7	0.5	2,812
Mali	12,572	10.3	0.8	122,019
Niger	1,266	1	1	126,670
Senegal	8,673	45	0.5	19,253
Togo	386	7.1	4.5	5,439
UEMOA Total	44,519	13%	1.25	342,455

^a Loss in percent of the remaining forest area each year within the given period.

Source: FAO, 2006.

Deforestation is a major threat in the UEMOA member countries, with an annual loss of over 555,000 ha of forest. The permanent destruction of indigenous forests and woodlands results in declines in habitat, biodiversity, wood for fuel, and quality of life. Local climates, including the water cycle, are altered as soil erodes, silting rivers and lakes, and desertification sets in. Addressing this problem is a huge priority.

Agricultural residues provide another important source of biomass. Cashew tree residues, cotton stalks, and sugarcane provide sustainable energy resources.

Agricultural Residues. Agricultural residues provide another important source of biomass, amounting to about 5 tonnes of dry matter per hectare of sorghum, 4 tonnes of straw and 2.5 tonnes of bran per hectare of rice, 2 tonnes of tops per hectare of groundnut and cowpea, and 10 tonnes of stubble per hectare of maize. In some countries, using these residues as substitutes for fuelwood is an important first step.

In Guinea Bissau, for example, biomass residues represent an estimated 65% of the cashew tree, providing a potential of 67,000 m³ of residue per year. This is equivalent to 12,000 tonnes of charcoal. Mali has about one million tonnes of cotton stalks per year after harvest. In Côte d'Ivoire, Mali, and Senegal, sugarcane residues (stalks, etc.) can be co-fired to generate electricity or reduced to biochar for soil fertilization.

Charcoal. Despite rapid urbanization in all UEMOA member countries, the transition of urban dwellers to become consumers of modern fuels remains slow.

At present, urban centers absorb the bulk of the charcoal produced in rural areas. Rapid urbanization and future population growth throughout UEMOA member countries is expected to continue to exert heavy pressure on this resource. The traditional production and use of charcoal is one of the most environmentally damaging practices in the UEMOA. All bioenergy strategies should make phasing out traditional charcoal use a priority and develop programs to produce cleaner, biomass-based fuels in rural areas. Such programs, combined with local production of cooking stoves, could make a significant contribution to reducing deforestation, increasing rural incomes, and reducing respiratory infections in women and children.

4.1.2 PETROLEUM PRODUCTS

Most of the UEMOA member countries are net importers of oil products. Only Côte d'Ivoire produces relatively significant quantities of oil, estimated at 2,109 kilotonnes in 2005. A number of other countries have potential petroleum reserves (e.g., Benin, Mali, Niger, Senegal, and Togo), none of which are in production.

Over the last five years, oil costs have strained state budgets. For certain countries, the oil bill represents more than 50% of their export earnings. For example, in Senegal, it accounted for 55%

of export revenues in 2005. As petroleum prices have almost tripled, the situation is only becoming worse.

Oil products are the second largest source of energy consumed in the UEMOA, averaging about 23% of total energy use. They are used primarily in the transportation and industrial sectors. Figure 4-4 depicts oil consumption by country.

UEMOA member countries are net importers of oil. For certain countries, oil costs exceed half of their export earnings.

Charcoal and wood are the main energy resources in the residential sector, with significant social, health, and environmental consequences. To reduce pressure on traditional sources of biomass, several UEMOA members initiated programs that substituted butane and kerosene for charcoal. After years of implementation, results are mixed and with oil price increases, the cost of these programs is increasing sharply.

The introduction of liquefied petroleum gas (LPG)⁴ in the UEMOA zone, while relatively more successful, remains concentrated in the coastal countries (Senegal, Benin, and Côte d'Ivoire). Demand in Africa for LPG has grown at rate of 5.7% each year since 2000. In 2007, total LPG demand rose to 10.3 million tonnes.

In Senegal, as a result of the availability of LPG, the share of biomass in energy consumption dropped from 56 to 35% between 1994 and 2005. LPG consumption rose from 68,000 to 130,000 tonnes. In Benin, the proportion of traditional biomass in total energy consumed declined from 74% in 1995 to 59% in 2005.⁵ While this is beneficial in reducing indoor air pollution, natural gas/LPG prices are rising in tandem with oil price hikes, undermining energy security and lowering consumer purchasing power. Also, in landlocked countries, LPG distribution is hindered by high import costs, inefficiencies caused by low purchasing volumes, and inadequate distribution

Figure 4-4: Oil Products Consumption (Kilotonnes) by UEMOA Countries, 2005



Source: IEA, 2005 and SIE, 2005.

⁴ Varieties of LPG bought and sold include mixes that are primarily propane, mixes that are primarily butane, and the more common mixes including both propane (60%) and butane (40%), depending on the season—in winter more propane, in summer more butane. Propylene and butylenes are usually also present in small concentrations.

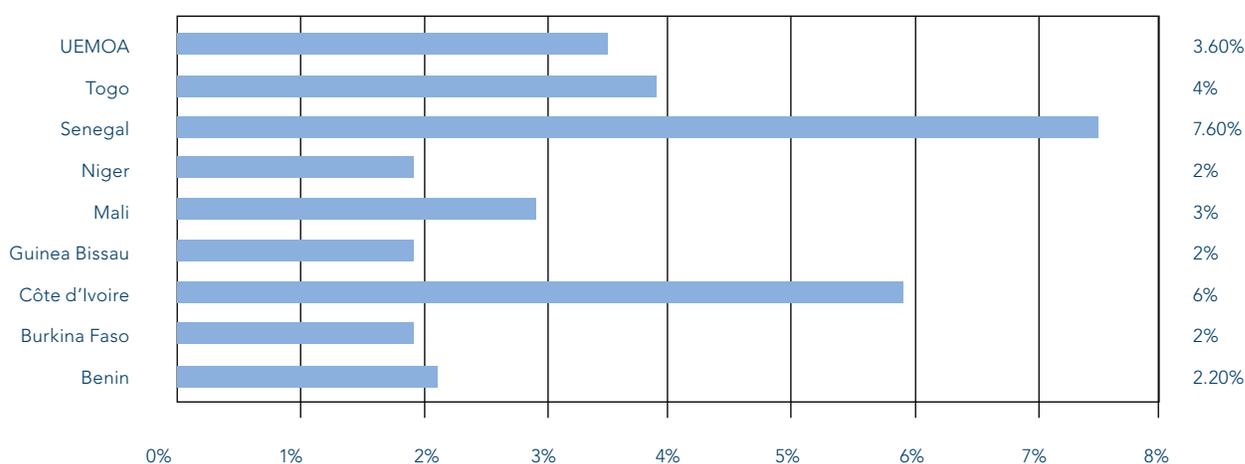
⁵ Energy balance sheet, Benin

networks. This has resulted in divided levels of LPG penetration between cities and rural areas, and between the Atlantic Sahel and the interior Sahel (ENDA TM, 2004).

4.1.3 ELECTRICITY

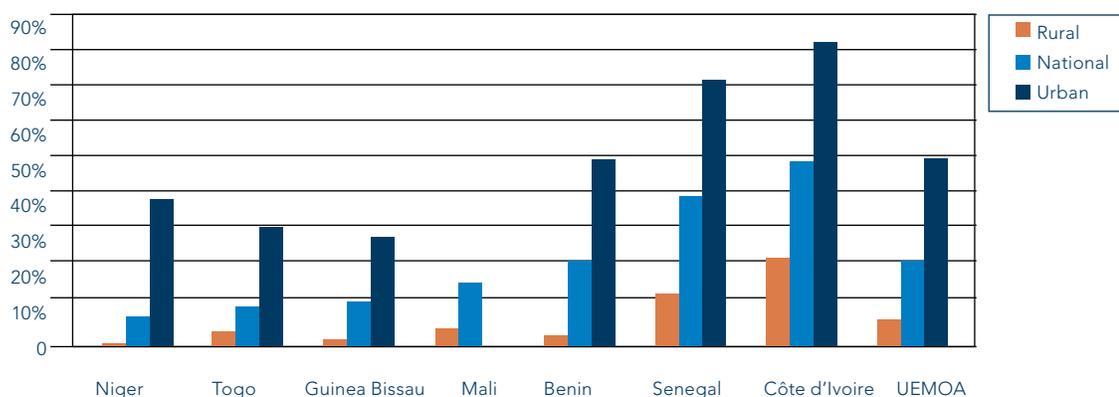
Electricity constitutes only 3.6% of total energy consumption in West Africa (see Figure 4-5). The region lacks infrastructure to produce, distribute, and store electricity. Existing means of generating electricity are inadequate and inefficient. High levels of poverty translate into a small base of consumers who can afford electricity.

Figure 4-5: Electricity as a Share of Energy Consumption



The average rate of electrification is 23%, but there is a huge disparity between access to electricity in urban and rural areas (see Figure 4-6). While in urban areas, electrification can be as high as 85% (Côte d'Ivoire), in rural areas it can be as low as 0.28% (Niger). Overall, rural electrification remains below 7% and is improving only marginally despite reforms.

Figure 4-6: Level of Electrification in the UEMOA Region



The majority of Côte d'Ivoire's electricity is generated through natural gas-powered stations. The country has turned into a regional exporter of electricity with Benin, Togo, Mali, Burkina Faso, and Ghana connected to the Ivoirian grid.

4.2 THE ENERGY CHALLENGE IN AGRICULTURAL PRODUCTION

Agriculture requires energy at all stages of production (see Box 4-1). Energy is used by agricultural machinery (e.g., tractors and harvesters) and irrigation systems and pumps, which may run on electricity, diesel, or other energy sources. Energy is also needed for processing and conserving agricultural products, transportation, and storage. In that respect, it is a critical factor in adding value in the agricultural sector. Indirect energy use occurs mainly through the production and application of mineral fertilizers and chemicals required to improve crop yields.

Box 4-1: Energy Use in Agriculture

Direct Uses

- Tractors and Other Agricultural Machinery
- Irrigation Pumps
- Drying Equipment
- Processing and Preservation of Products
- Agro-industrial Units
- Transportation of Agricultural Products

Indirect Uses

- Chemicals for Pest Control
- Fertilizers

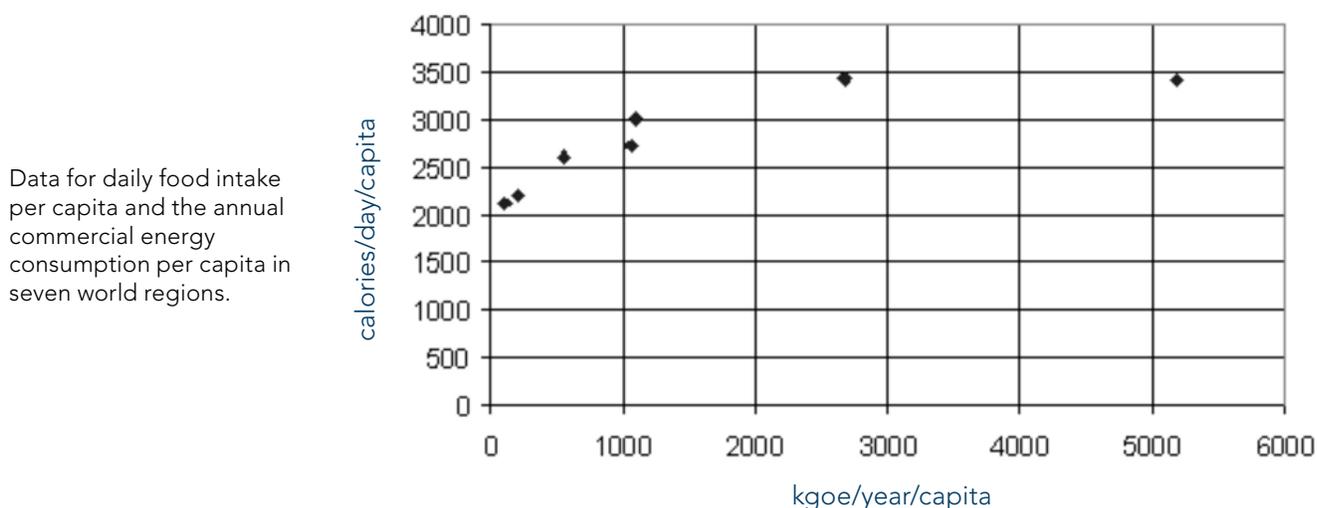
Energy for agricultural practices in the UEMOA member countries continues to be based to a large extent on human and animal energy, and on traditional wood fuels. As Figure 4-7 shows, there is a correlation between high per capita modern energy consumption and food production. Countries with higher energy consumption have higher agricultural yields (FAO, 2000). Any modernization in production methods presupposes sustainable access to energy.

At the national and regional levels, with few exceptions, rural energy access and energy for agriculture have not been incorporated into policy initiatives. This can be explained by several factors:

- Non-integration of energy needs of rural populations.
- Lack of linkages between energy and agricultural programs.
- Insufficient data about energy needs of agricultural activities.
- Little overall focus on agricultural and rural sectors.

In addition to these obstacles is an institutional vacuum. Typically, there is no institution “in charge” of energy for rural and agricultural development. As a result, energy usage data in the agricultural context is almost non-existent.

Figure 4-7: Modern Energy Consumption and Food Intake



Source: FAO, 2000. kgoe = kilograms of energy equivalent.

Stable, predictable access to water is also a major challenge for agriculture in West Africa. Overall, only 4% of the total agricultural land in Africa is estimated to be irrigated, with the remaining being rain-fed and therefore subject to climate and rain variability. Since the late 1980s, irrigation systems employing small water pumps have been expanded and are gradually taking the place of large dams, which have been criticized for their related social and environmental impacts. Decentralized irrigation systems contributed to enhancing water access and water control.

Limited expansion of irrigation may improve agricultural productivity in some areas, but it needs to be carefully studied. Better attention to water conservation and harvesting, as well as identifying water-retaining crops that could have multi-purpose applications, is likely to be a more sustainable approach for the entire region.

Mechanization of agricultural production is relatively limited when compared to other world regions, as shown in Table 4-2. For 2003, FAO estimated that African agriculture utilized a total of 537,917 tractors, compared to 1,765,242 in Latin America and 10,737,469 in Europe. There were 394 agricultural workers per tractor in Africa, compared to 24 in Latin America and 3 in Europe, with a world average of 51 workers per tractor (FAOSTAT, 2008).

Views differ on whether a mechanized model of agriculture is appropriate for Africa, given the abundant and relatively low-cost labor combined with the traditional communal form of agricultural

practice. However, mechanization versus non-mechanization is not the key issue; rather what are the best and most sustainable mechanized applications for smallholders? If they are planting annual or even perennial crops, use of community-owned tractors or plows might make sense. Very few smallholders need individual mechanical devices—rather, they need occasional access.

Table 4-2: Indicators of Agricultural Mechanization in Africa and the World (2003)

Designation	Africa	Latin America	Europe	World
Tractors	537,917	1,765,242	10,737,469	25,530,184
Agricultural workers per tractor	394	24	3	51
Hectares per tractor	2,113	67	45	187

Source: FAOSTAT, 2008.

Finally, with respect to nutrients, sub-Saharan Africa as a whole, including the UEMOA, has the world's lowest fertilizer usage (only 8 kg of nutrients per hectare; see Table 4-3), representing about 10% of average global use. Despite the availability of oil, gas, and phosphate reserves in the region, sub-Saharan Africa imports more than 90% of the agricultural fertilizers it consumes (IFDC, 2005). This factor is adversely affecting the agricultural sector/economy in Africa, underscoring the continent's current capacity constraints that make it difficult to expand domestic fertilizer production. Elsewhere in the world, increases in agricultural production and productivity were achieved through the intensification of land use and fertilizer applications. Sub-Saharan Africa is unique in the evolution of food production; its production increases were achieved not by increasing yields per hectare, but mainly by expanding the areas under cultivation at the expense of forests and grasslands (Riedacker, 2007). Clearly, this appears to be an opportunity for the region to develop its own fertilizer industry, increase agricultural production and productivity, and reduce dependence on fertilizer imports. This strategy should be coupled with promotion of sustainable fertilizer application practices.

In the absence of inorganic or organic fertilizers, soil mineral depletion exacerbates the low productivity while contributing to land erosion and degradation. This fact poses unique challenges for Africa where soils are nutrient deficient and of poor quality to begin with. The FAO estimates that stopping the depletion of existing mineral soils would probably require at least 70 kg of nutrients per hectare. At a special summit on fertilizers in Africa in 2006, the African Union set the objective of increasing fertilizer usage from the current average of 8 kg of nutrients per hectare to at least 50 kg per hectare by 2015. Views differ, however, as to whether higher levels of fertilizer use are the best way to increase soil fertility given the potentially dangerous environmental, health, and other effects. In the current context of rising oil and fertilizer prices, many of these plans could be jeopardized.

Table 4-3: Fertilizer Use Intensity by Country, 2002

Country	kg/ha
Benin	17
Burkina Faso	0.4
Côte d'Ivoire	15.8
Guinea Bissau	4.4
Mali	8.9
Niger	0.3
Senegal	13.4
Togo	6.5

Source: FAOSTAT, 2006.

A partnership between producers and agricultural research institutions needs to be developed and nurtured to explore the best ways to use energy in order to improve yield and production. What must be avoided, however, is repeating the mistakes of countries like the United States, which used this type of partnership to create industrial-scale monocultures. The InterAcademy Council report (InterAcademy Council, 2004) makes it clear that such approaches have failed before in Africa. Rather, this is an opportunity to exploit the characteristics of African agriculture patterns—smallholders, diverse production, multicropping—in ways that improve both productivity (yield per hectare) and production (quantities).

4.3 SUMMARY

- Final energy consumption in the UEMOA is comprised of traditional biomass (73%), oil products (23%), and electricity (4%). Wood, charcoal, and agricultural wastes constitute the bulk of the biomass resources in UEMOA countries.
- Forests—the main biomass sources—are unequally distributed across the region; they are diverse, including steppes, tropical forests, mangroves, and wetlands. Overuse has led to land degradation and deforestation and threatens key watersheds. Correcting this use pattern is a main priority.
- Energy is an essential component of agricultural production. It is required directly as a fuel to operate agricultural machinery, irrigation systems, and pumps that run on electricity, diesel, and other energy sources. Energy is also required in processing and conserving agricultural products, transportation, and storage. Indirect energy use occurs mainly through the production and application of

fertilizers and chemicals required to improve crop yields. Yet, with few exceptions, access to energy remains a low priority in policies that are already initiated or are on the drawing board in UEMOA member countries.

- Mechanization of agricultural production is relatively limited, particularly when compared to other world regions (e.g., Asia). Lack of mechanization puts real constraints on the amount of land that can be in permanent crops.
- With respect to soil nutrients, sub-Saharan Africa has the world's lowest level of fertilizer use in its agriculture and seriously nutrient-deficient soils. In the absence of inorganic and organic fertilizers, soil mineral depletion exacerbates low productivity and contributes to land erosion and degradation.
- Raising agricultural productivity overall is a better strategy than focusing on bioenergy crops alone.
- Other barriers to incorporating energy into agriculture and rural development in Africa include the non-integration of energy needs of rural populations; lack of linkages between energy and agricultural programs; insufficient data; and little focus on agricultural and rural sectors.
- High oil prices are having a direct effect on the agricultural sector—stifling growth, productivity, and production.