



Review Article

Women's use of indigenous knowledge in Africa

Calvin Gwandure^{*}, Phindile Lukhele-Olorunju

University of Mpumalanga, South Africa



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ABSTRACT

The aim of the study was to assess the role of indigenous knowledge systems used by women in rural development. A theoretical approach was used to assess the role of women in rural areas and small towns in economic development. It is posited that rural women in Africa contribute towards economic development through sustainable rural developmental projects. It is argued that women have shown significant economic contribution with respect to rural water source development, crop production, fish farming, mushroom production, honey production, biogas energy production and artisanal mining. Rural women work individually at household level and in groups as cooperatives to develop their communities, districts, and provinces. African governments are challenged to facilitate rural development through the provision of legislative and operational frameworks that guide women using indigenous knowledge systems and indigenous production methods. Statutory regulation of economic activities legitimises operations and provides safety to people and the environment. African governments are implored to be responsive and deliver on the constitutional mandate to empower women by facilitating domestic, regional, and international trade involving goods produced by rural women in Africa. Rural development is hampered by lack of markets and agents to promote rural produce. The production of fresh foods is affected by lack of refrigeration facilities although indigenous storage methods are used to preserve crops, fruits, and vegetables. The development of indigenous alternative energy sources such as biogas would stimulate economic development in rural areas and small towns. Biofuels are renewable energy sources that are promoted to replace non-renewable energy resources. It is argued that biofuels should be promoted in rural development as renewable energy is environmentally-friendly and reduces global warming. Future studies could focus on the economic contribution of rural women in reducing poverty and dependence on government.

1. Introduction

Rural development is neglected in many African countries as rural areas are considered to be of little economic significance (Merrell, 2022). Rural communities are generally marginalised and do not actively participate in large economic development projects. There are high levels of unemployment in rural areas and small towns. Women constitute the greater number of adults living in rural areas and small towns. It is estimated that women constitute more than 50% of Africa's population and 80% of them live in rural areas (UN Women, 2018). Rural development focuses on projects that target women in most African countries. Rural women participate actively in grassroots politics, elections, health promotion, income-earning projects and social development. This paper explores how women use indigenous knowledge in rural development with particular reference to indigenous water sources development, crop production, fish farming, mushroom production, honey production, biogas energy production and artisanal mining.

Whereas most of the studies on indigenous knowledge systems focus on discussing the hidden traditional knowledge systems which are not yet fully exploited, this position paper hinges on the research gap in terms of utilising the knowledge for commercial purpose and sustainable development.

Although indigenous knowledge is conveyed in folktales and applied to various social contexts, it is hardly utilised in rural development programmes in Africa (Da Silva, Pereira, & Amorim, 2023). The research gap addressed by the systematic review is that of harnessing indigenous knowledge systems in commercial enterprise.

Africa as a world region is sampled for the study as a greater number of women are involved in rural income-generating projects. Women in rural areas generate household income in countries with low employment rates due to low industrialisation (Stokes, Lauff, Eldridge, & Ortbal, 2015). The study focused on Southern Africa, Central Africa, West Africa and East Africa as the indigenous practices are relatively similar.

The study identifies economic activities that are based on indigenous

^{*} Corresponding author. University of Mpumalanga, Corner R40 and D725 Roads, Mbombela, 1200, South Africa.

E-mail address: calvin.gwandure@ump.ac.za (C. Gwandure).

knowledge systems and discusses the role played by women in rural communities of Africa. The role played by African governments in supporting business initiatives created by women is highlighted.

The contribution of the study to systematic review of literature is that not much has been researched on the commercialisation of indigenous knowledge. The study examines the application of indigenous knowledge in developing small towns and villages. The study argues that women contribute to economic development of African countries and indigenous knowledge improves the human development index of countries when it translates into business ventures for women which in turn uplift health, knowledge and the general standard of living of rural communities. The world of science would gain from the transformation of rudimentary scientific application of knowledge to modern methods of production and processing of commodities.

1.1. Research objective

The objective of the study is to identify the utilisation of indigenous knowledge systems by women in Africa for economic benefit in rural areas and small towns.

1.2. Research question

How do women in Africa use indigenous knowledge to develop rural areas and small towns?

2. Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology was utilised in this study

(Pahlevan-Sharif, Mura, & Wijesinghe, 2019). The PRISMA 2020 statement guided the study (Page et al., 2021). The PRISMA 2020 statement provides for either a quantitative approach in which inferential statistical analyses are performed or a qualitative approach which analyses information subjectively based on inductive reasoning and in some cases both approaches could be applied in one study. In this study, the qualitative approach was adopted. The few articles included in the study provided in-depth information that guided the conclusions of the study.

The PRISMA methodology was used for identification, screening, eligibility, and including articles for analysis (Pahlevan-Sharif et al., 2019). The study selected journal articles which were published from 1999 up to 2023. Google Scholar search engine was used to include and exclude articles for systematic review. The key words and phrases entered to search articles for the study were: women, Africa, indigenous, water sources, crop production, fish farming, mushroom production, honey production, biogas production, and artisanal mining. Articles that met the key search terms were included in the study and those that did not have the search terms were rejected. The rejected articles were not analysed as they did not meet the search criteria. Google Scholar search engine was the only software used to generate articles for systematic review.

Fig. 1 shows the PRISMA flowchart with zeros showing that rejected or irrelevant articles were excluded. No attempt was made to analyse irrelevant articles since this was a qualitative study.

The flow diagram was adapted from Pahlevan-Sharif et al. (2019, p. 160).

Table 1 below shows information on articles included in the study.

The selected articles met the eligibility criteria included in the key terms used to search articles on Google Scholar. Articles that did not include the search terms were excluded from the study. The content of

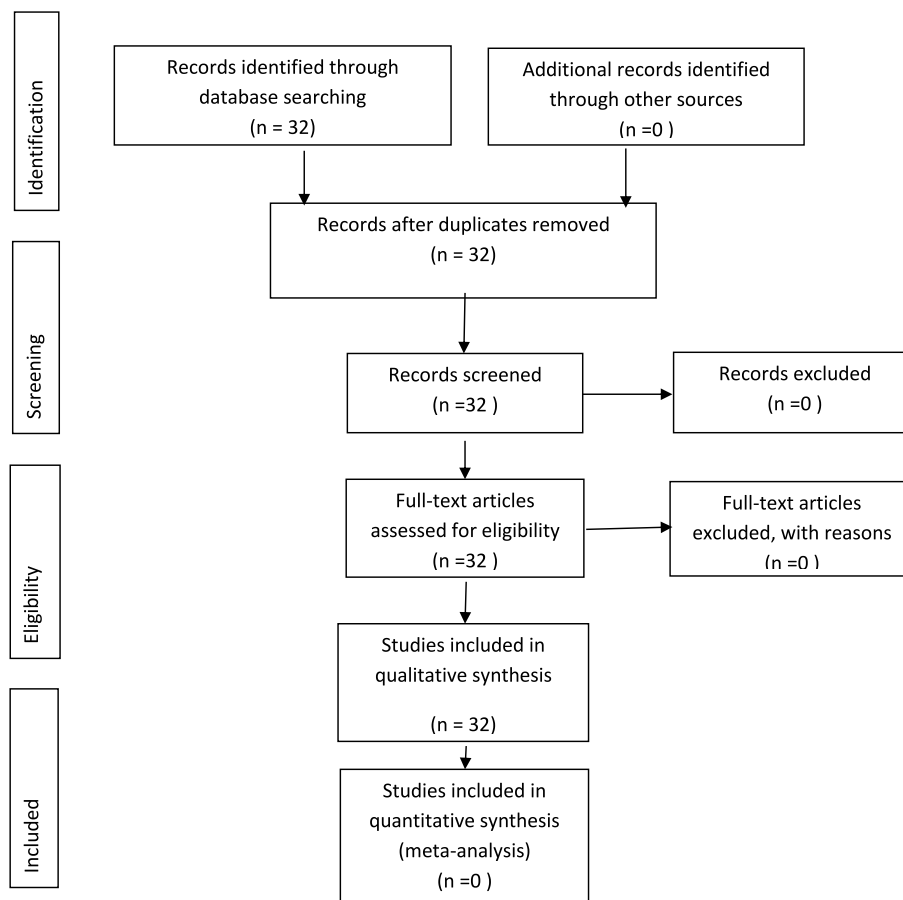


Fig. 1. The PRISMA Flow diagram.

Table 1
Articles included the study.

INDIGENOUS RESEARCH THEME	NUMBER OF ARTICLES INCLUDED	PUBLICATION PERIOD
Water source development	6	2015 to 2018 2 articles were published in 2015. 1 article was published in 2017. 3 articles were published in 2018.
Crop production	14	1999 to 2023 1 article was published in 1999. 1 article was published in 2005. 1 article was published in 2009. 2 articles were published in 2013. 2 articles were published in 2015. 1 article was published in 2016. 1 article was published in 2019. 2 articles were published in 2020. 1 article was published in 2021. 1 article was published in 2022. 1 article was published in 2023.
Fish farming	4	2007 to 2023 2 articles were published in 2016. 1 article was published in 2007. 1 article was published in 2023.
Mushroom production	3	2006 to 2021 1 article was published in 2006. 1 article was published in 2013. 1 article was published in 2021.
Honey production	3	2015 to 2018 2 articles were published in 2015. 1 article was published in 2018.
Biogas production	4	2016 to 2021 1 article was published in 2016. 1 article was published in 2017. 1 article was published in 2019. 1 article was published in 2021.
Artisanal mining	1	1 article was published in 2014.

the articles is highlighted in the literature review.

3. Literature review

3.1. Use of indigenous knowledge systems in water source identification and development

There is ancient-old indigenous knowledge on the identification of underground water sources in Africa. Rural communities in Africa are able to identify areas with permanent underground water supply using

indigenous knowledge systems. Women use indigenous knowledge to identify places where they can dig up wells. Indigenous values are utilised in the development of water sources by government (Jackson, Pollino, Maclean, Bark, & Moggridge, 2015, p. 141). The wells with a permanent water supply are linked to a water aquifer. Indigenous knowledge systems are based on indicators such as springs and occurrence of certain tree and grass species in an area. Soil colour and texture are predictors of underground water availability. Trees such as *mukute* (*syzygium cordatum*) and grass such as *magungira* or *majekacheka* (grass with razor-sharp edges) are strong indicators of a permanent water source. Indigenous knowledge is used to sink *mufuku* (riverbed wells) and the water is sieved for cleanness using traditional methods. Rural women do not rely on modern geotechnical systems and machines to sink wells; they are able to supply households with water using indigenous mechanisms.

Even modern geotechnical surveying methods capitalise on indigenous knowledge systems by surveying for water in areas that indigenous people sunk wells. Some water surveyors consult traditional leaders about ground water trends in the area and women usually lead in providing information on wells and their stability is supplying water seasonally or throughout the year. Geotechnical engineers would sink boreholes using modern technology to develop the indigenous water sources into permanent water sources that can supply a larger population in rural areas and small towns. They build tanks and install pipes to supply water to households. The water would be used for gardening and irrigation purposes on small farming plots. The health of rural communities improves with the development of water and sanitation facilities (Edokpayi et al., 2018, p. 159).

The economic development of rural areas and small towns is enhanced with the development of indigenous water sources. Women could use water from natural springs for commercial purposes. They could partner with commercial companies to sell bottled water. The bottled water would be marketed and sold within the rural communities and in small towns. Rural economies and small towns could be revitalised by selling the water to retailers in urban areas and exporting bottled water to larger overseas markets. Globally, bottled water is one of the fastest growing businesses as consumers are becoming more sceptical of tap water supplied by municipal authorities (Juba & Tanyanyiwa, 2017, p. 1) and marketing companies are strongly driving the water business to the public (Brei, 2018, p. 1220). There are consumers who like spring water as an indigenous commodity without water treatment chemicals. The perceived naturalness of the water attracts consumers with a flair for indigenous foods and drinks. The role of government would be to check the water quality and safety. Government would regularise production operations of the rural bottling plants to ensure compliance with environmental laws on pollution prevention. There are communities in Africa that have hot springs. Hot springs revitalise economies of rural communities and small towns by attracting local and international tourists. Bed and breakfast facilities or lodges managed by women could be developed in the area. Areas with thermal springs could be developed for medical tourism and tourists would be attracted to the facility for therapeutic purpose thus generating an income for rural development (Han, Lee, & Ryu, 2018:137).

The development of tourism and small-scale water bottling plants creates employment necessary for rural development. The development of indigenous water sources stimulates economic growth in rural areas and small towns. Tourism growth promotes entrepreneurship in rural areas and small towns and most of the small-to-medium businesses are managed by women (Jaafar & Rasoolimanesh, 2015: 17). The women would learn business management, marketing and financial skills as they run their small rural businesses in the tourism sector.

3.2. Indigenous knowledge, indigenous crop production and marketing

Women in rural areas use indigenous knowledge to produce indigenous crops. They could improve marketing strategies through the use of

information and communication technologies (ICTs) to search for markets and distribution of products. Indigenous crops are crops that are not genetically modified. The crops have been grown since ancient times by indigenous people. There is no hybrid seed used to grow the crops. Women use indigenous knowledge to grow *nyemba* (cowpeas), *nyimo* (*vigna subterranean*, Bambara nuts), *rukweza* or *zviyo* (finger millet), *mhunga* (millet), *manhanga* (pumpkins), *mapudzi* (bottle gourd) *makake* (cucumbers), *mashamba* (cattle melon) or *mapfunde* (sorghum) in rural areas. Chemical fertiliser is not used as many cannot afford it or avoid it for traditional reasons. Some of the targeted markets for the agricultural products require organic food grown on *murakani* (humus, which is made up of dry leaves, grass and plants) and manure from animals or poultry. Dry leaves and grass could make compost for growing indigenous crops and vegetables for the export market. Indigenous seeds are taken from mature indigenous crops during harvesting and stored for planting in the following year. The intergenerational transmission of the seed for planting dates back to ancient times and some of the plants were introduced during ancient civilisations and trade when Africans started to trade with European traders at the coast. Some of the traders and explorers penetrated the African interior establishing trade routes along which goods imported from Europe were transported to central Africa and raw materials from Africa were transported to the metropole or countries of the traders (Kalusa, 2015, p. 133). Viable trade routes were created which penetrated all African countries. The trade route networks linked Africa to the Middle East, Asia and Europe. The African farmers kept agricultural traditions that kept the identity of their crops. The crops can still be located in specific African countries today in their original indigenous form and quality. For example, *makake eminzwa*, the African horned cucumber (*Cucumis metuliferus*) is grown in Zimbabwe, Zambia, South Africa, Mozambique, Namibia, Botswana and Swaziland. *Nyimo* (*vigna subterranea*), *nyemba* (*vigna unguiculata* L. Walp. or cowpea) or *rukweza* (*eleusine coracana*, poaceae or finger millet) are traditional crops grown in Zimbabwe, South Africa, Mozambique, Nigeria, Ethiopia, Uganda and other African countries (Sipeyiye & Muyambo, 2021; Food and Agriculture Organisation of the United Nations, 2023). The trade revitalised the economic growth of African communities and international trade brought economic growth in Europe and globally during the pre-colonial era (Acemoglu, Johnson, & Robinson, 2005, p. 546). African communities that were involved in trade with early traders such as the Portuguese or Chinese had a better standard of living than communities that avoided contact with traders (Mark, 1999, p. 173). As of this moment, there are countries in Asia and Europe including the US that are importing indigenous crops from Africa and communities in rural areas and small towns that export agricultural products have revitalised the economies of their countries and they have improved their standard of living (Sousa & Raizada, 2020).

Nyemba (cowpeas) are processed into *rupiza* (mixture of cowpea and peanut butter) for commercial purposes. Indigenous groundnuts or peanuts are grown from traditional seeds which are stored and planted in the next season. Most of the imported or exotic groundnuts that are grown for commercial purposes are larger and genetically modified (Abady, Shimelis, Janila, & Mashilo, 2019). They are different from indigenous groundnuts in terms of appearance and taste. *Rupiza* is a nutritious meal that reduces malnourishment in rural communities. Malnutrition worsens the burden of disease in Africa (Bain et al., 2013, p. 120). Ground cowpeas and ground peanuts are sold to rural communities and small towns by women. Some of the retailers export the indigenous cow peas to international markets thus creating business for rural women. For example, Nigeria is the world's leading cowpea producer and has access to global markets (Kebede & Bekeko, 2020). There are overseas markets that are in search of indigenous crops that grow naturally without the use of chemicals for plant growth or crop protection.

Nyimo grows naturally from indigenous seed varieties that are stored and protected from damage by pests using traditional preservation methods. *Nyimo*, round nuts are eaten when they are green or dried. The

round nuts are sold to small towns and urban areas. Women sell dry *nyimo* to long distance travellers and historically, salted *nyimo* was traditionally regarded as a high energy food that travellers took as packed food for long journeys in which travellers spent several days away from home. Women traders prepared dried *nyimo* as food eaten on long journeys and periods spent away from home. Dried *nyimo* cause thirst after eating; workers who perform outdoor manual work where there are no canteens prefer to take *nyimo* lunch packs to work. Women sell *nyimo* in their communities, stalls along highways, small towns and some sell *nyimo* to neighbouring countries. African governments help women by applying less stringent laws on the trade and export of rural agricultural produce. Some consumers in urban areas and overseas markets like organic foods such as *nyimo* (Waarts, Bakker, Snels, & Danse, 2009, p. 45).

Zviyo (finger millet) is an indigenous crop that is associated with indigenous African customs such as rain-making ceremonies and *zviyo* or *rukweza* is used for brewing beer for the ancestors (Nyathi, 2022). The crop is also used in making *maheu*, or *mageu*, a traditional non-alcoholic beverage in Zimbabwe and South Africa. In some situations, Africans living abroad drink a cup or gourd of the traditional beer they make and pour some of it on the ground as a sign of drinking the traditional brew with the ancestors or African spirits (Machoko, 2013, p. 285). Women in rural areas take advantage of the quest for *zviyo* food and beverages by African people in the diaspora seeking contact with their roots. The women export *zviyo* food and beverages to overseas markets. The women sell finger millet meal in towns and cities and finger millet bags are exported for the larger market of consumers in search of indigenous or organic foods. Eating finger millet food is like being in touch with the ancestors or being in contact with one's soul among some of the people with African contact, roots, or ancestry living in Asia, the Middle East, Europe, Canada and the US. Drinking finger-millet beverages and eating finger millet food is reliving the lost food and beverage experience among Africans living in the diaspora with a strong attachment to their origins. The craving for indigenous foods creates a demand for finger millet products with a possible rise in the placement of orders for the product from rural women in Africa. *Mhunga* (millet) and *mapfunde* (sorghum) are indigenous crops that create business for rural women by selling the crops locally, regionally and overseas. African governments are frantically trying to create markets for their agricultural produce in countries where demand for indigenous foods and vegetables is high (Cernansky, 2015, p. 146).

Manhanga (pumpkins), *mapudzi* (bottle gourd) *makake* (cucumbers), *mavisi* (water melons) and *mashamba* (cattle melons) are grown using traditional methods. The seeds of these indigenous crops are not bought from commercial seed markets. Local indigenous seeds passed on from one generation to the other are used to grow the crops. No chemical fertilisers are used to grow them and the indigenous crops and vegetables are sold by rural women to the domestic and export markets. *Manhanga* are eaten when they are still green as vegetables. They are mixed with meat, green leaves, tomatoes, or beans. *Manhanga* can be exported at a profit. The indigenous dish is popular in small towns and urban areas. *Mapudzi* are eaten when they are still green. Some export markets buy green *mapudzi* in large quantities for supermarkets and green-produce or fresh-farm produce traders regionally and overseas. When they mature, the gourds are sold as traditional containers. Customers buy the containers for various purposes. Indigenous cucumbers *makake* are sold at domestic markets and there is a demand for indigenous cucumbers overseas. The hindrance rural women face in Africa is the lack of capacity to produce cucumbers in large quantities throughout the year as rural agriculture is mainly rain-fed (Siderius et al., 2016, p. 14). African countries could boost cucumber production by developing irrigation systems for women's agricultural cooperatives in Africa. *Manhanga* and *mashamba* (cattle melons) make *nhopi*, (traditional porridge) that is sold in small towns by women. The seeds are roasted with salt and eaten. The food makes people thirsty and that is regarded as healthy when people become thirsty and drink water after eating the

traditional dish. Rural women's ability to prepare traditional meals should be developed to revitalise rural development and self-reliance.

3.3. Indigenous knowledge and fish farming

Women in rural areas use indigenous knowledge systems to catch fish. In countries such as Côte d'Ivoire, Benin, Senegal, Gambia and other African countries, women take an active role in fishing and selling of the fish (Trottier, 2023). They use worms, fruits, or food as bait. Traditional methods such as fish traps and fishing rods are used to catch fish. Women catch fish types such as tilapia, catfish, eel, or sardines. Women are more involved in shallow water fishing where there is less risk of crocodile attacks. The fishing is mainly for domestic consumption and selling the fish locally to raise money for household needs. Indigenous knowledge systems are used for processing the fish for cooking, drying the fish, and storage for the market. Sun-dried or fire-dried fish is in demand, but large fish need to be dried over open fire to remove moisture (Jain & Pathare, 2007, p. 1315). The smoke protects the fish from rotting and keeps out pests that could degrade its quality and taste.

While there are agricultural specialists who help rural farmers to produce crops, there are few fish farming specialists employed by government to assist rural women to engage in commercial fishing in Africa. Governments in Africa protect large dams where commercial fishing is carried out by large fishing companies and cooperatives. Fishing in rivers and small dams is generally controlled by civil servants such as national parks and wildlife officers, conservation officers or game rangers. They protect rivers and dams against fish poaching. Agricultural extension officers in rural areas help women in fish farming or aquaculture. Research evidence shows that rural women trained in aquaculture become economically independent and uplift rural economies by selling fish (Farquhar, Khanal, Shrestha, Farthing, & Bhujel, 2017:1). The feeding of fish would be based on traditional foods and not exotic fish food.

The economies of rural areas and small towns could be improved by building small dams in rural areas. The dams would be used for fish farming and aquaculture. Women could use parts of their fields for fish farming. They can develop ponds for aquaculture in their fields. The fish would be fed with agricultural products such as maize, beans or food leftovers. Women would be assisted by agricultural extension officers to engage in safe and profitable fish farming methods. Mostly, fish farming in rural areas in Africa is spearheaded by non-governmental organisations. The fish is sold in small towns and urban areas. There is a large demand for freshwater fish in Africa. Promotion of fish farming by government in rural areas is essential for rural development and food security (McIntyre, Liermann, & Revenga, 2016, p. 12880).

3.4. Use of indigenous knowledge in the production of mushrooms and creation of mushroom markets for rural development

Mushroom grows naturally in rural areas and women gather the mushroom for consumption and selling to villagers and retailers in small towns. Indigenous mushrooms grow in places where conditions are conducive. As a fungi, mushroom grows in same places every summer. The abundance of mushroom and its variety depends on rainfall patterns. When adequate rain is received, there would be plentiful occurrence of mushroom in rural areas. There are different types of mushrooms, and each variety grows on specific soils. *Firifiti* (*Cantharellus symoensii*) is red, purple, or yellow and it grows on soils with vegetative material such as decomposing leaves, logs, sticks, grass and other materials which make the soil fertile. The mushroom grows on mountains, hills, bushes and forests. It grows in clusters and women collect the mushroom that grows daily in different places. The mushroom is cooked and eaten as relish. It can be dried and sold in small towns and cities. Fire-dried *firifiti* can be stored for over a year or longer periods. Rural women export mushroom to countries such as China through export incentive schemes initiated by African governments such

as Zimbabwe. It is an organic food which is liked by people who prefer indigenous food to genetically modified foods. *Nhedzi* (*Amanita Zambiana*) is mushroom that grows in places it has grown before. It is a fungi which appears seasonally. *Nhedzi* is white and greyish at the top and it provides a slippery dish. Women collect the mushroom, cook it and sell fresh dishes to restaurants in rural areas and small towns. *Nhedzi* is tasty and relatively more expensive. It is cooked and dried. It has a longer shelf life extending over a year without losing its taste. The export market for *nhedzi* is favourable and rural communities that trade in mushroom receive rewarding results necessary for the revitalisation of rural development (Tibuhwa, 2013:49). *Nharamutanda* (white mushroom that grows on dead wet wood) and *mazheve* (*Auricularia auricula-judae* or wood ear) grows on dead wet wood. Women collect the mushrooms and make dishes for the family and sell some of the mushrooms to the local community. *Uzutwe* is mushroom that grows on anthills and mostly on clay soil. Some of it grows on cattle manure. The mushroom occurs in large quantities, and it grows in one place. The mushroom is sold and women in rural areas generate an income from collecting *uzutwe*. *Dare* is a giant mushroom. It can grow to about one metre. Small animals like hare can rest under the *dare*. The *dare* dish is a delicacy that attracts buyers from towns and cities to rural areas to buy the mushroom. Tourists enjoy mushroom dishes and that promotes food tourism, nutrition and preventive healthcare in African countries through indigenous knowledge systems (Fernandes, Garrine, Ferrao, Bell, & Varzakas, 2021).

African governments should develop indigenous knowledge systems in mushroom production and they should help rural women by establishing mushroom markets. The markets could be located in small towns and cities, and overseas markets for mushrooms could be secured and promoted by embassies (Chang, 2006, p. 297). It is pointed out that mushroom gathering is gender oriented; more women than men collect mushrooms for domestic consumption and selling in Africa (Tibuhwa, 2013:49). African governments could improve indigenous processing methods for preserving mushrooms in rural areas using modern methods that promote health and safety in the mushroom industry. The mushroom industry in Africa could revitalise the economies of rural areas and small towns by stimulating growth in the production and marketing of edible mushrooms, development of medicinal mushroom products and sustainable collection of wild mushrooms (Chang, 2006, p. 297).

3.5. Indigenous knowledge, honey production and marketing

Honey production is a traditional activity for which many women in Africa earn a living from. *Mukoko* (beehive) is an indigenous bee skep that is used to keep bees and harvesting honey. It is made from a tree bark. Bees could be kept in the yard in a bee gum. A bee gum is a tree with a *mhango*, which is a hole in the trunk. Hollow trees provide a protected inside space for honey-making and the tree also provides rainwater to bees, birds, and tree-climbing animals. The water collects in holes on the tree trunk. A beehive could be a hole in an anthill, or any hole chosen by bees to be a hive (Ajao & Oladimeji, 2015, p. 41). Rural women could dig up a hole in their homesteads and put honeycombs and beeswax in the hole to lure bees. Bees without a hive or bees whose hives were disturbed would occupy the artificial beehives created by women. *Mukoko* is an artificial beehive which uses the same indigenous technique to keep bees for honey production. Traditional healers could keep bees in their homesteads for therapeutic functions. The routine movement of bees, that is, the going out and coming back into the hive denotes peace, tranquillity, health or stability. Bees live in harmony with people and communities. When the ecological environment is threatened and bees are killed in the process that could be an indication that the safety of humanity would be at stake (Mullin, Chen, Fine, Frazier, & Frazier, 2015, p. 27). Toxicity in the environment is shown by apathy in bees characterised by scattered and disoriented movement. Some of the returning bees die at the entrance of the hive. Traditional healers uphold indigenous knowledge systems by emphasizing the fact that what

disturbs bees equally disrupts human life and what kills bees could kill humans. Indigenous knowledge systems are related to evolutionary survival instincts in animals that humanity has depended on. Foods that are eaten by wild animals are considered to be safe for human consumption.

There are plants that produce poisonous flowers that contaminate the quality of honey. Environmental pollution affects the quantity and quality of honey produced. If the taste of honey is bad, rural women use indigenous knowledge systems to identify toxic plants that could contaminate honey-making and processing. Rural women would not harvest honey during periods that poisonous plants are flowering. They would harvest the honey when the quality is good and when the bees are apparently healthy. Honey is sold to retailers and some of it is exported. *Dendende* or *monga* is honey made by insects that are not bees. The insects do not look like bees but look like small flies. They are smaller than bees and they do not sting. They usually create their hive underground on anthills or trees. The insects are found in Zimbabwe, Mozambique and other African countries. Agricultural extension officers and agroforestry officers could assist women with honey production and marketing as a rural development strategy. Women in rural areas could be economically empowered through honey production (Heckle, Smith, Macdiarmid, Campbell, & Abbott, 2018, p. 1). African governments could create markets for indigenous and organic foods regionally and internationally.

3.6. Indigenous knowledge and biogas production

Indigenous knowledge in gas production is shown by the use of manure for heating purposes (Lee, Hong, Lee, Park, & Lee, 2021). Women in rural areas use indigenous knowledge to warm food or boil eggs by putting pots in cattle manure. After harvesting, manure from cattle, sheep, goats, and poultry is piled in one place before it is taken to the fields. The manure could be kept during autumn, winter and spring before the farming season. Eggs put in manure would be ready for eating without boiling them over fire. This is the indigenous knowledge about manure and heat production that is capitalised on by scientists to produce biogas from manure. Biogas is a renewable bio-fuel which is used for heating, cooking and generating electricity (Achinah, Achinah, & Euverink, 2017, p. 299).

Non-governmental organisations in Africa such as UN Women, are helping rural communities to produce biogas which is an alternative source of fuel apart from fossil fuels (UN Women, 2019). In Tanzania, women participate in biogas energy production in rural areas to reduce environmental degradation and in this regard they are supported by UN Women, UNESCO, and UN Women's Fund for Gender Equality. They utilise agricultural waste to generate energy (Achinah & Euverink, 2016, p. 143). The provision of lighting and electricity in rural areas stimulates economic growth. Home industries are essential in rural development for the manufacture of agricultural implements, buildings materials, repair of farming equipment and provision of refrigeration services for women's cooperatives. The manufactured products could be marketed and sold in towns and cities. The agricultural industry is strengthened when rural areas generate renewable energy to sustain agricultural production.

3.7. Indigenous knowledge and artisanal mining

Artisanal mining has a substantive contribution to rural development in Africa. Women use indigenous knowledge systems to identify minerals such as gold, chrome, coal and diamonds. The indigenous knowledge systems in mining were used during precolonial times in Africa when Africans traded with early traders from Europe and other parts of the world. Women mine and process the minerals using indigenous knowledge systems. The minerals are sold to approved buyers. The department of mining and mineral resources in African countries is responsible for approving artisanal mining rights and it provides

gazetted regulations on mining operations. New mines owned by international syndicates are usually developed from small artisanal mines.

African governments could promote artisanal mining through regulation of mining activities to reduce damage to the environment. The ministers of mining and mineral resources in Africa should create government units that expedite the purchase of minerals produced by rural women. Markets should be created to facilitate trade in mineral resources. Artisanal mining is a large income-earner for rural development and women in artisanal mining contribute to the national income (Debrah, Watson, & Quansah, 2014, p. 913).

3.8. Implications for rural development

African governments should consider the revitalisation of rural economies and small towns as a priority for national development. Women in rural areas reduce poverty and initiate development through the use of indigenous knowledge. Civil servants should work with women individually at household level and in groups as cooperatives to boost rural development. African governments should promote rural development projects initiated by women and supported by international donors at village, district and provincial levels. Rural women could take advantage of corporate social responsibility programmes of private organisations to create economic partnerships that bolster rural development. The gross domestic product of African countries would not be significant without the economic contribution of women in rural areas and small towns.

4. Conclusion

Rural development is often neglected in many African countries resulting in underdevelopment and poverty among rural populations. Policies relating to the utilisation of indigenous knowledge and empowerment of women in Africa should be implemented. Indigenous knowledge and economic development should be interlinked.

5. Policy implications

African governments are challenged to develop and implement policies that revitalise the development of water sources, crop production, fish farming, mushroom production, honey production, renewable energy production and artisan mining for the economic development of rural areas and small towns. Sustainable rural development could reduce dependence of local authorities or district councils on government funding for rural development. Future studies could focus on the role of women in reducing government spending on rural development.

Credit author statement

We declare that we contributed equally to the writing of the paper for publication. Prof Calvin Gwandure (first author), Prof Phindile Lukhele-Olorunju (second author).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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