

*Full Length Research Paper*

# **An analytical assessment of brick moulding processes and its impact on local ecosystems, biodiversity, environment and human health in a rural Zimbabwean village**

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Climate change, environmental degradation, loss of biodiversity, changes in the ecosystem and disasters play an important role in the development and economic advancement. In Zororo Village, Zimbabwe, environmental degradation, changes in the ecosystem and biodiversity have occurred rapidly during the last few decades. A literature review, key informant interviews, and focus group discussions were the methodologies used for this research. All the participants agreed that environmental changes had occurred during the last few decades, however, they could not connect these to activities such as brick moulding. Brick moulding is a lucrative and economic backbone of many communities in rural Zimbabwe and other Southern African countries. It is a way of value adding to the clay deposits for economic development but the practice is associated with various environmental challenges linked to the various stages in the brick production process. The process impacts on the environment, ecosystem, biodiversity and human health. Vegetation, indigenous trees, edible insects, small animals and wild fruit trees have disappeared from the environment. Children and domestic animals drown in uncovered holes which also become breeding sites for mosquitoes and other vectors. This article discusses community contributions to the negative impacts of environmental degradation, changes in the ecosystems, biodiversity and human health, through the destruction of anthills in the process of brick moulding in rural Zimbabwe.

**Key words:** Brick moulding, kiln, climate change, communities, disasters, anthills (mounds), health impact, sustainable livelihoods, vertical shaft brick kiln.

## **INTRODUCTION**

During all winter seasons, rural communities in Zimbabwe and other Southern African countries destroy many anthills/mounds in order to make clay bricks either for sale

or for their own consumption in building infrastructure. Brick moulding commences with land clearing, followed by excavations of the clay materials, moulding and baking

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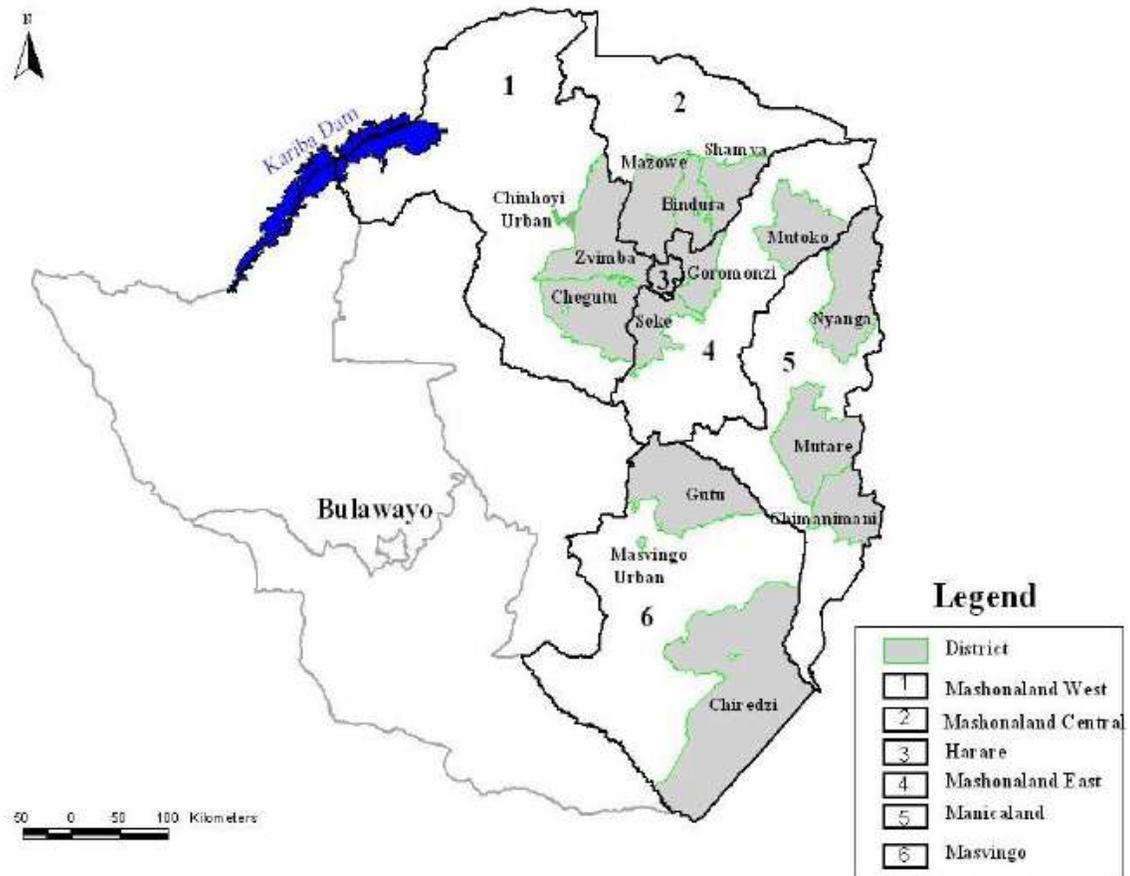
bricks in kilns. Massive tree and vegetation cutting is a normal practice in brick moulding during site clearing and wood is the preferred method of the brick-making process. There is a resulting loss of animal and insect habitat. Most rural brick kilns are fired by wood whilst commercial brick moulders use coal-fired kilns. Coal is a non-renewable energy source. Deforestation and carbon dioxide emissions have further indirect effects on the ecosystem and climate. In the rural areas fire may be used in the clearing of targeted anthills, and the collateral damage is the burning of whole veldts resulting in carbon dioxide emissions. The pits that develop during excavation collect water during the rainy season becoming breeding grounds for pathogens and vectors such as mosquitoes, which may cause malaria and dengue fever, and can also cause the drowning of animals and humans. Anthills are also a supply chain for some very nutritious foods for the communities, including termites, white flying termites, wild fruits, and small animals that hide in their undergrowth, destroying the anthills plays a role in limiting food availability (Calvalcanti, 2015; Van Huis, 2017). It is important to note that the bricks are from clay deposits that occur in the solum. The solum is the part of the soil profile that constitutes the top and sub-soil horizons both of which are important for agriculture and the ecosystem (Herald, 2017). Mounds (Anthills) and soils of termite have numerous functions in African communities. These include geochemical properties, making bricks, plastering houses, making pots, and use as fertilisers (Van Huis, 2017). Geophagy (the practice of eating soil) especially among pregnant women is an important practice on the African continent (Van Huis, 2017). Mounds are also used as important burial places. Anthills play a very important role in the economies of communities in most African countries. They provide food such as vegetables, termites and other insects with high micronutrient and protein content (Srivastava et al., 2009). The soil is also used as fertiliser for fields and small gardens that communities use for their daily foods (Macheka et al., 2018). They are also very important for the environment because of the vegetation and trees that grow on them. In most countries of Southern Africa, they are the source of bricks for the villagers and in poor communities, people mould bricks using these same anthills thereby making money for sustenance as shown in Figures 2, 3 and 4. In the past, communities applied good conservation practices by using only parts of the anthills allowing them to reform. However, the current practice is to completely destroy the anthills creating negative environmental impacts and accentuating climate change impacts. Figures 3 and 4 show how anthills are stripped of vegetation and trees.

The destruction of the anthills also causes the migration of termites and other insects. Termites have been delicacies in most African societies for centuries. They contain many micro-nutrients including Iron which would be a very good source for people to avoid anaemia which

is a big problem in the region (Costa-Neto, 2005a). Crickets which have a high protein content also migrate when ant-hills get destroyed. These are also cuisine in most communities, other insects also edible will move away. These termites and insects are usually harvested especially in summer and are free of charge since anyone can lay the traps. With the destruction of anthills, this source of food also disappears and the poor lose some of the easily available food sources. This definitely has a health impact on nutrition amongst the poor when malnutrition is already a problem in most communities. Some of the insects also have medicinal values that are lost by the destruction of anthills (Calvalcanti, 2015; Costa-Neto, 2015a, b). Some edible vegetables are also found on some anthills. These vegetables are of great nutritional value to the rural and poor folk.

Figure 1 shows an example of excavated holes that are never filled and are left in the ground, whenever bricks are made. These holes during the rainy season, become reservoirs for stagnant water, which in turn become breeding ponds for mosquitoes. This increases morbidity and mortality due to malaria. In countries with collapsed health systems, these ponds increase not only the burden of disease but costs to the health system. This could be avoidable if only bricklayers could use the broken brick to fill these holes so that they do not accumulate rainwater. Council environmental and health departments should play a role in behaviour change through communication and mobilization of affected communities. Community and opinion (elder) leaders could also assist because the negative consequences have an impact on the social and health well-being of their people. Figure 5 shows an anthill half destroyed with plenty of clay bricks ready for being burnt in kilns. At the end of the day this whole anthill will be completely destroyed. This labour-intensive work is done mostly by jobless youths and women in the villages to make brick to sell to those constructing buildings within and outside the villages. Brick moulding only takes place during the winter months that stretch from March to the end of August. As soon as the rainy season comes around September, the excavated areas become reservoirs for stagnant water and breeding grounds for mosquitoes.

Bricks only become strong after being baked red. A kiln is built for this purpose and firewood is needed (Figures 6, 7 and 8). Big logs are needed for this purpose and in abundance since burning may take up to 12 h. This requires plenty of firewood most of which is cut from forests that have lost plenty of trees already. In most instances, anthills are cleared of any trees they may have, not only to pave way for brick moulding but the wood will also be used to burn the bricks. Many forests have been decimated due to this process that takes place every winter. This naturally will have a major impact on climate change. Unfortunately, most communities do not connect the felling of trees to climate change and its negative impacts.



**Figure 1.** Provinces and districts chosen for the studies on plant virus knowledge and perceptions by stakeholders in Zimbabwean agriculture. The provinces are numbered 1 to 6 while districts are shaded grey. Source: Charles et al., 2017



**Figure 2.** Termite Mount (Anthill) being prepared for brick moulding. Source: Author



**Figure 3.** Termite mound (Anthill) totally stripped of vegetation including trees.  
Source: Author



**Figure 4.** Dug out holes/excavations that are let unfilled.  
Source: Author



**Figure 5.** Moulded clay bricks before they are baked in kilns.  
Source: Author



**Figure 6.** Example of a Kiln for baking moulded brick.  
Source: Author



**Figure 7.** Fired used as energy source for baking bricks to make them stronger.  
Source: Author



**Figure 8.** Burning of bricks to make them brown/red and stronger.  
Source: Author

## LITERATURE REVIEW

Very few articles have been written and published on the impact of both rural and commercial; brick moulding in Southern Africa. There was a very good piece on the subject matter in the business section of the Zimbabwe Herald on the 10th of May 2017. Interesting, no comments were made on this piece as if it was a negligible problem. Many studies have been done in both South Africa and Uganda on the brick moulding but most have been concentrating on the strength of the bricks or how they conserve heat on the resultant buildings (Perex, 2009). However, a paper in Sustainability by Hashemi et al. (2015) mentions the environmental impact of brick moulding although the paper concentrated on construction methods and materials in low-income tropical housing. A study by Macheka et al. (2018), in the rural Chivi District of Zimbabwe, shows the impact of mining of sand and clay for brick moulding, illegal mining and cutting down of trees for firewood harvesting on the environment. The paper concludes that poor people have resorted to various environmentally hazardous activities as a means of earning livelihoods.

A 2021 article from Chembe, Malawi by Mahdjoub et al. (2021) suggests that instead of using clay soil, communities could use stockpiled and unsorted crushed post-consumer waste glass as partial aggregate replacement in burnt or fired clay brick. This would actually preserve anthill/mounds and is a way government could invest into for their communities. Whereas in the developed North, circular economy strategies such as landfill mining, urban mining, and recycling have contributed to sustainable resource recovery and reuse, this is not the case in the developing South (Mahdjoub et al., 2021).

Research into this should be encouraged, however, this needs investment by local authorities into engineered landfills or even consolidated dumpsites. Anaikaiye et al. (2021) argue that the use of locally available materials such as clay from riverbeds and anthills, firewood from a nearby forest or waste products from agriculture makes the brick-making process cheap and contributes positively to the socio-economic status of brick moulders. However, the low-cost firing technique contributes to emissions that are detrimental to the health of the brick moulders and the environment. The green method of brick production which entails recycling of industrial wastes would enhance the development of a sustainable environment (Anaikaiye et al., 2021). The gradual transition from traditional techniques of brick baking to an environmentally friendly technology is necessary. Research in South Africa has shown that the establishment of a community-owned energy-efficient kiln such as the vertical shaft brick kiln (VSBK), serving as a source of employment for local brick makers would go a long way in reducing emissions associated with brick production. The VSBK has been shown to be highly

efficient, energy saving and environmentally friendly compared to other modern technologies (Anaikaiye et al., 2021).

This paper looks at the environmental impact of brick moulding in Zororo Village, Seke District, in Mashonaland East, Zimbabwe and other southern African countries including the impact on vector borne diseases and nutrition. It also discusses ways to mitigate some of the impacts on the environment, ecosystem, biodiversity and health.

## Objectives of the study

The following were some of the objectives of this study:

- (1) Assess the knowledge of communities and local authorities on changes in the ecosystems and environmental degradation, and the roles of their activities such as brick moulding play.
- (2) Assess whether communities are observing the changes in ecosystems, biodiversity and changes in climatic conditions particularly rain patterns
- (3) Assess whether brick moulders and wood harvesters understand the impact of their activities on the ecosystem, biodiversity, environment and health of the communities
- (4) Develop responses to the negative impacts of the activities of communities on the ecosystems, biodiversity, environment and health including capacity building of communities using their own indigenous knowledge.
- (5) Develop recommendations for national, district and local levels to counter the negative impacts of some local activities that impact on the ecosystem, biodiversity, environment and health of communities.

## Description of the study area

Zororo Village, as shown in Figure 1, is one of the several villages that are part of the Seke District Council which is Mashonaland East in Zimbabwe and falls under Chief Seke. The village is 30 km from the Capital City of Harare and 10 km from Chitungwiza which is one of the biggest townships under Greater Harare. The village is separated from the commercial farmlands on the East by the Manyame River and on the West the Masikandoro River. These rivers only flow during the rainy seasons if there are enough rains, whereas 10-20 years ago they flowed all year round. Figure 1 shows a sketch of Seke District under which Zororo Village falls. The last 20-40 years have seen major environmental and ecological changes to the study area (observed by the Author who grew up here). The area has become semi-arid with sandy soils and very little and sporadic rainfall. Several species of trees including Msasa tree/*Brachystegia spiciformis* (Zebrawood), tsubvu tree/*Ziziphus abyssinica* (Smelly

**Table 1.** Categories of community members interviewed during the research study.

Category of community member	Numbers	Male	Female
Village elder	21	13	08
Brick moulders	69	60	09
Wood harvesters	23	20	03
Others including politicians and local government employees	15	07	08

Source: Author

berry fingerleaf fruit tree), mazhanje/*Uapaca kirkiana* (wild loquat) to name but a few have disappeared from the environment. This also has been followed by the disappearance of edible and non-edible insects, such as mandere or chafer beetles, tsambarafuta/*Carebara vidua*, gurwe/*Brachytrupes membranaceus* (tobacco cricket) and termites, to name just a few. Whereas, in the past, villagers would go hunting for wild small animals such as rabbits, kodus and springbok, there are no more trees and vegetation for cover and food. The young children of today only hear the names of most of these trees, insects and small animals from their elders but can only see them either at zoos or in their books.

## MATERIALS AND METHODS

The destruction of anthills/mounds in the rural village at an alarming rate during the last 5 years was observed and decision was made to research the negative impacts of the brick moulding production, which was responsible for the destruction of these anthills. To generate sufficient evidence to fulfil this research the methodological approach combined a desk review and application of qualitative techniques to obtain information from various sources that include traditional leaders, elders from the village, brick moulders, local council officials and local political leaders. Focal group discussions were held with brick moulders, their assistants and harvesters of wood. A questionnaire was developed for key informant interviews which were held with councillors, elders, etc. Fieldwork consisted of FGDs with brick moulders and harvesters of wood. The desk review of literature on brick moulding using clay from excavations of anthills was mostly done on the SADC region.

## RESULTS

Table 1 shows the category of people who either answered questionnaires or were part of the focus group discussions. This was an unstructured methodological approach in the sense that the researcher could ask any villagers met on the way a few questions as just a conversation. This was made easy because the researcher was from the village and virtually everyone knew him. One of the questions asked to the elders was to state some ecological and climatic changes in the last 20-40 years; all of them mentioned the disappearances of certain trees and vegetation, the disappearance of certain edible insects and small wild animals including hares/rabbits, kodus, springbok, etc. They also mentioned the

disappearance of several wild fruit trees. Women were found to be more observant than their male counterparts, this might be because they are responsible for subsistence farming and gathering of wild fruits and edible insects. Most of the brick moulders and wood harvesters were young people, most of whom had secondary education. They understood the issue of climate change from their social studies at schools; but had the misconception that it is the problem of industrialized countries where there is a lot of pollution and commercial agriculture on a larger scale. They did not connect the felling of trees and destruction of anthills/mounds with the negative ecological and environmental observations, everyone seemed to be noticing. Politicians seemed to be the least informed about climate change and its negative impacts; one had the audacity to say, "These are tricks of the opposition parties to confuse communities". Local government employees responsible for both health and the environment showed the least interest, in fact, they seem to politicize the issue. Politicization is a weapon used by many people in order to curtail a conversation on something.

It was disappointing to find out that there were no community based organizations (CBO) and non-governmental organization (NGO) assisting communities on climate change and the environment, most respondents felt that it is because of bills passed by the government (Private Volunteer Organization Bill) that made it hard for NGOs to operate in rural areas. Some chiefs insist that any NGOS or CBO to operate in their area must have permission from them, which in most cases is impossible to achieve.

## DISCUSSION

The youths who do most of the brick moulding are educated and understand the issue of climate change, however, most of them have the misconception that negative climate change impacts are caused by big industry emissions, vehicles and animal husbandry. Further, they were of the opinion that the impact is currently being felt more in industrialised countries than in Africa. When they were asked whether their activities could play a role in climate change, they felt it was too

small an industry to cause a major impact although the felling of trees was something, they observed had caused desertification in some areas. It was interesting however to note that older people, were of the view that the whole anthill should not be utilized so as to allow termites to rebuild it back as good ways of conservation. Older people felt that the young generation did not understand that their activities were destroying nature with no replacement. It is also interesting to note that the older people can talk about how weather and environment has changed, although not connecting it to some of the activities such as brick moulding. The older people however like everyone else mentioned that the cutting of trees has had a major impact on subsistence farming. The elders have also noticed the disappearance of fruit trees, vegetables, insects and small animals of "their time". This definitely has had an impact on nutrition. It was disappointing to note that Council Officials seemed not to be concerned and worried about the impact of brick moulding with some of them saying it is an old age activity. Local politicians and local government employees do not take issues of the environment as a priority, they seemed oblivious of what was happening around them and not interested in the issues of the ecosystem and the environment. This is unfortunate since these are the cadres who could develop the relevant policies and encourage capacity development of communities on relevant issues around the impact of climate change and environmental degradation.

Poverty plays an important role in the destruction of the environment in many African countries (Macheka et al., 2018). As income generating projects, brick moulding, selling firewood and charcoal is big business where many trees and anthills are destroyed with little chance of recovery. Many indigenous foods such as mushrooms, small animals like rabbits and kudu, termites (Shona: Ishwa), red ants (Shona: majuru) and the white ants (tsambarafuta shona, Zimbabwe), vegetables such as *Brassica carinata* (Shona Zimbabwe: chembere dzagumana) and wild okra or *Corchorus asplenifolius* (Shona Zimbabwe: derere), honey from honey-pot ants (Shona: huchi whe monga), cleome gynandra (Shona: Nyevehe), etc., are also completely destroyed. These foods are easily accessible and available to most members of the communities especially the poor members of communities. In Southern Africa there are mainly three types of malnutrition: under-nutrition which includes stunting, wasting and underweight, overweight including obesity, and micronutrient deficiencies, including deficiencies of Vitamin A, Iron, Zinc and Iodine; entomophagy which is the practice of eating insects as part of human diet has played an important role in the history of human nutrition in Africa, Asia and Latin America (Srivastava et al., 2009).

In most African societies, *Macrotermes bellicosus* stands out as the species used in diets. *M. bellicosus* has a very high content of calcium and iron, whilst

*Pseudacanthotermes militans* (*P. militans*) has highest zinc content (Kinyuri et al., 2013).

Thus, termites eaten by African communities have high levels of micronutrients, proteins and unsaturated fatty acids (oleic and palmitic acids) (Kinyuri et al., 2013). Another important use of insects by humans is medicinal which is called entomotherapy (Costa-Neto, 2015a; Srivastava et al., 2009). In Nigeria, *Macrotermes nigeriensis* is used as a medicine against anaemia (Calvalcanti, 2015).

Furthermore, the disappearance of vegetation cover has an impact on the feeding patterns of domestic animals such as goats, sheep and cattle. These are the very subsistence economies of the poor village communities. Another problem associated with leaving behind open holes/excavations has caused the drowning of small children in these pools of water while trying to learn how to swim. Many small livestock were also drowned either whilst trying to drink water or in other accidents. Snakes which control the mice population which destroy cereals and other foodstuffs are also disappearing. Deforestation plays an important role in the increase of green gases by increasing carbon dioxide content in the atmosphere (reduced photosynthesis).

Destruction of forest resources which include fruit trees such as Marula deprives communities of nutritious foods and commercial activities (Tiritose.com). Tables 2 and 3 show the insects and fruit trees destroyed after destruction of anthills whilst making bricks.

Research in many countries has shown that plums are very nutritious; both plums and prunes are sources of vitamins, minerals and antioxidants (Perex, 2009). Other researches have also shown that sour plum for instance is rich in Vitamin A, very high in antioxidants compared to many fruits, high in potassium, also contains b-carotene iron, and vitamin K (Scrivener.co.zw). One cup of plums gives 87% of body recommendation of Vitamin K, 8% of calcium, 72% of B vitamins and 27% potassium (Calvalcanti, 2015; Scriventer.co.zw).

Masawu (Jujube) was originally an Indian fruit but is now available in Southern Africa: a 100 g of jujube contains 79% calories, 1 g proteins, 20 g carbohydrates, 10 g fibre, 77% of daily value (DV) vitamin C and 5% potassium D (Healthline.com and India Today). Matohwe is rich antibiotics, antifungal, antioxidants, anti-hyperglycemic, and good in absorbing iron (Wikipedia). Matamba (African Monkey Oranges) according to recent research contains the following: Calcium 56, Magnesium 49, Potassium 1370, Sodium 21.7, Iron 0.11, and Zinc 0.22 (Pinterest). Mukwakwa (Black Monkey Orange) is another indigenous fruit eaten in most Southern African countries, its skin contains a high level of Oleic Acid, however, its seeds contain a high level of strychnine which is poisonous (some communities use it to catch fish) (Fruitsinfo.com).

Another common rainy season fruit is muonde (common cluster fig), also very common and eaten in the

**Table 2.** Indigenous edible insects disappearing due to destruction of anthills

Shona name	English name	Nomenclature
Makurwe	Sand Crickets	Gryllidae
Tsambarafuta	Tree ants	Carabera vidua
Ishwa	White flying ants	Macrotermes falciger
Mandere	Christmas beetles	Eulepida masnona/anatine
Majuru	Soldier ants	Macrotermes goliath
Madora	Mopane worms (caterpillars)	Gonimbrasia belina
Mhashu	Locusts	Locusta migratoria
Harugwa	Stink bugs	Haplosterna delagorguei
Chikudyu	Black cricket	Acheta gryllidae
Madumbudya/dandamafuta	Long-horned grasshopper	Ruspolia nitidulus/differens

Source: Scriver.co.zw: Top 8 edible insects in Zimbabwe (Scriver.co.zw)

**Table 3.** Indigenous fruits trees disappearing due to deforestation

Shona name	English name	Nomeclature
Nhengeni	Sour plum	Ximenia Caffra
Nhunguru	Governors plum	Flacourtia Indica
Hacha	Mobola plum	Parinari Curatellifolia
Nyii	Bird plum or African sweets	Berechemia discolor
Tsubvu	Smelly berry	Vitez mombasae
Masawu	Jujube (Indian)	Sishiphus jujube
Matohwe	Snot apple	Gorona tula
Matamba	African monkey oranges	Strychnos spinose
Mukwakwa	Black monkey oranges	Strychnos madagascariensi
Muonde	Common cluster fig	Ficus racemose
Mushuma	Jackal berry	Diospyros mespiliformus
Matufu	False Wild medlar	Vangueria infausta
Mupfura	Marula fruit	Sclerocarya birrea
Tsambatsi/Tsombori	Wild grapes	Vitis Vinifera
Hute	Water berry	Syzygium cordatum
Mazhanje	Wild loquath	Aupaca Kirkina

Source: Tiritose.com: Wild Fruits in Zimbabwe (Tiritose.com).

Southern African region. This plant is not only nutritious but has medicinal qualities 100 g of common cluster fig contains 81.9 g of water, 1.3 g of proteins, 0.6 g of total fat, 0.6 g of ash, 0.21 g of nitrogen (no carbohydrates), 37.77% of vitamin B2, 16.2% of iron, 11.11% of copper, 10.81% of potassium, 8.33% of magnesium, 7.20 calcium and 6.71 phosphorous 15 (Calvalcanti, 2015). Common cluster figs also have medicinal qualities including phytochemicals for the prevention and management of muscular pains, pimples, boils, cuts, haemorrhoids, anti-diabetic, antioxidant, anti-asthmatic, anti-malarial, anti-diarrhea, anti-pyretic and the juice from Muonde is used to treat hiccups (Calvalcanti et al., 2015).

Mupfura (Jackal Berry), contains ascorbic acid, calcium, carbohydrates, water, iron, phosphorous, fibers,

riboflavin, saponins, fat, magnesium, proteins, tannin, niacin and Vitamin B group. Mupfura also has very important medicinal properties: the leaves, the bark and roots contain tannin which is used as a styptic to staunch in bleeding (Healthline, Pinterest.com and Tiritose.com). The roots are also consumed to purge parasites and are thought to be a remedy for leprosy. It is also used in dealing with boils (abscesses), as an analgesic, as treatment of bronchitis and as a local antibiotic.

Whilst poor people suffer more through the negative impacts of climate change, in Africa they also play an important role in causing it albeit on a small scale. Although the old people may not talk confidently about changes in weather and climate variability as compared to "their time", they do not understand the causes thereof.

Not only are there no programs to capacitate them but the literature on climate change and its impact is out of reach of them.

## Conclusion

The negative impacts of climate change have become a global problem and the effects can be observed on the African continent. Communities in Africa are lagging behind other continents in understanding the roles they play in creating some of the causes of climate change. There is, therefore need to capacitate communities, politicians and local authorities on the negative impacts of some of the activities on the ecosystem, biodiversity, environment and health.

Governments should develop behaviour communication strategies on climate change and also adopt some of the approaches suggested by the Intergovernmental Panel on climate change (IPCC) (IPCC Report, 2013). These approaches would include prioritization and adaptation of efforts for local levels in communities where vulnerability is highest, prioritizing the strengthening of existing capacities at the sub-national levels and leveraging the opportunities in disaster prevention and response, to promote effective community-based adaptation and risk reduction (IPCC Report, 2013).

The Government of Zimbabwe and governments in the SADC region should develop climate change strategies that include education, training and public awareness on climate change for a good community response. There is a need for the production of environmental education fact sheets for communities, preferably in the vernacular languages. These should have been disseminated to the villages, schools, churches, etc. Capacity building on climate change and disasters is required at all levels in society and particularly at the village or local levels.

It is clear that the current anthill/mound utilisation by communities is not sustainable. To ensure sustainability utilisation should promote mound restoration by termites, by adopting indigenous methods of utilising only half of the mound and leaving it fallow so as to allow termites to migrate and build back. Unfortunately, the young generation now utilising the mounds does not understand and practice this.

The recommendations may assist countries and communities to respond better to the negative impact of climate change, environmental degradation, changes in the ecosystem and loss of biodiversity.

## RECOMMENDATIONS

(1) Commercial clay bricks should be moulded at designed sites; operators should be given a licence after doing an environmental impact assessment and the site

inspected regularly by environmental authorities. The local authorities and government can give grants to youths to start such programs as income generators.

(2) Apply positive indigenous/traditional approaches like harvesting only half of the anthill and then leaving it for a few years to recover. There is also need for regulation by rural district authorities; it might be necessary to issue licences and do regular inspections of brick moulding sites by environmental officers to ensure open sites are filled and restored. Currently, no one seems perturbed by the rate of destruction, including the killing of termites, clearing of vegetable cover and creation of mosquito breeding ponds which in the long run affects the health of local communities. Indeed, most rural were actually surprised and amazed by my queries and enquiries.

(3) Both rural and commercial brick moulders should be encouraged to use efficient heating kilns. In this way, the carbon footprint of the brick kiln heating can further be reduced by using renewable energy such as natural gas, fast regenerating tree species that are re-grown, sawdust and other timber offcuts from other products. Countries on the African continent should share technology skills on brick production which are environmentally sustainable. Green technology should also be encouraged.

(3) Countries should review their Environmental Management Acts/Legislation to include the issues of brick moulding particularly in the rural areas and put in place prevention and mitigation factors. Veldt fires destroy the environment, life and property; rural councils should have legislation and policies that control this as many are started by farmers and also during brick moulding.

(4) There is need for capacity development of communities in Africa on Climate change; causes and negative impacts. Communities need to know the roles they play both in causation, prevention and control. It might actually be necessary to introduce climate change, disasters and related subjects in school curricula so that people know from an early age in life.

(5) There is also need to review policies on climate change to include some of the issues happening at community levels instead of concentrating on traditional Eurocentric issues. Countries should look at indigenous causes of climate change at all levels, national and sub-national and disseminate the results of this information to all levels as well.

(6) There is need to fight corruption at all levels; most local government authorities, traditional leaders and politicians give a blind eye to communities breaking environmental policies and legislations because they are paid bribes. These same leaders need to be capacitated to understand the impact of their decisions on both environmental impact and negative impacts of climate change.

(7) Governments, non-governmental organization and other stakeholders in the environmental field and ecosystems need to start capacitating communities on

issues on the environment, ecosystems and negative impact of climate change.

8) Communities need to understand that there is need for change of behaviour and practices that are not (environmentally friendly). There is need by all stakeholders to develop behaviour change communication strategies on the environment and impacts of climate change.

(9) There is need for both national and community based non-governmental organizations to assist government in making communities aware of their roles in mitigation of climate change impacts and skills to assist in preserving the environment and ecosystems. There is need for political dialogue between governments and NGOs since there is a lot of mistrust amongst them which hinders progress; unfortunately, except in South Africa, most governments in the SADC region look at NGOs with suspicion and curtail their activities or ban them altogether.

(10) More research works need to be done on issues pertaining to the roles on communities in the degradation of the environment. This should be done in consultation and collaboration with communities so they understand the subject matter better. Literature on climate change should also be produced in the vernacular languages, and not in English, French, Portuguese, etc.

## ABBREVIATIONS

**CBO**, Community Based Organization; **FGD**, Focus Group Discussion; **IPCC**, Intergovernmental Panel on Climate Change; **SADC**, Southern African Development Community; **VSBK**, Vertical Shaft Brick Kiln.

## CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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