
Towards Sustainable Charcoal Production and Use: a Systems Approach

Evans Kituyi

African Centre for Technology Studies, PO Box 45917, Nairobi, Kenya

e-mail: e.kituyi@cgiar.org

1.0 Introduction

The majority of African households will continue depending on traditional fuels to meet their daily energy needs for many decades to come. In particular, the demand for charcoal in most countries in the region continues to grow at high rates owing to the ever-increasing rural-urban migration. These trends, coupled with inefficient charcoal production and consumption practices, and inaccessibility by most households to reliable and affordable commercial energy forms puts in deep uncertainty the future dependence on the already-dwindling biomass resource for energy. A systems approach to sustainable biomass production and consumption as regards charcoal is proposed. Based on the life-cycle concept, the optimum policy and institutional arrangements necessary for this strategy to achieve its goal are prescribed. The strategy can be potentially adopted in all sub-Saharan African countries with various socio-economic and environmental gains. At a time when the continent is searching for lasting solutions to energy insecurity as well as reducing poverty, the strategy proposed provides such a chance for the poor to achieve this goal in the short term, while preparing them to gain access to reliable and affordable commercial energy options.

2.0 Significant increases in access to cleaner commercial energy are unlikely

Africa starts the 21st Century as the poorest, the most technologically backward, the most debt distressed, and the most marginalised region in the world¹. Drought, disease, civil conflict and poor governance make the situation worse. Consequently, Africans' quality of life continued to erode over the last decade. In sub-Saharan Africa, an average 52% of people live on less than US\$1 per day and urban poverty is increasingly severe, with about 43% of urban dwellers living below the poverty line of US\$47 per month per capita². National economies have not performed well over the past decade and opportunities for employment and household-level income generating have diminished-hence the family savings to facilitate transition to and investment in modern energy are minimal. Because of these, at least 80% of the African population continues to depend on traditional biomass fuels (charcoal and firewood) for their energy needs³.

The continent's urban population growing at an average rate of 4% per annum⁴....mainly increasing the urban poor population.... is putting more demand for charcoal, and by extension

¹ ECA (2001) Transforming Africa's Economies. Economic Report on Africa 2000, Economic Commission for Africa, 85p. Addis Ababa.

² ECA (2001) *Ibid.*

³ African Ministerial Statement, African Preparatory Conference for the World Summit on Sustainable Development, 18 October 2001, Nairobi, Kenya.

⁴ Harsch, E. (2001) African cities under strain, AFRICA RECOVERY, Vol.15 No.1-2 United Nations. June, pp30-34.

the forests and other biomass sources. Although the cost of renewable energy technologies (RETs) have fallen over the past decade⁵, the magnitude of the drop has not been significant enough to compete kerosene...the commonly used liquid fossil fuel. Significant awareness of RETs has, however, been raised in many countries in Africa. It is therefore reasonable to infer that biomass (mainly firewood and charcoal) will remain the key sources of energy for most of the population in sub-Saharan Africa for several decades to come. This observation is shared by various institutions including the World Energy Council⁶, the Food and Agriculture Organization (FAO)⁷, and the UNDP⁸.

Therefore little change, if any, will occur in as far as increasing the percentage of the population (both the rural and urban poor) is concerned. This pessimism is shared by the African Union, which proposes a modest 25% increase in the number of households with access to reliable and affordable commercial energy supply in 20 years (from the current 10% to the projected 35%). This is part of the proposed objectives of the Union's widely accepted pathway towards sustainable development, the New Partnership for Africa's Development (NEPAD). A grim scenario is presented for Africa's household energy future and there's no evidence that any special attention is being given to biomass energy development and technological innovation. That the majority of Africans will not experience improved livelihoods (in general and energy poverty in particular) is not good news for a continent in dire need of sustainable development.

3.0 Towards sustainable biomass energy production and use

The realistic picture that emerges from the preamble implies further suffering by the majority (at least 65% of the population, going by NEPAD's projection as the best case reference) of Africans as we enter the new millennium. Biomass will remain the major source of energy for rural populations, coupled with niche renewables such as Solar PV, provided they are affordable, reliable and a proper payments system is established⁹. However, biomass resources themselves are under threat from overuse, creating additional environmental challenges¹⁰. The increasing distances to biomass sources in many regions¹¹ and the number of households that are increasingly being conditioned to purchase their needs from markets, as well as the ever-increasing fuelwood costs demonstrate this¹².

⁵ WEO (2001) World Energy Outlook 2001. International Energy Agency, <http://www.iea.org/>

⁶ World Energy Council in its WEC Statement 2000.

⁷ Gustafson, D. (2001) The role of woodfuels in Africa, Food and Agriculture Organisation In *Proceedings of the African High-Level Regional Meeting on Energy and Sustainable Development* (N. Wamukonya, Ed.) 10–13 January 2001, Nairobi, Kenya. pp 99–101.

⁸ UNDP (2000) World Energy Assessment, UNDP/UNDESA/WEC.

⁹ WEC (2000) Energy for Tomorrow's World—Acting Now! WEC Statement 2000. World Energy Council. 146p.

¹⁰ Statement by Dr Klaus Toepfer, Executive Director, UNEP at the African High Level Regional Meeting on Energy and Sustainable Development for CSD 9.

¹¹ Gustafson, D. (2001) *Op Cit.*

¹² Kituyi, E. et al. (2001) Biofuel consumption rates and patterns in Kenya, *Biomass and Bioenergy* 20:83–99.

The message of this brief is that whereas efforts to promote access by all to modern commercial energy technologies must be encouraged (increasing the ratio of commercial options in the overall household energy mix), concurrent agendas should be in place for the sake of the majority who will never have the means to gain access to cleaner commercial energy for the better part of the 21st Century. For the short and medium terms, any sustainable development solutions in the household energy sub-sector in Africa must focus on biomass energy technology development and dissemination. This includes sustainable fuelwood production and its efficient utilization through adoption of improved energy technologies, with sustained efforts to eliminate barriers to access to commercial energy. Many opponents to this school of thought do exist, who argue that nothing but leapfrog by Africans to cleaner commercial energy should be promoted. Whereas this could be necessarily true, it is neither practical nor realistic in the short or medium term.

It is from this realization that some institutions including the UNDP¹³ and the G8¹⁴ have been proactive at seeking solutions towards accelerated cost-efficient adoption of improved efficiency biomass conversion technologies. Others such as the International Energy Agency¹⁵, the Shell Foundation¹⁶ and the World Bank-ESMAP do finance studies aimed at identifying barriers to the large-scale adoption of existing biomass technology innovations as well as intervention projects. The objective is usually the attainment of environmentally sound and cost-competitive bioenergy on a sustainable basis to make a substantial contribution to meeting future energy demands. These institutions have laid the foundation upon which future work in the region may be built upon through appropriate institutional linkages with many indigenous organizations.

4.0 Sustainable charcoal production and consumption via the systems approach

Whereas the standards of living of rural and urban poor people may not increase in the near future, there is consensus that both the urban population and their demands for charcoal are growing at unprecedented rates. The need for increased supplies of charcoal produced from improved and efficient pyrolytic processes is urgent. However, this is not enough. A systems approach (tracking material flows from extraction through disposal) is recommended to ensure sustainable material consumption at all biomass life-cycle stages (wood harvesting, Pyrolysis, charcoal use, ash disposal). The proposed sustainable consumption scheme is presented in Figure 1. Under the sustainable consumption concept, the aim is to minimize material and energy losses at all stages. In this case, wood obtained from sustainably produced biomass resource is harvested using efficient ways ensuring minimum waste is generated. The wood is then converted into charcoal using improved and efficient kilns after which proper handling is ensured during packaging, storage and transportation to minimize waste. Charcoal easily crumbles depending on the quality. Finally, the generated charcoal is consumed using improved cookstoves such as the Kenya Ceramic Charcoal (KCJ) in Kenya.

¹³ See various projects at UNDP Bioenergy page at

<http://www.undp.org/seed/eap/Projects/biomass.html>

¹⁴ G8 Renewable Energy Task Force Report. Corrado Clini and Mark Moody-Stuart (Co-Chairmen) 2001. 61p.

¹⁵ See website on bioenergy at <http://www.iea.org/impagr/imporg/iadesc/bioener.htm>

¹⁶ See website at <http://www.shellfoundation.org/> for details on project types.

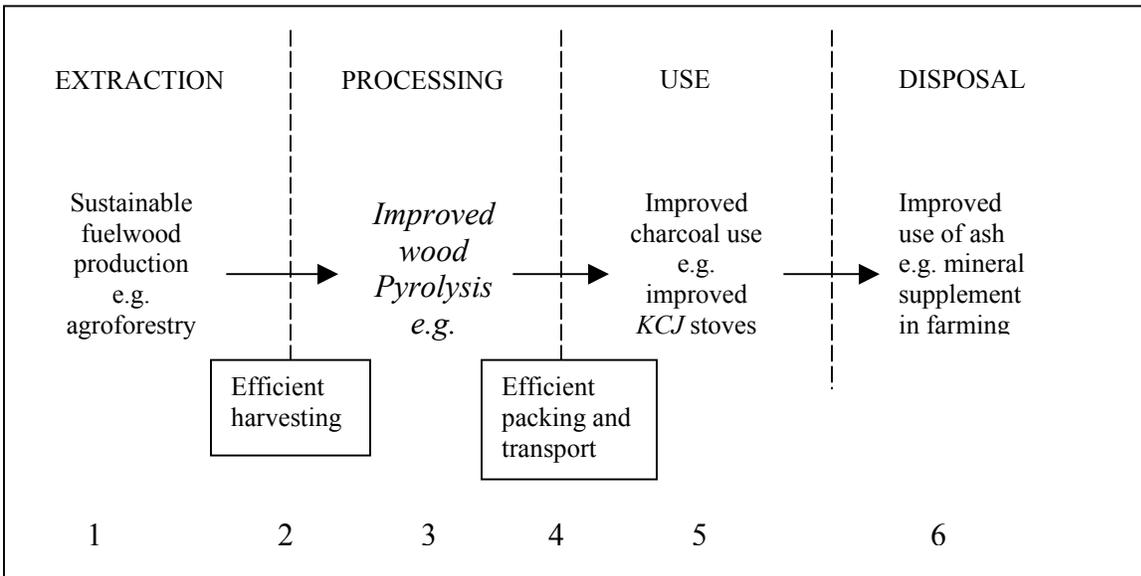


Figure 1: The proposed sustainable consumption scheme for charcoal production and utilization

There are various environmental and socio-economic benefits associated with each stage in the process. These are presented in Table 1. In addition to these benefits, there are other well documented ones in conventional literature that include improved health among women and children owing to reduced exposure to toxic indoor air pollutants¹⁷. Acute respiratory infections rank fourth in the share of the burden of diseases in sub-Saharan Africa (accounting for 7% of the total)¹⁸. These respiratory infections cause reduced productivity and lower life expectancy, amounting to 6% of the GNP of developing countries¹⁹. Due to increased on-farm availability of fuelwood, the time spent daily gathering fuelwood is saved for use in more productive activities. Furthermore, the capacities of the locals to initiate and sustain biomass husbandry projects, charcoal production and stove fabrication would be strengthened. Other skills gained would include small business management and marketing.

Improved livelihoods can also be envisaged from improved household incomes resulting from increased income generating and employment opportunities in this sustainable charcoal production and consumption framework. Families may then save enough to invest in commercial energy alternatives including renewables such as Solar Home Systems.

¹⁷ Kammen, D.M. and Ezzati, M. (2001) Acute respiratory infection and indoor air pollution from biomass combustion in Kenya: an exposure-response study. *The Lancet* **358**, 619–624 (August 25 issue).

¹⁸ World Health Report 1999, World Health Organisation.

¹⁹ Fuel for Thought, p.27, The World Bank, 2000.

Table 1. Benefits accruing from various life-cycle stages in the system wide approach

Stage	Activity	Benefits
1	Sustainable fuelwood production	<ul style="list-style-type: none"> • Increased carbon sink and moisture reservoir • Enhanced household energy security • Entrepreneurial opportunities created through sales of poles and firewood. • Increased soil fertility for food production
2	Efficient biomass harvesting	<ul style="list-style-type: none"> • Reduced wood residues/wastes • Sales of residues as firewood and wood chips or sawdust as raw material for chipboard e.t.c.
3	Improved pyrolysis efficiency	<ul style="list-style-type: none"> • Reduced CH₄ emissions to the atmosphere <ul style="list-style-type: none"> ▪ Carbon sink preserved from avoided tree cutting. ▪ Less wood required to yield same amount of charcoal
4	Improved charcoal handling	<ul style="list-style-type: none"> • Reduced charcoal crumbling during handling • Income generating opportunity through briquetting of the pulverized charcoal
5	Improved charcoal use (KCJ)	<ul style="list-style-type: none"> • 34% CO₂ reduction (reabsorbed by growing vegetation) • 33% fuel saving • 15% CO reduction (improved health) • Significant reduction of toxic gases (improved health) • Monetary savings (26% per household per annum) <p>See source²⁰ for details</p>
6	Innovative ash disposal	<ul style="list-style-type: none"> • Reduced dependence on costly mineral fertilizers

A number of advantages can be associated with this life-cycle focused strategy. It is designed to minimize material and energy losses at the various life-cycle stages and could supply extra wood for competing demands. It has the potential for application in the entire sub-Saharan Africa region with a wide array of social, economic and environmental gains. If well designed and

²⁰ Kituyi, E. (2000) Fuel-switch Strategy: Can it Protect the Climate? *Innovation* Vol 7 No 2, November. pp21–25.

implemented, the approach is potentially cost-effective with high chances of success due to local community participation.

5.0 Prerequisites for optimum functioning of the proposed systems approach

As implied from the ongoing, the poor also have an opportunity to contribute to sustainable development in general and their own energy security in particular. However, implementing activities exactly as presented in the scheme may be constrained by various barriers, which must be eliminated if the goal is to be met. These include, *inter alia*, finances, awareness, technical capacities, and governance. Key barriers, however, are policy and institutional frameworks to oversee successful implementation and replication of project activities defined by the scheme in Figure 1.

Policy Issues

Need exists for official recognition of charcoal production and marketing by national energy policies. Energy policies for many countries in Africa tend to put more emphasis on commercial energy, denying biomass energy the comprehensive treatment it deserves. Where some policies exist, they tend to lack coherence. For instance, although energy policy in Kenya favours development and promotion of improved charcoal cookstoves and sustainable farm forestry for fuelwood^{21,22} charcoal making remains illegal in the country. Only with official policy recognition can community development initiatives including capacity building in farm forestry methods, charcoal-making and stove fabrication, charcoal trade and entrepreneurship be realized.

Secondly, national energy and technology policies need to be harmonized to allow for cross-border technology transfer and capacity building. Personnel exchanges among collaborating institutional entities would be promoted through such schemes. The KCJ has been a great success in Kenya²³ while the relatively more efficient *Casamance* charcoal kilns have significantly spread in Senegal. These could be spread further in other African countries under appropriate institutional and policy frameworks. Thirdly, *land tenure policy* in many countries in sub-Saharan Africa need to be streamlined. Land tenure is a key source of conflicts. But when a household has rights over a given land area, it can confidently develop it further through activities including modern farm forestry methods.

6.0 Institutional issues in biomass project implementation and replication

An institutional framework to coordinate the implementation and replication of prescribed activities at various life-cycle stages 1–6 in Figure 1 is necessary at national level. Though various institutions exist within countries in the region, each has its own priorities and interests.

²¹ Republic of Kenya (1994) The National Environment Action Plan Report, Ministry of Environment and Natural Resources, 203p.

²² Republic of Kenya (1987) National Energy Policy and Investment Plan, 1987. Ministry of Energy and Regional Development.

²³ Karekezi, S. and Ranja, T. (1997) Renewable energy technologies in Africa. AFREPREN, Zed Books Ltd, London.

Coordinated interactions among these actors are necessary if projects are to be successfully implemented and replicated.

A coherent bioenergy policy that is coordinated at a high level will more effectively promote and expand bioenergy than an uncoordinated set of disparate local activities. A central institution, probably a governmental agency would be an appropriate one. Among the tasks such a body would perform include rule making, with authority to design a coherent legal framework that clarifies rules and roles of participants. It should also develop and promulgate socio-economic and environmental guidelines for improved stove projects, including rules regarding access to project information and provisions for public participation. A role for the private sector in expanding improved wood harvesting, charcoal production, marketing practices and charcoal stove use is important to consider in this regard. The body could also serve as an information clearinghouse for scarce or difficult-to-access but useful information on bioenergy. It could also provide guidance on financing or coordinate interactions between other financial institutions and project developers. Finally, the centralized body could also give diverse support to local coordinating institutions, which are the primary fora for community participation.

7.0 Conclusion

A systems approach to sustainable charcoal production and utilization for sub-Saharan African countries is proposed. If well designed and implemented, this approach will ensure minimum material losses at all stages from biomass harvesting, processing, use and final disposal. Energy losses will also be minimized in addition to a wide array of social, economic and environmental benefits. However, energy technology and land tenure policies of the countries in the region must be strengthened and harmonized, and appropriate institutional arrangements for implementing and replicating the proposed approach put in place if this strategy is to function optimally. It is envisaged that the economic gains made by households and groups participating in the strategy will gradually enable investments in reliable and affordable cleaner commercial energy alternatives. The systems approach is, hence, recommended for promotion alongside other strategies aiming to eliminate poverty in sub-Saharan Africa.