Assessment of traditional ecological knowledge and beliefs in the utilisation of important plant species: The case of Buhanga sacred forest, Rwanda

Authors:
Runyambo Irakiza1,2
Minani Vedaste1
Bizuru Elias1
Brigitte Nyiramambugutse1
Nsengimana Joram Serge2
Ndimukaga Marc3

Affiliations:
1Africa Rice Center (AfricaRice), East and Southern Africa, Weed Sciences, Dar es Salaam, Tanzania
2Institute of Scientific and Technological Research, National Herbarium of Rwanda (ACNR), Kigali, Rwanda
3College of Science and Technology, University of Rwanda, Rwanda

Corresponding author:
Runyambo Irakiza, claudedeigloire@gmail.com

Dates:
Received: 21 Aug. 2015
Accepted: 05 Feb. 2016
Published: 22 July 2016

Introduction

Traditional ecological knowledge is defined as a cumulative body of knowledge, practice and belief. It is a mutual relationship between living beings (including humans) and its environment which evolves by adaptive processes and are handed down through generations by cultural transmission (Berkes 1999). Such knowledge has contributed to conservation of biodiversity (Gadgil, Berkes & Folke 1993), rare species (Colding 1998) and protected areas (Johannes 1998) as well as to sustainable resource use (Berkes 1999) from one area to another. In Africa, there are important elements to take into account regarding indigenous or traditional spirituality towards the nature. The value of traditional knowledge of natural resources is widely recognised among indigenous people because it was accumulated and transferred orally across generations. According to Charnley, Paige and Jones (2007) and Berkes, Colding and Folke (2000), the integral success of the traditional ecological knowledge into biodiversity conservation depends on active participation of the knowledge holders, such as indigenous communities and institutions. To avoid loss of biodiversity, traditional rules play an important role when developing conservation strategies for rare species by limiting illegal activities such as selective trees felling (Ormsby 2013). Some sacred species constitute excellent totems. Totems are often plants or animals that are a stand-in of its owner and their presence dissuade from illegal access to sacred areas. Furthermore, these sacred species contribute significantly in conservation by acting as umbrella species to the overall ecosystem (Ndimukaga 2009). Sacred place functions under the principle of faith and fear of god and other supernatural forces. This principle requires honesty, respect of ancestors and observation of moral values (Kamga-Kamdem 2008).

How to cite this article: Irakiza, R., Vedaste, M., Elias, B., Nyiramambugutse, B., Serge, N.J. & Marc, N., 2016, ‘Assessment of traditional ecological knowledge and beliefs in the utilisation of important plant species: The case of Buhanga sacred forest, Rwanda’, Koedoe 58(1), a1348. http://dx.doi.org/10.4102/koedoe.v58i1.1348

Copyright: © 2016. The Authors. Licensee: AOSIS. This work is licensed under the Creative Commons Attribution License.

Traditional ecological knowledge is an integrated part of the African people and indeed the Rwandese for cultural purpose. Buhanga sacred forest is a relict forest of tremendous ecological importance to Rwandan society located in Musanze District. The aim of this study was to assess the traditional ecological knowledge and belief in the utilisation of some important plant species for the conservation of Buhanga sacred forest. Ecological information about ethnomedicinal and traditional practices were collected following structured questionnaire through interview involving eight traditional healers and three focus group discussions. Data were collected from the natural habitats, home gardens, farmlands and roadsides of Buhanga sacred forest. A total of 45 botanical taxa belonging to 28 families were reported to be used by the local community. Species such as Brillantaisia cicatricosa and Senna septemtrionalis were the popular species cited by traditional healers to treat human and animal diseases and ailments, respectively. The results of the study indicated that because of the cultural norms and values associated with the sacred forest, this has led to non-exploitation. The study presents key sites and plant species in which their use and belief can lead to their conservation. However, not only is it imperative to conserve traditional local knowledge for biocultural conservation motives but there is also need to train traditional healers on how to domesticate indigenous species as conservation measure because some species have become susceptible to extinction.

Conservation implications: Highlighting indigenous species investigated in this research will provide a powerful tool for ensuring biodiversity conservation through community participation in a country of high population density in Africa. Some plant species that provided satisfactory Local Health Traditions among communities surrounding Buhanga can contribute as good material for further research in Rwanda.
Rwandan culture history and forest

In many sub-Saharan African societies, the traditional ecological knowledge among indigenous people is synonymous with spirituality, which contributed to sustain the sacred forests. Rwanda, one of the smallest countries in the world with only 26,338 km², has a rich forest heritage. The value of Rwandan culture is based on oral history, ecology and nature, geographical sites and by igitarano. Igitarano constitutes a gathering of families, communities and friends with songs and dances. During pre-colonial time, Rwandan society was inherently linked to forest, which hides great lessons concerning rites, ancestral customs, taboos, arts, crafts, music, dance and many more. Such integral links led to the emergence of traditional medicine (Karangwa 1997). The Rwandese are aware of the existence of these traditional healers who provide home-based healthcare. Locally, they are known as abuwuci gakondo or abapfumu. The former denotes traditional healers involved in the use of plants and the latter denotes those who are involved especially in the ritual component of traditional medicine (Rwangabo 1993). But it has been said that sometimes abapfumu use leaves, roots or barks of plants to protect their clients in exchange for money (Adenkule 2007). As a matter of fact, traditional ecological knowledge is still very much alive in Rwanda because it contributes significantly to solve health problems. In Rwanda, cutting of certain tree species is seen as a taboo as well as killing of indigenous animal such as primates, elephants, leopards, birds, etc. According to Kimenyi (1989), this conservation emphasised the symbiotic and interdependence relationship between people, plants and animals. It is for these reasons that cultural values are an essential component of every society and they act as checks and balances in the management of natural resources (Verschuuren et al. 2010).

The context of Buhanga sacred forest

Buhanga sacred forest is a relict forest of tremendous ecological importance to Rwandan’s society for cultural purposes. It lies in volcanic belt and has one of the highest population density in Rwanda and Africa, with up to 500–700 people per km² (NISR 2012; Plumptre, Masoza & Vedder 2001). Buhanga relict forest contains sacred water-spring, marshland, medicinal plants, native trees and even a last refuge for arboreal, migratory birds. For example, African Pitta Pitta angolensis is a migrant bird that breeds in central Tanzania, Malawi, southeast Democratic Republic of Congo, eastern Zambia, Zimbabwe and possibly northern South Africa that was sighted in Buhanga sacred forest (BirdLife International Africa Partnership e-bulletin 2008). Unfortunately, reports indicate that this relict forest is facing many threats as a result of human interference on the environment in various ways, such as harvesting of firewood and agriculture (MINITERE & CGIS-NUR 2007; REMA 2009). In fact, high pressure of disturbance of natural reserves in Rwanda was noticed until the resettlement of refugees after the genocide during the year 1997–1998 where people both settled and farmed within many natural reserves (Plumptre et al. 2001). It should be mentioned that in most cases natural resources are still viewed as limitless in the mind of the resource-poor local communities in Rwanda as a source of income. However, it should be seen furthermore that without any practical actions for sustainable utilisation of so-called ‘limitless resources’ and usage of traditional ecological knowledge, there is a risk of genetic loss and lack of traditional information from generation with time.

To address the issue of loss of this critical cultural forest in Rwanda, the goal of this study is to document the traditional ecological knowledge and belief in the utilisation of some important plant species of Buhanga sacred forest. Hence, there is a need for such information and documentation with the help of local communities to develop comprehensive and useful strategies for public awareness but also to formulate recommendations for monitoring natural resources for better future (Figure 1).

Material and methods

Geo-ethnographical overview of the study area

Buhanga sacred forest is an archaic forest located in Northern Province, District of Musanze, Nkotsi sector and Bikara cell, at the right side of the road that leads towards Vunga business centre. The site is situated at approximately 114 km from Kigali, the capital city of Rwanda and covers an area of 33.252 ha, of which 16.0011 ha is still intact and located between 1°34’00” and 1°34’30” South latitude and 29°34’30” and 29°37’30” East longitude at an altitude ranging between 1623 m a.s.l. and 1657 m a.s.l. Geo-climatically the area falls within the tropical rainforest of the volcano massif where climate is controlled by various factors such as altitude, latitude and vegetation. The climate is cool and wet and temperatures fluctuate around 20 °C during the day. Most of the lands surrounding Buhanga sacred forest are used for agriculture subsistence. Near subsistence agriculture, coffee, tea and pyrethrum plantations are prominent land uses as cash crop generating local employment. Projects funds from government and international non-governmental organisations have been used for a range of activities from environment protection (tree planting, soil erosion control and beekeeping) to limit access in the sacred forest (Figure 2).

Source: Association for the Conservation of Nature in Rwanda, 2008

FIGURE 1: View of Buhanga sacred forest.
Figure 2: Map of the study area.

Source: Google Earth and GPS points by Iraguha, 2004
Ethnobotanical survey

Our study was carried out during the period of 26–31 May, 2008. A reconnaissance survey was conducted in Abadahemuka cooperative at Nkotsi-Bikara, Musanze District. In Rwanda, most of the traditional healers are grouped into cooperatives under the supervision of the Ministry of Health in close collaboration with the Institute of Scientific and Technological Research. The traditional healers provided the information about traditional healing practices for both humans and animals, while the elders provided information regarding rituals and beliefs surrounding the forest. The information regarding the use of medicinal plants was collected following structured questionnaire through interviews involving eight traditional healers (five men and three women) aged between 41 and 80 years. These traditional healers were recognised by the local government authorities and selected based on their reputation on herbal medicinal uses. Plant species mentioned by traditional healers were visited inside the relict forest and home gardens to verify the reliability of data obtained during interviews (Alexiades 1996; Gerique 2006). The recorded field data include the following: collection number, plant local name, scientific name, habit, plant parts used, mode of preparation, habitat and locality (Martin 1995). The information regarding the traditional practices and utilisation of Buhanga sacred forest were captured through three focus discussion groups. Each discussion group comprised 15 persons (10 men and 5 women) who were natives of the Nkotsi-Bikara village aged between 50 and 80 years; inclusion was based on a good knowledge of Buhanga sacred forest history. During the discussion, each member of the group took about 5–8 min to talk about the importance of cultural knowledge and use of Buhanga sacred forest.

Species information provided either during the interview or group discussion were recorded. When a species was physically observed in home garden and not in the forest and vice versa, the information regarding that species was collected. Species recognised only through vernacular names without physical identification either in home garden or in the forest was considered unreliable and rejected. Species botanical identification was carried out in the National Herbarium of Rwanda using voucher specimens, identification keys, field guides and the flora of Rwanda (Troupin 1966, 1978, 1982, 1983, 1985, 1988; and Fischer & Dorothee 2008) (see picture showing different sites of study area in Appendix 1).

Data analysis

Validation of plant names, family and plant authority were carried out using the Royal Botany Garden and Missouri Botanic Garden plant names database (http://www.theplantlist.org).

Collected data were analysed using descriptive statistics. The determination of relative frequency of citation of reported medicinal plant species was done using the following formula:

\[
RFC (%) = \left( \frac{FC}{N} \right) \times 100
\]

where, FC is the number of informants mentioning the use of medicinal plant species and N is the total number of informants participating in the survey.

Results

Plant diversity

This study recorded 45 plant species that were used by local communities in the vicinity of Buhanga sacred forest. Of the 45 species, 38 plant species were categorised in 34 genera and 19 families to have medicinal value. In terms of species composition of medicinal plants, the family of Asteraceae, Acanthaceae and Fabaceae had three species each followed by the family of Chenopodiaceae, Rutaceae, Rhamnaceae, Ranunculaceae, Polygonaceae, Solanaceae, Menispermaceae, Verbenaceae, Urticaceae and Cucurbitaceae with two species each. The remaining 14 families were represented by a single species each (see Figure 3). Regarding life form, 21 species (47%) were herbs, 8 species (18%) were trees, 10 species (22%) were climbers, 4 species (8%) were shrubs and 2 species (4%) were grasses (see Figure 4).

Plant species role in ecological, social and cultural welfare

Results of medicinal plants collected from different habitats show that most of the plant species, about 29 species (62.22%) were harvested from natural vegetation followed by 9 species (20.00%) under cultivation in home gardens, 6 species (13.33%) collected in farming plots and 2 species (4.44%) found near the roadsides. The goods and uses of the vegetation in our study area showed that most of the plant species are used for medicinal purposes (38 plant species [74.51%]) followed by raw materials (8 species [15.69%]), social symbol (3 species [5.88%]) and 2 species (3.92%) for spiritual purpose (see Figure 5 and Table 1).

Interviewees from the three group discussions recounted stories of transgressors who had taken resources from a sacred forest and misfortunes fell on them (see Table 2). For example it was said that villagers would not dare to enter the Buhanga sacred forest for fear of angering some spirits in control of the forest. They believe that these spirits were able to curse them by sending a resident giant snake protective of the surrounding marshland called igishanga cya gihanga. Moreover, Buhanga sacred forest is a habitat for many rare species of snakes which upon sight a curse follows. Calamities such as drought were also associated with such omens.

Medicinal flora

Of the 38 plant species reported to have medicinal uses, 29 species distributed in 19 families were reported to be used against human health problems, six species belonging to six families were used against cattle diseases and three species belonging to three families were used against both human and cattle diseases. The most striking diseases recorded in 17 human health problems were the poison vomiting treated by...
six plant species followed by mental diseases and Kilondatumbo (Symptoms of Kilondatumbo: painful sensation in the digestive system with presence of ulcers in the ileum and rectum) treated with five specific plant species (Table 3). Stomach ache was treated by three plant species while other plant species were used to treat one or two diseases (see Table 3). In regard to ethnoveterinary medicine, the most remarkable diseases were tick-borne diseases (East coast fever, Babesiosis and Anaplasmosis) treated by four species followed by sexual dysfunction treated by two species. All other diseases were treated by one species each (see Table 4).

Regarding of some medicinal plants popular than others, Brillantaisia cicatricosa was the most popular plant cited by 5 traditional healers for its medicinal value (Relative frequency of citation [RFC] = 62.5%) followed by three plant species Senna septemtrionalis, Thalictrum rhynchocarpum and Solanum terminalae mentioned by 4 traditional healers (RFC = 50%). The species Zanthoxylum sp., Remex abyssinicus, Prunus africana,
Ranunculus multifidus, Trogia brevipes, Urtica massaica and Ajuga alba were mentioned by 3 informants (RFC = 37.3%) while Chenopodium apulfolium, Cyathula cylindrica, Solanum aculeastrum and Solanecio mannii were mentioned by only 2 traditional healers (RFC = 25%) (see Tables 3 & 4).

Concerning plant parts used frequently for medicinal preparation, the leaves were the most used parts followed by both leaves and tree barks in human health problem representing 81% and 6% respectively. Regarding the ethnoveterinary medicine the leaves were also the most plant part used followed by both roots and tree barks and flowers representing 78% and 11% each. The majority of remedies were prepared in the form of juice from freshly collected plant parts. The juice was prepared by pounding or crushing a plant part in a wooden or stone motor and pesters. Water was the most liquid substance used to dilute the prepared juice. The remedies were taken orally, accounting 84% of medicinal plants use, followed by external application except remedies from the species Eucalyptus maidenii giving anally as smoke to treat haemorrhoids and fresh leaves from T. brevipes rubbing on painful joint to treat rheumatism accounting both 3% (see Figure 6).

Discussion

Taking consideration the size of Buhanga sacred forest, there is a high percentage of plants being naturally harvested in the forest by local communities. The fact that more than a half of remedies were prepared from herbs in natural habitat than cultivated or home gardens indicates that the natural area of Buhanga sacred forest is very important for local communities to satisfy their home-based healthcare. Our finding is similar to the finding of Edwards (2004) reporting that 2/3 of medicinal plants used worldwide are harvested from the natural environment. During interview, traditional healers reported that more medicinal plants were harvested previously than now in Buhanga sacred forest and some species formerly forest-habiting species are now rarely encountered in the area. This is the case of the species P. africana that became extinct in the natural forest while C. cylindrica still existed occasionally due to overharvesting in the past. Studies involving Rwanda on medicinal plants reveal decline of these resources (Stewart 2003).

Our research findings revealed that the poison vomiting, mental diseases and Kilondatumbo in human health problems were the most cited diseases in our study area because remedies against these three predominant health problems were mostly prepared. In a situation where several drugs in one area are required, this indicates a prepotency of a particular disease (Dawit & Ahadu 1993). The potential of medicinal plants recorded in this study were also confirmed by other research conducted elsewhere in Rwanda (Dessouter 1991; Kamagaju et al. 2013; Kayonga & Habiyaremye 1987; Mbarubukeye & Niang 1996; Rwangabo 1993). As per the ethnoveterinary medicine represented mostly by tick-borne diseases, suggests that these diseases were very important in the area. According to Byava et al. (2000), Mbarubukeye (1991) and Van Puyvelde et al. (1985), the East Coast fever (theileriosis) played a vital role in cattle mortality in Rwanda, particularly in exotic pure breed crossing with the Ankole breed while anaplasmosis and babesiosis represented an enormous cost in term of time and money. Also study conducted by Nshimiyimana and Mutandwa (2010) indicates that damages attributable to ticks borne diseases in Rwanda.
were considered as the first economic damage of bovine production transmitting sucking blood parasites diseases such as theileriosis, anaplasmosis and babesiosis.

With more than 70% of leaves used as ingredient in making of medicinal concoction indicates that leaves are more required to solve the health problem in our study area. In reference to Dawit and Ahadu (1993) and Poffenberger et al. (1992), the normal harvesting leaves estimated of up to 50% does not significantly affect the growth of plant species or does not cause a great danger to existence of individual plant when compared to the collection of underground part, stem or whole plant from both ecological points of view and survival of species. The extinction of *P. africana* as reported by the healers is due to overutilisation of both its leaves and barks as ingredients and was replaced by agricultural activities. The same were reported by Sayer, Harcourt and Collins (1992) Stewart (2003) and MINITERE (2003). In general there was no really threat of overharvesting of plant in Buhanga sacred forest as it used to be in the past because the remedies are prepared and used locally, and therefore harvested in small quantities. Traditional healers reported that they do not store remedies for a prolonged period of time because when the need comes, they go out to collect plants, prepare the remedies and use it for treatment. However the importance of Buhanga were known a long time ago, this sacred forest has acquired since 2005 a status of...
TABLE 4: Plants used in veterinary medicine.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Vernacular name</th>
<th>Family</th>
<th>Life form</th>
<th>Substance</th>
<th>Medicinal indication</th>
<th>Plant part used</th>
<th>Route of administration</th>
<th>Mode of preparation</th>
<th>RFC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zanthoxylum sp. (Engl.)</td>
<td>Intareyi’irungu</td>
<td>Rutaceae</td>
<td>Tree</td>
<td>Juice, powder</td>
<td>Babesiosis (Umushitwe)</td>
<td>Roots, Tree bark</td>
<td>Oral</td>
<td>Dcmw</td>
<td>37.5</td>
</tr>
<tr>
<td>Basela alba L.</td>
<td>Urunyanja, Ururarama</td>
<td>Baselaceae</td>
<td>Liana</td>
<td>Juice</td>
<td>Anaplasmosis (gasheshe)</td>
<td>Leaves</td>
<td>Oral</td>
<td>Cmw</td>
<td>12.5</td>
</tr>
<tr>
<td>Cyathula cylindrica Moq.</td>
<td>Igifashi</td>
<td>Amananthaceae</td>
<td>Herb</td>
<td>Leaves</td>
<td>Cow cannot feed the calf</td>
<td>Udder</td>
<td>Rucl</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Agrostis sp.</td>
<td>Urwiri</td>
<td>Poaceae</td>
<td>Herb</td>
<td>Leaves</td>
<td>Injury</td>
<td>Leaves</td>
<td>Skin</td>
<td>Acl</td>
<td>12.5</td>
</tr>
<tr>
<td>Senna septemtrionalis (Viv.) Irwin &amp; Barneby</td>
<td>Umukubanzoka</td>
<td>Cleopolinaceae</td>
<td>Shrub</td>
<td>Juice</td>
<td>Diarrhoea</td>
<td>Leaves</td>
<td>Oral</td>
<td>Cmw</td>
<td>50</td>
</tr>
<tr>
<td>Rumex abyssinicus L.</td>
<td>Umufumbagishi</td>
<td>Polygonaceae</td>
<td>Herb</td>
<td>Juice</td>
<td>Sexual arousal</td>
<td>Leaves</td>
<td>Genital part</td>
<td>Acl</td>
<td>12.5</td>
</tr>
<tr>
<td>Rumex usambarensis (Eng) Dummer</td>
<td>Umufumba</td>
<td>Polygonaceae</td>
<td>Herb</td>
<td>Juice</td>
<td>Sexual dysfunction</td>
<td>Leaves</td>
<td>Genital part</td>
<td>Acl</td>
<td>12.5</td>
</tr>
<tr>
<td>Solanum aculeastrum Dunal.</td>
<td>Intobokarema</td>
<td>Solanaceae</td>
<td>Herb</td>
<td>Juice</td>
<td>East Coast Fever (kibagarira)</td>
<td>Leaves</td>
<td>Oral</td>
<td>Cmw</td>
<td>25</td>
</tr>
<tr>
<td>Lobelia gibberosa Hersley</td>
<td>Intomvu</td>
<td>Lobeliaceae</td>
<td>Herb</td>
<td>Juice</td>
<td>East Coast Fever (kibagarira)</td>
<td>Leaves</td>
<td>Oral</td>
<td>Cmw</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Dcmw, Dried, crushed and mixed with water; Cmw, Crushed and mixed with water; Rucl, Rubbing the udder of cow with leaves; Acl, Apply crushed leaves; RFC, Relative frequency of citation.

proportion of plant species

Source: Association for the Conservation of Nature in Rwanda, 2008
FIGURE 6: Proportion of plant parts used for human and cattle health problems: (a) Proportion of plant parts used for human health problems; (b) proportion of plant parts used for cattle health problems.

Conclusion

This study has revealed the importance of traditional ecological knowledge in Buhanga sacred forest plays a vital role in our heritage. The high plant diversity used in traditional medicine to treat different ailments was localised mostly in the natural habitat and does not really present threat of overharvesting because remedies are prepared on a need-to-need basis. Also this study has shown how cultural values and beliefs are crucial tools for conservation and should therefore be incorporated in all management plans of Buhanga sacred forest.

In light of this research finding, we recommended that traditional healers should be trained on how to domesticate natural plant species as some of them has becoming rare or extinct in the surrounding area due to past anthropogenic activities. Among others 15 species were documented and reported in our study area as priority species for preservation of stored grains for their medicinal importance uses. These include: B. cicatriceps, S. septemtrionalis, T. rhynchocarpum, S. terminalis, Zanthoxylum sp., R. abyssinicus, P. africana, R. multifidus, T. brevipes, U. massica, A. alba, C. opulifolium, C. cylindrica, S. aculeastrum and S. mannii.

Acknowledgements

This study was funded by the regional non-governmental organisation (NGO) of Albertine Rift (ARCOS) in partnership with Association pour la Conservation de La Nature au Rwanda (ACNR). We thank the National Herbarium of Rwanda for their support in species identification and other relevant botanical information, the local government authorities’ of Musanze District and traditional healers, members of Abadahemuka cooperative. Special thanks go to Ir. Glorioso Barebwayire from Projet d’Appui du Développement de l’Elevage Bovin Laitier (PADEBL/ MINAGRI) for excellent technical support in cattle diseases identification, Mrs Usambyimbahazi Madeleine, a student at the National University of Rwanda (NUR)-Botany Department for her kind field assistance and Mr Felix M. Waweru (AfricaRice Center - Dar es Salaam) for editing and proof-reading.
Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

Authors’ contributions

N.J.S. was the project leader, M.V., B.E. and B.N. made conceptual contribution, N.M. was involved in data collection and R.I. was responsible for data collection and analysis, writing up the article and project design.

References


Appendix 1

(a) Photo showing the village surrounding the study area, (b) one of the group discussion with local indigenous, (c) and some important sites and species of Buhanga sacred forest including the mysterious water-spring, (d) cave (e) and Dracaena steudneri (Ighondohondo).

Source: Association for the Conservation of Nature in Rwanda, 2008

FIGURE 1-A1: (a) Photo showing the village surrounding the study area, (b) one of the group discussion with local indigenous, (c) and some important sites and species of Buhanga sacred forest including the mysterious water-spring, (d) cave (e) and Dracaena steudneri (Ighondohondo).
FIGURE 2-A1: Remarkable places in Rwanda.