INOSR Experimental Sciences 15(3):27-32, 2025. **ISSN: 2705-1692**
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International Network Organization for Scientific Research
https://doi.org/10.59298/INOSRES/2025/1532732

Exploring the Socioeconomic Impact of Medicinal Plant use on Malaria Prevention

Mugisha Emmanuel K.

Faculty of Science and Technology Kampala International University Uganda

ABSTRACT

Malaria remains a formidable public health and socioeconomic challenge across sub-Saharan Africa despite progress in modern control strategies. In parallel, traditional medicinal plants continue to play a critical role in community-based healthcare, particularly in remote and underserved regions. This paper explores the intersection of indigenous knowledge, plant-based malaria prevention, and the socioeconomic impacts of such practices. Drawing on global malaria statistics and case studies from Mozambique and Kenya, the study identifies key medicinal plant species with antimalarial properties, examines community health outcomes, and evaluates their economic significance. It investigates how medicinal plant use contributes to health accessibility, cultural preservation, and biodiversity conservation, while also highlighting socioeconomic barriers and the threat of knowledge erosion. The findings underscore the value of integrating traditional medicine into national malaria control strategies, promoting sustainable development, and preserving ethnobotanical knowledge. Ultimately, a balanced approach involving both modern and traditional methods can contribute to malaria reduction and economic empowerment in vulnerable communities.

Keywords: Medicinal Plants, Malaria Prevention, Socioeconomic Impact, Traditional Medicine, Plasmodium falciparum, Indigenous Knowledge, Public Health, Biodiversity Conservation.

INTRODUCTION

The use of medicinal plants to treat malaria dates back to prehistoric times, focusing on traditional ecological knowledge to discover alternative antimalarial drugs. Numerous studies worldwide have identified over 200 medicinal plants with antimalarial or anti-fever properties. Initial research has explored diverse plant species, revealing distinct antimalarial compounds. While many medicinal plants belong to the families Fabaceae, Apocynaceae, and Asteraceae, three main classes of antimalarials—quinoline, alkaloid, and terpenoid have been identified, with new chemical entities under investigation. Bioassay-guided methods complement traditional screening in the search for effective antimalarial drugs. In Mozambique, 15% of local plant genetic resources are utilized by rural communities for health care, primarily by traditional healers who use over 102 plant species. Malaria, caused by Plasmodium parasites and transmitted via infected Anopheles mosquitoes, remains a major global health issue, with 228 million infections and 405,000 deaths reported in 2018. Mozambique has seen a 29% decrease in malaria mortality since 2010, though it still represents a significant burden, especially among children under five and pregnant women. Disparities in malaria-related morbidity and mortality persist due to local ecological and socioeconomic factors, particularly in one of the poorest regions of Mozambique [1, 2].

Background on Malaria

Malaria is a preventable and treatable disease caused by protozoan parasites of the genus Plasmodium, which are transmitted to humans through the bites of infected female Anopheles mosquitoes. There are five species of Plasmodium known to infect people; the deadliest form is Plasmodium falciparum, which accounts for the majority (80%) of malaria-related deaths globally. In 2021, an estimated 247 million malaria cases occurred worldwide, resulting in 619,000 deaths, most of which were in the WHO African Region (234,000 deaths, or 95%), of whom most were children under five years old. Of the 67 countries where malaria transmission was reported in 2021, 35 (52%) were in the WHO African Region. Nearly all

cases (96%) and deaths (95%) occurred in the African Region. Malaria is endemic in 44 (89%) of the 49 countries in the African Region. The 11 African countries reporting no malaria cases in the year 2021 are mostly island states. At the country level, the most malaria-endemic countries in the African region have traditionally been those with favorable environmental conditions for transmission, including climatic parameters and eco-ecological niche types. Cases and deaths reported globally are also highly clustered; 80% of both cases and deaths were reported by just 15 countries. Malaria incidence worldwide has decreased by 64% since 2010. The dramatic success of control efforts has been attributed to major increases in the distribution of insecticide-treated bed-nets and indoor residual spraying of insecticide, which in combination, have significantly decreased vectorial capacity. At a country level, malaria persistence is associated with traditionally understood socio-economic factors whose effects are magnified by health-facility related variables, such as distance to nearest facility, which may restrict access to preventive and curative modalities [3, 4].

Overview of Malaria

Malaria is a significant public health challenge in Sub-Saharan Africa, impacting socioeconomic development. Recent statistics show that about 3 billion people are at risk in over 95 countries. In 2018, there were 221 million new cases globally, with approximately 405,000 deaths. Africa continues to bear the highest burden, with an estimated 229 million new cases and 409,000 deaths reported in 2019, accounting for 94% of global estimates. Zimbabwe's Ministry of Health has focused on malaria control since 1999, aiming to reduce the disease burden by 75% by 2023 through its national strategic plan (2014-2019). Malaria is caused by Plasmodium parasites, transmitted by infected female Anopheles mosquitoes, of which over 100 species exist in Africa. Approximately 30 species are effective malaria vectors; P. falciparum, P. vivax, P. malariae, and P. ovale are responsible for human malaria. P. falciparum is most common in tropical regions and accounts for over 95% of malaria-related morbidity and mortality in Africa. Understanding malaria transmission and control requires consideration of the ecosystem where it is prevalent [5, 6].

Global Malaria Statistics

The World Health Organization (WHO) African Region has a heavy burden of malaria, accounting for most of the global cases and deaths. Malaria is widespread in many countries in sub-Saharan Africa and South Asia, where the Anopheles mosquito is found. Across sub-Saharan Africa, it is estimated that over 240 million cases occur annually, accounting for over 627,000 deaths, mostly among children under five years in the 87 high-burden countries. Roughly 80% of malaria deaths occur among children under five years, mostly in sub-Saharan Africa, where malaria is a leading killer of young children. Malaria remains a public health problem in many mineral-rich developing countries. Despite the exponential increase in malaria expenditure in many parts of the world and savings in terms of averted costs and lives, much of the benefits of the investments have yet to be counted. The World Health Organization (WHO) reports that despite the drops in incidence and death, the burden of malaria remains massive. In 2021, there were an estimated 247 million malaria cases and 619,000 malaria deaths in 85 countries worldwide, giving a global incidence of 62.8 cases per 1,000 population. The incidence of malaria is revealed to be high in sub-Saharan Africa and South Asia, where about 95% of all cases are found globally. In 2021, the WHO African Region accounted for 93% of the global cases and deaths. The latest WHO estimates suggest that globally, there has been a 12% increase in malaria cases and a 7% increase in malaria deaths between 2019 and 2021. A 95% increase in malaria cases between 2019 and 2021 is estimated in the WHO South-East Asia Region, while the WHO European Region reported no malaria cases in 2021. An estimated 81% of total malaria and 90% of malaria deaths occurred among children aged less than five years in 2020. Malaria is endemic in many mineral-rich developing countries. However, contrary to expectations, countries rich in mineral resources have a heavy burden of malaria [7, 8].

Current Prevention Methods

Malaria prevention relies mainly on vector control and intermittent preventive treatment (IPT) for pregnant women with sulphur drugs. Due to limitations in current methods, exploring alternative prevention is crucial. Many medicinal plants used locally for malaria treatment may have mosquito-repelling properties. A community study in João Gomes identified 43 plant types employed in malaria management. Traditional healers possess significant knowledge about these plants, having engaged with various government institutions. Mosquitoes, a common nuisance in homes, appear less bothersome to locals, suggesting that certain domestic plants might offer protection. A long-term study assessed garden plants from 18 families for repelling activity. In the Konso community of Southwest Ethiopia, malaria transmission and control are shaped by indigenous knowledge and cultural practices. They categorize mosquitoes as malaquaya, which can cause malaria, and malaquen, which cannot. The Konso view mosquitoes as foreign and do not believe in the efficacy of repellent plants [9, 10].

Medicinal Plants and Their Uses

Medicinal plants have been used since ancient times for preventing and curing human diseases especially with more emphasis on African countries. WHO estimates that more than 80% of the world's population relies mainly on medicinal plants for their healthcare and 95% of these medicines are derived from plants. Plants are selected as sources of medicinal agents owing to their vast range of biological activities and chemical constituents and due to their easy availability and cost-effectiveness. More than 4000 species of plants are acclaimed as useful in indigenous medicine among which about 2000 species have been claimed to be used for remedying various human ailments. Many drugs derived from plants are employed for treating diseases. Medicinal plants are immensely valuable for human welfare, and for development of pharmaceutical industries. They are also used as food, food ingredients, antiseptic agents, insecticides, colorants, odorants, worships, fumigants etc. They have been used as health protective and enhancers. Medicines are defined as the substances used for curing diseases. This implies that their use by mankind exists because of the recognition of their therapeutic values and thought about their safety [11, 12].

Socioeconomic Factors Influencing Medicinal Plant Use

Medicinal plants serve as a crucial healthcare resource in rural areas with limited medical access. Among 547 surveyed plants, 481 are linked to agropastoralism. Traditionally, knowledge of these plants is shared orally, fostering a gap that threatens traditional practices. Modern influences and protected areas complicate access, highlighting a need for education on herbal knowledge to prevent cultural erosion, especially among youth. This knowledge, conveyed within families and social networks, is expected to be passed down for community benefit. Variables like household size and children impact medicinal plant knowledge (MPK). Some secluded locales retain vast plant knowledge, yet all areas face modernity's challenges. The socioeconomic landscape dramatically affects MPK, particularly in developing nations, where tradition and nature resources are vital. Improvements in economic conditions often correlate with the loss of MPK and cultural identity. Ethnobotanical research effectively illustrates societal changes by examining plant usage within different socioeconomic and cultural contexts, underscoring MPK's role in health, livelihoods, and cultural heritage [13, 14].

Case Studies

An extensive ethnobotanical investigation conducted among the Luhya community residing in Kakamega East sub-County, Kenya, resulted in the identification of a total of 53 distinct plant species belonging to 33 different families, which are utilized specifically for the management and treatment of malaria. This study meticulously documented a range of details that encompass local names of the plants, the various plant parts that are employed, the methods of preparation used, and their specific medicinal applications. It is notable that the majority of these medicinal plants are primarily sourced from the wild environment, particularly from the rich biodiversity found in Kakamega forest. However, the community is currently grappling with a decline in traditional knowledge related to herbal medicine, driven by factors such as rapid modernization, a significant increase in population growth, mounting land pressure, stringent restrictions imposed on the use of herbal medicine, and the unfortunate loss of experienced elderly herbalists who possess invaluable knowledge. Therefore, the documentation and preservation of this ethnomedical knowledge within the community is of utmost importance and urgency. In a similar vein, a comparable study conducted in Mogovolas District, located in Northern Mozambique, uncovered a total of 16 plant species that were identified by 16 traditional healers spread across 12 different villages, all of whom utilize these plants for the treatment of malaria. Among these plant species, there are several notable examples which have been recognized for their efficacy in treating fever; these include Acacia polyacantha, Cleome gynandra, Eucalyptus globulus, Mangifera indica, and Thunbergia alata. Furthermore, eleven of these identified species were subjected to rigorous examination to assess their in vitro antiplasmodial activity against various strains of Plasmodium falciparum. Remarkably, five of these plants demonstrated significant effectiveness, particularly at concentrations of $\geq$ 10 µg/mL, presenting new findings that are particularly vital for dealing with resistant strains of malaria. This highlights the importance of further research and exploration of these natural resources for future medical applications [15, 16].

Impact on Community Health

The study of the societal impact of medicinal plant use presented by focused on communities in the Kakamega region that exploit these resources for malaria treatment. Impact on community health was divided into two categories: therapeutic impact and management and preservation of biodiversity. This region was chosen because it is rich in biodiversity and use of herbal remedies to treat malaria has been recorded in studies dating as far back as the mid-nineteenth century. Questions explored overall importance of use and conservation, perception of plant availability, and influence of rapid ecological change. There was broad consensus that medicinal plants are important to individuals and the

community, ecological knowledge should be preserved, plant availability is changing, and the community has discussed conservation issues since the early 1990s. Knowledge of management strategies is low and among practitioners, younger age and secondary education are related to lower belief in plant effectiveness. The key therapeutic impact relates to safeguarding of biodiversity knowledge along with rectifying misconceptions regarding CM use eliminating misuse of local plants. Future research should investigate correlation between perceptions of importance and continuing use. A longitudinal analysis would give information on shifts in the utility and knowledge of plants. Overall, native medicinal plants are important for the health of individuals and the community while also increasing the community's knowledge of conservation, remedy misuse, and local plant importance. These community perceptions are especially useful in identifying perceptions that are not being addressed in day-to-day health management, biodiversity management, education, and health promotion strategies. Among practitioners, education and age were implicated as important in both the perceptions of plant importance and personal motivations for remedial use. Future studies should investigate perceptions more deeply in areas that are more typical of the productive human-nature interface. This study highlights the importance of medicinal plants both for the health of the individual and the community, underscoring the importance of maintaining ecological knowledge and biodiversity. Changes in ecological knowledge and local plant use should be regarded as a serious health and governance issue [17, 18].

Economic Impacts

International efforts to combat malaria in Africa have intensified recently. National programs focus on early diagnosis and effective treatment, long-lasting insecticidal bed nets, and indoor residual spraying, leading to significant reductions in malaria morbidity and mortality. A decrease in malaria transmission is linked to potential elimination and is expected to yield significant socioeconomic gains for affected communities. In countries like Tanzania, malaria remains a major health issue, yet the long-term socioeconomic impacts of these public health initiatives are not well-documented. Research indicates that insecticide-treated nets (ITNs) influence child health and education, highlighting the economic implications of malaria control strategies. Significant investments from local and international stakeholders aim to relieve communities from the heavy economic burden posed by malaria. Economic benefits can arise from reduced expenditures in prevention, diagnosis, and treatment, improved school attendance, and enhanced earnings. Outcomes can be categorized as lost productive time and healthcare spending. Lost productivity stems from the disease's direct effects and caregiving responsibilities. Healthcare costs encompass out-of-pocket expenses for treatments and related costs, which can be documented through expenditure logs or estimated using predetermined formulas. Additionally, local supply and demand conditions can affect the utilization of chronic or preventative care [19, 20].

Challenges and Limitations

Although Pushkinia floribunda is established as the study's control, researching its chemical constituents against P. falciparum is essential to identify active phytochemicals that combat diseases and guide the search for new compounds. This study explores new terrestrial environmental conditions to enhance diversity in medicinal and organic compounds while predicting resilience to climate change and invasion. Investigating P. floribunda's ability to thrive in contrasting climatic regions through field surveys or experiments is crucial. Understanding their disparity levels can lead to conservation strategies, reducing the risk of losing these important plants. Basic information on traditional medicinal plants in Rukungiri District serves as a foundational starting point for future ecological studies and conservation efforts. The generated data will also create a database of plants used for malaria treatment for professionals and researchers. This study should be replicated in other districts to deepen knowledge of antimalarial flora for commercialization and bioprospecting. Raising public awareness on the conservation of species traditionally used for remedies is important, along with quantifying economically significant or threatened plants and conducting integrated ethnobotanical studies [21, 22].

Future Directions

Medicinal plants have been used for the promotion of health all over the world. Though many scholarly and scientific research studies have already been done on plants with medicinal properties, there is still a research gap in this area, especially in the context of lower socioeconomic regions. This work is likely to promote anagenesis in the way of exploiting plants for medicinal use through humble methodology. It would give an idea to submit a manuscript to the attention of scientists for making public the information generated in this regard. It is likely that through emphasizing plants with antimalarial response, some untoward medicinal plant species might come up to find a genuine place under proper divergence. Rukungiri is one of the malaria-endemic districts of Uganda. Many plant species used for malaria treatment have been recorded and discussed. However, there still exists sewage information about their socio-economic aspect. Therefore, there exists a crucial need to take this important research work

urgently. The information so generated with cardinal specification will be useful not only locally but also at a larger scale worldwide. Therefore, the purview of work is to provide adequate information. Such a study is likely to inspire research for bio-prospecting new or novel antimalarial molecules and compounds through requisite analysis of reported species and evaluations of bioactivity of screening extracts used traditionally [23-27].

CONCLUSION

The use of medicinal plants in malaria prevention offers more than therapeutic value—it represents a vital intersection of health, culture, and economic resilience for many African communities. This study has highlighted how traditional medicinal knowledge serves as a critical health resource in regions where formal healthcare systems may be lacking. Medicinal plants not only provide accessible treatment alternatives but also foster ecological stewardship and cultural continuity. Moreover, their use may alleviate the economic burden of malaria by reducing direct medical expenses and preventing income loss due to illness. However, the ongoing threats of modernization, ecological degradation, and generational knowledge loss pose significant challenges. Integrating ethnobotanical knowledge into public health frameworks, investing in ethnopharmacological research, and promoting conservation initiatives are necessary steps for preserving both biodiversity and traditional health systems. A comprehensive, inclusive approach to malaria prevention—one that values and protects indigenous knowledge—can significantly contribute to sustainable health and economic development in malaria-endemic regions.

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CITE AS: Mugisha Emmanuel K. (2025). Exploring the Socioeconomic Impact of Medicinal Plant use on Malaria Prevention. INOSR Experimental Sciences 15(3):27-32.
https://doi.org/10.59298/INOSRES/2025/1532732