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Realities on Deforestation in Tanzania — Trends, Drivers, Implications and the Way Forward

Jafari R. Kideghesho

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Abstract

Deforestation ranks at the top in the global environmental agenda. Its importance is prompted by economic and ecological roles played by the forests and the notable adverse effects caused by deforestation on human and other species. These effects include biodiversity loss, greenhouse gas emissions, disruption of water cycles, increasing soil erosion and disruption of livelihoods. Deforestation rate is more serious in tropical countries where human population growth is high with extreme poverty. Tanzania, one of the tropical countries in Sub-Saharan Africa, is not exempted from these scenarios. This chapter provides some insights on deforestation problem in Tanzania with emphasis on status and trends, major drivers, ecological impacts and current efforts geared towards addressing this problem. Finally, the chapter offers some recommendations to pre-empt further impacts associated with the problem.

Keywords: Tanzania, deforestation, drivers, trends

1. Introduction

Forests play a critical role in enhancing the quality of life, guaranteeing the existence of other species and the functioning of the planet's natural systems. They support the poor in reducing their vulnerability to economic and environmental shocks. The livelihoods of about 1.6 billion people, over 25% of the world population living in extreme poverty are sustained by forests [1]. The World Bank has estimated that medicinal needs of about 1 billion people worldwide are met by drugs derived from forest plants [2]. About 40–50% of these drugs, worth an

estimated value of US\$108 billion a year, originate from tropical forest plants [3]. In many developing countries, forests provide fuelwood, the primary source of energy, which occasionally meets as much as 90% of energy requirements [4].

The forest products industry alone contributes substantially to economic growth and employment. The global forest products traded internationally was in the order of US\$255 billion in 2011 and some 40% of this value is generated in developing countries, where forest-based employment provides 49 million jobs [1]. Worldwide, forestry sector employs over 100 million people in a formal sector [5]. The forestry sector is a major provider of rural employment in many countries. Economic importance of forests is also derived from non-wood forest products. Recent estimates indicate the global value of non-wood forest products (NTFPs) to be less than US\$17 billion annually [6]. However, lack of information and relevant assessment tools at the country level makes this value underestimated. According to FAO [5], about 75% of the overall tropical tree species are used for their NTFPs value.

The IUCN's 'Livelihoods and Landscapes programme' classified forest reliance under three levels: (i) modest or special purpose forest reliance (average contribution of forests to livelihoods is around 18%, e.g. transmigrants in Sumatra, parts of China, dry areas of Tanzania); (ii) forests form a major part of livelihoods (average contribution of forests to livelihoods is up to 35%, e.g. in Sahel, North Thailand, rural Guatemala); and (iii) forests are as important as or more important than agriculture (average contribution of forest to livelihoods is 50% or more, e.g. Congo Basin, Indonesian Papua) [7].

Beyond sustaining the household economy, the companies and governments derive substantial commercial benefits from forests. The FAO (as of 2008) estimates that forest industries contribute over US\$450 billion to national incomes, nearly 1% of the global GDP, and providing formal employment to 0.4% of the global labour force [8]. Other benefits from forests include incomes and subsistence benefits, informal work opportunities and reservoirs of economic values that help to ameliorate shocks to household incomes – particularly in rural areas of poor countries [9].

Forests are home to nearly 90% of the world's terrestrial biodiversity [1] and are important biodiversity hotspots with several endemic species [10]. For example, the forests of the Eastern Arc Mountains of Kenya and Tanzania contain 1500 endemic plant and 121 endemic vertebrate species in 2000 km², the highest ratio for endemics per area of all biodiversity hotspots [10, 11]. The current commitment by world governments to gazette large areas of their land as protected areas (exceeding 10% of the global land) is motivated by growing recognition of the critical role played by forests as the reservoirs of terrestrial biodiversity [9].

Forests play a vital role in carbon sequestration (i.e. locking up atmospheric carbon in vegetation via photosynthesis). They absorb about one third of recent anthropogenic emissions of carbon dioxide (CO₂) to the atmosphere [12]. Estimates put the carbon storage of boreal forest at 703 gigatonnes, tropical forests at 375 gigatonnes and temperate forests at 121 gigatonnes [13]. The Amazon Forest alone contains 90–140 billion metric tons of carbon, suggesting that the release of even a portion would accelerate global warming significantly. Rainforests produce over 40% of the world's oxygen [14].

By reducing the capacity of forests to lock up atmospheric carbon in vegetation, large amounts of carbon are released into the atmosphere as carbon dioxide. The build-up of carbon dioxide along with other greenhouse gases (nitrous oxide, methane, and other nitrogen oxides) in the atmosphere is known as the 'greenhouse effect'. The amount of carbon released into the atmosphere each year as a result of clearing and burning of forests and peatlands accounts for about 15–25% (or 3.7–8.1 gigatonnes of CO₂ emissions) of humanity's total GHG emissions, greater than the total amount released by the entire global transport sector [3]. Through their absorption and creation of rainfall and their exchange of atmospheric gases, forests regulate climate and local weather. For example, the Amazon alone creates 50–80% of its own rainfall through transpiration [15].

More forests are being destroyed today than ever before, suggesting that more greenhouse gases (GHG) are being released into the atmosphere. The 1980–1990 estimates indicate that deforestation was responsible for release to the atmosphere of between 25% and 30%, roughly 1.6 billion tonnes, of carbon each year [16].

Forest species and habitats have major social, cultural and spiritual significance. For example, in northern part of Tanzania some big and small forests known as *Mshitu* and *Mpungi*, respectively, are venerated by different clans of Pare and Gweno tribes [17]. Many cultures around the world have a spiritual connection with different species of trees and few have played an important part in human history. For example, the Romans associated the branches of a fig tree with the cradle containing Romulus and Remus that became caught in the place that was to become Rome while Chinese and Indians held belief that large fig trees are the homes of spirits and demons. The common fig (*Ficus carica*) was the first plant mentioned by name in the Bible, as the source of the leaves that formed the aprons that covered Adam and Eve's nakedness [18].

2. Status and trends of deforestation in Tanzania

About 35.3 million hectares or 39.9% of Tanzania's land is covered with forests [19]. Almost 90% of these forests are woodlands. Other forest types include Montane, Mangrove and Acacia forests and coastal woodlands. About 18 million hectares of Tanzania's forested land is under protection as forest reserves while 4.1 million hectares are managed under Participatory Forest Management (PFM) [19]. Approximately, 50% of forested land falls under village and general land with unclear management regime, thus being subjected to severe deforestation and degradation [19].

Tanzanian forests provide goods and services which are crucial in enhancing the livelihoods of poor households and the national economy. They contribute over 90% of the energy supply through firewood and charcoal [20], 75% of the construction materials [21, 22] and almost all indigenous medicinal products. Over 25% of all plant species used are wild-harvested medicinal plants [23]. The economic value of forest goods and services to the Tanzanian economy in the past ten years were estimated to be around US\$2.2 million, or 20.1% of the GDP [24]. Contribution of forest products to the country's registered export earnings ranges between 10% and 15% [25]. However, trade in non-timber forest products (NTFPs) and timber

is to a large extent informal and therefore it is difficult to estimate its real value [21]. Tanzania forests provide formal employment to approximately 1 million people (mainly rural), while about 5 to 10 times more are informally employed [25].

Other than economic benefits, Tanzanian forests and other woodlands are critical habitats for a variety of animal and plant species. They are home to about 116 known species of amphibians, 1100 birds, 316 mammals and 335 reptiles [26]. Of these species, 9.0% are endemic and 6.1% are threatened. Over 10,000 species of vascular plants, including 1120 endemics, are found in Tanzania. Scientific evidence from recent studies indicates that these forests contain several species which are yet to be discovered. For example, the latest research findings on the faunal richness of the tropical moist forests of the Eastern Arc Mountains show the discovery of 27 vertebrate species that are new to science; and 14 other species that were previously unknown to exist in the area [27, 28]. The living forest biomass contains about 2019 million metric tons of carbon.

The rationale of gazettement forest lands and other woodlands as forest reserves and other protected areas is derived from the ecological and economic importance of forests to mankind and other species. However, efforts to safeguard these important ecosystems are subdued by human needs. The forests are increasingly being subjected to deforestation and degradation as demand for arable land, fuelwood, furniture and infrastructure increase.

Tanzania is facing unprecedented loss of its forests and other woodlands. Between 1990 and 2010, the country lost an average of 403,350 ha or 0.97% per year. Between 1990 and 2010 (Table 1), the total loss was estimated to be 19.4% (about 8,067,000 ha) of the forest cover [6]. In this period, Tanzania was, among the ten countries that had the largest annual net loss of forest area (Table 2). Recent report indicates that the country has already lost about 38% of its forest cover [29]. According to the report, the rate of loss is 400,000 ha per annum and, the risk is high as the country’s entire forests can be depleted within the next 50 to 80 years if the current trend remains unabated.

Year	Trends in total (net) forest cover, 1990–2010			Trends in forest loss, 1990–2010		
	Forest cover (1000 ha)	Annual Change rate (1000 ha)	Annual change rate (%)	Forest* cover (1000 ha)	Annual change rate (1000 ha)	Annual change rate (%)
1990	41495	-	-	41345	-	-
2000	37462	-403	-1.02	37262	-408	-1.0
2005	35445	-403	-1.10	35215	-408	-0.99
2010	33428	-403	-1.16	33188	-407	-1.09

*excluding planted forests; Negative numbers represent deforestation.

Source: [6]

Table 1. Tanzania trends in total net forest cover and loss, 1990–2010

Country	Annual change 1990–2000		Country	Annual change 2000–2010	
	1000 ha/yr	%		1000 ha/yr	%
Brazil	–2 890	–0.51	Brazil	–2 642	–0.49
Indonesia	–1 914	–1.75	Australia	–562	–0.37
Sudan	–589	–0.80	Indonesia	–498	–0.51
Myanmar	–435	–1.17	Nigeria	–410	–3.67
Nigeria	–410	–2.68	Tanzania	–403	–1.13
Tanzania	–403	–1.02	Zimbabwe	–327	–1.88
Mexico	–354	–0.52	Congo (D.R)	–311	–0.20
Zimbabwe	–327	–1.58	Myanmar	–310	–0.93
Congo (D.R.)	–311	–0.20	Bolivia	–290	–0.49
Argentina	–293	–0.88	Venezuela	–288	–0.60
Total	–7 926	–0.71	Total	–6 040	–0.53

Source: [6]

Table 2. Ten countries with largest annual net loss of forest area, 1990–2010

While data for various land cover in Tanzania from 1990 to 2010 indicate the declining trend for forests and other wooded lands, the area used for other purposes such as agriculture, settlements and infrastructure is increasing (Figure 1). Given the escalating human population growth [projected to increase from 44.9 million people [30] to 69.1 and 129.1 million in 2025 and 2050, respectively [31], it is apparent that more forests and woodlands will be lost to meet the increased demand for food, agriculture and settlements.

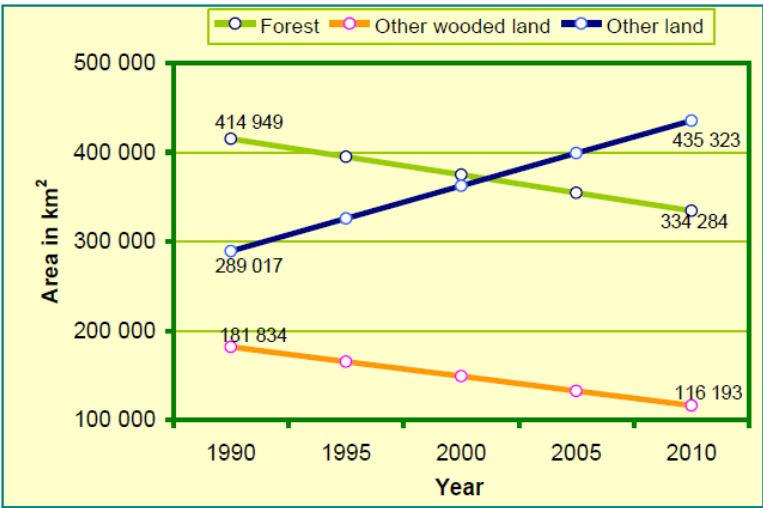
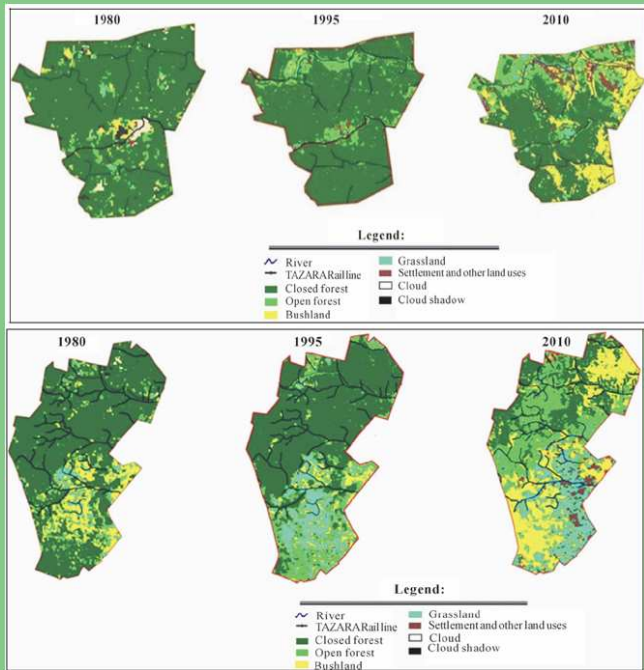


Figure 1. Trends of various land cover in Tanzania, 1990–2010 (Source: [30]).

Box 1: Forest Cover Changes in Pugu and Kazimzumbwi Forest Reserves, Tanzania

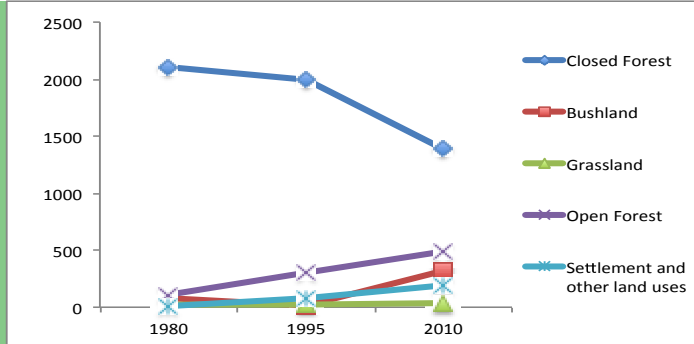
Pugu and Kazimzumbwi Forest Reserves (PKFRs) are part of the coastal forests of Tanzania and are located in Kisarawe District in the Coast region. The two forest reserves are adjacent to each other, one to the north and the other one to the south. The population of Kisarawe District has continued to increase from 95 615 in 2002 to 101 598 in 2012.



PKFRs have experienced significant decline in forest cover over time. During the periods 1980-1995 and 1995- 2010, the forest reserves have shown a significant degradation mainly due to charcoal burning and logging, encroachment for agriculture and pole cutting, expansion of farms and climate change. For the periods 1980-1995 and 1995-2010, Closed Forest in PFR decreased by 4.5% and 25.3%, respectively, while for KFR, Closed Forest decreased by 11.9% and 31.3%, respectively. The maps on the right present the land cover maps of PKFRs for the periods 1980, 1995 and 2010, respectively.

Land cover map for the year 1980, 1995 and 2010 for PFR (above) and KFR (below).

During the period 1980, Closed Forest in PFR occupied 2106.6 ha (87.2%) while in 2010 it declined to 1386.3 ha (57.4%) only. Likewise in KFR, Closed Forest occupied 4050.9 ha (75.7%) in 1980 and declined to 1740.55 (32.5%) in 2010. On the other hand Settlement and other land uses showed an increasing trend (Figure below).



PKFR land cover map for the year 1980, 1995 and 2010 (Source: [34])

Extent of deforestation differs from one ecosystem or forest type to another. For example, a loss reported for mangrove forests in Tanzania mainland in a period of 25 years from 1980 to 2005 was 18% [32]. In Zanzibar, the loss was estimated to be 50% (Figure 2). The loss of Miombo woodlands since the 1990s is estimated to be 13% [33], while nearly half of the forest cover in the Eastern Arc Mountains, one of the world's biodiversity hotspots, has been lost [28]. The current rate of deforestation and degradation in this important hotspot hints that if the current baseline scenario continues unabated, the remaining 330,000 ha in the mountain belt may be lost within the next 20 years [28]. Land clearing for agriculture expansion and livestock grazing as well as landslides due to logging on steep slopes has caused loss of one third (about 41 km²) of montane forest of Mount Kilimanjaro during the past 70 years [33]. Pugu and Kazim-zumbwi Forest Reserves (Box 1) have recorded significant decline of their cover over time mainly due to charcoal burning and logging, encroachment for agriculture, pole cutting and expansion of farms [34].

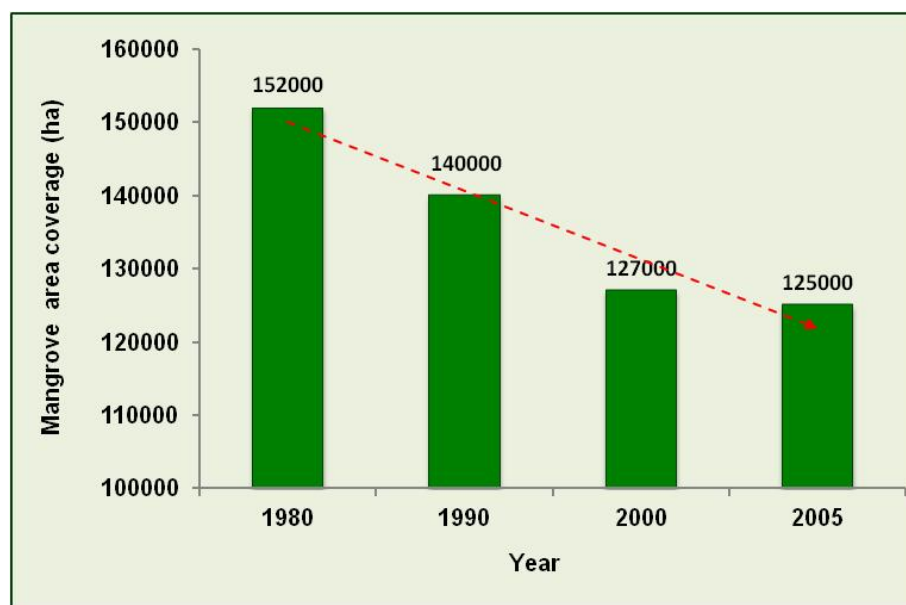


Figure 2. Trends in mangrove area coverage (1980–2005) (Data source: [32]).

3. Wildlife habitats and deforestation

Encroachment is one of the management issues facing the wildlife protected areas. Habitat destruction and, subsequently, local extinction of species emanate from encroachment and deforestation carried out to open land for agriculture and settlements along with obtaining forest products such as fuelwood, timber and building material [35–37]. The situation is worse for wildlife habitats located outside the protected areas where legal protection status is inadequate or lacking.

CORRIDOR/DESCRIPTION	THREATS
1. LOAZI-NTANTWA-LWAFI: Connects Loazi Forest Reserve and Lwafi Game Reserve via open land and Ntantwa Forest. Contains a range of savanna and forest species, the most notable being the chimpanzee.	These forests are rapidly being felled and reduced by charcoal manufacturers, and converted to agriculture. There is not, and has never been, any management of any of these protected areas, and thus illegal activity is commonplace. Many villages across this area (and within the corridor detailed above) consist mainly of Congolese bushmeat hunters who have temporarily settled in Tanzania, and exploit this area's remote and unmanaged status. Bushmeat (including chimpanzee) is exported from Tanzania across Lake Tanganyika for sale in the Democratic Republic of Congo.
2. MANYARA-NGORONGORO (UPPER KITETE/ SELELA): The corridor is utilised by elephants and buffalo moving between Manyara National Park and Ngorongoro Conservation Area.	Outside the southern edge of the Ngorongoro Conservation Area, the increased human settlement and cultivation caused interruption to the movement of elephants, buffalo and other large animals from the northern Highland FR to the lowlands below the escarpment. Even though cultivation was stopped, homes, domestic livestock and cattle dips still exist in the corridor. All areas adjacent to the corridor are settled and cultivated by local people (Mangewa, 2007).
3. UZUNGWA-SELOUS: Anecdotal evidence indicates that, until recent decades, there was regular and abundant movement of large mammals between the Udzungwa and the Selous ecosystems across the Kilombero Valley. Used by elephants and buffalo during migration between the two ecosystems. Other animals reported from the corridor include the aardvark, Angolan black-and-white colobus, bushbuck, crested porcupine, Harvey's duiker, bushbuck, hippopotamus, leopard, lion, puku, spotted hyena, waterbuck and the Udzungwa-endemic Udzungwa red colobus.	This Corridor is under immediate threat, especially in the Namwai forest area, from rapid destruction of habitat by cutting of timber (including commercially) and burning; pole cutting and charcoaling; new human settlements and conversion of woodland to agriculture; hunting; increased cattle herding. An additional very recent threat is the settlement of Wasukuma immigrants along the western bank of the Kilombero River, with associated large herds of cattle and planting of crops.
4. WAMI MBIKI-MIKUMI: Links Wami-Mbiki and Mikumi National Park (approximately 100 km apart).	Wildebeest are reported to have moved between Mikumi and Wami back in the 1980s, until sugar cane production and human settlements cut off this migratory route. There are signs of elephant and buffalo moving in this direction from Mikumi NP, with elephants raiding small farms.
5. WAMI MBIKI-SAADANI: Links Wami-Mbiki and Saadani National Park. Used by elephants and buffaloes and other animals	The corridor is under increasing pressure due to human settlements, timber exploitation and charcoal burning and Arusha Dar Highway.

Source: Jones *et al.* [37].

Table 3. Wildlife corridors classified as EXTREME (< 2 years before they disappear)

Despite the critical ecological roles played by wildlife corridors¹, they are inadequately or not legally protected. The wildlife corridors are, therefore, under constant pressure from anthropogenic activities such as logging, cultivation, houses and infrastructure construction and mining operations. While some corridors had already vanished few decades ago [38–40], some still exist but most of them (over 80%) under endangered status [37]. Jones et al. [38] evaluated and mapped the wildlife corridors of Tanzania that existed in 2008. Based on the rate of anthropogenic activities and habitat change, each of the 31 identified corridors was assigned a status as either MODERATE (less than 20 years remaining before they disappear), CRITICAL (less than 5 years remaining) or EXTREME (less than 2 years remaining). Corridors which were under extreme state were seven (Table 3); moderate five and 19 were under critical condition. Due to the fact that this evaluation was conducted in 2008, the chances are slim that all corridors that were under critical and extreme condition still exist, particularly if no management interventions were taken to reverse the trend.

4. Drivers of deforestation

Deforestation in Tanzania is a function of several factors covering social, economic and governance. This section highlights few of these factors: human population growth, poverty, urbanisation, political instability, trade, expansion of agricultural lands, emerging of new economic options and infrastructure development.

4.1. Human population growth

The Tanzanian population increased from about 12 million people in 1967 to 44.9 million in 2012, almost four times (Figure 3). With the annual growth rate of 3.1%, Tanzania's population is projected to reach 69.1 and 129.1 million in 2025 and 2050, respectively [31]. Population growth, both in rural and urban areas, is the underlying factor behind rapid rates of deforestation in Tanzania. Population growth increases the demand for food, settlements, infrastructure development, fuelwood, furniture, building materials and other products. In meeting these expanding demands, deforestation is inevitable.

The impact of population growth on deforestation is worsened by the reality that the increased population remains in poverty with limited livelihood strategies and, therefore, compelled to pursue unsustainable economic options including deforestation.

4.2. Poverty

Poverty has been defined as 'a pronounced deprivation in well-being', characterised by 'low incomes and the inability to acquire the basic goods and services necessary for survival with dignity, low levels of health and education, poor access to clean water and sanitation, inade-

¹ The roles of wildlife corridors among others include: allows the movement of wildlife species from one area to another in case habitat in one area becomes unsuitable; allows genetic flow and exchange between species in two habitat patches;

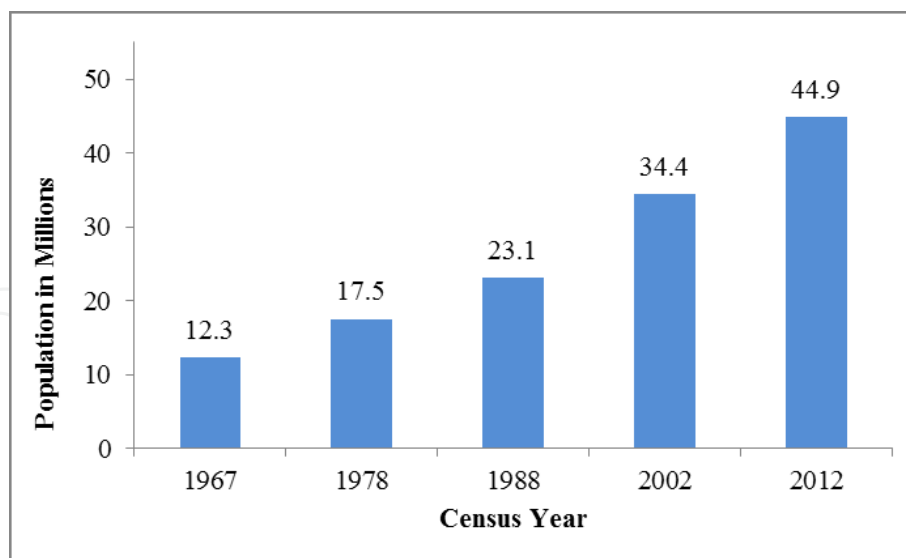


Figure 3. Trends of population growth in Tanzania (Source: National Bureau of Statistics [41]).

quate physical security, lack of voice, and insufficient capacity and opportunity to better one's life' [42].

Tanzania, though endowed with abundant natural resources, has been classified as one of the poorest countries in the world. The World Bank [43] acknowledges a significant decline of poverty over recent years, but this has not exempted the country from being poor. In 2012, Tanzania's average per capita income stood at \$570, placing it in the 176th position out of 191 countries of the world. A number of poor people (about 12 million) residing in Tanzania today is almost the same as that of 2001 [43]. The 2011/12 National Household Budget Survey estimates the basic needs poverty line and food poverty line at 36,482 Tanzanian Shillings (US \$24) and 26,085 Tanzanian Shillings (US\$17) per adult equivalent per month, respectively [44]. Using these two poverty lines, Tanzanian population falling below the basic needs poverty line is 28.2%, while 9.7% falls below the food poverty line.

Poverty has repercussions on natural resources including forests and woodlands. It increases the pressure on forests to meet the basic needs. Its contribution to deforestation can be manifested through: limited livelihood strategies compelling the poor to seek alternatives from the forests, low purchasing power and inability to afford agricultural inputs (e.g. fertilizers) for improvement of productivity of the existing arable land and, therefore, causing agricultural extensification and encroachment into marginal lands, and inability to afford fuel-efficient and environmental-friendly energy, which forces people to rely on forests and woodlands for fuelwood.

4.3. Urbanisation and deforestation

Urbanisation, the process of transforming natural landscapes (such as wetlands and forests) to built environments, is a matter of great concern globally. The UN-HABITAT's report on the State of the World's Cities [45] indicated that half of the world's population was already living

in cities. The report forecasted 60% to reside in urban areas within a period of two decades. The report forecasted further that, by 2050, the urban population of the developing world will be 5.3 billion. Africa continent, whose urban population is 1.2 billion, will host nearly a quarter of the world's urban population [45].

Tanzania, one of the African countries, is experiencing rapid rate of urbanisation, mainly due to high rates of rural–urban migration. The country's urban population grew almost 17 times, from 6.4% in 1967 to 29.6% in 2012 (Table 4). The urban population has been increasing at a rate of 9.3% per annum for the period from 1978 to 2002. The proportion of the national population living in urban areas increased from 25% in 2002 to over 30% in 2012 [41].

Year	Total population	Urban population	Percent urban	Urban growth rate
1967	12,313,469	786,567	6.4	
1978	17,512,610	2,412,902	13.8	10.2
1988	23,095,878	4,247,727	18.4	5.7
2002	34,569,232	7,943,561	23.1	4.5
2012	44,928,923	13,305,004	29.6	5.2

Source: National Bureau of Statistics [41].

Table 4. The trends of urbanisation in Tanzania (1967-2012)

More towns and cities are growing as economic opportunities are emerging and political decisions are implemented. For example, minerals have acted as the important population pull factor to areas such as Kahama, Mererani, and Bulyankulu while wildlife and tourism have led to the development of towns close to famous protected areas such Ngorongoro Conservation Area, Serengeti, Lake Manyara and Ruaha National Parks.

Similarly, change of administrative units in the country has contributed to urbanisation. In 1975, there were twenty regions in Tanzania mainland. Today, six more regions namely, Manyara, Geita, Katavi, Njombe, Simiyu and Songwe have been designated. The designation of new regions goes hand in hand with the designation of new districts, divisions, wards and villages.

The urbanisation and population growth have implications on forests and woodlands. More lands are cleared in order to provide space for administrative offices, social services, settlements and infrastructures. The effects of urbanization are also felt in areas away from the urban areas. Building materials and furniture (timber) are obtained from rural areas. Furthermore, urbanisation creates high demand for fuelwood, especially charcoal [46] (Figure 4). For instance, using figures from three sources [47–49], Msuya et. al. [50] estimated the amount of charcoal consumed in Dar es Salaam to be 1904 tonnes per day or 694,960 tonnes per year. The analysis indicated further that charcoal consumption in Dar es Salaam in 2009 alone caused a loss of about 105,300 ha of forests, and projected that by 2030 demand for charcoal in Dar es Salaam alone would lead to loss of 2.8 million ha of forests [50].



Figure 4. Urbanisation creates high demand for charcoal from rural areas (Source: [46]).

4.4. Expansion of land under agriculture

Agriculture is the biggest driver of deforestation globally, accounting for about 80% of total deforestation in poor countries. Subsistence agriculture is responsible for 48% of deforestation while commercial agriculture contributes 32% [51].

In Tanzania, the impact of agriculture on deforestation is influenced by a number of factors including human population growth, poverty and government policies. Human population growth translates into the expansion of land under agriculture in forest areas in order to meet the increased demand for food and income (Figure 5). For instance, in Kilwa District of Southern Tanzania the area under cultivation increased to 104,744 ha in 2010 from less than 63,000 ha under cultivation in 2005, an increase of approximately 40% [51].

As pointed out earlier, poverty is linked to the inability to afford the agricultural inputs for more crop production. Consequently, people are forced to abandon the existing farms and clear virgin forests for new farms, the practice commonly known as shifting cultivation. To farmers, virgin forest lands have a number of advantages, making it less laborious. Virgin forest soils are easy to work with; new farms are more fertile and productive; after clearing, the area is burned and is ready for planting; new farms have less weeds for about two seasons, therefore weeding is very much reduced; new farms are less infested by pests; new cleared forest soil is well drained and requires zero or minimum tillage before planting [51].

Government policies and programmes may, in a way, stimulate deforestation as more priority is placed in agricultural production. Tanzania's agricultural sector is regarded as the founda-



Figure 5. Destruction of mangrove forests for paddy cultivation in Rufiji (Source: [46]).

tion of the economy as it accounts for about 25% of the GDP and about 20% of traditional export earnings. Furthermore, it provides 95% of food requirement, employs 75% of the population, controls inflation (since food contributes about 56% of the inflation basket) and has the highest multiplier effect in the economy [52].

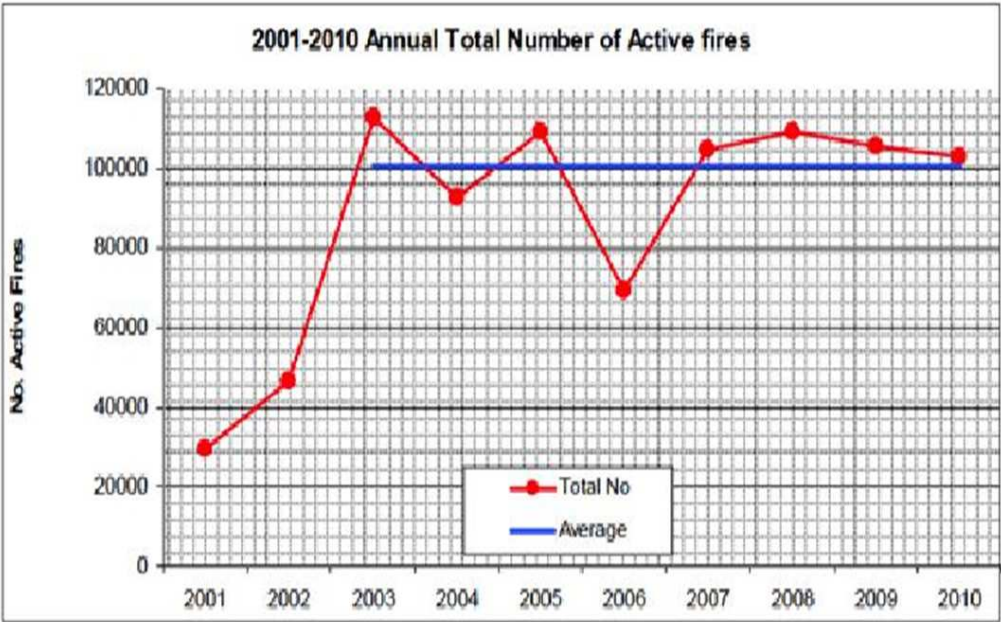
Tanzanian government policy firmly supports the development of both large- and small-scale farming, and recognises that large-scale farming has an important role in stimulating agricultural growth. The country has numerous programmes aiming at promoting agriculture and food security. Some of the recent programmes include KILIMO KWANZA (Swahili words for Agriculture First), BRN (Big Results Now) and SAGCOT (Southern Agricultural Growth Corridor). While it is indisputable that agricultural development is important and inevitable, implementation of various programmes may detrimentally affect the forests by encouraging conversion of forests into croplands.

4.5. Incidences of wildfires

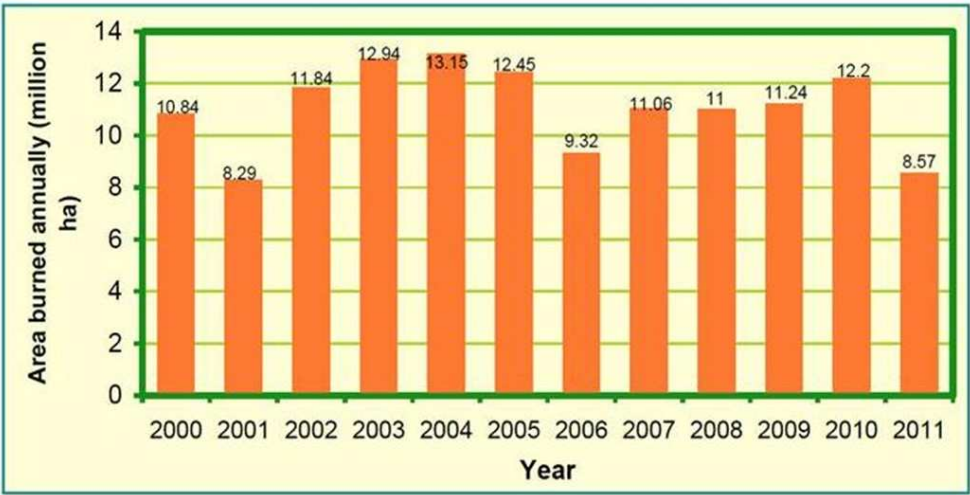
Tanzania forests and woodlands are prone to destructive wildfires set for a variety of reasons. Over years, this problem has been growing and, therefore, contributing to increasing rate of deforestation in the country. MNRT [24] estimated destruction of 65,000 ha of forests and other wooded areas per annum. According to FAO [53], the wildfires affected an average of 12% of

the area of Tanzania annually between 2001 and 2007. Between 1990 and 2010, Tanzania lost an average of 403,350 ha of forest or 0.97% per annum [5].

The incidences of wildfire (Figure 6a and 6b) have made Tanzania, one of the four most affected countries in the SADC region [53]. Reasons for setting wildfires include needs for improving pasture quality, killing parasites, facilitating wildlife hunting, honey collection, charcoal burning, mining, pit sawing, grazing, opening farms, arson and wildfire attributed to pedestrians.



(a)



(b)

Figure 6. (a) Trends of active fires in Tanzania (Source: [54]). (b) Trend of annually burned area in Tanzania (Source: [54]).

The growing trend of wildfires is attributed to insufficient plans and programs to control fire, inadequate human and financial resources, insufficient extension programme for local communities and lack of/or weak integration of informal (Indigenous) knowledge and policy implementation relating to forest fires management [54].

4.6. Political instability and the influx of refugees

Unlike several other African countries, Tanzania is one of the few countries which have enjoyed political stability and peace for a long time since their independence. Many African countries have been confronted with civil wars attributed to high levels of poverty, failed political institutions and economic dependence on natural resources [55].

Despite the prevailing peace and political stability, Tanzania had had a share of problems caused by wars waged in the neighbouring countries. One of the problems, among others, is environmental degradation perpetrated by thousands of refugees resulting from these wars (Figure 7). Forests and woodlands are cleared for settlements, fuelwood, building poles and arable land, leading to a dramatic impact on vegetation and wildlife habitats.



Figure 7. Refugees fleeing civil wars from their countries have contributed to population increase and deforestation in western Tanzania. (Source, <http://www.intechopen.com>).

The western part of the country had been the most refuge-prone area. Although the problem had persisted for several decades before [56], it became more notable following the aftermath of the 1994 genocide in Rwanda. Citing different government reports, Akarro [56] shows that eleven wards in Kigoma region were recipients of 373,213 refugees in addition to 217,095 local people in October 1993. By December 1994, refugees and refuge operations cleared about

20,700 ha of land. In August 1994, about 467,670 refugees formed 64% of the population which lived in 16 wards of Kagera region. Between 1993 and December 1994, 24,000 ha were cleared with addition of 50,000 ha experiencing varying degrees of destruction due to widespread deforestation to meet the demand for fuelwood [56].

In 1994, population in Ngara District increased by 262% following addition of over 500,000 refugees to 191,185 local people [56]. Some months later, the refugee population grew further to 800,000. This population exerted huge pressure on about 95,000 ha of forests and woodlands in the vicinity of the refugee camps. The studies conducted in the area revealed a decline in forest regeneration by 35% following four years of deforestation [57]. This regeneration is quite low to allow quick rejuvenation of the deforested land.

At the peak of the Rwanda refugee crisis, the Kagera region alone recorded very high consumption of firewood amounting to 1200 tonnes per day [58]. In 1997, an average daily fuelwood consumption was estimated to be 300 metric tonnes [59]. The impacts of deforestation were felt some 20 km away from the camps. Nearly 1000 km² of land in BENACO Refugees Camp and the adjacent areas were affected by deforestation. Aerial photos taken in 1996 showed that roughly 225 km² and 470 km² of the affected region were completely and partially deforested, respectively [59].

4.7. Poor governance and corruption

Corruption triggers deforestation by undermining the governance of the forestry sector. Study by the the wildlife trade monitoring network, TRAFFIC, on governance and development of the sector uncovered a large-scale corruption and collusion between national and foreign private interests and government officials [21]. According to study, the emerging dynamics of powerful and organised involvement of senior public officials in timber-related businesses, including members of the executive, obstruct efforts in fighting corruption in the sector. The control over forestry resources is often linked to developing political factions and, therefore, shorter-term decision-making and forms of corruption are very difficult to reverse.

Along with corruption, political interference on the governance of forestry sector has notable contribution to deforestation. The tendency of political interests to override the professionalism is not uncommon. Some decisions are politically motivated regardless of the detrimental effect they may pose on forests. The efforts by the natural resources officials to check the illegal and destructive activities over forests are often frustrated by the politicians who claim to defend their voters. For instance, currently, there are pending cases where people are living and earning their livelihoods illegally inside the protected areas. However, some politicians are against it and there is a move to pressurise the government to degazette some or parts of the protected areas.

Poverty and poor living conditions among the forestry staff and other civil servants are other drivers of corruption. Until recently, the minimum salary for most of the civil servants was US \$85. Bribery and corruption are, therefore, seen as alternative sources of complementing the meager salaries earned by civil servants.

4.8. Growth of trade

Agricultural output and timber prices have been linked to deforestation rates, i.e., when trade affects these prices, it will also affect deforestation rates [60]. As agricultural prices increase, the opportunity cost of conserving forest increases. Farmers react to the opportunity of more profitable cultivation by forest clearing. Furthermore, the extra money earned from agriculture finances more conversion of forestland to cropland [61]. Tanzania, along with Mexico, Thailand, Brazil, Costa Rica, Australia and Brazil, are among the few countries cited to have experienced increased deforestation due to increased agricultural and timber prices [60].

Similarly, timber trade is a lucrative business and, therefore, more people are engaging in this business. The most valuable timber species such as *Milicia excelsa* (Mvule), *Pterocarpus angolensis* (Mninga) and *Dalbergia melanoxylon* (Mpingo) are at risk of extinction due to overexploitation. The factors influencing this trade in Tanzania are accessibility to remote forest areas, corruption and market availability.

4.9. Infrastructure improvement and emerging of new economic opportunities

The past three decades have seen Tanzania investing in developing and improving infrastructures in view of allowing accessibility to different parts of the country. Currently, virtually all parts of the country, previously regarded as remote areas, are easily accessible through good roads. The total classified road network in Tanzania Mainland is estimated to be 87,524 km [62]. The Ministry of Works through Tanzania Roads Agency (TANROADS) is managing the National Road Network of about 29,487 km (33.7%) comprising 10,042 km of trunk and 19,445 km of regional roads. The remaining network of about 58,037 km (69.3%) of urban (5,897 km), district (29,537 km) and feeder roads (22,603) [62] is under the responsibility of the Prime Minister's Office Regional Administration and Local Government. According to TANROAD, the overall road condition assessment at the end of December 2010 indicated that 40% were good, 46% were fair and 14% were poor compared to 25% good, 40% fair and 35% poor in December 2001. Between 30 June 2000 and 30 June 2009, a total of 912 km of trunk and regional roads were upgraded/rehabilitated to bitumen standard [63].

While, on one hand, the improvement of the road network is a credit to the government and important entry point towards social and economic development, it has undesirable consequences on the other hand. These efforts, apart from improving people's living standards, can lead to serious environmental and socio-economic tradeoffs such as a surge in uncontrolled logging and timber trade activities. Areas with intact forests and high-quality timber trees have been subjected to heavy logging to satisfy market demands within and outside the country. For example, forest inventories conducted in 2005 rated most forests in southern Tanzania as "degraded" or "heavily degraded". The main reason was cited as the completion of the Mkapa Bridge in early 2000s [21, 51]. Similarly the completion of the Umoja (Unity) Bridge (in Ruvuma River) connecting Mozambique and Tanzania has increased logging as the bridge is also being used to transport illegally harvested timber into Tanzania from Mozambique [64]. Moreover, traders use Mozambique as a scapegoat to harvest trees illegally in the border districts of

Tanzania and claim that they are from Mozambique, in order to secure permits for transporting them to Dar es Salaam and elsewhere.

Along with infrastructure improvement, new economic opportunities have emerged in the country, prompting government's decisions to tap these opportunities, regardless of the reservations from some conservationists. Examples of such economic opportunities include discovery of mineral deposits in different parts of the country such as uranium (Namtumbo and Bahi), gold (Buzwagi, Bulyakulu, Nzega and Geita) and gas (Mtwara). Presence of these mineral deposits serves as a major population pull factor to the areas and, consequently, a need to clear huge segments of land to allow mining operations, construction of settlements, opening of roads and other infrastructures. Furthermore, the population increase creates high demand for forest products to satisfy domestic and commercial needs (e.g. furniture, fuelwood, etc.).

5. Implications of deforestation

Considering the role played by the forests, it is obvious that deforestation has serious economic and ecological consequences. Among others, the effects include:

- a. Loss of livelihood options among the poor people who rely on forests for food, medicine, fuelwood, building poles and furniture.
- b. Reduction or loss of tourism potentials due to destruction of principle resources including charismatic wildlife species and attractive sites. Examples include local extinction of species in some areas due to habitat loss and isolation [37–40]. Recent trend of snow melting in Mount Kilimanjaro presents another detrimental effect on tourism industry (Figure 8).
- c. Increased human–wildlife conflicts due to proximity and overlap in the use of space between wildlife, livestock and humans. Incidences of property damage by wildlife, diseases transmission, poaching and retaliatory killings increase with increasing human–wildlife contacts.
- d. Increased risk of inbreeding depression among the migratory species due to isolation of protected areas caused by blockage of wildlife corridors;
- e. Increased emission of greenhouse gases in the atmosphere and global warming and;
- f. Reduced land productivity due to loss of soil fertility and inadequate or unreliable rainfall patterns.

The impacts of deforestation can clearly be elaborated by the Eastern Arc Mountains belt. The area lost almost 50% (approx. 300,000 ha) of its montane and sub-montane forests in a period of 5 years from 2000 to 2005 [28]. As a result of this, 90 million tonnes of carbon have been released to the atmosphere. It is estimated that if the current trend of deforestation will continue unabated, the remaining 330,000 ha will be lost within 20 years time. The impacts of this loss are summarized in Box 2.



(a)



(b)

Figure 8. (a) Deforestation at the base of Mount Kilimanjaro (Photo by Rhett Butler). (b) Snow melting on Mount Kilimanjaro is associated with deforestation.

Box 2: What will happen if Eastern Arc Mountains forests are lost?

- Loss of its ecological role as a carbon sink. The current estimate of the carbon storage of the forests is about 152 million tonnes.
- Increased household poverty to adjacent communities. Firewood, construction material, medicinal herbs, wild fruits and other food materials account for 40% of household consumption.
- Reduced water quantity and quality for domestic and industrial use in big cities such as Dar es Salaam, Morogoro, Iringa, Coast and Tanga.
- Serious electricity interruptions. Over 90% of electricity in Tanzania is hydro-based. The EAM forests provide over 90% of the country's hydroelectric power generated at Kidatu, Kihansi, Nyumba ya Mungu, Hale, Pangani and Mtera Stations.
- Reduced soil fertility and change of rainfall patterns may lower yields for crops such as sugarcane (grown in Mtibwa and Kilombero), rice and tea.
- Tourism potential of the area will be lost due to reduced or extinction of charismatic species found in this forests.
- Loss of the area's reputation as one of the world's 24 biodiversity hotspots.

Source: [28].

6. The way forward

This chapter has uncovered a variety of benefits derived from forests. From these benefits, it is apparent that loss of forests is tantamount to putting human life and other species in jeopardy. Unfortunately, in the face of human population growth, poverty, corruption, economic and technological advancement, forests are being depleted at alarming rate, thus threatening the survival of humankind and other species. Tanzania is one of the countries with a notable deforestation rate. Currently, numerous measures are in place to address this problem. However, these measures are either inadequate or are poorly implemented. In reversing the trend of deforestation, there is a need to reinforce these measures and adopt new ones to complement the existing measures. The possible options include the following.

6.1. Enhance conservation education to public

The strategy should aim at educating people about the benefits of forests and adverse impacts that may result from the unsustainable behaviours and actions on forests, sustainable practices that promotes the health of forests and alternative strategies for sustaining their livelihoods beyond those causing damage on forests.

6.2. Addressing the issue of human population growth

Tanzania, like other developing countries, relies on natural resources. Population growth often means farming in marginal lands, migration to urban areas and deforestation, as people try to earn a living. Thus, land use change in this manner causes emissions that contribute to climate change. Addressing the problem of overpopulation will reduce deforestation rates. Some of the strategies, among others, that can be adopted include: empowering women and families to plan the number of children by improving the reproductive healthcare, provision of

education and job opportunities (especially for women in order to alleviate poverty, gender inequality and overpopulation) and creating awareness of environmental and social costs of overpopulation.

6.3. Adopt sustainable and environmental-friendly poverty reduction strategies

The strategies should target provision or introduction of sustainable economic activities that will make people refrain from ecologically damaging activities. Projects like poultry ecotourism, mushroom farming and beekeeping may provide alternative means of living to people and, therefore, reduce pressure on forests. Introduction of these projects should go hand in hand with assisting the communities to access reliable markets for their products.

6.4. Address the problem of corruption and poor governance

Forestry, like other sectors, is confronted with huge corruption. Acknowledging the magnitude of this problem is imperative in developing the viable mitigation strategies. The war against this immorality should be intensified at all levels by all stakeholders including government organs, religious organisations, NGOs, media and individuals. More emphasis should be directed in strengthening institutions such as legislature and judiciary, strict enforcement of the rule of law, discouraging political patronage, restoring/promoting the independence and professionalism of the public and private sectors, building capacity for the civil society to hold perpetrators to account and increase vigilance in the implementation of the 2003 United Nations Convention against Corruption (UNCAC) at all sectors. The four pillars of the convention – prevention, criminalisation, asset recovery and international co-operation – are essential in promoting open, honest and efficient decision-making, fair competition and ethical procurement systems and supporting effective government development strategies [65]. The Forestry staff should be adequately remunerated to inspire them to resist the temptation of participating in corruption practices.

6.5. Provision of alternative sources of energy

Reduction of the continued widespread dependence of household biomass sources of energy requires provision of alternative sources. Modern sources of energy (electricity, liquefied petroleum gas and kerosene) should be provided at reasonable price which is affordable to poor households. Fortunately, natural gas has been discovered recently in Tanzania. What is required is political will and proper planning so that these discoveries can curb deforestation in addition to enhancing the economy at the household and national level.

6.6. Implement benefit sharing schemes

Benefit sharing arrangements are important in motivating people to refrain from activities leading to deforestation. One of the benefit sharing mechanisms is benefit sharing for REDD. REDD-plus can potentially be a significant source of financial benefits for poor rural communities relying on forests for their livelihoods. Payments consist of compensation for the opportunity costs of land-use changes plus a so-called REDD rent. It entails agreements

between stakeholders about the distribution of monetary benefits from the commercialisation of forest carbon. Benefit sharing for RED is built on two premises: it creates effective incentives by rewarding individuals, communities, organisations and businesses for actions that change land-uses and reduce emissions and; it builds wider national (and international) legitimacy and support behind the REDD-plus mechanism. However, implementation of the schemes should identify and address possible contentious issues that may thwart the success of the programme. For instance, one of the controversial issues is ambiguous definition of forests and deforestation, whether plantations should be regarded as forests that deserve consideration under REDD scheme. It is apparent that if the terms are not properly defined, the policy prescriptions may lead to loss rather than saving the forests.

7. Conclusion

The role of forests to mankind and other living organisms cannot be overemphasised. Their role in maintaining ecological functions and sustaining economic development is well acknowledged. However, recent trend of deforestation attributed to rapid human population growth, poverty, poor governance and corruption, among other drivers, puts our life at risk. While this chapter recommends a number of options for reversing the trend, it is an eye-opener for policy-makers, general public and other actors to understand the magnitude of the problem and act accordingly and promptly. The current situation suggests that actions and measures to curb deforestation cannot wait and that the problem calls for multisectoral rather than a single sector approach.

Author details

Jafari R. Kideghesho*

Address all correspondence to: kideghesho@yahoo.com

Department of Wildlife Management, Sokoine University of Agriculture, Morogoro, Tanzania

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