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EASTERN ARC MOUNTAINS AND THEIR NATIONAL AND GLOBAL IMPORTANCE

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ABSTRACT

The Eastern Arc Mountains comprise a chain of separate mountain blocks running from southern Kenya through Tanzania in a crescent or arc shape. In Tanzania, the Eastern Arc consists of North and South Pare, East and West Usambaras, Nguru, Ukaguru, Rubeho, Uluguru, Udzungwa and Mahenge Mountains. The mountains and forests on them are very important to Tanzania and also globally. A large number of products and services are provided from the forests to the Tanzanian people, and globally important biodiversity values are found. In this paper, these important features are highlighted.

INTRODUCTION

The Eastern Arc Mountains are a chain of isolated crystalline mountains running from southern Kenya, through Tanzania in a crescent or arc shape (Lovett, 1990). The mountains are under the direct climatic influence of the Indian Ocean and were formed about 100 million years ago when the earth's crust faulted (Hipkiss, 1997). They are the oldest mountains in East Africa (Griswold, 1991).

From north to south the Eastern Arc Mountains are: Taita Hills (Kenya), the North and South Pare, West and East Usambara, Nguru, Nguu, Ukaguru, Rubeho, Uluguru, to Udzungwa and Mahenge Mountains in the South (Tanzania). In total the Eastern Arc covers less than 2 % of Tanzania's total land area. However, the mountains, and especially the forests they support, are important to Tanzania and also have a global value in terms of conservation.

IMPORTANCE

The Eastern Arc Mountains are important at both the global and national levels:

Global level

Biodiversity

Biodiversity can be defined as the numbers and variability of life forms. The Eastern Arc Mountains are noted for their high rates of endemism (species not found elsewhere) and species richness (Lovett, 1989; Griswold, 1991).

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As examples, the Eastern Arc forests harbour 30–40 % of Tanzania's species of flora and fauna (Hipkiss, 1997), there are 16 endemic plant genera, and 20 of the 21 African violet *Saintpaulia* species are endemic to the Arc. Moreover, according to Lovett (1993) the Eastern Arc Mountains have 20–30 % endemism among the 2,000 plants occurring in them, and Hedberg, O. and Hendber, I. (1990) report that the Usambara Mountains contain more endemic species than any other similar sized area in Africa. High species endemism in the Arc Mountains is also reported by Pócs (1990) and Nsolomo & Chamshama (1990). The Mountains are sometimes referred to as the Galapagos of Africa because they are small and fragmented 'islands' (of forest), within a 'sea' of miombo woodland.

Tourism

In 1992 the Government of Tanzania created the Udzungwa Mountains National Park (UMNP), which covers an area of 1,990 km^2 and ranges between 250 and 2,500 m altitude. It is developing as a tourist attraction. The Udzungwa Mountains rain forests in Iringa Region, but outside UMNP have also now been zoned for management. This zonation includes an amenity zone aimed at utilising the forests' unusual topographic and other natural features for purposes of recreation (Sabuni, 1997). In May 1997, the Government also created Amani Nature Forest Reserve, which also aims to attract ecotourists. Tropical forest tourism is a relatively new venture, which has proved successful in some parts of the world, notably Central America and may have potential in Africa (Hamilton, 1989b).

Agriculture

The Eastern Arc forests are important for large-scale agriculture. Due to their steep topography on an otherwise flat coastal plain, they have the ability to trap the humid air from the Indian Ocean, thus maintaining a relatively stable high rainfall. The agricultural areas surrounding the forests also have productive soils, and when combined with the favourable climate, this is responsible for their agricultural importance. The main estate crops grown are tea and coffee, with areas of other cash crops such as cardamom and *Cinchona* spp. In addition to these crops, sugar cane is grown in Mtibwa and Kilombero. These sugar estates are in the foothills of Nguru and Udzungwa Mountains respectively.

Evolutionary Studies

The Eastern Arc Mountains are a very important 'field laboratory' where evolutionary processes can be studied. This is because of their immense history of forest cover (perhaps 30 million years) and their isolation from the main forest blocks in Western Africa (perhaps 10 million years ago) (Burgess, 1997).

National level

In addition to the global importance mentioned above the Eastern Arc mountains are important to Tanzania at the national level:

Water Supply

The Eastern Arc is vital for Tanzania's water supply. The forests in these mountains provide the major catchment for most of the larger rivers in Tanzania. The rivers supply water to coastal communities including some large urban areas. The Usambara and Pare Mountains for example feed the Pangani River while the Ngurus feed the Mligasi and Wami Rivers. The Ukaguru, Rubeho and Ulugurus also feed the Wami River; River Ruvu is fed by the Uluguru Mountains while Ruaha/Rufiji and Kihansi are fed mainly by the Udzungwa Mountains.

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River Ruvu supplies water to Dar es Salaam City. Tanga Municipality's water supply draws from Sigi River, which has its source in the Usambara Mountains. The Uluguru Mountains serve as catchment for Morogoro River, which supplies water to Morogoro Municipality and neighbouring areas. It is estimated that the Eastern Arc Mountains serve as water catchment for more than 4 million city-dwelling Tanzanians, and more in the rural areas. Breweries and soft drink industries in Dar es Salaam also use water from a catchment in the Ulugurus.

Hydroelectricity

The major hydropower supply in Tanzania is generated at Kidatu and Mtera Dams, (Ruaha/Rufiji) and Pangani Falls and Hale (Pangani). A total of 382 megawatts of electricity can be generated. This is 61.5 % of the total electricity generation capacity in the country of 621 megawatts. Construction of a hydropower plant at Kihansi Falls is in progress and is expected to generate 180 megawatts. Hydropower is vital for Tanzania's development. As already mentioned the rivers supplying this hydroelectricity all have their catchment in the Eastern Arc Mountains.

Wood Energy

The forests in the Eastern Arc Mountains provide wood fuel to the forest-adjacent communities. The fuel is used for cooking and heating. Sabuni (1997) reports on the collection of deadwood for firewood by communities in the Udzungwa Mountain rain forests in Iringa Region. Hamilton (1989a), Ruffo (1989) and Mziray (1990) also report that the forests of the Usambara Mountains are an important source of fuelwood for forest-adjacent communities. The use of Eastern Arc forests to provide fuelwood is also reported by Nsolomo and Chamshama (1990) and Temu (1990a) who specifically mention the use of *Zenkerella* spp.

Building Poles

The forests provide building poles to surrounding communities (Hamilton, 1989b; Ruffo, 1989; Temu, 1990a).

Timber

Timber is harvested (selective harvesting) in some Eastern Arc Mountains *e.g.* Udzungwa. According to Sabuni (1997), selective timber harvesting is permitted in the 'production' zone of Udzungwa rain forests in Iringa District. Mechanical logging is not permitted in this zone. The Eastern Arc forests, especially in the Usambaras, have been cleared in the past for timber production, but this is no longer permitted (Hipkiss, 1997).

The following timber species occur in the Eastern Arc forests (Kimariyo, 1990):

- *Milicia excelsa* occurs in the foothills of West Usambaras, Uluguru and other Eastern Arc Mountains.
- *Ocotea usambarensis* occurs in South Pare and West Usambaras.
- *Podocarpus usambarensis* occurs in West Usambaras and Pare Mountains.
- *Khaya anthotheca* occurs as a riverine forest in the foothills of Eastern and Western Usambaras, Ngurus and Ulugurus.
- *Juniperus procera* occurs in East Usambara.
- *Allanblackia stuhlmannii* occurs in the East Usambaras, Uluguru and Nguru Mountains.
- *Cephalosphaera usambarensis* occurs in the East Usambaras.

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Herbal Medicines

For hundreds of thousands of years, all over the world, people have relied on plants for their medicines. Ruffo *et al.* (1989) estimated that about 80 % of the world's rural population depends on the herbalist for their medicinal problems. These authors further found that 35 % of different plant species used by 14 herbalists (medicine men) in the Usambara were trees from the local mountain forests.

The importance of Usambara forests as a source of herbal medicines used to treat a host of diseases is also reported by Temu (1990b). Sabuni (1997) reports on forest-adjacent communities in the Udzungwa Mountains being allowed to collect medicinal plants. The bark of *Cinchona* tree contains an alkaloid—quinine—which is used to treat malaria. *Cinchona* is grown in the Usambara Mountains. Minja (1994) lists 20 plant species found in the Udzungwas in Iringa region which are used as medicine to treat various ailments, including those of livestock.

Hunting and fishing

As part of Joint Forest Management in the Udzungwa Mountain rain forests, hunting is allowed in order to provide game meat to forest-adjacent communities (Sabuni, 1997). Most of the major rivers listed above have fish. Fishing in these rivers is an important activity, earning fishermen income and contributing to supply of protein to communities.

Habitat for wildlife

All Eastern Arc forests provide important habitat for a rich variety of wildlife. The Udzungwa forests, for example, provide habitat for many threatened wildlife species including two locally endemic primate taxa, the Iringa red colobus *Colobus badius gordonorum* and the undescribed new subspecies 'Sanje crested mangabey' *Cercocebus galeritus* ssp. nov. (Stephenson, 1997).

Edible fruits

Among some useful plants of the East Usambaras listed by Ruffo (1989) are fruit trees. Mziray (1990) describes *Allanblackia stuhlmannii, Pachystella msolo* and *Sorindeia madagascarensis* as tree species providing edible fruit in the Usambaras. Fruits are also collected by forest-adjacent communities in the Udzungwa Mountains rain forests in Iringa (Sabuni, 1997). The fruits are an important source of essential vitamins and minerals for the communities, and offer scope for commercial jam making. The fruits and jam produced from them can also be sold to earn income for the communities.

Cultural values

Some communities treat certain forest sites as sacred and use them for worshipping. Mziray (1990) for example reports that man derives spiritual fulfilment from forests.

Fodder

The foliage of many tree/shrub/herb species is used as fodder for domesticated animals and wildlife.

Fibre

Fibres are important for making ropes and other uses needing cordage. In Iringa region, the bark of *Dombeya torrida* is beaten to produce fibre which is used to make ropes among other

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products (Minja, 1994). According to Ruffo (1989) climbers obtained from forests in the Usambara Mountains serve as ropes used for various purposes.

Bee products

Bee keeping is practised in the Eastern Arc forests. Some tree species in the East Usambara Mountains, for example, are important as source of nectar or pollen for bees (Ruffo, 1989). Bee products include honey and beeswax. Honey, which has a high carbohydrate content, is used in honey-wine making and in traditional nutrition. Honey is also used as a medicine in treating wounds and burns. Beeswax is extracted from honeycombs. It is mainly used in the cosmetic industry, candle making, preparation of medicines, furniture polishes etc. It is also exported from Tanzania.

Soil protection and improvement

Forests and trees protect soil against erosion. Tree cover breaks the force of the wind and heavy rain. Leaf litter on the forest floor reduces the water flow (except in downpours) and thus prevents erosion by runoff, while giving water the time to infiltrate or sink into the soil. Trees enrich the soil with nutrients and organic matter through their leaf litter nitrogen fixation and mycorrhizal associations.

Edible fat

The seeds of *Allanblackia stuhlmannii* and *A. ulugurensis* yield an edible fat that is used as cooking oil.

Soap and candles

According to Minja (1994) fat extracted from *Allanblackia* species is used in soap and candle making in Iringa region.

Edible leaves

Leaves of certain tree species and other plants are used as vegetable in the fresh or dried form. The vegetables provide essential vitamins and minerals. Vegetables obtained from Eastern Arc forests include *Solanum nigrum, Sessamum* spp and *Gyandropsis gyandra* (Minja, 1994); also *Zanthoxylum chalybeum* and *Corchorus* spp (Mziray, 1990).

Dyes

In Iringa Region, dyes used for decorating baskets and mats are extracted from tender leaves of *Agauria salicifolia* and the bark of *Bridelia bridelifolia* (Minja, 1994). Dyes for colouring material for weaving mats and baskets are obtained from forests in the Usambara Mountains (Ruffo, 1989).

Mushrooms

Mushrooms are picked and used by a number of communities in the Usambaras (Mziray, 1990).

Beverages

Chihongo (1994) reports that bamboo juice is tapped from the bamboo *Oxystenanthera abyssinica* and used to produce local beer. This plant grows in the Eastern Arc Mountains such as Udzungwa.

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Handicrafts
In Iringa Region, extraction of bamboo from the forest reserves for making baskets and other products is a common practice (Minja, 1994). Stems of *Sinarundinaria alpina* are widely used to make baskets used as tomato and fruit containers. Chihongo (1994) reports that this bamboo is used also for mat weaving, making of toothpicks, in fencing and as seedlings pots. *Phoenix reclinata*, a wild palm (ukindu), is also used extensively in mat and basket weaving in many areas of Tanzania, including areas in the Eastern Arc Mountains (Nsolomo & Chamshama, 1990; Ruffo, 1989).

Edible insects
Many people in the rural areas of Tanzania supplement their protein requirements by eating insects such as termites (Chihongo, 1994). The insects are usually available seasonally, and are normally most common outside of the forests.

Miscellaneous products
Most of the basic equipment in the majority of homesteads in the Usambaras is made of plant products. These include furniture, food processing and eating utensils, storage containers, arms and ammunition (bows, clubs, arrows, arrow poison etc.) as well as musical instruments (Mziray, 1990; Ruffo, 1989; Temu, 1990a).

Tool handles
Temu (1990a) reports the use of *Zenkerella* spp for the manufacture of handles of hoes and axes.

Income generation
The sale of various forest products (wood and non-wood) generates income for forest-adjacent communities. Income is also obtained from tourism in the Udzungwa National Park.

Employment
A number of people are employed in the management of the forest reserves and national parks in the Eastern Arc forests. In addition to those employed directly to manage forests and national parks, there are others employed in the energy, agriculture, fisheries and tourism sectors. The extraction of wood and non-wood products also creates employment.

Revenue to government
Incomes to employees in the forest, tourism, and energy, fisheries sectors contribute to government revenues through taxation of gross incomes. The national income benefits through other multiplier effects arising from increased disposable incomes.

Ornamental plants
Ruffo (1989) reports that the forests in the East Usambaras have plants that have potential for ornamental purposes. In particular these include most of the known species of African Violet (*Saintpaulia* species), which form the basis of a globally important horticultural industry.

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CONCLUSIONS

Eastern Arc Mountains contribute:

- Significantly to the economic development of Tanzania (water supply, hydro electricity, estate agriculture, employment, tourism etc.).
- To food security in adjacent areas. Communities in these areas supplement their diets with food obtained from the forests.
- To poverty reduction.
- To health (provision of water, food and herbal medicines, protein from game meat, fish).

Their high biodiversity contributes to:

- Ecosystem stability.
- Scientific value.
- A high potential for ecotourism.
- Genepool value.

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