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Managing Renewable Natural Capital in Africa

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MANAGING RENEWABLE NATURAL CAPITAL IN AFRICA

There is a growing evidence suggesting that the ecological degradation in Africa is accelerating faster than the region's economic decline. More seriously, trees in Sub-Saharan Africa are being felled 30 times as fast as they are being replaced; implying the highest rate of deforestation in the world. Unless this trend is slowed down, the increasing demand for woodfuel coupled with high population pressure are capable of destroying the forests in less than sixty years.

This paper is organised as follows. Section 1 discusses the seriousness of the deforestation problem in Africa. The related salient features in Sub-Saharan Africa emphasize the interrelationship between the environment and economic system so that environmental degradation should not be analysed in isolation. The statistical evidence in section 2 indicate that renewable natural assets are being lost at an unacceptable and economically inefficient rate due to a combination of factors: structural, market and more significantly government intervention failures. The assessment of the available policies and measures adopted to slow down or reverse the trend and loss of forests failed to achieve their goals. Section 3 reveals that a rational management strategy to maintain natural capital stock in a sustainable fashion is not considered important at the prevailing state of the art, unless both its economic dimension and its impact on the development of Africa can be indicated. With this background in mind, Section 4 adopts a long-term view strategy to manage natural capital. Our starting point is that corporate organisation to manage common property resources are practiced by many African tribes and local communities. Such a collective action is the best available option to manage a sustainable natural capital. However, the success of this viable remedy goes beyond the means of local administration in Africa. What is needed to strengthen the managerial capabilities of these communities are biological services, sufficient international financial flows and adapted technological advances. The concluding remarks identify a practical format to share the responsibility by all concerned parties in a form of development contract between donor community and African states during the short to medium term of operation.

Stylized Facts

The re-birth of environmentalism is not only confined to the developed countries, there is also an increasing world-wide concern about environmental problems in developing countries and in particular Sub-Saharan Africa. For example, a recent World Bank study reports that the global impact of environmental trends in Sub-Saharan Africa can be expected to command increasing attention in the future, as environmental issues become increasingly prominent in world affairs.[1] Although reliable data on the state of environmental degradation do not exist for most African countries, forestry statistics is available and the series date back to the 1960s. Recent surveys reveal that deforestation outstripped the rate of new tree planting by 29 to 1; thus making forests the fastest depleted capital in the continent. With the exception of Haiti and Nepal, Sub-Saharan African countries have the highest rate of deforestation in the world.[2] More seriously, the majority of these countries have to contend with the high rate of deforestation. This is because at the height of economic adjustment and a priority concern for basic necessities, policy-makers in Sub-Saharan Africa regard environmental policies as luxuries.

A related salient feature is that African countries have a direct dependence on forests and pastoral land than other developing countries. In Africa, natural resources constitute a major component of the wealth of the continent and are vital as life-support system. In these countries fuel usually means fuelwood, shelter requires wood and sustainable tree cover is an insurance to feed the herds and animals. The multifunctional characteristics of the forest suggest that this renewable natural capital is more interconnected with other natural assets than is demonstrated by the negative consequence model of resource interconnection. The reason is that deforestation in many African countries accelerated desertification and at its current rate is capable of producing irreversible shock to the ecosystem.[3] In turn, the shock weakens the resource base of these countries to the extent that a drought, civil war or any supply shock can easily lead to starvation, disaster and many years set back in development prospects as witnessed recently in the Sahel, the horn and east Africa.

Third, land rehabilitation policy required to accompany the unabating resource depletion is absent in almost all Sub-Saharan Africa. This tends to exacerbate the depletion

episode of natural resource base in Africa. Typically, deforestation entails both a loss in wind shelter to the soil and an increase in water run-off. Both effects are capable of reducing soil fertility and hence land productivity. More directly, as trees are reduced, fuelwood becomes scarce; thus reinforcing the World Bank's empirical finding that as many as 80 million Africans have difficulty finding fuelwood.

The effect of the scarcity of fuelwood is greatest in the poorest countries of Sub-Saharan Africa. In these countries more than 98% of households depend on traditional fuel. These households are more vulnerable to resource shock since there is no affordable substitute to fuelwood.

The disappearance of Africa's forest has implication beyond the human cost. Deforestation also leads to an inevitable destruction of the environment that wild animal require for their existence. Sub-Saharan Africa is well-endowed with wild animals and plants. There are at least 300,000 species and a significant number of them are unique. There is also a loss of the scenery, landscaping and generic material for future development of crops, habitat and medicine.

Causes of Deforestation

There are varying opinions on the factors behind deforestation in Africa. Some blame the external factors beyond Africa's control such as drought, encroaching desert, dumping toxic waste by some industrial countries and too little aid. Although there is no strong evidence to support this claim, it is easily arguable that external factors might have accelerated the process as witnessed in the Sahel. Others lay the blame on erroneous domestic policies. The widely discussed interventions include land tenure, open access, neglect of forestry sectors and inappropriate incentives. Country experiences are in variance and the degrees of importance of these factors are numerous.[4] Despite these differences, most recognize the increasing demand for woodfuel and high population growth as main determinants of deforestation in Africa.

FAO and Dasgupta among others confirmed that the greatest cause of deforestation today is not the market for food products, but rather, the need for woodfuel and agricultural

land.[5] These reports estimated that 50% of the trees cut down in the world is for fuel use. However, this ratio is significantly higher in Africa. The reason is two fold. First, in developed and newly industrialized developing countries the transition to fossil fuel is largely complete. Whereas, in Sub-Saharan Africa fuelwood, charcoal and to a less extent crop residues are the basic source of fuel. More than 80% of the population relies on this traditional fuel and 98% of household energy demand is met from fuelwood and charcoal. Table 1 shows the degree of reliance on traditional woodfuels in selected African countries. For Sub-Saharan Africa as a whole two-third of energy consumption is obtained from woodfuel. If this trend continues, the World Bank projected the demand for woodfuel to triple before 2020. Second, the rate of growth of forest products export are either negative or moderate as summarized in Table 1. The same conclusion can be drawn in case of agricultural and food production in these countries (Table 1). Thus, leaving the demand for traditional woodfuel and its determinants as the main causes for the high rate of deforestation.

The sharp increase in woodfuel consumption in Sub-Saharan Africa can be explained empirically by the unabating high cost of kerosene, high growth of population, lingering poverty and low income of the majority of the population. Table 1 attests to this fact and in particular the poorest countries of Africa who can least afford to import petroleum product substitutes for direct household use of woodfuels (kerosene and liquefied petroleum gas, LPG).[6] In these communities electricity is a very limited substitute since it is not used for cooking and the cost of an electric stove far exceeds the annual per capita income.

The population in Sub-Saharan Africa now is twice its size in the mid 1960s and the population growth rate is among the highest in the world. If this trend continues, Africa's population would double every 20 years, reaching 1 billion before 2010 according to a very real UNECA's nightmare scenario.[7] This population pressure on land is, among other things, accelerating deforestation. This factor coupled with the absence of woodfuels substitutes are making fuelwood increasingly scarce. Deforestation and fuelwood scarcity will be accelerated further by the rapid urbanisation rate.

TABLE 1: Basic Economic and Environmental Indicators in some African countries

Country	Woodfuel dependency rate in 1980-84	Deforestation rate per year in the 1980s	Growth rate in forest products exports	Growth rate in Agricultural production in 1980-85	Growth rate of food production in 1980-86	Growth rate in per capita food production in 1980-85	Growth rate in food aid in 1980-85	Annual population growth rate in 1980s	Urbanisation rate in the 1980s	Per capita GNP growth rate in 1980-86	GNP per capita in 1988 US$	Debt per capita in 1988 US$
Malawi	92	3.5	0	2.7	1.2	-1.9	-9.4	3.9	8.6	0	160	165
Tanzania	91	0.3	6.6	0.9	1.6	-1.8	-1.3	3.5	11.3	-1.8	150	191
Guinea-Bissau	89	2.7	-17.3	4.9	5.0	3.1	6.0	1.8	4.4	2.1	160	450
Ethiopia	89	0.3	- -	-0.9	-0.5	-2.9	33.3	2.3	4.6	-2.4	120	65
Sudan	83	0.2	- -	1.6	0.6	-2.2	32.2	3.2	4.2	-1.8	340	499
Niger	80	2.6	- -	-2.1	-2.1	-5.0	52.0	3.0	7.5	-6.8	310	249
Uganda	71	0.8	- -	4.9	3.4	0.1	-9.2	3.0	5.0	0.8	280	119
Kenya	71	1.7	-16.7	0.7	-0.7	-4.7	18.9	4.1	8.6	-1.0	360	256
Gambia	70	2.4	- -	4.9	5.1	2.8	17.1	3.4	8.5	-3.0	220	398
Liberia	64	2.3	5.7a	2.8	3.3	-0.0	37.6	3.3	5.9	-5.2	450	680
Senegal	60	0.5	- -	1.3	1.0	-1.5	11.7	2.9	3.8	-0.1	630	506
Morocco	35	- -	1.1	3.0	3.1	0.5	33.3	2.6	- -	-0.4	874	850
Zambia	35	0.3	- -	2.5	2.1	-1.1	-6.0	3.5	6.6	-5.6	300	868
Zimbabwe	30	0.4	6.8	2.3	0.3	-3.1	- -	3.7	6.3	-1.0	660	287
Sub-Saharan Africa (excluding Nigeria)	67	- -	- -	1.6	1.4	-1.3	19.8	3.0	5.9	-1.6	365	334

Sources:

Pearce, D. W. & Turner, R. K. *Economics of Natural Resources and the Environment*, (New York and London: Harvester Wheatsheaf, 1990) 344

World Bank/UNDP *Energy Assessments*: Country Energy assessment, (Washington and New York: The World Bank and United Nations Development Programme, respectively, 1980-84)

World Bank *Sub-Saharan Africa, from Crisis to Sustainable Growth: A Long Term Perspective*, (Washington, D.C.; The World Bank 1989) Tables 1 and 2, 221-222

World Bank *World Debt Table*, (Washington: The World Bank, 1989-90 and 1990-91)

Note Dependency rate = $\frac{\text{traditional fuel (fuelwood and charcoal)}}{\text{Total primary energy}} \times 100$

[a] indicates average growth rate for 1981-86 per annum. In the rest growth rate for the period 1980-85

- - means not available

Urbanisation rate in Sub-Saharan Africa as a whole is less than the prevailing rate in most of the poorest African countries. The overall rate is approaching 6% which is higher than the average rate for developing countries (Table 1). The majority of the migrated urban dwellers in Sub-Saharan Africa are addition to the urban poor who consume wood for both shelter and cooking. Poverty and declining per capita income lead to further dependence on traditional fuel and consequently increases the demand for woodfuel and charcoal, thus confirming the universal claim of an inverse relationship between traditional fuel use and economic development.

The overall economic growth in Sub-Saharan African countries, with the exception of Guinea-Bissau, is either negative or negligible. The per capita debt exceeds per capita GNP in the majority of these countries. The debt in Sub-Saharan Africa has grown faster than in other developing regions since 1980. This disappointing growth record and worsening economic and environmental indicators forced Sub-Saharan Africa to satisfy its widening food gap from food aid (Table 1).

Unless this situation is reversed, the statistical evidence in Table 2 predict eventual depletion of this renewable environmental asset and faster than reported elsewhere. For example, Cote d'Ivoire lost two-third of its forest in slightly more than two decades. If this rate of deforestation persists, the forest in Cote d'Ivoire will be destroyed in less than 20 years, less than 30 years in Malawi, less than 40 years in Guinea-Bissau and Nigeria. If the reported rates of deforestation in Table 2 continue, it will only take 40 to 60 years to destroy the forests in the Sahel of west Africa: Niger less than 40 years, Gambia and Mauritania less than 45 years and Benin and Burkina Faso less than 60 years. Even in countries with modest effort to plant trees such as Kenya, forests are expected to last for only 60 years.[8] If the impact of Africa's civil wars is considered, the stock of natural capital in Chad, Liberia, Mozambique, Somalia and Sudan will be significantly lower than reported in the Table. In some instances, as in Liberia, the forest is likely to be destroyed before its estimated life of 44 years. Even in countries with high initial stocks (Ethiopia, Nigeria, Sudan, Tanzania and Zaire) excess consumption at levels shown in the last column of Table 2 would only be tolerable for few years after which the gravity of the situation will affect the whole continent.

Table 2: Forests, woodland, deforestation and excess harvesting of fuelwood in Sub-Saharan Africa

	Forest and woodland, 1980s ('000 hectares)	Ratio of forest land to total land area		Average annual production of fuelwood and charcoal 1984-86 ('000 cubic meters)	Deforestation 1980s ('000 hectares/ year)	Reforestation 1980s ('000 hectares/ year)	Excess harvesting over sustained yield
		1965	1987				
Low -income							
Ethiopia	27,150	0.27	0.25	36,132	88	6	150%
Chad	13,500	0.12	0.10	3,063	80	0	30%
Zaire	177,590	0.80	0.77	27,989	347	0	- -
Guinea-Bissau	2,105	0.39	0.38	422	57	0	- -
Malawi	4,271	0.54	0.46	6,211	150	6	31%
Mozambique	15,435	0.22	0.19	14,203	120	1	- -
Tanzania	42,040	0.51	0.48	21,604	130	7	150%
Burkina Faso	4,735	0.30	0.25	6,452	80	2	30%
Madagascar	13,200	0.31	0.25	6,083	156	12	- -
Mali	7,250	0.08	0.07	4,599	36	0	30%
Gambia	215	0.30	0.17	829	5	0	30%
Burundi	41	0.02	0.03	3,593	1	1	- -
Zambia	29,510	0.42	0.39	9,418	80	3	- -
Niger	2,550	0.03	0.02	3,680	67	2	193%
Uganda	6,015	0.32	0.29	10,868	50	0	21%
Somalia	9,050	0.16	0.14	4,358	13	1	- -
Togo	1,684	0.45	0.29	603	12	0	- -
Rwanda	230	0.23	0.20	5,535	5	2	- -
Sierra Leone	2,055	0.30	0.29	7,635	6	0	- -
Benin	3,867	0.44	0.33	4,181	67	0	- -
Central African Republic	35,890	0.58	0.58	2,925	55	- -	- -
Kenya	2,360	0.08	0.06	30,874	39	0	- -
Sudan	47,650	0.24	0.20	17,690	104	11	71%
Comoros	- -	0.16	0.16	- -	0	0	- -
Lesotho	- -	- -	- -	525	- -	0	- -
Nigeria	14,750	0.23	0.16	87,656	400	14	73%a
Ghana	8,693	0.43	0.36	8,219	72	3	- -
Mauritania	554	0.15	0.15	7	13	0	893%
Liberia	2,040	0.22	0.22	3,913	46	1	- -
Equatorial Guinea	- -	0.46	0.46	447	3	- -	- -
Guinea	10,650	0.49	0.41	3,647	86	0	
Middle-income							
Senegal	11,045	0.35	0.31	3,505	50	2	- -
Zimbabwe	19,820	0.52	0.52	5,867	80	5	30%
Swaziland	74	0.08	0.06	560	0	5	- -
Côte d'Ivoire	9,834	0.60	0.20	7,970	510	3	- -
Congo, People's Republic	- -	0.64	0.62	1,585	22	2	- -
Cameroon	25,620	0.59	0.53	9,134	110	1	- -
Botswana	32,560	0.02	0.02	1,107	20	- -	- -
Mauritius	- -	0.34	0.31	14	0	1	- -
Gabon	20,575	0.78	0.78	2,525	15	- -	- -
Seychelles	- -	0.19	0.19	- -	- -	- -	- -
Angola	53,600	0.44	0.43	3,903	84	0	- -
Djibouti	106	0	0	- -	- -	- -	- -

Sources:

Anderson, D. and Fishwick, R. *Fuelwood Consumption and Deforestation in African Countires, World Bank Staff paper*, No. 704 (Washington, D.C. 1984)

Pearce, D. W. and Turner, R. K. *Economics of Natural Resources and the Environment* (New York and London: Harvester Wheatsheaf, 1990)

World Bank/UNDP *Energy Assessment: Country Energy Assessment* (Washington, D.C. and New York: The World Bank and the United Nations Development Program, 1980-84)

World Bank Sub-Saharan Africa: From Crisis to Sustainable Growth, A long Term Perspective Study (Washington D.C: The World Bank, 1989)

Note [a] refers to North Nigeria only, the Sahel West African countries (except Niger and Mauritania) average 30% of excess harvesting of woodfuel over sustainable yield.

- - indicates not available.

Policy Options

Recommended policies to slow or reverse the forest loss trend range from pure pricing policy, assignment of property rights to conservation. The basic argument for pricing policy to secure a rational management of natural resources is that trees for fuelwood will be planted in a significant scale only when wood becomes a marketed commodity and prices are attractive to growers. On the demand side the argument is that high fuelwood prices are likely to slow down the rise in fuelwood consumption. On the other policy side, expansion in agricultural land that caused deforestation can be reduced by reversing the agricultural development policy in Sub-Saharan Africa. The claim is that recent agricultural conversion processes have been artificially stimulated by a range of subsidies, price guarantees and tax incentives given to farmers.

By way of contrast, woodfuel in Africa is a necessity with practically no substitute, hence high prices may induce growers (if they exist) to clear the forest rather than planting trees. Other supporting example in the Sahel is that firewood is collected most often from trees and shrubs that are common property. For this reason the increased demand for woodfuel in the Sahel has not readily provided an incentive, via prices, to transfer land from other uses to forestry.

Since wrong signals may induce environmental degradation, lending institutions and few academics recommended secure land tenure and clarification of resource rights to manage natural resources in Africa. The basic argument is that tenure insecurity reduces the growers incentive to invest in forest land improvement. Following the neoclassical tradition, it is argued that traditional African land-tenure systems induce inefficient allocation of resources because property rights are not clearly defined, costs and rewards are not internalized, and contracts are not legal or enforceable. Consequently, the World Bank emphasized the need to promote freehold tenure with title registration and the more general establishment of individual rights by land demarcation through survey. Some African countries including Botswana, Ghana, Kenya, Somalia, Uganda and Zimbabwe are quick to accede to these recommendations by establishing some form of individual land tenure. However, Barrows and Roth among others concluded that regardless of tenure status, land

rights appear to be secure in situations of low population density, little land scarcity, limited economic opportunity, and where strong local communities sanction usufructuary rights on the basis of long-term settlement.[9] New evidence suggest that there is a slow learning process by the World Bank and other lending institutions that tribal and communal rules in Africa represent the best available solution to manage these potentially renewable resources. In many African communities there are close, effective rules of social cohesion which guarantee proper resource management. However, policy-makers and many economists shied away from this fact favouring instead the imposition of state regulation to manage common property resources.[10] Our approach employs this inherited African managerial capability by emphasizing strict application of communal rules to all users and the sanctions for breaking the fundamental rule of environmental management. The rule embraces both economic efficiency and non-economic benefits (such as intergenerational justice) of natural capital stocks. Indeed keeping this resource-base intact is central to achieving sustainable economic development in Sub-Saharan Africa.[11]

Management Strategy

The resource interconnections are summarised in Fig. 1, leading to environmental degradation and the proposed management strategy. The latter includes policy guidelines to manage the potentially renewable capital in Africa in four interrelated propositions.

Proposition 1:

The fuel crisis in many parts of Africa can only partially be alleviated by communal woodlots and plantations of fuel species.

Proposition 2:

Systematic management of forest cover must be transferred to local communities (chieftain, shiekhdom, head of tribe, group of wisemen, village committee or designated leadership in the existing structure of the local community in the region).

Proposition 2 is desirable to achieve both administrative and financial efficiency. It is commonplace knowledge that inherited societal rules are widespread in Africa, especially

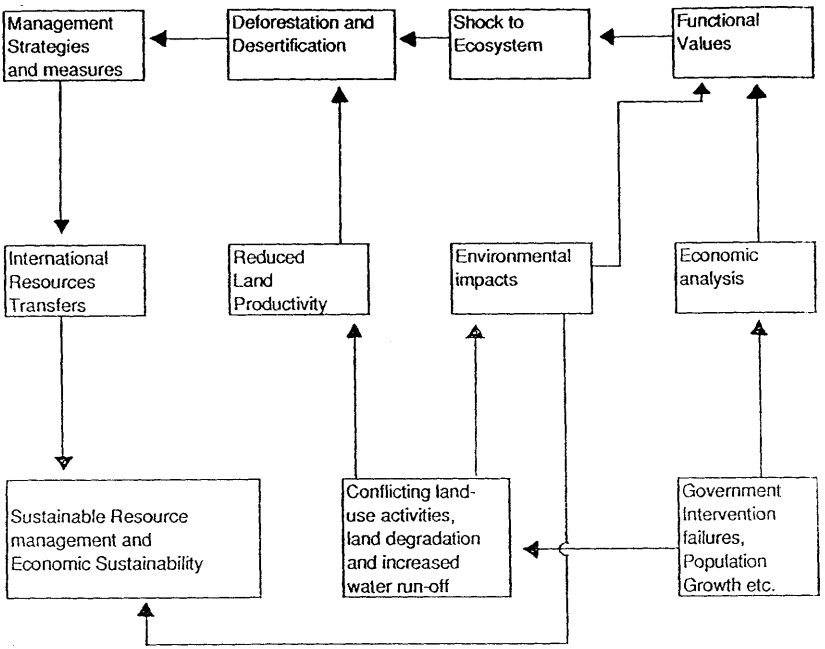

Figure 1: A rational management strategy.

Adapted from Barrow and Roth (1990) p. 338

where common property or common-pool resources exist. The usual practice in these communities is to develop rules of use or limiting the use that any individual or family is allowed to make of the common resource. In rare occasions will African communities abandon such rules. If rules are neglected, then this is an inevitable a consequence of replacing local administration by modern forms of village/town councils. However, in these communities there has been a revival of cultural and local administration. Furthermore, it is widely accepted that local collective action in Africa is not only administratively efficient, but it requires less financial resources than either privatisation or government regulation.[12]

Each community should decide, based on the fundamental management rule and technical data from forestry services, on allocation of fuelwood to be harvested, to provide for regenerating stocks and to ensure in the long run that costs are recovered.

Proposition 3:

The fundamental rule to manage the forest is that the rate of use (harvest rate) of the forest should not exceed its natural regeneration rate.

This rule must be maintained over lengthy periods of time so that the resource stock of renewable resources should not decline over time. One way of insuring the constancy of natural capital stock over time is by allocating suitable compensatory financial resources to be drawn from forthcoming development fund, discussed in proposition 4. The proposition integrates sustainability consideration with the development-preservation decision and, furthermore, the decision itself is internalized.

A corollary to this proposition is that existing stocks in some Sahelian countries are significantly below the desired (optimum) level to satisfy rural energy needs and part of the urban needs without causing further deforestation, desertification and other environmental damage. In this case additional efforts to plant more trees to achieve optimal stock in a short and technically feasible time must precede the implementation of the fundamental management rule.[13]

Proposition 4:

The lack of financial and technical support to sustain proper management of natural assets in Sub-Saharan Africa is beyond the capacity of local communities. If the proposed

strategy is to succeed, financial and technical responsibilities will have to be shared in the short to medium run between forestry services, specialized government entities and the international financial and donor communities.

Forestry services can provide technical assistance on planting, seedling, improvement of seedling and timber varieties, expansion of renewable stocks and other extension services. Intensive new efforts with full patronage and participation of donor's targeted technical support programmes to strengthen the agroforestry research at country-level, to link it to multicountry or regional research network and then to specialized international institutions to focus more research effort on Africa, in particular problems of deforestation and desertification, must start immediately.

The state efforts are best received and accepted by local communities as complementary to the communities' own programme (not administrative , supervisory nor regulatory). The state can, for example, co-ordinate and facilitate research efforts, provide logistics to research institutions, involved non-government organisations and international community. More importantly, the state or preferably its specialized entity entrusted with technology and technological progress can design and introduce more fuel-efficient wood and charcoal stoves at affordable prices similar to the Mai Sauki experiment in Niger or to encourage the private sector to produce such commodities.[14] Other areas for government's participation in technological progress is advancement of research to allow for increased efficiency of resource use such as acceleration of joint ventures with oil companies to develop and utilize natural gas reserves and oil exploration in countries like Cameroon, Cote d'Ivoire, Gambia, Sudan and Tanzania. In the long run technological advances can be extended to include modern energy conservation measures in both production and consumption similar to what advanced economies are experiencing now relative to hundred years ago.

Finally, donor community can earmark part of its aid to strengthen management of renewable natural assets linked to propositions 1-3 or similar management strategy, to reactivate debt swaps to save and improve environmental assets and to enter in a

development contract, similar to WIDER's proposal, with countries adhering to long-term development programmes that protect, not destroy, the environment.[15]

Conclusions

The tree cover of Africa is declining rapidly than reported officially basically due to continuous increase in traditional woodfuel consumption and high population growth rate. Trees in Sub-Saharan Africa not only provide life-support system for its population, but the forest has multifunctions. Fragile soil trees protect the soil against wind and rain, provide organic matter to improve soil structure, and draw on deep groundwater and nutrients that the roots of annual crops cannot reach. Expanding herds of livestock exert a heavy grazing pressure, reducing the ability of forests to regenerate naturally. Wild animals, birds, unique natural species, are loosing their shelter and the required environment for their existence. Although there are numerous reports of a decline in fertility of cultivated land in many parts of Africa and an increasing difficulty to secure enough woodfuels for cooking, our understanding of the ways in which natural forests protect microclimates and support development need more research in Africa. So far recommended policies to reduce deforestation in Africa are either overly general and nonintegrated or too simple, applied at small scale and are not applied widely to produce significant impact in a single country.

This study developed a management strategy that differs significantly from current practice in most Sub-Saharan Africa. In these countries, governments still manage forests at all levels, however, with no integrative plan or co-ordinated policy actions to produce sustainable yields from natural assets. With very insignificant exceptions, little attention is being given to the environmental impact of deforestation and desertification. More seriously no provision has been made to enable local communities to take full charge of their asset. Our strategy reverses all of that to improve management policy through local administration, to co-ordinate technical services of forestry and to insure strong commitment and mobilization of foreign savings with the required technical know-how to sustain renewable natural capital in Sub-Saharan Africa. The chances of success depend on the degree of autonomy and support of the local communities, community-forestry services relation, less

state intervention except in technological advances and donor's willingness to support and contribute effectively in the short to medium term during the execution of the strategy.

NOTES

[1] The World Bank, *Sub-Saharan Africa from crisis to sustainable growth, a long term perspective* (Washington: The World Bank, 1989), 33.

[2] UNDP estimated a reduction in the forest area of 59% between 1956 and 1977 in Haiti. The World Bank conservatively estimated the annual rate of decline at 5%. The remaining forest area is less than 200,000 hectares at present. In Nepal, forest area has shrunk from 6.4 million hectares in 1963-64 to 4 million in 1980 and the forests are disappearing at the rate of 100,000 hectares per annum. For country data on rates of deforestation, interested readers may refer to World Bank/UNDP, *Energy Assessments: country energy assessment* (Washington and New York: The World Bank and the United Nations Development Programme), several issues.

[3] The model asserts that removal of tree cover will have negative impact on both health and food output through various linkages of natural resources. The logic and details of the model can be found in Dasgupta, P. *The control of resources* (Oxford: Basil Blackwell, 1982), 180-1; and Pearce, D.W. and Turner, R.K. *Economics of natural resources and the environment* (New York and London: Harvester Wheatsheaf, 1990), 347-9.

[4] Broad trends and examples of country to country experience were discussed in Barrows, R. and Roth, M., land tenure and investment in African agriculture: Theory and evidence, *Journal of Modern African Studies*, 28, 2 (1990), 265-97 and The World Bank, op. cit.

[5] Dasgupta op. cit. and FAO, *The state of food and agriculture* (Rome: Food and Agriculture Organisation of the United Nations, 1978) and subsequent reports. Sommer, A. , Attempts at assessment of the world's tropical forests, *Unuasylva*, 28 (1976), 5-24 provided statistical evidence suggesting that a significant portion of forests are depleted annually for agriculture alone. However, a growing evidence by most researchers confirmed that the current trend of deforestation is mostly attributed to the demand for traditional fuel.

[6] One would expect the actual dependency rate in Zambia to exceed the average rate for Sub-Saharan Africa since Zambia has slipped from the middle-income to the low-income group as classified by the World Development Report in the past decade. The remaining economic and environmental indicators are similar to those in other low-income Sub-Saharan countries.

[7] UN Economic Commission for Africa, *ECA and Africa's development 1983-2008: a preliminary perspective study* (Addis Ababa: United Nations Economic commission for Africa, 1983).

[8] In the majority of Sub-Saharan African countries, the rate at which forests are being denuded are higher than those reported in Dasgupta. Consequently, forests in these Sub-Saharan countries are expected to be destroyed earlier and faster than the tropical forests in other developing countries as argued in the text. Dasgupta demonstrated that at the prevailing deforestation rate of 100,000 square kilometres per year, the tropical forests in the Indian sub-continent will be destroyed in 80 to 90 years.

[9] Barrows and Roth, loc. cit. p. 289. Their empirical review indicate that there is still debate over the effect of tenurial change on natural assets and there is a great deal more to be learned before any significant conclusion can be reached. For more in the issue, readers may consult:

Coldham, S. The effect of registration of title upon customary land rights in Kenya, *Journal of African Law*, XXII, (1978), 91-111.

Johnson, O.E.G. Economic analysis: The legal framework and land tenure systems, *Journal of Law and Economics*, XV, (1972), 259-76.

[10] The argument of averting the tragedy of the commons has been raised to justify full authority of the state to manage common property. A common property resource is a resource that is owned by some defined group of people (a community, tribe, etc.) However in an open access resource no one owns the resource and access is open to all, i.e., there are no limits to new entrants. Both the tragedy of the commons and the forest are more aptly applied to open access than common property resource. Wade among others, considered the forest a common-pool resource. Common-pool resources are public goods with finite, or subtractive, benefits. Therefore, common-pool resources are potentially subject to congestion, depletion or degradation as discussed in Blomquist and Ostrom, Randall and Wade. For more far-reaching proposals to manage the commons, readers may refer to:

Blomquist, W., and Ostrom, E. Institutional capacity and the resolution of commons dilemma, *Policy Studies Review*, 5, No. 2, (1985), 383-93.

Hardin, G. The Tragedy of the commons, *Science*, 162, December (1968), 1343-8.

Olson, M. *The logic of collective action*, (Cambridge: Harvard University Press, 1971).

Wade, R. The management of common property resources: finding a cooperative solution, *World Bank Research Observer*, Vol. 2, No. 2, (1987), 219-34.

[11] Resource and environmental economists define economic sustainability to meet targets of human needs satisfaction without violating environmental and other socio-economic standards, thresholds or capacities. Although this definition is directed primarily towards the satisfaction of human needs, this study assumed implicitly, otherwise we recommend the extension of, the concept to be general enough to encompass the survival of non-human nature and its natural habitat. For more discussion of resource management and economic sustainability see the following references:

Ahmad, Y.J., El Serafy, S. and Lutz, E. (eds.). *Environmental Accounting for Sustainable Development* (Washington: The World bank, 1989).

Barnett, H. J. and Morce, C. *Scarcity and Growth: the Economics of Natural Resource Availability*, (Baltimore: John Hopkins, 1963).

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Dasgupta, P. op. cit.

Falloux, F. and Mukendi, A. (eds.) *Desertification Control and Renewable Resource Management in the Sahelian and Sudanian Zones of West Africa*, World Bank Technical Report No. 70, (Washington: The World Bank, 1988).

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Pezzey, J. *Economic Analysis of Sustainable Growth and Sustainable Development*, World Bank Environment Department Working Paper No. 15, (Washington: The World Bank, 1989).

Repetto, R. et al. *Wasting Assets: Natural Resources in the National Income Accounts* (Washington: World Resource Institute, 1989).

[12] Common property management is favoured to privatisation in Africa for two reasons. Theoretically, Pearce and Turner showed that a common-property solution carries less risk of resource extinction if there is a critical minimum size of the stock of renewable natural resources. Secondly, privatisation in Africa often occurs naturally as forest land deteriorated and converted into other use.

[13] It is tempting to argue in this case that conservation could be a sound risk-averse strategy. However, the reality in these countries is that people must consume woodfuel to survive. Conservation is either a non-viable strategy or will be redundant if nothing is done.

[14] The government of Niger mounted a programme in the 1980s to improve the efficiency of fuel consumption by urban households. An efficient stove (known at the Mai Sauki) was designed, artisans were trained to produce it, the marketing network was improved and the new stove was advertised and sold.

[15] The system of development contracts was first proposed by The Swedish Foreign Affair Minister Thorvald Stoltenberg in 1989. The contract is between donors and developing countries and is meant to move the process of development from short-term adjustment to long-term framework. World Institute of Development Economics Research (WIDER) of the United Nations University propagated the idea in several meetings and publications. The idea is that each developing country needs to formulate a development strategy to maintain socially necessary growth. The development plan should be supported by donor community for basic needs purposes. The estimated initial financial resources needed to support Sub-Saharan Africa's development goals would be US $ 7 billion. For further details and discussions of this issue, see

Jayawardena, L. op.cit., Taylor L. *Foreign resource flows and developing country growth.* WIDER Research for Action Series, (Helsinki: World Institute for Development Economics Research of the United Nations University, March 1991).

Dasgupta, P. et. al. *The environment and emerging development issues*, WIDER Study Group Series No. 7 (Helsinki: WIDER, October 1991).

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