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RESEARCH ARTICLE

Evoking an integrated community environmental education heuristic for the sustainable management of Nandi Hills Forests

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ABSTRACT

The involvement of the community in sustainable forest management needs to be anchored on sound knowledge and vast understanding of forests, forest resources and their sustainable exploitation mechanisms. Humans encroachment into the Nandi Hills Forests, compounded by urban expansion, unsustainable timber harvesting and agricultural practices have over the years threatened to annihilate this catchment area. The study was undertaken in three districts; Nandi South, Nandi Hills and Nandi North Districts. A mixed methodological approach was used in this study, where concurrent triangulation and nested/embedded designs prevailed. The study reveals that environmental education has been institutionalized in the Nandi County and is yielding sustainable forest management. However, some institutional and capacity gaps do exist. Government agencies, international organizations and community-based organizations have been profiled as the predominant institutions that are involved in building the capacities of the locals through environmental education and forest conservation. Change detection, undertaken by way of GIS and remote sensing, has corroborated the perceptions and undertakings of the locals and institutions on forest management; exemplified by the level of awareness on the state of forest cover, and the ensuing consequences. The study proposes a heuristic for community environmental education centered on institutional arrangements, policy frameworks, formal and informal education approaches, GIS and remote sensing. Integrated community environmental education, epitomized in the heuristic, could be a robust tool for sustainable forest management once it is rolled out.

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INTRODUCTION

The United Nations Conference on Environment and Development [UNCED] (1992, section 36.1), agrees, writing that “education is critical for achieving environmental and ethical awareness, values and attitudes, skills, and behaviour consistent with sustainable development and for effective public participation in decision making” and a distinguished group of 22 university presidents from 13 developing countries pledged to have their institutions play educational leadership roles in the necessary quest for a sustained future (Pandey, 2005). According to Matiru (1999), there is need for forums where government officials and community representatives can discuss their expectations of increased community participation. She further points out that presently, a number of NGOs, CBOs and voluntary organizations are making good strides in enlightening the common citizen on laws and their rights in Kenya and this upsurge of environmental lobby groups has resulted in more awareness of the local citizens on environmental issues that affect them and the community at large. While advances in modern science and technology have had significant impacts on the forest sector these technologies remain inaccessible to many in Africa and there is a continued dependence on indigenous or traditional knowledge in managing forests and other natural resources (Parrotta and Agnoletti, 2007). Langton and Ma Rhea (2003), assert that, traditional methods of irrigation and crop production, and maintenance of seed stock and cultivars, have maintained food and grazing resources, and traditional water management systems have

been critical to societies across all ecosystems. Development professionals consider indigenous knowledge as an invaluable and under-utilized knowledge reservoir, which presents developing countries with a powerful asset (Richards, 1995). In the past few decades, traditional environmental management knowledge practices have been the focus of attention. A post-modernist paradigm supports this paradigm since it calls for the decentralisation of views on social reality in order to create a more inclusive science (Blaikie, 1995; Richards, 1995).

The latest front in the area of environmental education and education in general is the growth of Information and Communication Technologies (ICTs). This has had significant direct and indirect impacts on forestry and has been central in accelerating the pace of globalization (Edoho, 1997). The Internet and mobile communications have created unprecedented opportunities for those who were traditionally outside the global information loop, including small and medium-sized enterprises. ICTs have increased labour productivity, reduced costs and increased returns. Online stores provide marketing opportunities for wood product and service suppliers. ICTs have also fostered institutional change in forestry (Hetemaki and Nilsson, 2005). The increased ease of information sharing and global networking diminishes the power of vertically structured organizations and fosters the development of small organizations. ICTs have helped to promote transparency and accountability on an unprecedented scale, as very little information can be kept away from public access and scrutiny. ICTs have also facilitated awareness-raising about forest-related issues such as deforestation, biodiversity loss, forest fires and the marginalization of

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indigenous communities (Hetemakiand Nilsson, 2005; Nyrudand Devine, 2005).

According to FAO (2009), institutions are key factors in sustainable resource management and societal adaptation to social, economic and environmental changes. As in other sectors, the overall trend in forestry is towards a pluralistic institutional environment, attributable to two divergent trends: globalization and localization. Increased cross-border movement of capital, labour, technology and goods resulting from globalization has necessitated adaptation by existing institutions and the establishment of new ones. At the same time, local communities have become more involved in resource management through decentralization and devolution of responsibilities. Matiru (1999) believes that substantial efforts are required to revamp the institutional framework to strengthen the science and technology base of forestry in Africa; otherwise, major breakthroughs are likely to bypass the African forest sector or at best will benefit only a small segment of the population. In the Kenyan context, the rising human population in the Nandi Hills forests (a major water catchment area for Lake Victoria) has incrementally changed the structure and characteristics of the downstream hydrological balance (Mwiturubani, 2010). Such changes jeopardize the ability of the Lake Victoria watershed to meet growing societal needs, as well as the capacity to support the large variety of terrestrial and aquatic life forms (Mwakubo and Obare, 2009). The Nandi Hills fall within the upper Lake Victoria North Catchment Area (Government of Kenya, 2002) and is one of the sources of rivers and streams for the Lake Victoria Basin. However, continual encroachment of humans into the Nandi North and South Forests, unsustainable timber exploitation, shifting cultivation, urban expansion, and other human activities, are posing increasing threats to this ecosystem. As in many developing countries in the tropical and subtropical regions, Nandi County has lost substantial portions of its forest cover due to conversion of forested land into agricultural land in order to feed local populations (Singh (1991).

METHODS

A mixed methodological design which incorporated both qualitative and quantitative data was embraced. The mixed method approaches used in this study were the concurrent triangulation and nested/embedded designs. A three-tier analysis was carried out once all the data had been coded and grouped. The analysis covered three categories of the population in the study area; namely the households, institutions and community groups. Various methods were used in establishing the research needs and postulating the research findings. The local community population sampled was the true households according to the 2009 population census (KNBS, 2010). The sample unit for data generation was the household, which was chosen for this study as the lowest identifiable social institution within which production and consumption activities take place. Focus Group Discussions (FGDs) among the NHF's communities and stakeholder institutions, formal interviews with forest management practitioners, and physical visits to the NHFs were undertaken. The FGDs conducted for the local communities were structured such that they laid more emphasis on the informal aspects of EE but also with a few dimensions of simplified formal EE. NHFs cover three Districts, which are Nandi North, Nandi South and Nandi Hills Districts (Figure 1). The formal interviews with key informants from the stakeholder institutions and forest management practitioners respectively were more structured and technical in both content and language. An FGD for the stakeholder institutions was done under the auspice of the Nandi Environmental Forum, which brought together international partners, government agencies, private sector and the Community Based Conservation Groups (CBCGs). Besides, a perception survey of the NHFs communities on their forest resources was also carried out through the administration of household questionnaires to strengthen empirical defense to this paper. Landsat TM series of 1990s and ETM of 2000s imagery were evaluated for land cover change at a temporal scale of 5 year interval (1994, 1999, 2003 and 2008).

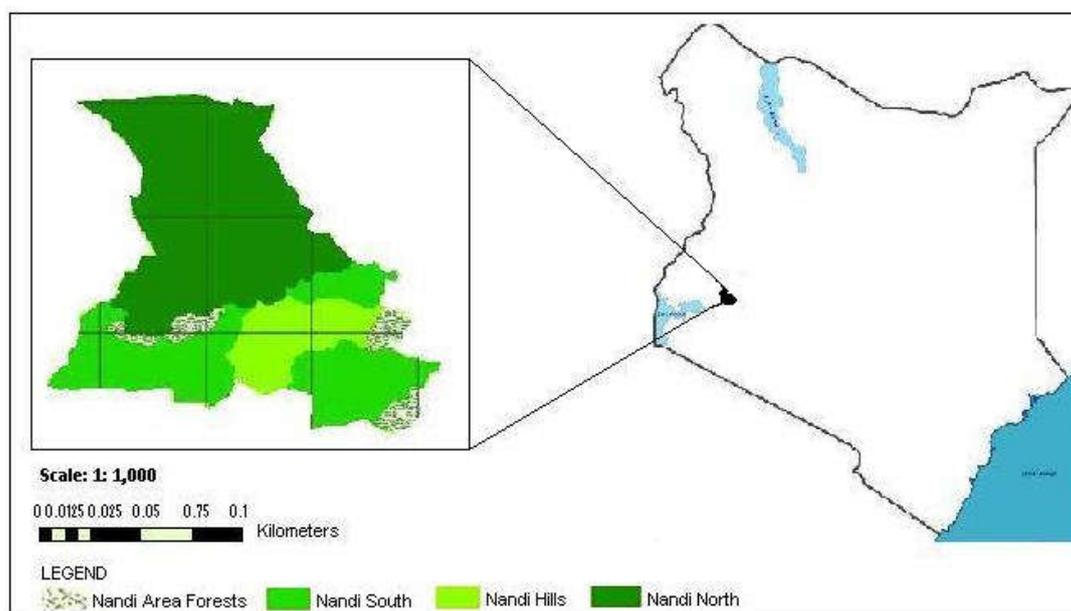


Figure 1: Map of Nandi Area Indicating the Remnant Forests

Sound forest management practices, backed by updated forest legislation and policy, and strong institutional arrangements are necessary in order to ameliorate and turn around the degradation of the Nandi forests (Governments of Kenya, 2003). Recognition of this issue and the fact that environmental education has been recognised as a vital tool in achieving environmental sustainability, have motivated this study.

The remote sensing (satellite) data were applied in assessing the land cover changes. Standard procedures were followed during image interpretation based on land cover types and visual interpretation of the tonal, textural and structural characteristics renders on images that helped in delineation of land cover classes digitized for various image dates. The various land use and their associated changes were mapped based on the pixel size of the satellite data types. The interpreted data informed on landscape qualities, land cover changes and land use patterns over the study area. These included land use

land cover typologies from 1994, 1999, 2003 and 2008 from the respective Landsat images

RESULTS

Profiled institutions in Nandi County

The data indicate that only slightly over two thirds (67%) of the respondents were able to identify one or more institutions that are involved in the management and conservation of the Nandi Hills Forests, while 33% of those sampled had no idea of the existence of any institutions involved in the management and conservation of the forests (Figure 2), suggesting that more needs to be done to increase awareness of such institutions in the Nandi Hills water catchment area.

Furaha Nature Group
Kaptukong' Women Group
Cleopas Group
Langas Group
Forest Action Network
Kolonge Group
Testai Self Help Group
Umoja Association Group
Friends of Nandi
Furaha Conservation Group
Nandi Environmental Forum (NEF)
Green Belt Movement (GBM)
Osach Women Group
Korosiot Tree Planting Group

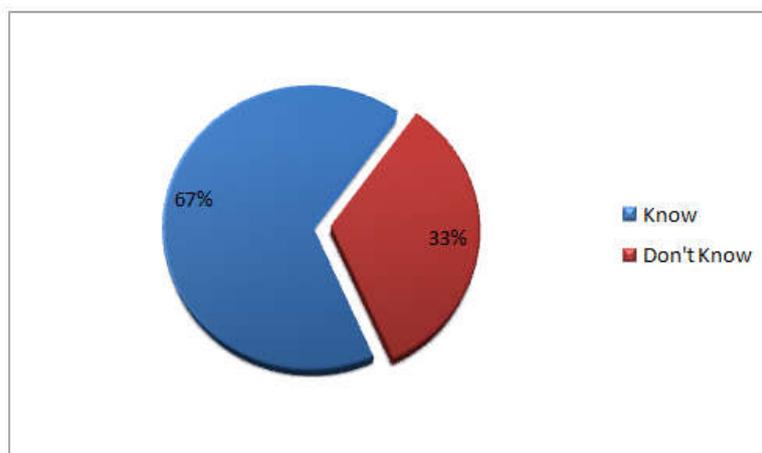


Figure 2. Knowledge of existing institutions that contribute to the management of the Nandi Hills water catchment area (n = 882)

Categorization of the data revealed by the literature search indicated that the institutions that make a contribution to the management of the Nandi Hills Forests fall into three major categories, viz. international organizations, government agencies, and non-governmental/community-based organizations (NGOs/CBOs), as indicated in Table 1. The interview data also revealed that the institutions which the interviewees believe are active in the affairs of the forests fall under the same three broad categories and include the same organizations (Table 1).

Table 1. Institutions involved in the management and conservation of Nandi Forests

Category	Name of Institution
International	United Nations Environment Programme (UNEP) East Africa Wildlife Society (EAWS) CDTF
Government	Kenya Forest Service (KFS) National Environment Management Authority (NEMA) Kenya Wildlife Service (KWS) Nyayo Tea Zone Development Authority (NTZDA) Kenya Forest Research Institute Lake Victoria Environment Management Programme (LVEMP) Water Resources Management Authority (WRMA) Kenya Forest Research Institute (KEFRI) National Museums of Kenya (NMK) Moi University Primary and Secondary Schools
CBO's/NGO's	Nature Kenya Kamaenjei Women Group Kamarich Youth Group South Nandi Biodiversity Group (SONABIG)

Institutionalizing environmental education

International organizations

Members of CBOs, government agencies and to a small extent, the locals could identify the United Nations Environment Programme (UNEP), the Community Development Trust Fund (CDTF) and the East Africa Wildlife Society (EAWS), without any prompting, as the international organisations which impact on the management of the Nandi Hills Forests. The interviewees were then asked to comment on the roles of these organisations and on issues that they felt were relevant. Most of the responses noted the positive contributions that these institutions made to the management of the Nandi Hills Forests, while a few members of the beneficiary CBOs provided negative statements, as indicated in Table 2.

Government of Kenya

The issues identified by the various stakeholders (local residents and members of CBOs and NGOs) as being the government's role in the management of the Nandi Hills Forests included:

- Legislation of laws that have led to improved forest management in the Nandi Hills Catchment;
- Enforcement of policies and laws relevant to the management and conservation of Nandi Hills Catchment through the Kenya Police Service, KFS and KWS guards;
- Provision of seedlings for the afforestation and reforestation programme through KEFRI;
- Inclusion of environmental studies in the primary and secondary schools curriculum;
- Developing and offering courses on natural resources management, environment, and forestry at the tertiary colleges and universities;
- Conduction research on forest related disciplines through the various universities and KEFRI;
- Creation of forest buffer zones (Nyayo Tea Zones) through the NTZDA; and

Table 2. Roles of international organizations in the management of Nandi Forests

Institution	Role(s)	Notable remark
UNEP	<ul style="list-style-type: none"> Developing internationally accredited forest management practices to be replicated and/or adopted by national governments to suit their needs; Publishing and disseminating magazines, journals brochures on forest conservation; Organizing seminars and conferences at their headquarters in Nairobi and inviting stakeholder to participate and learn Funding of CFM initiatives by the KFS; 	<ul style="list-style-type: none"> Implementation is still not robust especially in Nandi Hills Forests Challenge of access to the publications by locals Not all stakeholders may be in a position to attend KFS hasn't rolled out the programme sufficiently
CDTF	<ul style="list-style-type: none"> Funding forest conservation initiatives by CBO's and/or NGO's e.g. Nature Kenya & NEF; Provide monitoring and evaluation mechanisms for forest conservation projects they fund 	<ul style="list-style-type: none"> Preconditions are sometimes too restrictive for many CBO's Enables effectiveness of the projects & sustainability in their post-exit project life
EAWS	<ul style="list-style-type: none"> Publishing and disseminating magazines, journals brochures on forest conservation; Partnering with Nature Kenya in biodiversity conservation initiatives; Conducting research on specie dynamics in the Nandi Hills Forests; Organizing seminars and workshops to empower the local CBO's on effective biodiversity conservation approaches; 	<ul style="list-style-type: none"> Challenge of access to the publications by locals; Has been successful; A crucial intervention in determining biodiversity index; These have been lauded by the CBO's to be significant in promoting best practices

- Profiling the cultures of the Nandi people particularly that have been significant in the sustainable management of the forests through the NMK;

The shortcomings of government in ensuring the sustainable management of the Nandi Hills Forests were identified to be the following;

- There being few forest guards hence hampering law enforcement in the forests;
- Corruption in government which has led to irregular allocation of forest land to individuals and illegal logging and poaching in the forests;
- Lack of a perimeter fence cordoning off the forest reserves in the area; and
- Ineffective implementation of the Kenya Forest Act of 2005 which laid emphasis on community participation in the forest management.

Several government agencies were noted as being involved in the management and conservation of the NNFs, as indicated in Table 3.

Table 3. Government ministries involved in the management of the Nandi Forest catchment

Ministry	State Corporation/Parastatal
Ministry of Environment and Mineral Resources	NEMA, LVEMP
Ministry of Forestry and Wildlife	KFS, KWS, KEFRI
Ministry of Water and Irrigation	WRMA
Ministry of Agriculture	NALEP
Ministry of Education	Primary and Secondary Schools
Ministry of Higher Education	Tertiary Colleges and Universities
Ministry of Culture and National Heritage	NMK
Ministry of Regional Development Authorities	NTZDA

Non-governmental/community-based organisations (NGOs and CBOs)

The organizations that were identified by the household respondents are presented in Table 4. Verification of their existence and functionality was done by obtaining the database of the CBOs and NGOs involved in the management and conservation of the Nandi Hills Forests (see Table 4), as was the contributions they that wish to make to the management of Nandi Hills Forests.

Table 4. Roles of the NGO's and CBO's in the management of Nandi Forest catchment area

Organizations	Roles
NGO's	<ul style="list-style-type: none"> Fundraising for and funding of the forest conservation initiatives; Sensitizing the locals to sustainably manage the forests through workshops, seminars and demonstration forums; Providing tree seedlings for the locals to assist them increase the forest cover; Acting as checks and balances for the government on its pledges to sustainability of the forests; Launching alternative livelihood initiatives for continuity by the CBO's to avert overdependence on the forests.
CBO's	<ul style="list-style-type: none"> Enhancing the locals' perception of ownership of the forests; Fundraising for the forest conservation initiatives; Sensitizing the locals to sustainably manage the forests through demonstration forums and campaigns; Organizing the community to protect sensitive water sources; Augmenting the government's forest guards' roles through the forest scouts initiative; Improving livelihoods of the community through sustainable alternative livelihood initiatives;

Change detected using GIS and remote sensing

The results of spatiotemporal variability in land use based on false colour composite Landsat images prepared from the clipped bands 2, 3 and 4 of the 1994, 1999, 2003 and 2008 revealed the variation in land cover and land uses within the study sites. The total area covered by each of the five land use/land cover types in 1994 and 2008 as mapped from the Landsat satellite images, as well as the changes that were calculated by subtracting the sum of the areas of each cover class in 2008 from their corresponding areas in 2003, 1999 and 1994, are summarized in Table 5 below. From the results indicated in the table above it can be seen that the spatiotemporal variation in cover types that occurred in Nandi Hills forest area between 1994 and 2008 were mainly an increase in the areas under shrubs, tea and grasslands areas. Tea cultivation increased by 97.443 km² (62%) and areas covered by forest cover decreased by 9.219 km² (18%). Bare ground also decreased by a considerable value of 11.7504 km (38%), while shrubs increased by over 18%. The data collected from households indicate the reduction in natural vegetation cover especially forests has reduced the protection of the soil against erosion. Vegetation has thinned out in most areas with the highly affected sites being the Nandi hills.

Table 5. Representation of the spatiotemporal variation in land use between 1994 and 2008

Land use / Land cover Class	1994 Area (km ²)	1999 Area (km ²)	2003 Area (km ²)	2008 Area (km ²)
Forest	51.3477	42.8328	63.9441	42.1317
Shrubs	26.2089	37.0593	28.8207	31.0905
Tea	15.7302	32.7798	25.3332	25.4745
Grassland	23.6512	23.4234	17.4258	29.9916
Bare ground	31.1589	12.0006	12.5721	19.4085

DISCUSSION

Integrated community environmental education heuristic for sustainable forest management

Research in natural forests now focuses more on integrating environmental, social and economic objectives according to the principles of sustainable forest management. A number of national, regional and international initiatives focus on the development of criteria and indicators for measuring progress towards sustainable forest management, outlining the nature of technology to be adopted (Rebugio and Camacho, 2005). Implementation of sustainable forest management requires substantial strengthening of the science and technology base. To this end, much research focuses on ecosystem structure and functioning, the spatial and temporal linkages among ecosystem components and processes, and their relation to the immediate and larger social and economic context. However, implementation of such research remains a challenge (Centre for International Forestry Research, 2004), especially in developing countries. In view of the findings of this study, the following heuristic is offered for consideration when developing and implementing community environmental education based on what is available in the area (institutional arrangements, policy frameworks, formal and informal education approaches), evidence that can be gleaned from the local population, and data that can be generated from technological sources (GIS, remote sensing, mapping of land use changes), as was done in this study. The proposed heuristic is illustrated in Figure 3.

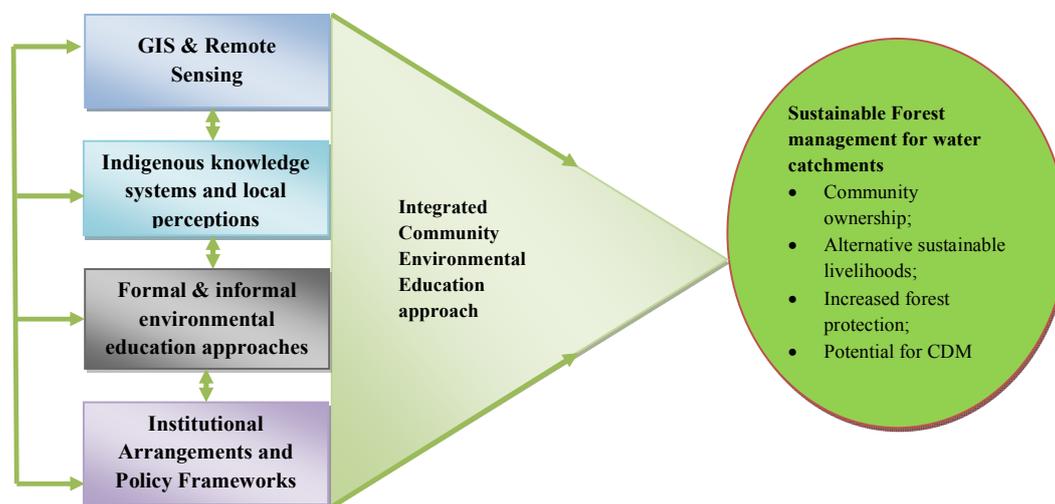


Figure 3. An integrated community environmental education heuristic for sustainable forest management

The data generated in this study suggest that a combination of these four aspects should result in an integrated approach to community environmental education. The GIS and RS data corroborate the assertions of the local community on the land cover, and local knowledge and formal environmental education have been key drivers of awareness creation and sustainable forest management. Well documented GIS and RS data could be disseminated through both formal and informal educational practices to create environmental awareness, and the current legal and institutional

Frame works provide means of advancing environmental education and sustainable practices in the area. The effective implementation of SFM should address the economic, social and environmental functions of forests; hence it is an important approach to ensuring a balance between the objectives of production and conservation. Maintaining critical ecosystem functions is a key pillar of SFM since by this; the forests can be able to make economic sense to the local community without putting their availability to future generations in jeopardy (Rebugio and Camacho, 2005). Accuracy in acquisition and dissemination of data to aid in SFM is highly dependent on application of appropriate technologies, such as GIS and remote sensing which complement local knowledge pools and institutionalized mechanism for forest management. Community Environmental Education should be achievable through the exploitation of both the indigenous and conventional environmental education approaches available and which is considered to be 'workable' by the local community. Involving the community relies on their ability to interact with basic technologies involving GIS and RS and also get better equipped with tools for CFM (Foody, 2001). Raising awareness of community benefits and the impact of local practices (governmental, NGO, business and individual) on forest resources, and issues of community ownership, and challenges to sustainably manage the forests as if they were their own, enhance the probability of all concerned coming to greater consensus on sustainable management of the local natural resources. Increased awareness of locals and wider implications, such as sustainable income generation and water provision to Lake Victoria (which has implications for both Kenyans and other African nations fed water by the Nile), also improves attitudes to forest preservation possibilities

of embracing more sustainable alternative livelihoods. Once better understandings of local issues are developed, further opportunities such as the potential of the community to benefit from compensations drawn from carbon trading under the Afforestation and Reforestation Clean Development Mechanism envisaged by the Kyoto Protocol, can be better argued and understood.

Conclusion

This study has brought to light the essence of environmental education that is incorporative of the community through formal and

informal approaches in forest knowledge acquisition and management in the Nandi County. The heuristic developed in this study encapsulates an integrated community environmental education approach that is anchored in institutional and policy frameworks, local forest knowledge, formal environmental education, and GIS/remote sensing. The heuristic (Figure 3) enables the adoption of strategies using readily accessible, though loosely applicable, information for problem solving in developing and implementing community environmental education practices for effective forest management and conservation practices that are responsive to the needs of the Nandi Forest Community. Such environmental education has the potential to best reveal to the local community the accruable benefits they stand to reap by sustainably managing the Nandi Forest, which are dependent, to a great extent, on the level of awareness of the local community of the significance of sustainable forest management and what their actions and/or inactions mean to the forests. The heuristic study portends a great potential for the integrated community environmental education approach, which has been underscored as a robust tool for the sustainable management of forests, and in particular the Nandi Hills Forests. The knowledge generated on the place of the integrated community environmental education approach needs to be rolled out. Dissemination of the approach espoused by this heuristic cannot be underscored. Workshops at the university (eg. Moi University), organizing seminars for the Nandi Forest Stakeholders through the NEF and undertaking to further publish more broad-based offshoot concepts based on this integrated community environmental education heuristic are some of the ways that will ensure that the assertions of the heuristic remain consequentially beneficial to the community.

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