Propelling virtuous and breaking vicious cycles:

Responding to health and climate risks for informal residents and workers in two areas of Zimbabwe

Report of evidence from a mixed methods study

Training and Research Support Centre,
Zimbabwe Congress of Trade Unions,
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In the project 'From surviving to thriving: Learning from responses to the health effects of climate change in informal workers and informal settlements of Zimbabwe'

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Executive summary

The project 'From surviving to thriving: Learning from responses to the health effects of climate change in informal workers and informal settlements of Zimbabwe' sought to analyse and better understand the intersection of health risks in selected informal settlements and among informal sector workers in Zimbabwe in order to inform and support dialogue at local and national levels on how to strengthen positive responses, while also addressing risks and harmful responses. The project also aimed to contribute to wider learning on interventions for informal settlements and workers' occupational health, and urban development strategies to mitigate the impacts of climate change. It covered sites in two areas: Harare and Masvingo.

The findings from the separate literature review, survey and focus group discussion (FGD) reports are synthesised in this report. They indicate that significant health and environment challenges in the survey areas revolve around the provision of infrastructure and basic services including primarily: housing; management of water resources and access to safe drinking water; clean, affordable energy supplies; sanitation and hygiene; as well as risks linked to soil and air pollution, vector control, management of chemicals and waste and food safety. These challenges are exacerbated by the negative impacts of climate change, unplanned and rapid urbanisation and uncontrolled rural to urban migration, all of which increase pressure on already overburdened health systems.

Informal workers and residents are affected by and exposed to a plethora of health challenges by virtue of living and working in informal settlements. Climatic factors – heat, drought, storms –- interact with these occupational, shelter-related and social factors to create further stress. Given the multiplicity of challenges faced by these residents and workers, a comprehensive holistic approach is needed to address the issues at policy, operational and local levels. The findings also suggest that enhanced access to services and infrastructure, such as improving access to safe water and affordable clean energy can have multiple impacts on health and environments, improving the ability to respond to climatic changes and creating an array of co-benefits for climate resilience and urban health equity.

Evidence from the literature review suggests that to respond to these concerns, long term plans are needed to address the structural issues of democracy, governance and politics, as well as those of the economy, that stimulate informality. These vital issues are rarely addressed since individuals and policymakers focus on the more visible social services and immediate economic challenges. The importance of collective action, building coalitions and associations that encourage those affected to act in solidarity to confront their challenges is also highlighted.

A number of areas were prioritised, particularly in the FGDs, proposing immediate and longer-term actions to enhance the conditions of informal residents and enable socio-economic contribution in promoting community health and better managing and mitigating climate change-related risks. The following principles to guide current and long-term actions have been raised:

- Ensuring equitable access to health and other social services with measures ensuring access for youth, women, people living with disabilities and other disadvantaged groups.
- Appropriately sequencing actions to prioritise those with wider impact, such as providing affordable renewable energy with its crosscutting impacts on pollution, water supply, street lighting, security and nutrition.
- Taking a collaborative 'whole of society'' approach to maximise synergies across actors.
- Ensuring legal recognition of all residents, so that all, including those in informal settlements benefit from these measures.

Recommendations for supporting positive approaches and addressing harms

Given the broad principles above, the following specific actions are proposed and need to be supported by national and wider sectoral actions including:

a. Revitalising the national economy to provide a sustainable base for job creation, especially for youths, to address financial distortions that cause rising prices and increased cost of living.
b. Ensuring devolution of national resources and conservation choices, such as in land and water that support wellbeing and protect future generations.

c. Improving supply of and access to affordable energy/electricity, given the range of impacts it has on pumping water, nutrition and cooking and increasing security from public lighting. The FGDs raised a need for a more equitable distribution of existing energy supplies and investment in 'quick win' solar solutions such as solar pumps for community boreholes, solar street lighting and support for clean solar and other energy for cooking. The FGDs also raised investment in long-term renewable sources of energy, which currently represents a missed opportunity for local authorities to invest in biogas systems to deal with increased, uncollected waste to provide clean, cheap energy for households as well as reducing the emission of greenhouse gases and air pollution.
d. Investing in infrastructure for improved rainwater harvesting for drinking and irrigation, including application of legal instruments to reduce pollution of water bodies by industry, and improved water treatment plants, as key for population health and to enable adaptations to manage climate change, as well as in infrastructure for transport, communications and energy (as above) and in health and education services and personnel.

On follow-up dialogue, information sharing and interaction on the findings

Key cross-cutting issues are proposed for further discussion and follow-up in various policy platforms, including:

a. Promoting and enhancing **communication, awareness and networking** on the following key issues: registration and formalisation of plastic waste recycling and recyclers (one-stop shop concept), renewable energy solutions and practical measures to harness them, and to avoid mixed messages between local councils and other actors.
b. **Policy enforcement, monitoring and reform** including regular monitoring of air and water quality, introduction of a pollution policy for motor vehicle and sanctions for polluters; regularisation of land tenure for informal settlers; subsidies for renewable energy sources in the face of irregular power supplies; incentivising urban farmers and solid waste pickers and recyclers and regularising their work environments; and use of recycled water (red taps) for irrigation purposes in urban areas.
c. **Governance issues such as improving accountability** on inputs and resources within health and education services and de-politicising service provision. The FGDs also prioritised collaboration of all actors through joint platforms on issues and use of common messaging. Central and local government, through the office of the district administrator, were seen as strategically positioned to enhance co-ordination.

Knowledge gaps and future research areas

Zimbabwe's informal economy sustains a large share of the urban population, and will likely do so in the future. However, informal sector workers need support and capacity-building to enhance their livelihoods and economic role. As the formal sector declines, it is inevitable that Zimbabwe's economic growth must be based in part on the development and growth of the informal economy. There is an opportunity to improve living and working conditions and environments in the sector and to benefit all through interventions such as enhanced access to water, energy and management of public spaces and services. Thus, for future research areas it is suggested to investigate the informal sector's potential to play a role in the following:

- expansion of green technologies, water harvesting, value-add recycling and other interventions that respond to the needs generated by climate change.
- Mechanisms to support urban agriculture and solid waste recycling as these have potential to ensure food security, generate income for low-income urban communities and can contribute to sustainable environments.

Learning on building synergies between climate and health for climate-sensitive and people-centred urban development in the informal sector

There are long-term solutions to some of the challenges facing informal settlements, especially as these relate to investment in smart and clean technologies that enhance health benefits while protecting the environment and mitigating climate change. Investing in clean energy for informal residents and workers could open new opportunities for innovative technology use, enhance living conditions and production and improve communication and marketing, among other benefits. While residents and workers in both sites are eager to pay for energy supplies, their provision requires capital investments that are beyond their means. Policymakers and financial institutions would thus need to develop inclusive financial mechanisms that meet community contexts and needs.

1. Introduction

1.1 The ZIMINFO project in Zimbabwe

The project 'From surviving to thriving: Learning from responses to the health effects of climate change in informal workers and informal settlements of Zimbabwe' sought to analyse and better understand the intersection of climate-related and occupational health risks in selected informal settlements and with selected informal sector workers, to inform and generate dialogue on how to support and strengthen positive responses while addressing risks and harmful responses in both local informal settings and at national level. The project also aimed to contribute to wider learning on climate-sensitive urban development strategies and interventions for informal settlements and the occupational health of informal workers. Sites in two areas, Harare and Masvingo, were covered.

The project was given ethical clearance from the Medical Research Council of Zimbabwe in May 2019, under reference number MRCZ/A/2467. It was implemented by Training and Research Support Centre (TARSC) (www.tarsc.org), in collaboration with the Zimbabwe Congress of Trade Unions (ZCTU) (www.zctu.co.zw) and the Zimbabwe Chamber of Informal Economy Associations (ZCIEA) (www.zciea.org.zw), with financial support from the National Institute for Health Research UK, through the International Institute for Environment and Development (IIED) (www.iied.org). In addition, IIED provided technical support and obtained ethical approval from the University of Warwick (reference BSREC REGO-2019-2340).

1.2 Why did we do this work?

Climate change is an increasingly central issue in all facets of people's lives globally and Zimbabwe is no exception. The United Nations Development Programme (UNDP) identifies climate change as the single greatest threat facing mankind today (UNDP, 2017). Zimbabwe, like other countries in the sub-Saharan region, is susceptible to "changes in temperature and precipitation with extreme events such as droughts, heatwaves, heavy rains accompanied by flash floods, strong winds and hailstorms becoming common" (UNDP, 2017:22).

In fact, the implementation phase of this project coincided with the major disaster of *Cyclone Idai,* which hit the country in March 2019, affecting over 270,000 people. It was accompanied by flooding and landslides and resulted in the deaths of at least 340 people, with many remaining unaccounted for. Heavy damage was inflicted on agricultural land, schools infrastructure, homesteads and public amenities such as roads and bridges. It has been classified as the worst tropical cyclone to hit the Southern Africa Development Community (SADC) region in recent history (Chitongo et al., 2020). Its economic and social impacts were far reaching and continued to be felt in 2020. Thus, the impacts of a changing climate in Zimbabwe (and elsewhere) are no longer theoretical but must be anticipated and planned for in all spheres of life, particularly for the most vulnerable groups and especially those living in informal settlements, who are generally the worst affected (Satterthwaite et al., 2020). Informal urban settlements are generally built on land poorly suited for housing and as they are not recognised by municipal authorities, lack basic services and infrastructure. This results in a vicious cycle where poor urban dwellers lack services because they live in informal settlements, and their areas are often highly stigmatised and increasingly marginalised because they lack both services and political recognition (Misilu, 2010). Urban areas are highly vulnerable to heatwaves, floods and other extreme weather events; climate change is likely to heighten the frequency and intensity of these disasters (Rosenzweig, et al. (ed.) 2018).

The literature documents a number of health and well-being challenges affecting the lives of those living in informal settlements and/or working in the informal sector including: exposure to occupational hazards; high levels of food insecurity and low or erratic incomes; poor housing with low-quality provision and over-crowded spaces; and limited access to healthcare and other services. Households face rising costs, social and income insecurity and may suffer from depression, harmful use of alcohol abuse, crime and social conflict (Fallavier et al., 2005; Misilu, 2010). Climate change is likely to exacerbate poverty and marginalisation, particularly as many informal workers and residents in informal settlements lack the assets and adaptive capacity to respond to climate-related risks (Stein, Moser, 2014). Some informal sector activities also contribute negatively to climate change, including unsafe solid waste disposal

resulting in water and land pollution, backyard incinerators that contribute to air pollution, and use of firewood and other unclean fuels as a household energy source that lead to depletion of vegetation and soil erosion.

For people living in urban areas, the informal sector is an important source of income and a means of survival, yet there is some evidence that the conditions under which people live and work, such as outdoor workers, also make them susceptible to the impacts of climate change (Moda and Minhas 2019). The physical, economic and social conditions that increase this susceptibility require evidence to inform policy and practice in order to address them. Furthermore, the informal economy is highly diverse, with workers facing a wide range of occupational health risks; activities are often segmented based on workers' gender, age and access to capital (among other factors), as well as varying based on local politics and broader economic trends (Lund et al., 2016, Chen et al., 2016).

Zimbabwe's informal sector has evolved over time, driven by factors ranging from racial segregation in the pre-independence period to post-independence economic structural adjustment programmes. At present levels, the informal economy is large and complex accounting for over 60% of GDP post 2010 and 84% of total labour in 2011 (ZIMSTAT, 2012). Machemedze (2018) provides a taxonomy of Zimbabwe's informal sector as (i) semi-regulated small to medium enterprises, (ii) unregulated informal businesses, (iii) illegal activities and (iv) some consultancy services. The informal sector has shown resilience and innovation in a number of areas, including production of small-scale appropriate technologies that improve people's lives by enhancing access to safe water, food, transport and incomes through the application of value addition technologies. In some cases, these innovations use recycled material such as metal or plastic as raw materials, thus reducing the national carbon footprint, though on a small local level. We need to better understand this sector to identify key entry-points to support measures that simultaneously help address the causes of climate change, reduce workers' vulnerability and foster resilience to multiple risks including climate change.

While there is some evidence on the social determinants of health in informal settlements and their interaction with the informal sector, studies are yet to document the relationship between them and the combined occupational, environmental and public health risks and how such informal settlements and economic activities are impacted by climate change. It was to fill this gap that we were motivated to build the evidence on the intersection of health and climate related risks, assets and responses in Zimbabwe's informal economy and settlements. This report outlines the process followed to build this evidence base and the key findings from the study.

1.3 What did we want to find out?

The project sought to specifically answer the following **research questions:**

1. What are the key health determinants and health outcomes for informal workers and those living in informal settlements?
2. What is the interaction between these in relation to public health, occupational and environmental health?
3. How do the current and projected impacts of climate change affect this interaction?
4. What approaches are being used by informal workers to mitigate risks and enhance any benefits?

To this end, we adapted a widely used analytical framework that uses drivers, pressures (major concerns), state (major responses/policies), impact (implications) to analyse the interaction between climate-related and occupational health risks and the patterns, evidence, trends, factors and responses in Zimbabwe's informal workers and settlements. See *Table 1.*

Table 1: Summary of the analytical framework used

Drivers and major concerns	Major concerns faced by informal settlements residents and workers *vis-à-vis* the research questions.
State, trends and major responses	State and trends of climate change in Zimbabwe including their links to health-related areas in informal settlements as well as occupational health, safety, environmental health. Institutional roles, linkages and responsibilities
Implications	Implications of climate change on the various determinants of health in informal settlements and informal workers (includes implications on public health, occupational and environmental health)

1.4 Methods

We employed an explanatory sequential mixed methods study design.
Due to time and budget limitations we used three informal sector activity entry points, namely:

a. Informal sector workers involved in **solid waste collection and recycling** of plastic waste.
b. Informal workers in **urban agriculture and food marketing** in informal settlements by informal sector workers.
c. **Water access and quality** as a major environmental and health issue for both informal residents and workers.

We purposively selected two study sites – Harare and Masvingo –to include an area with a large concentration of people in the informal sector (Harare) and a smaller city with different climatic conditions (Masvingo) but with otherwise similar residential and labour patterns. Both also had ZCTU and ZCIEA structures to support data collection and follow through recommendations and actions from the research. Purposive convenience sampling was used to select two clusters within each site.

1.5 Limitations

We are aware of methodological shortfalls despite comprehensive measures to reduce bias and improve data quality such as piloting and testing of tools, training of enumerators, field support and data integrity checking.

- Due to budgetary and time constraints, only three entry points were used, viz urban agriculture, solid waste collection and recycling and water issues. Thus, we do not seek to generalise issues across all informal sector activities in Zimbabwe.
- We were unable to apply random sampling of informal sector waste pickers in the sites; compiling a register to inform sampling proved impossible due to the high mobility of the groups. Instead, we employed a mixture of cluster and snowball sampling which limited the representativeness of the data as we may have left out specific subgroups within this sector who were not known to those interviewed. Only a limited number of workers were missed, however, and we sought to reduce bias by triangulating with evidence from knowledgeable local informants.
- The interviews and focus group discussions were done in local languages and some technical terms in the tools, despite being translated and piloted, were difficult for some respondents, especially the elderly, to understand. In helping these groups better understand, the enumerators and facilitators may have introduced some bias, such as by giving examples on specific issues. However, we estimate this bias to be minimal.
- In Masvingo, we found that informal economy workers involved in solid waste picking and urban agriculture mostly resided in the formal settlements of Rujeko and Mucheke and a sample of those only from informal settlements was not possible. Also, in Mabvuku-Tafara, informal urban agriculture workers mostly resided in formal parts of the settlements. Thus, we disaggregated our findings by work sector only rather than by sector and residence, as was done in Hopley, Harare.

1.6 Who is the report for?

This report is targeted at a wide audience:

- Informal sector workers and those living in informal settlements: it provides a systematic approach to understanding public, environmental and occupational health issues and how they link with current and projected impacts of climate change and provides them with possible entry points towards strengthening multi-sectoral actions to address the risks they face.
- Community level organisations including residents' associations, trade unions, health and environmental activists: the report provides evidence that can inform and strengthen their advocacy efforts.
- Local and national policy actors including technical and elected officials at local and national levels (local authorities, councillors, government departments, parliamentarians): the report raises options for consideration in developing policy reform in the areas covered.
- Researchers and the academic community: the report provides evidence that adds to the body of knowledge on the intersections of climate change and public, occupational and environmental health in informal sector settings.

2. The growth of informal settlements in Harare and Masvingo

At Independence in 1980, Zimbabwe's new government removed restrictions on migration and free movement of people within the country that had been imposed on the black majority by the colonial government; black people were not allowed to settle in or even pass through certain areas in the cities. Racial segregation ended at independence and the country saw a rapid increase in rural to urban migration. According to ZIMSTAT, in 1980, the urban population was only 22.4% of the national total (7.6 million) but by 1992, had risen to 31% of the 10.4 million citizens and to 34% of 11.6 million citizens by 2002 (ZIMSTAT, 2012). The most recent population census in 2012, showed over 39% of the country's 13 million people to be living in urban areas (TARSC, ZCTU, ZCIEA, 2020a).

Urban population increase is a common characteristic of most low- and middle-income countries where people move from rural to urban areas in search of better livelihoods and living conditions (Tibaijuka, 2005). Rapid urbanisation can result in overcrowding and may be linked to challenges in accessing adequate housing, water, sanitation and energy.

According to the UN, this is due to two inter-related circumstances: "First, many migrants to the city operate in the informal economy. Second, most local authorities depend ... on central government transfers which rarely increase in proportion to demographic growth, thus contributing to declining municipal revenues and expenditures in per capita terms. This ... translates into a serious erosion of local government capacity in terms of planning, environmental management and the provision of basic services" (Tibaijuka, 2005: 22).

In Zimbabwe, this has been witnessed in the major cities of Harare, Bulawayo, Mutare and Gweru, all of which attained population growth rates of over 5% per annum throughout the 1980s (ZIMSTAT, 2012) overstretching the capacities of central and local government to provide housing, infrastructure development and other basic services for the urban majority, particularly the poor. As a result, informal settlement dwellers are exposed to living conditions that pose threats to their health and well-being.

Zimbabwe's adoption of the IMF and World Bank's Structural Adjustment Programme (SAP) in the mid-1990s aggravated the situation further, resulting in massive retrenchment of skilled and unskilled labour and civil servants, the closure of many manufacturing industries, generalised price increases and deterioration of social services. These unintended consequences were further exacerbated by the deregulation and liberalisation of the economy and led to the structural decline of the formal economy and the proliferation of the informal economy, particularly in and around urban centres such as Harare and Masvingo. The combination of these circumstances creates high poverty levels that impact most on the marginalised, particularly women and youth.

2.1 Economic Collapse

The SAP programmes and economic governance problems led to rapid decline in the Zimbabwe economy, leading to a prolonged period of unique hyperinflation that ended only when the country adopted a multi-currency system in 2009 and dropped the Zimbabwe dollar. Even after hyperinflation was contained, the African Economic Outlook report for 2017 noted that Zimbabwe's formal economy continued to contract due to company closures and "increased informality with the share of informal employment to total employment rising from 84 percent in 2011 to 94 percent in 2014 (IMF, 2017). The Zimbabwe Government reported that in 2014 of the 1.5 million paid employees, 1.4 million (93%) were in informal employment, with around 13.7% of all employed persons (859,060 persons) employed in the informal sector, 52.5% of whom were women. It further noted that some 85.9% of these were unskilled, with 54.4% being women (GOZ, 2016).

Economic decline left thousands of workers eking out a living by engaging in urban agriculture, waste picking and recycling, vending, trading in clothes and other commodities, and provision of various other services, all contributing to the exponential growth of both the informal economy and informal settlements.

Although many livelihoods remain precarious, the informal economy has nonetheless sustained livelihoods and kept the wheels of the economy turning through entrepreneurship, creativity, innovation and product development and it presents a complicated but positive social organisational fabric where 'apprenticeship' and knowledge transfer are shared.

2.2 Climate change and informal settlements

Climate change is one of the greatest threats to the whole of humanity. The World Health Organisation (WHO) observes that climate change threatens the factors of good health such as clean air, safe drinking water, nutritious food supply and safe shelter – with the potential to undermine the progress made in global health. The literature review observed that climate change is predicted to have a wide range of impacts on human health including increased morbidity and mortality due to extreme temperatures and extreme weather events.

Further health impacts include rising levels of malnutrition, water-, food-, and vector-borne diseases (UNDP 2018b; Barata et al., 2018), whose impact will likely disproportionately affect marginalised residents, including those living in informal settlements. There is a need to plan for this by establishing socio-economic activities with reduced impact on climate change (i.e. a green economy), while adopting mechanisms to promote climate resilience among workers and communities.

Climate change is already affecting low-income urban communities in relation to:

- **Water and sanitation:** Safe drinking water and adequate sanitation are essential elements in determining the quality of living standards; they reduce morbidity from diseases such as diarrhoea, dysentery, cholera, typhoid and schistosomiasis (Bartram and Cairncross, 2010; Wold et al., 2018; Muller, 2007), which can be induced or aggravated by climate-related shocks and stresses such as floods and droughts. Exposure to improperly managed solid waste increases risks of infection and is aggravated by changes in rainfall or temperature due to climate change (Lamond et al., 2012).
- **Destruction of infrastructure and settlements:** Heavy rains and flash floods result in damage to infrastructure even in formal settlements, but in informal settlements any infrastructure that exists is already highly compromised. Such settlements are often built on wetlands, floodplains and other hazardous sites with no paved roads or drainage, aggravating the effects of flooding; houses are often overcrowded and temporary, built of poor-quality materials such as plastic sheets, tin and wood and therefore more vulnerable to climate shocks. In addition, construction on wetlands has other negative environmental effects impacting on water availability, increasing pollution and flood risk.
- **Increased frequency of vector-borne diseases:** Changes in temperature and precipitation, combined with limited or no sewerage provision, increase the frequency of vector-borne diseases including malaria, dengue and yellow fever and water-borne diseases such as diarrhoea and typhoid fever (Barata et al., 2018). Given their already inadequate access to water, sanitation and hygiene (WASH) and elevated levels of vector-borne diseases, informal settlement residents and workers are at greater risk.
- **Increased incidence of wild fires:** Rising temperatures also increase the risk of fire outbreaks, while smoke from wildfires and from solid waste, "contains particulate matter, carbon monoxide, nitrogen oxides, and various volatile organic compounds and can reduce air quality significantly, both locally and in areas downwind of fires. Smoke exposure increases respiratory and cardiovascular diseases and the need for medication for asthma, bronchitis, chest pain, chronic obstructive pulmonary disease, respiratory infections, and lung illnesses, according to UNDP, (2018b). Fire outbreaks are more likely in informal settlements due to the building and cooking materials used and to the fact that houses tend to be built very close together (Pharoah, 2012).

Despite these hazards, informal settlements receive less attention from local authorities in terms of provision of social and economic infrastructure and enforcement of construction regulations and are also subject to the activities of 'land barons' who sell unsuitable land to unsuspecting low income residents. All these factors impact on the health of the environment and of those living in informal urban communities and will be further heightened by climate change, which is the focus of this report.

3. Research findings: Factors affecting the health of informal workers and residents

As noted in the introduction, workers and residents in informal settlements face a plethora of issues that affect their health on a day-to-day basis. The literature review, survey results and focus group discussions establish that they lack access to clean, safe water and to adequate sanitation facilities. Where some semblance of facilities exists, drainage systems are often blocked due to lack of maintenance and no one, including the responsible authorities, takes responsibility for them; the areas experience frequent waterlogging during the rainy season increasing the risk of water- and vector-borne disease such as typhoid and cholera. Because of their informal status, there is no provision for rubbish collection by the local authorities, which encourages burning of rubbish and/or increasing the rat and pest populations by dumping. In synthesising the findings from the different stages of the research, separately reported, it was observed that informal settlements and workers lack access to adequate social services and infrastructure with grave impacts on their health and well-being.

This section summarises the factors affecting the health of informal workers and residents especially as they relate to the following:

i) access to safe drinking water
ii) access to basic sanitation services
iii) access to energy for cooking and lighting
iv) housing, and
v) infrastructure and services.

3.1 Living conditions

Our findings indicate that, as noted in the literature, health and environment challenges within informal settlement areas revolve around the absence of basic social services including housing and health services, roads infrastructure, safe drinking water, sanitation and hygiene; management of water resources, soil and air pollution; vector control; management of chemicals and waste and food safety among others (TARSC, ZCTU, ZCIEA ,2020a) and will be intensified by climate change, unplanned urbanisation, uncontrolled rapid population growth and urban migration, all of which increase pressure on already overburdened health systems (WHO Afro, 2014).

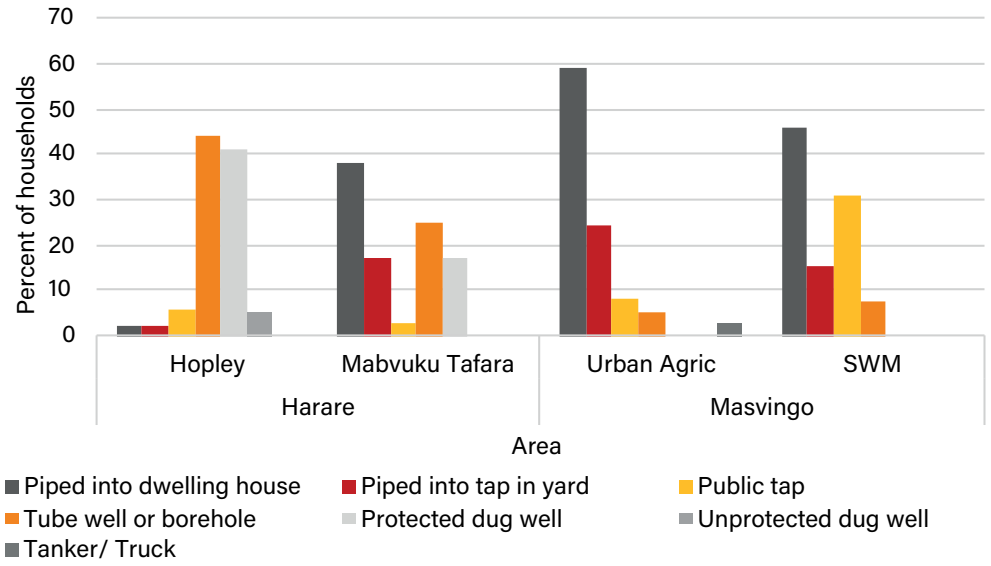
Below, we summarise the key issues affecting the living conditions of residents and workers in informal settlements and informal workers living in formal settlements.

Source of drinking water

The Zimbabwe Demographic Health Survey (ZDHS, 2015) defines improved sources of water as "piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, and rainwater" (ZIMSTAT, ICF international, 2016). The survey established that while the majority of households and workers in both Harare and Masvingo have access to improved water sources they struggle with low-quality and intermittent provision (TARSC, ZCTU, ZCIEA, 2020a). Some respondents reported piped water to be of poor quality with old infrastructure and leaks resulting in water contamination, while many boreholes and wells were observed to be within 2–5 metres of sewage systems, including pit latrines and septic tanks.

Figure 1 overleaf shows the respondents' sources of drinking water as percentages (both for households and workers in Harare and Masvingo). Residents and workers in Harare's formal settlements of Mabvuku-Tafara as well as in Masvingo (Mucheke and Rujeko) have piped water infrastructure in their homes, while informal workers live mostly in backyard dwellings with access to piped water (when available). In contrast, residents and workers in Hopley informal settlement (Harare) primarily access water from boreholes and protected dug wells, while some of those interviewed use unprotected dug wells (TARSC, ZCTU, ZCIEA, 2020a). Given the irregularity of piped supplies and the quality of water when it is available, the picture given by *Figure 1* does not translate to actual access to safe water.

Figure 1. Source of drinking water



Source: TARSC, ZCTU, ZCIEA,2020a

The FGDs confirmed that safe water supplies are extremely unreliable, with low and erratic functioning. In Mabvuku-Tafara, water was reported to be available only once in three to four months; water quality, is affected by rust in pipes, while vandalism and theft have further undermined infrastructure (TARSC, ZCTU, ZCIEA, 2020b). In Hopley, wells and boreholes usually fail in the dry months, when water tables fall, while in Masvingo, water availability was reported to differ by area but typically ranges from once a week to once a month. Urban agriculture workers bring water from their homes for drinking and use whilst working in their fields but sometimes carry inadequate quantities for their daily needs as they travel long distances to their fields. The quote from one participant is adjacent.

> Water is life. The government (central) should come in and help the councils so that they are able to provide water to everyone in the city. We have spent almost 20 years here without a reliable source of water. We cannot put our faith entirely on donors, the council should play its part now'.
>
> Urban farmer, Mabvuku Tafara

It might be expected that living in a larger, wealthier city such as Harare would enable better living conditions. However this was not always the case. For informal workers, the FGDs showed, for example, that safe water supplies in Harare are erratic and with low levels of availability, and were more reliable and of better quality in Masvingo, the smaller city (TARSC, ZCTU, ZCIEA, 2020b).

Box 1: Sex for water in Mabvuku-Tafara

The continued shortage of water in Harare has led to desperate women and girls being preyed upon for sex by some suppliers of water using bowsers as revealed by participants at a Water Dialogue Forum held in Mabvuku Monday. ... Women who attended the forum complained about unfair distribution of water by mobile water bowsers in Mabvuku due to favouritism mostly driven by sextortion. "The drivers and volunteers of water bowsers are openly asking for sex in order to supply us with water, we refused and are no longer supplying our section with water," said an angry woman. "The water situation has not spared even the young women who are giving in to the demands of the volunteer workers distributing water. The water distribution has increased vulnerabilities among women as they come as late as 7pm distributing water"

Source: Tapfumaneyi, 27 October 2020

While bulk water is supplied in urban areas, in areas of water stress this brings additional challenges as water is supplied late in the evening (around 7pm) forcing women and girls to queue for hours in areas where electricity and street lighting are limited, exposing them to attacks from robbers, rapists and murderers. Communities also fall prey to those with power and influence in supplying this precious commodity and recent newspaper reports indicate that women have been subjected to sexual violence by water bowser controllers, exposing them to sexually transmitted infections and unwanted pregnancies. *Box 1* on page 12 summarises some of the ills recently reported in Mabvuku-Tafara regarding access to water. Women are forced to walk long distances to access water, often at night, increasing risk and making life very hard for the elderly and the disabled.

> ‘The queues at the boreholes are also not orderly, the disabled find it hard to go there’.
>
> Plastic waste picker, Masvingo

Sanitation and solid waste management

In informal and formal settlements in both Harare and Masvingo most residents use flush toilets connected to a piped sewer system or septic tank, or ventilated improved pit latrines (Blair toilets) and pit latrines. In Hopley informal settlement, 30% of respondents interviewed use a pit latrine with a slab. Here and in Mucheke and Rujeko, a small number use open pits. Each of these sanitation facilities is impacted differently by climate factors such as rain, temperature and air pollution (TARSC, ZCTU, ZCIEA, 2020a).

For workers and residents of informal settlements, the FGD findings on waste collection and management also suggest better conditions in Masvingo than in the capital, Harare. In theory, most residents in Mabvuku-Tafara and Masvingo receive waste disposal services from the local authority but this was erratic, with Mabvuku-Tafara reporting the last municipal refuse collection as being three months prior to the survey, while Hopley has almost no local authority waste collection. As a result, many residents dispose of their waste by throwing it outside the yard or in open spaces or resorting to burning. Some illegal dump sites were later cleared and used for farming within the residential areas. In Masvingo, weekly municipal refuse collection was reported, although with uncertain collection days (TARSC, ZCTU, ZCIEA, 2020b).

Energy for lighting and cooking

With reduced electricity generation throughout the country due to low water levels in Kariba dam, which generates 80% of the country’s electricity, as well as elderly infrastructure in electricity generation plants in Hwange, load shedding had become the norm in urban areas, while the cost of electricity is rapidly exceeding people’s ability to pay. The survey found that while some residents in Masvingo and Mabvuku-Tafara depend on the national electricity supplier (Zimbabwe Electricity Supply Authority), in Hopley, in contrast, only 1% of respondents use electricity for lighting with the majority relying on solar energy or candles (TARSC, ZCTU, ZCIEA, 2020a). However, many residents of Mabvuku-Tafara and Masvingo also use candles as an alternative source for lighting due to long periods of load shedding. An even higher proportion use firewood for cooking, which is also the main cooking fuel in Hopley. While residents of Mabvuku-Tafara and Hopley also use charcoal and liquefied petroleum gas for cooking, this is not the case in Masvingo.

As the FGDs confirmed, all areas with electricity (Mabvuku-Tafara and Masvingo) reported daily load shedding with only an average of five hours supply, from 11pm to 4am. Households in Mabvuku-Tafara reported using alternative cooking fuels that affect their respiratory health and generate air pollution such as old shoes, plastic bottles, clothes and tyres (TARSC, ZCTU, ZCIEA, 2020b).

> ‘The issue of electricity is about civilisation; we have children who have not seen a television in this area. These children are lagging behind - they have not seen or used a computer. Technology is the driver of the future’.
>
> Plastic waste picker, Hopley

It was also noted that erratic electricity supply affected nutrition as households reduced consumption of foods requiring refrigeration or longer cooking times, such as beans. In Masvingo, people reported using firewood, which results in deforestation. Street lighting was also reported to have been vandalised. The lack of electricity also affects public lighting, making areas less safe as they seek to access water especially for women and those with disabilities.

> 'Women are not safe. They wake up when it is still dark to go and look for water and we have no public streetlights. We have had three cases of women who were sexually abused.'
>
> Plastic waste picker, Masvingo

Housing/shelter

The majority of housing structures in informal settlements are wooden cabins and shacks made of plastic and grass. Reports of fire outbreaks are numerous, destroying residents' property and deepening their poverty (Pharaoh, 2009). Because of the flammable building materials and overcrowding the fires spread rapidly, destroying many properties. These fires also impact on the environment as the burning plastic releases polluting gases and greenhouse gas emissions, contributing to climate change.

In Hopley, most houses are built with poor quality farm bricks, a cheap mixture of clay and water, moulded and hardened through baking, mostly fuelled by firewood. In formal settlements, the bricks used are industrially produced and meet the quality standards defined in municipal by-laws.

Figure 2: Housing in Hopley informal settlement, Harare. Sokwanele, 2007, under CC

Figure 2 shows a house in Hopley, typical of informal shacks and vulnerable to destruction by heavy rains, strong winds and flash floods. The roof of metal sheets sags in the middle, suggesting inadequate support trusses and posing the danger of potential collapse.

3.2. Working conditions

Informal workers in solid waste management and urban agriculture are also affected by the living conditions discussed above but, in addition, they have difficulty accessing affordable, quality health care and services. They are negatively impacted by their social and legal status, which makes them susceptible to poor health, injury and illness; this is further aggravated by their unsafe and unhealthy working conditions where poor sanitation and waste disposal, energy and access to safe and clean water pose major threats to their health and well-being. For those involved in solid waste management, the following factors have diverse negative effects on their health.

The survey established that 46% of solid waste pickers and recyclers in Hopley spend more than 22 days a month picking, transporting, sorting and cleaning waste for various recyclers, while in Masvingo, the percentage is even higher, at 61% (TARSC, ZCTU, ZCIEA ,2020a). More workers in Hopley than in Masvingo spend between 1–5 hours a day at work, in part because some Hopley informal workers have to travel over 15km a day to pick waste; the business is now oversubscribed so workers must travel further to find adequate waste and carry it on foot to the cleaning sites. They are subjected to harsh weather conditions as they walk in the sun, sometimes in the rain and along major roads and highways, exposing them to road accidents.

For workers involved in urban agriculture, almost two thirds (63%) of those interviewed in Mabvuku-Tafara spent 13 days or more in the fields each month, compared to 59% of those in Masvingo. Nearly all respondents spent on average between one and eight hours a day on their fields, with some in both sites travelling 1km–5km to get to their fields, mostly on foot (TARSC, ZCTU, ZCIEA, 2020a).

3.3. Sources of waste

Table 2 shows where the majority of pickers spend their time. There are large differences between Masvingo and Hopley as to where they get their waste. In Hopley, most depend on household waste, whereas in Masvingo, the majority spend their time in local illegal dumpsites and industrial areas.

Table 2: Sources of waste for informal workers

	Percentage	
	Hopley	Masvingo
Households	86	31
Local illegal dump sites	71	43
Municipal dump sites	37	26
Industrial areas	72	43
Others*	11	23
*Includes city centre and areas where functions are held		

Source: TARSC, ZCTU, ZCIEA, 2020a

Landfills in the form of municipal or local illegal dumpsites pose various hazards to the health of pickers and to the environment. Such hazards include: contamination of surface, ground water and soil; potentially poisonous gases (including greenhouse gases) and bad odours; fire and explosions due to fires; slope instability due to loss of vegetation; and injuries due to glass and metal cuts.

Waste Sorting

This involves separating glass, various types of plastic and bio-degradable materials. In Harare and Masvingo, most sorting takes place outdoors and involves separating plastics from other waste. *Box 2* reports the experience of workers sorting and cleaning waste at a dam site in the informal settlement. Women cleaning and drying plastic waste have no shelter, exposing them to both sun and rain. If they need to rest, they must improvise shelter using the available materials. As there are no facilities or sanitation services, workers relieve themselves in the nearby bush. Some workers carried water from home for rehydration, but the majority reported waiting to go home in the evenings to drink water, or asking for it from nearby homes (TARSC, ZCTU, ZCIEA, 2020b).

Box 2: The tale of waste pickers in Hopley

According to two women waste pickers in Hopley informal settlement, on picking days, they leave their bales of plastic at designated areas in the dumpsite. When these are full, they collectively hire a lorry to deliver them either to their homes or straight to the dam for sorting, tearing and washing.

The women said their business was "doing well", although they worked without any protective equipment (gloves, masks, googles, safety shoes etc). They explained that they bribe council workers by paying USD1 to pick what they want at Chitungwiza dumpsite, noting that this might rise to USD2 because so many people were now involved in the trade. They are aware that these payments are illegal, as is the picking itself, but they have no choice as this is their livelihood. They revealed that they paid $2 for a bale of plastic of similar colours and $1.50 for a bale of mixed colours. Washing is done at the dam where the water itself is dirty as it is continually reused. Firstly, the plastics are opened to allow them to dry faster, then they are washed and left to dry at the dam. This takes between 1 and 2 days and on the third day, they load them into sacks and hire a pushcart to carry them.

Source: TARSC, ZCTU, ZCIEA, 2020a

3.4. Sources of water for urban agriculture

Most of those interviewed in Mabvuku-Tafara (91%) and 85% of those in Masvingo, rely on rainwater for their farming activities (TARSC, ZCTU, ZCIEA, 2020a). However, in recent years, there have been major droughts challenging crop production and impacting on their food and nutritional requirements. The research found that urban agricultural workers were hugely affected by the drying up of wells, water shortages and siltation of water sources like dams and rivers. In Masvingo, soil erosion was reported to be high due to farming along stream banks and in wetlands. With the impact of climate change, Zimbabwe's dependence on rainfed agriculture and on maize calls for urgent emphasis on climate-smart agriculture practices (see *Box 3*).

3.5. Land ownership for urban agriculture

Urban farmers primarily utilise open spaces earmarked for other developmental projects within their areas such as recreation, schools, churches, among others. Since the land may be reclaimed by the owner at any time, they are constrained from developing the lands. The survey established that urban farmers mainly grow vegetables in their backyards, while those who travel to council land and wetlands grow maize, sweet potatoes and legumes (ground nuts and round nuts). Growing maize, Zimbabwe's staple food, has helped cushion families from mealie meal shortages that have affected the country from time to time.

Very few respondents (2%) in Masvingo reported owning the land they farm, while a larger number (18% and 25% in Mabvuku-Tafara and Masvingo, respectively) farmed on a small scale in their backyard gardens. A considerable number of urban farmers, particularly in Harare, utilise wetlands and swamps for cultivation. Our research established that 36% of Mabvuku-Tafara respondents and 25% in Masvingo farm in the wetlands and swamps in their neighbourhood (TARSC, ZCTU, ZCIEA, 2020a). This was confirmed by our literature review, which found large scale take-over of Harare wetlands for construction, farming and various businesses (TARSC, ZCTU, ZCIEA, 2019). Urban farming on wetlands is discouraged because of its impact on water supplies, but there is inconsistent application of by-laws by local authorities.

3.6. Pollution of soil and water

Water and soil pollution due to use of fertilisers and pesticides in urban farming were identified as issues affecting water quality in both Harare and Masvingo.

The main water sources used for farming in Mabvuku were wells, while in Masvingo, the key source was the Mucheke River, which runs through the city's suburbs. People practice illegal streambank cultivation, which FGD respondents noted has led to soil erosion and pollution of the river (TARSC, ZCTU, ZCIEA, 2020b).

The FGDs established that waste pickers were exposed to chemicals from plastic containers and other discarded hazardous substances such as electronic waste and cell phone batteries in dumpsites. Use of protective clothing was rare. Workers, especially those involved in plastic waste picking, had inadequate information on the danger chemicals pose to health or of the symptoms of poisoning, which were obtained through both formal and informal channels, such as from radio programmes, formal and informal chemical suppliers, chemical labels and through workmates and other social networks (TARSC, ZCTU, ZCIEA, 2020a).

3.7. Markets for produce

While the majority of residents in formal and informal settlements produce crops, vegetables and other products for personal consumption, a number also produce for sale in well-established street markets. In Masvingo, most urban farmers reported selling their produce, whilst in Mabvuku-Tafara, produce was primarily for family consumption.

At market stalls, which are generally on the streets, fresh produce is often exposed to contamination and due to water shortages, the produce is not washed before being sold or eaten; poor storage can also permit bacteria growth. As was noted earlier, many urban farmers travel 1–5km to their fields on foot and most carry their produce in sacks. Those urban farmers and solid plastic waste pickers who can afford to, hire vehicles or lorries to carry their produce and materials, while some rely on wheelbarrows or pushcarts.

4. Health and wellbeing outcomes

Informal workers and residents are exposed to and affected by a plethora of health and wellbeing challenges as a result of living and working in informal settlements. The survey and FGD findings indicate exposure to air pollution from multiple causes, including: use of unclean cooking fuels; fumes from unroadworthy vehicles and trucks used in sand extraction; home industries and repair of generators; and dust from the local cement manufacturer in Mabvuku-Tafara. This increases respiratory and cardiovascular diseases and the need for medications for asthma, bronchitis, chest pain, chronic obstructive pulmonary disease, respiratory infections and other lung illnesses (UNDP 2018b). Air pollution means that people living in these areas will be disproportionately affected by related climate change impacts due to their living and working conditions.

4.1. Common factors for health and climate change

Extremes of heat

Survey respondents, particularly those in urban agriculture in both Harare and Masvingo, reported experiencing occasional to very frequent **extremes of heat** over the past five years. Heatwaves impact on the health of workers and residents as well as on the environment.

The extremes of heat, and associated drought, impact residents and workers in different ways. For those involved in solid waste management, the impacts of extremes of heat are shown in *Table 3*.

Table 3: Impacts and responses to heat extremes

Responses on extremes of heat	Percent raising the theme	
	Harare - Hopley Solid Waste Management	Masvingo Solid Waste Management
Reduced work time and negative effect on incomes: Can't work, shorter working hours/cannot work for long	57	56
Lower working efficiency due to effects of heat on health: can't walk for too long, tiredness, makes me weak, frequent headaches; vectors will be many, hard to work, Work in high temperatures unpleasant, People collapse due to dehydration, affects eyesight	63	51
Risk recognised but options to take corrective measures ignored/ limited: We continue to work –if we don't work we suffer	14	7
Others including involuntary resting	0	5

Source: TARSC, ZCTU, ZCIEA, 2020a

Those engaged in urban agriculture reported extremes of heat as a major factor affecting their work and living conditions as it reduces water available for irrigating crops and domestic use. Drying up of wells and boreholes in the summer season puts more pressure and stress on residents and workers as they have to fetch water from other sources.

Health impacts from dehydration, such as headaches and heat exhaustion, as well as impacts on domesticated animals such as chickens and increased pests such as mosquitoes were also reported, with significant impact on sanitation facilities including bad odours from toilets and poor hygiene practices due to limited water. Lack of municipal refuse collection in extremes of heat also increases vector reproduction in dumpsites, exacerbating disease outbreaks such as cholera and typhoid.

Flooding

In the past three decades, Zimbabwe has had a history of severe floods driven by cyclones, sometimes with devastating effects. Exposure to improperly managed solid waste increases infection risk, aggravated by rainfall and temperature changes due to climate change (Lamond et al., 2012). While the survey established limited flood impact in Harare, respondents in Masvingo reported occasional flooding, while 27% of those working in urban agriculture and 41% of those working with solid waste management raised it (TARSC, ZCTU, ZCIEA, 2020a).

Air and water pollution

In both sites, respondents identified smoke and fumes (from burning tyres, veld fires, rubbish pits and dumpsites, unclean cooking and fossil fuels, vehicle exhausts and electricity generators); dust (from roads and construction sites, cement factories and steel makers) as major sources of pollution. They also reported bad smells from toilets, burst sewerage and water pipes, dump sites and burning of cadavers from hospitals (TARSC, ZCTU, ZCIEA, 2020a). Respondents also noted worsening pollution of water sources including from open sewers, sewage seepage into water sources, industrial effluent discharged into streams and waste from dumping sites and local abattoirs, which pollute both ground and surface water. Urban agriculturalists reported pollution of water sources by chemicals and fertilisers and increased siltation due to streambank cultivation, eutrophication of reservoirs and other water bodies.

Blocked drains from solid waste Mbare, Harare.
P Feiereisen, 2011 under CC

4.2. Health challenges

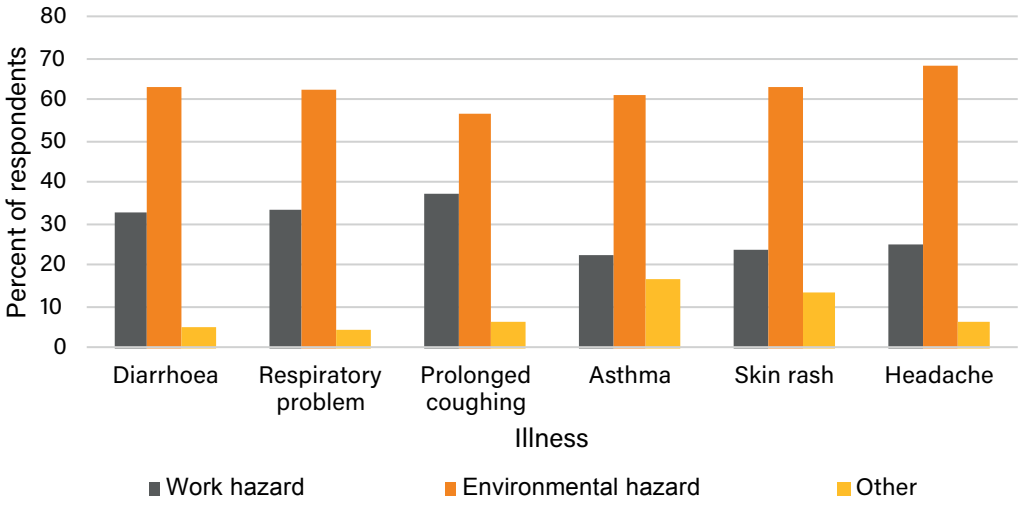
The FGDs corroborate many of the health and environmental challenges documented in the literature review and the survey. For those who reported work-related illnesses in the prior twelve months, the majority reported bouts of diarrhoea, prolonged coughing, skin rashes, headaches and other respiratory problems, including asthma (TARSC, ZCTU, ZCIEA, 2020a; TARSC, ZCTU, ZCIEA, 2020b). For those involved in solid waste management, the high burdens of disease reported suggest prolonged exposure to fumes and chemicals in dumpsites and from working with waste materials. As noted earlier, headaches may also be due to dehydration from walking long distances with insufficient water. Dust from gravel roads in the settlements also contributes to respiratory problems. The FGDs confirmed that most people working in waste management reported high levels of respiratory problems due to poor air quality. For those involved in urban agriculture, headaches and prolonged coughing may be associated with persistent exposure to direct sunlight and soil dust from working in the fields.

As one urban farmer noted:

> ‘Our air is not clean. It has a lot of dust from roads, from the nearby cement factory and smoke from use of firewood, tyres and shoes for cooking. We have informal generator repair shops in residential areas, and the smoke from them is causing the air to be dirty. We used to have open spaces long ago to clean the air, but these spaces are no longer there.’
>
> Urban farmer –Mabvuku-Tafara

Figure 3 shows the causes of illnesses as reported by respondents, commonly due to environmental hazards like air, water and soil pollution, and work hazards related to exposure to heat and sunlight, dust and allergic skin reactions from plant leaves like maize. 'Other' causes includes hazards from using chemical pesticides, herbicides and fertilisers without protective clothing.

Figure 3: Causes of illness in Harare and Masvingo (for solid waste pickers and urban farmers)



Source: TARSC, ZCTU, ZCIEA, 2020a

In discussing illness, the FGDs raised issues of air pollution and hazardous materials. While water quality was tested by health authorities, albeit infrequently, there was no provision for testing air quality. With extremes of heat, the FGDs highlighted the need for adequate hydration and the constraints faced by workers in accessing safe water; they travel long distances and are unable to carry sufficient water for their daily needs (TARSC, ZCTU, ZCIEA, 2020b).

Other wellbeing issues

Urban farmers reported exposure to chemicals such as pesticides and fertilisers, whose hazards were aggravated by poor storage, handling and use. Chemicals purchased from unregulated, informal markets were often poorly labelled or not labelled at all. In Masvingo, chemicals used to preserve harvested maize were reported to have led to people becoming ill (TARSC, ZCTU, ZCIEA, 2020a).

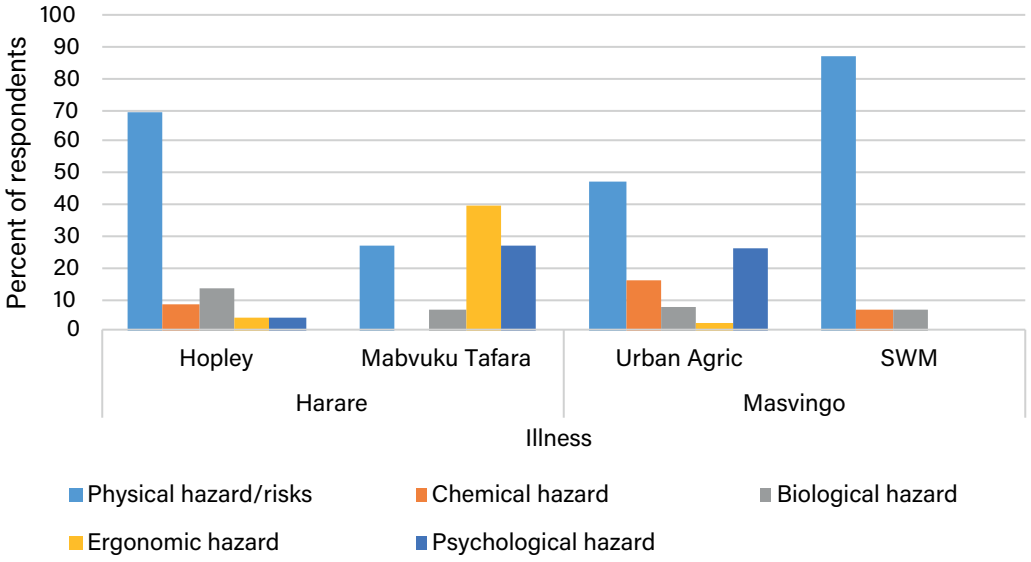
Climatic factors – including heat, drought and storms – interact with these socially generated conditions to raise further stress, such as the reported difficulty in remaining hydrated. Clearly, common measures - such as improving access to safe water and clean energy – can have multiple benefits for health and improve working environments and the ability to withstand climatic changes.

Occupational injuries

The FGDs suggested that while informal workers in solid waste picking and recycling experienced more frequent occupational injuries there were more fatal accidents in urban agriculture, caused for instance, by stray wild animals (as reported in Masvingo).Survey respondents across the study sites reported work-related injuries in the last 12 months from varied causes (*Figure 4*).

Those involved in solid waste management suffered more injuries than those involved in urban agriculture, while some respondents across all areas reported injuries to their legs, knees, ankles and heels (TARSC, ZCTU, ZCIEA, 2020a). Other common injuries reported by waste pickers in Tafara-Mabvuku were to the back, spinal cord and pelvis, although no one in Masvingo reported such injuries. Head and face injuries were also reported. As shown in *Figure 4* on the next page, physical factors are the greatest cause of injuries.

Figure 4: Causes of occupational injuries, Harare and Masvingo solid waste pickers and urban farmers



Source: TARSC, ZCTU, ZCIEA, 2020a

For those involved in solid waste management, the major physical hazards/risks reported included cuts from sharp objects (dumpsites), vehicle accidents, (as they walk long distances along roads), injuries in fights with competitors and burns from burning material in dumpsites.

For those in urban agriculture, injuries are mostly caused by snake bites and ergonomic factors due to prolonged work in the fields (posture), lifting heavy loads and standing for too long (TARSC, ZCTU, ZCIEA, 2020a). The survey also noted that as waste picking becomes more competitive, some have claimed 'ownership' of certain dumpsites/areas, preventing others from picking waste there for fear of physical violence.

Chemical risks from containers picked by plastic waste pickers were also an issue as these were not always recognisable; pickers reported realising risks only after experiencing rashes and skin burns, while chronic problems go undetected. Working when there were fires in dump sites exposed them to air pollution and other hazards. While avoiding work at such times reduced exposure, it also resulted in lost income.

From the FGDs, people are aware of the risks they face but their informality appears to prevent them accessing information about them and how to address them. As some participants in the FGDs noted:

> 'We have little knowledge on the chemical risks we face. We just read the labels on the containers we pick. Sometimes the labels will be defaced or we just ignore reading the labels as we will be in a hurry.'
>
> Plastic waste collector, Hopley

> 'We use no protective clothing to protect ourselves from the chemicals, so we breathe them in and they get in contact with our skin. We spray for aphids and other pests in our crops. We have no prior knowledge of the effects of these chemicals on our health.'
>
> Urban farmer, Masvingo

Impact of injuries: The majority of the workers reported missing work due to injuries. In Hopley, 70% of respondents reported missing an average of 5 days consecutively, while in Masvingo (solid waste workers) 60% reported missing ten days. Urban agriculture workers In Mabvuku-Tafara (40%) and Masvingo (50%) reported staying at home for nine and thirteen days respectively (TARSC, ZCTU, ZCIEA, 2020a).

There were no major variances between residents and workers involved in solid waste management and urban agriculture, though those involved in solid waste management seem to be at greater risk of injuries due to physical and ergonomic factors compared urban farmers, who were mostly affected by environmental hazards (heat and cold) and prolonged periods standing or bending and lifting heavy loads. *Table 4* shows expenses incurred for injuries needing medical attention.

Table 4: Impact of injuries sustained by workers in Harare and Masvingo

Area		Could not go to work		Incurred medical expenses	
		Percent respondents	Average number of days	Percent respondents	Average costs in US$
Harare	Solid Waste Management	70	5.2	39	0
	Urban Agriculture	40	9.3	27	0
Masvingo	Urban Agriculture	50	3.2	58	97
	Solid Waste Management	60	10.3	67	70

Source: TARSC, ZCTU, ZCIEA, 2020a

Besides direct impacts of the injuries on the workers and residents, as noted earlier, use of unsafe cooking fuels contribute to air pollution and respiratory problems, which as reported in the FGDs in all sites particularly affect women, given their domestic roles. Psychosocial risks and sexual abuse of women were also an issue where farmland was remote, especially when maize crops were tall and abusers hidden (TARSC, ZCTU, ZCIEA, 2020b) and in settlements when women had to fetch water.

> 'We use water from a spring (kumatombo). We travel for about three kilometres to the spring, and people with mobility problems like those with arthritis and the disabled are worse off. In October we wake up as early as 2am in the morning and come back at about 11am. There will be many people there. Some school children especially those in crèche and grade 1 are missing school as the parent will be fetching water. Thieves also break into our houses when we are away' .'
>
> Urban farmer- Mabvuku-Tafara

5. Research findings: Interaction of climate change with determinants of health

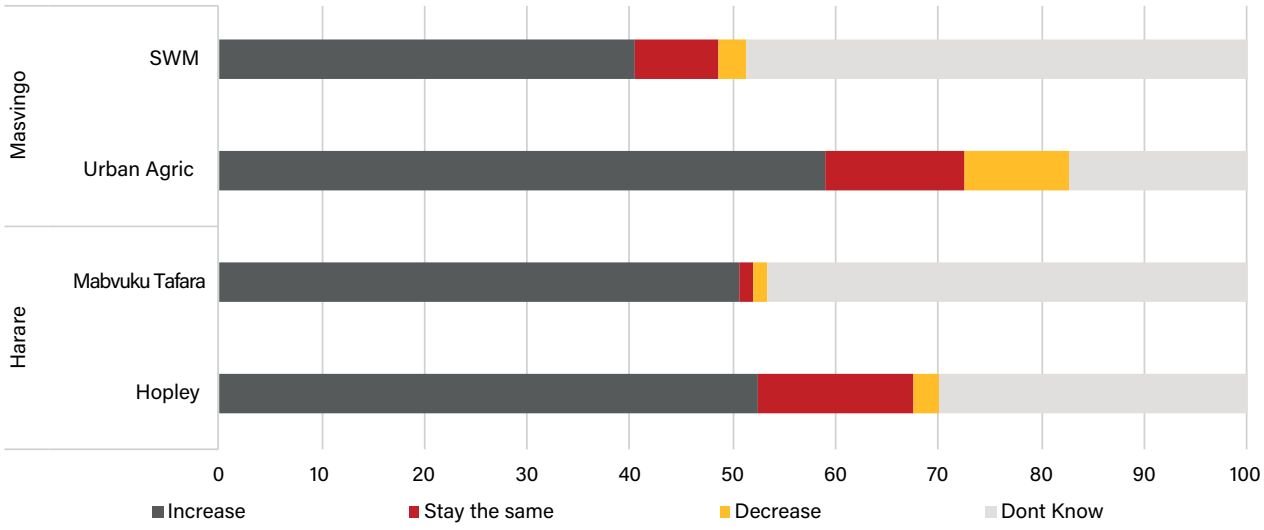
The literature review indicated that climate change will have significant impacts on human health and the environment. These are primarily due to: **extreme temperatures**, which increase morbidity and mortality and are likely to increase the geographic range of infectious disease vectors such as malaria; and **extreme weather events** increasing water-borne, food- and vector-borne diseases (UNDP, 2018b; Barata et al., 2018). The review also noted increased floods, storms, fires, droughts with various impacts on human health. However, other factors that aggravate climate change such as air pollution, particularly from chlorofluorocarbons, also contribute to the burden of non-communicable diseases (NCDs) affecting the cardiorespiratory system (Frumkin et al., 2019). As noted in *section 4*, exposure to air pollution also increases respiratory and cardiovascular diseases. The survey and FGD findings corroborate many of the health and environmental challenges documented in the literature review and indicate that informal settlement residents and workers will be disproportionately affected by climate change impacts, due to their living and working conditions.

5.1. Health and climate change risks and worker responses

Extremes of heat

As noted in section 4, respondents in both areas, especially those in urban agriculture, reported experiencing extremes of heat over the past five years, impacting on both health and the environment. As shown in *Figure 5*, most survey respondents expect temperatures to continue rising in coming years as the world grapples for effective solutions to mitigate climate change.Those in urban agriculture reported extremes of heat as a major factor affecting their work and living conditions as discussed in section 4. Temperature increases also raises the risk of fire outbreaks, particularly in overcrowded informal settlements, while smoke from fires including that from solid waste can reduce air quality significantly, as noted in section 2.2, both locally and in areas downwind of fires" (TARSC, ZCTU, ZCIEA, 2020a).

Figure 5: Perceptions on expected future developments on extremes of heat



Source: TARSC, ZCTU, ZCIEA, 2020a

Responses to extremes of heat: In responding to curbing the impacts of the extremes of heat on their health, all the FGDs raised the need for water for rehydration due to extremes of heat at home and at work, but most can neither access nor carry sufficient water for the sometimes more than 5km walk to work.

Residents minimise their exposure to direct heat by staying indoors, wearing hats, using umbrellas and staying in the shade. In Hopley, plastic pickers reported ready access to water when selling their plastics as there are 'free water access points' in the city.

As mentioned in *section 5.1* households have adopted environmentally friendly agricultural practices to conserve moisture and in addition, farmers have been urged to adopt the *Pfumvudza* concept which gained traction in the 2020/2021 farming season, in response to previous climate change-induced droughts. See *Box 3*.

> 'We know we need to drink more water when it is very hot, but safe water is not easy to get so we end up drinking less and just stay indoors.'
>
> Plastic waste collector, Hopley

Box 3: Pfumvudza conservation agriculture on a roll in Zimbabwe

A new government initiative is aimed at increasing farmers' resilience. The Government of Zimbabwe has set a target to train 1.8 million farmers in Conservation Agriculture (CA) by October 2020 for the 2020/21 cropping season and 1 million farmers have already been trained. The Food and Agriculture Organization of the United Nations (FAO) and Foundations for Farming (FfF) have trained government extension staff to implement the *Pfumvudza* concept – which comprises CA practices – improve food self-sufficiency in Zimbabwe. It is hoped that the project will address problems of low levels of productivity and production, making the country more resilient to climate shocks and ensuring food security. The scheme also offers commercialisation potential for by encouraging smallholder farmers to produce surplus food for sale.

Pfumvudza is a crop production intensification approach that ensures the efficient use of (inputs and labour on a small area of land in order to optimise its management. "*Pfumvudza* means a new season of increased productivity... of producing more on less land and with less resources; a season of climate proofing our agriculture through ... [the] adoption of Conservation Agriculture," said the Permanent Secretary of the Ministry of Lands, Agriculture, Water and Rural Resettlement, John Basera.

What makes *Pfumvudza* unique is the size of the plot used: at just 16m x 39m the plot is small enough to easily prepare, to manage with mulch, to weed, and even to water by hand with harvested rainwater in the event of a mid-season dry spell or drought. The concept has been successful in helping farmers to produce grains including maize, sorghum and millet, and encourages the rotation of legumes such as beans, ground nuts or cowpeas. According to Matthew Mbanga, CEO of FfF Trust, "The secret to the project's success has been its scalability; CA drastically reduces the workload for farmers and limiting the size of plots makes it even more manageable". All 1.8 million beneficiaries of the Presidential Inputs Scheme, now called the Climate-proofed Presidential Inputs Scheme, are expected to establish three *Pfumvudza* plots over the 2020/21 agricultural season. The government's objective is to climate proof the agricultural production of smallholder farmers (who make up 80% of farmers in Zimbabwe) and ensure food self-sufficiency for the nation. Through the project Strengthening coordination, scaling up and governance of Conservation Agriculture in Southern Africa (SUCASA), FAO is working with partners – including FfF – to increase collaboration in scaling up CA in the region. Warming at twice the global rate, southern Africa is one of the epicentres of global climate change and through the Malabo Declaration, African heads of state declared that 25 million farmers should adopt climate resilient production systems by 2025 to protect their food and nutrition security and livelihoods.Zimbabwe's efforts are certainly a step in the right direction, according to Lewis Hove, Head of FAO's Resilience Hub for Southern Africa, and SUCASA Coordinator. "Ultimately," he says, "this is only going to help Southern Africa's farmers become more resilient to climate shocks."

Source: adapted from FAO, 2019

Besides the *Pfumvudza project,* other practices to mitigate the impact of climate change were raised in the FGDs, such as reforestation and land reclamation, including wetlands.

Flooding

World Bank research shows that nearly 70% of Zimbabwe's natural disasters are water-related – floods and droughts – due to climate variability (Davis and Hirji, 2014). In the past two to three decades, Zimbabwe has experienced cyclones all of which caused severe flooding, sometimes with devastating effects, in 1976, 1977, 1986, 1997, 2000, 2003, 2017 with the most recent and perhaps the worst being *Cyclone Idai,* which killed over 340 people and flattened some settlements in the eastern part of the country.

While no one in the survey or FGDs raised the issue of destruction of infrastructure from heavy rains or flooding suggesting that, as yet, this is not a common occurrence in either city, the literature review identified that heavy rains and flash floods do result in damage to infrastructure and that with the highly compromised housing and infrastructure of informal settlements this is likely to be an issue in the future. (discussed also in section 4.1).

Air and water pollution

Smoke and fumes from unclean cooking fuel; dust (from roads and construction sites, cement factories and steel makers) were identified as major sources of pollution, as well as worsening pollution of water sources as discussed in section 4.1.

Given its multiple and widely dispersed sources and impacts, few community and household approaches to deal with water and air pollution were raised in the FGDs. Participants reported that measures were limited, inadequate and uncoordinated and that access to clean affordable energy was essential to limit air pollution. This was discussed in section 5.2. Due to the absence of water or air quality monitoring, people were usually unaware of the issues and community-led enforcement mechanisms were weak. For instance, attempts to discourage the use of burning tyres to split rocks was done without knowledge of the relevant legal provisions such as the 2018 Public Health Act.

The FGD report from Masvingo noted participation of plastic waste pickers in Environment Management Authority (EMA) organised health clubs and skills building, which trained them to manage risks at work, promote health, as well as to add value and improve market linkages in their processes. It also assisted them with skills building and addressing business risks, including exploitation by plastic waste buyers, who had to register with EMA in order to buy from the waste pickers (TARSC, ZCTU, ZCIEA, 2020b).

Pollution of water sources aggravates and compounds the impacts of climate change, reducing the amount of water available for human use, given reduced rainfall and increased evaporation, while pollution of groundwater is of significant concern, given the increased likelihood of dependence on groundwater in the light of climate change.

5.2. Priorities in responding to climate risk impacts

The FGDs observed that socially generated conditions interact with climatic factors – especially heat and drought - to further increase stress, such as in the reported difficulty of maintaining adequate hydration. Enhanced access to services and infrastructure and improved access to safe water and clean energy have multiple impacts on health, environments and communities' ability to respond to the impacts of climate change.

Priorities to improve working conditions: These focused on the potential to enhance health, climate resilience, food security and productivity. Urban farmers raised the issue of security of land tenure, improved water availability for irrigation and measures to avoid theft of produce (such as by identifying common, fenced areas for urban farming, which could also allow provision of common water sources). They also prioritised installation of solar-powered boreholes, rainwater harvesting systems and promotion of climate-smart technologies such as drip irrigation, conservation farming, and use of greenhouses.

The FGDs also pointed to a need for agriculture extension services to promote capacity-building and links to markets and capital and raised a need for stronger enforcement of laws on sand extraction to reduce the threats it poses through increased erosion and reduced land for farming.

Informal plastic waste pickers prioritised regularisation of the sector through training and certifying buyers, pickers and others, as well as setting standards for those involved. Council-recognised and workplaces were seen to improve recognition and address workplace risks such as fire outbreaks and pollution of water sources. They also proposed introduction of central plastic collection sites or community cages in communities for collection of plastic waste.

Enhanced capacity-building in enterprise development, business management, value addition and adoption of new technologies for both urban farming and plastic waste recycling were prioritised by both groups to enhance efficiency and increase incomes (TARSC, ZCTU, ZCIEA, 2020b).

Priorities to improve climate and environmental conditions: The FGDs identified testing of air and water quality by local authorities and others to identify hotspots and address the causes of air and water pollution, including from motor vehicles.

Communities, local authorities and the EMA can all play a role in mapping risks, raising awareness, taking action, and sanctioning polluters (TARSC, ZCTU, ZCIEA, 2020b). For these to be effective, participatory urban planning should be encouraged so that the new approaches are owned and understood by the community. Key priorities included: the need for green spaces in urban areas; protection of wetlands; reforestation programmes; and climate-friendly technologies in agriculture and recycling.

One urban farmer highlighted the need for reforestation and recommended cultivation of fruit trees, with multiple potential gains for health, nutrition, and climate resilience.

> ‘We need capacity and education on how to start our own recycling businesses, instead of selling our plastic as it is. We are being exploited. No buying prices are gazetted, and buyers and middlemen are the ones who benefit from our sweat. We need better sharing of wealth from the plastic business.’
>
> Plastic waste collector, Hopley

> ‘We need to have reforestation programmes to replace the trees that have been cut to provide firewood in urban areas. We could do it differently and plant fruit trees that will also help with our nutrition.’
>
> Urban farmer, Masvingo

6. Research findings: Acting on health opportunities and challenges

Evidence from the literature review (TARSC, ZCTU, ZCIEA, 2019) suggests the need for long term plans to address structural deficiencies in informal settings with a long-term goal of improving integration, social cohesion and democracy. Long-term plans must include informal sector responses to address these structural issues, yet residents, decision makers and other actors typically focus on the immediate/visible economic and social services. Thus, the need to act collectively by building coalitions and associations that encourage the affected people to act in solidarity is also noted. In this section, we report on the individual and collective responses of households and workers, as well as those of other actors.

6.1. Worker, household and community responses: assets and deficits

Both informal sector residents and workers reported that education was a vital asset in obtaining the skills required to respond to occupational, public health and environment-related issues (TARSC, ZCTU, ZCIEA, 2020b).

It contributed to their capacity to build family and community values and mutual respect and solidarity for harmony in the home and community. Solid waste pickers were using education to better identify recyclable plastics and segregate waste and recognised its value for developing options to improve value addition, business processes and market access.

They were using it to sustain their enterprises by tracking profits and sustainability, budgeting and planning.

Box 4: In their own voices...

"Education is helping me with knowledge on how to grow tomatoes and use technology that conserves water. I don't have money to put drip irrigation on my tomatoes, so I am using used plastic bottles that I put on each and every plant. The bottles will be turned upside down and a small hole will be inserted on the lid that allows small amounts of water to drip onto each plant. This conserves water". Urban farmer, Masvingo

"We are using education in reading and understanding labels on plastics. We are able to know which plastic to pick and not to pick, we are able to understand the differences in the plastics and which ones fetch more money than others, we are also able to clean and store the plastics before we sell them". Plastic picker, Hopley.

"Through education, I learnt the process of making compost from leaves and other organic matter, I save as I will not be buying fertilisers. I also use grass and other matter to mulch my crops to conserve moisture". Urban farmer, Mabvuku Tafara

"I do not produce any waste from my farming. I use the maize stalks after harvesting to make compost which I use as organic manure in the next season. I keep some of the maize stalks and use them as mulching to conserve moisture when I plant in the next season." Urban farmer, Masvingo.

Source: TARSC, ZCTU, ZCIEA,2020b

In urban agriculture, education was seen as key in achieving improved yields and responding to climate-related risks through application of scientific approaches, water conservation practices and 'climate-smart' techniques in growing crops from 'field to floor'; i.e. in land preparation, fertility and yield enhancement, pest control, harvesting and reducing post-harvest losses. Education was reported as being acquired through the formal system and through children, informal networks, radio programmes, non-governmental organisations and government agencies. Nonetheless, participants reported knowledge gaps with the formal education system viewed as largely theoretical. While plastic pickers saw potential for their businesses to thrive beyond their current survival mode and contribute towards the national economy, they lacked adequate business skills to run their businesses professionally and strategically, preventing the transition from 'surviving to thriving'.

Social cohesion was also regarded as vital capital for household economic, health and environmental improvements such as in Mabvuku-Tafara where households share farm tools and equipment and in Hopley where solid waste pickers worked in groups sharing transport and other social burdens as local network 'social support systems'. Working together helped them get better prices for bulk sales, although powerful buyers undermined this activity.

Households involved in urban agriculture were using crop diversification, composting maize stalks, using manure from chicken runs in their vegetable gardens, waste reuse and mulching to conserve moisture to maximise their returns. A variety of crops was being planted to enhance families' nutrition (TARSC, ZCTU, ZCIEA, 2020b). To mitigate the risk of theft, some urban agriculturalists in Mabvuku-Tafara were growing crops in smaller plots spread across several areas.

In response to reduced returns and falling prices, plastic waste pickers began negotiating in advance with buyers for better prices, either as individuals or small groups. They were also working to improve business processes by exploring options to have plastic collected from them to save their incurring transport costs for delivery to their buyers. However, this was discouraged by individualistic working arrangements as they reduced economies of scale for buyers, thus workers continue to face physical and ergonomic risks transporting their plastic. Some waste pickers have been creative with the plastic they collect. Besides selling to recycling companies, they also 'value add' by upcycling the materials to maximise profits, as shown by female waste pickers in Masvingo. *Figure 6* shows some of their products made from recycled plastic, including door mats, table mats, hats and small handbags.

Figure 6: Upcycled plastic waste.

Source: ZCTU, ZCIEA, Masvingo, 2019.

These are mostly sold to households within the community, while others have taken advantage of the motorists on their way to South Africa and sell their craft for foreign currency. In Masvingo, one worker runs a thriving plastic recycling enterprise (*Box 5*) but few workers were adding value primarily because of cost and information barriers, despite appreciating the opportunity for growing their business.

Box 5: In their own voices...

"I am a bit different from others. I am working closely with the Environmental Management Authority and have been registered. I am processing plastic through burning and melting it and moulding it into pavers which are used for constructing driveways and pavements. The container labels are not required and we throw them away. I am now also capturing the smoke from the burning plastic so that it doesn't get into the environment and it is used to make oil. The ash is used to make fertilizer. Plastic waste recycler, Masvingo.

Source: TARSC, ZCTU, ZCIEA ,2020b

6.2. Community organisation

Community assets and approaches:

The literature review reported how poverty, deprivation and increased vulnerability of informal workers and residents to climate-change induced shocks derive from systems that alienate them because of their informal status, combined with limited collaboration and poor social cohesion. Without a multi-faceted approach to addressing these issues, they will continue to limit any efforts at improving prospects for the sector. The findings from this research suggest the beginnings of small but important community-led steps towards achieving this.

At community level, the FGDs established that education and awareness to promote solidarity were seen as key, while social connectedness was recognised to be important in resolving issues of household economic, health and environmental improvements. For instance, although most households and workers earn insufficient income to cover their daily needs, they were contributing to pooled community funds to improve local infrastructure. In Hopley, such funds were being used to mend roads to ease the transportation of their plastic to markets (TARSC, ZCTU, ZCIEA, 2020b).

Co-operating in this way helped them obtain better prices for bulk sales. They were also investing in children's education and health, two key foundations for improving wellbeing and human development at individual, family and community levels in the long term. In Mabvuku-Tafara, households share farm tools and equipment, while in Hopley, individual waste pickers work as groups, providing social support systems in local networks and sharing transport and social burdens.

To mitigate risks to health and climate impacts, communities were also employing various approaches. The participation of plastic waste pickers in Masvingo in EMA-organised health clubs that trained them to manage risks at work and promote health and also supported them in managing exploitation by plastic waste buyers, in adding value and improving market linkages. This support needs to be expanded to include climate change related issues, given the importance of reducing plastic waste and associated pollution to improving the environment and mitigating the impacts of climate change.

Overcoming the unreliable, inadequate supply of safe water: In all areas, the FGDs reported that households boil water and use water purification tablets to make water safe to drink. In Masvingo, treated municipal water is stored in closed containers and water from laundry is re-used to flush toilets. In Hopley and Mabvuku-Tafara, households access water from protected wells but these are liable to groundwater contamination and receding water tables, while situating wells on small stands is problematic (TARSC, ZCTU, ZCIEA, 2020b).Those in the urban agriculture FGDs felt these measures were inadequate and called for local authority-coordinated measures, such as drilling boreholes, rainwater harvesting, and widening use of water conservation technologies (TARSC, ZCTU, ZCIEA, 2020b). However, no activities to mitigate the impact of climate change on water availability or reduce activities that exacerbate it were reported.

Controlling risks to health and environment at work: As noted above, urban farmers and plastic waste pickers draw on their education to gain information on hazards from product labels, national radio and social networks to enable them to avoid risk. For example, plastic waste pickers either avoided chemical plastic containers or used improvised gloves such as other plastic material to handle harmful waste. Meanwhile, those in urban agriculture disposed of used agrochemical containers by burying them. However, both groups pointed out that chemicals were sometimes unlabelled or decanted into containers normally used to store water and food.

Low use of protective clothing by both groups was due to cost barriers, and the few using it were either using insufficient protection for their level of risk, or using it inconsistently. To overcome the ergonomic hazards plastic pickers transported plastic in push carts, while some were pooling resources to hire vehicles to transport plastic to buyers. Households are using environmentally friendly agricultural practices to conserve moisture to address drought, such as mulching using maize stalks from their harvest, using organic manure and digging wells to use groundwater for irrigating crops.

They were also switching to early-maturing crops and small grains which is a climate change adaptation, but there is room (and urgency) for the adoption of additional climate-smart adaptations. Masvingo farmers also saw a need to implement longer-term measures such as reforestation to avert some of the problems of climate change.

Limited measures to address air and water pollution: Few community/household approaches were raised in either the survey or the FGDs to address water and air pollution, given their multiple sources and the lack of water or air quality monitoring. At household and community level, efforts to reduce contamination of water supplies included burying waste inside yards (Harare and Masvingo), making septic tank linings impervious (Hopley), and participating in private sector organised clean-up campaigns (Mabvuku-Tafara). There was some awareness of the effects of burning waste and its impact on air pollution with Hopley residents discouraging stone blasters from using burning tyres to split rocks. However, participants in the FGDs argued that people need an affordable clean energy source for cooking, if air pollution is to be controlled and deforestation reduced.

Given high poverty levels, high cost of living and limited alternative economic options in informal settlements, government and local authorities need to take measures to mitigate climate risk and reduce pollution and provide greater support for sustainable climate-friendly economic activities.

6.3. Access to health services

The survey generally confirmed the existence of public clinics in all areas, which were preferred by residents and workers because of their accessibility, affordability and availability of health workers. Whilst these are strong assets in responding to communities' health challenges, the FGDs noted that clinics need to be better resourced to improve availability and affordability of medicines, personnel and services for both chronic and other conditions. Mental health services were limited and provision of these and of community health workers were seen as vital.

Participation by plastic waste recyclers in EMA-organised health clubs help informal workers address business risks, including exploitation by plastic waste buyers – as discussed in section 5.1 (TARSC, ZCTU, ZCIEA, 2020b).

> 'The clinics are not able to deal with our mental health problems. The nurse (health worker) who will be attending to you will also be stressed due to poor salaries and too much work. Maybe if they improve their salary or provide community-based counselling services that could help.'
>
> Plastic waste collector, Hopley

6.4. Other services and sector responses

Both the survey and FGDs reported diverse non-state actors providing material inputs, capacity building and awareness programmes, as well as promoting food security, better diets, health services for disadvantaged community members and awareness on gender, disability and rights which directly benefit whole communities.

Better management of solid waste was encouraged through provision of bins, while in one Masvingo FGD, ZCIEA was reported to be helping households dialogue with the local council regarding use of open spaces in the city for urban agriculture (TARSC, ZCTU, ZCIEA, 2020b).

A multiplicity of actors offering different services promoting public, occupational and environmental health was noted in the survey, but concern was raised over the limited capacity of local authorities to coordinate and monitor their activities across the policy and service areas. As the local planning body, local authorities need to identify critical areas for allocation of resources and infrastructure to support these activities (TARSC, ZCTU, ZCIEA, 2020a)

7. Discussion

7.1. Interactions between health and climate change

The findings reported in *sections 3–6* indicate the correlations between environmental factors and health that affect living and working conditions in the informal sector and in informal settlements, in relation to access to safe drinking water, basic sanitation services, energy for cooking and lighting, housing and infrastructure and services. These factors strongly influence health and are also aggravated by climatic conditions.

Water is a major determinant of health and survival

Availability of and access to water for drinking, cooking, sanitation and commercial use (agricultural and waste management) is essential. Limited availability of piped water to residents testifies to poorly maintained infrastructure and lack of planning for increasing urban populations. Uncontrolled pollution of water sources by industries, siltation of dams, and streambank agriculture attest to the failure of local authorities to enforce existing laws. Climate change, through reduced rainfall and eutrophication caused by increased heat and nutrients, especially nitrogen and phosphorus, will further reduce the availability of safe and clean water.

The collapse of health and sanitation infrastructure increase the risk of groundwater contamination through sewage seepage, industrial effluent and agricultural chemicals combined with increased reliance on open water sources and boreholes exposes people to communicable diseases. Certain bacteria survive for long periods in sewage sludge especially in higher temperatures caused by climate change and open water sources such as local pools and river which are often polluted. There is an urgent need for investment in water provision in both residential and work environments so that residents can enjoy wider workplace and social benefits, better health, stronger livelihoods and promotion of climate resilience. The study found that unsustainable farming practices also affect water quality in communities. Unsustainable 'illegal' urban farming in wetlands, on steep slopes and stream banks is causing massive land degradation, destroying ecosystems and further compromising water availability.

Multiple risks linked to inadequate water supply and poorly sited sanitation

In the FGDs, communities identified ways of improving water supplies such as drilling boreholes powered by solar systems. However, drilling too many urban boreholes can leave shallow wells used by poorer households dry and reducing the water table (Chikodzi, 2013) with long-term negative effects. Improperly sited boreholes may also be a source of unsafe water. Improved regulation of bulk water supplies in urban areas is also needed to improve safety and security of women and girls and to inclusion of the elderly and those with disability, as discussed in section 6.4

Whilst the majority of people in both sites have improved sewerage facilities, in Hopley, wells and boreholes are sited barely 5 metres from toilet facilities (see section 3.1); while some houses have been constructed in wetlands, increasing the likelihood of flooding of toilet facilities and water contamination, especially during the rains. Moreover, the reluctance of local authorities to prosecute those constructing buildings and drilling boreholes in wetlands indicates a serious governance problem that needs attention. Given the intricate relationships that exist in the human-environment ecosystem, worsening climate change and the impact of human activities on the environment will have disastrous health consequences on the urban population.

The absence of proper water supplies in informal settlements also has a huge bearing on residents and workers' choice of sanitation facilities as this is constrained by limited water supplies. Poorly sited and constructed sanitation facilities, especially in Hopley, expose residents and workers further to water-borne disease, should they collapse. This challenge will also be worsened by climate change if urgent measures are not taken to reduce its impact.

Deficient waste management linked to multiple health risks

The literature review shows that local authorities are challenged by the growing urban population with regard to provision of sanitation services including waste collection (Hoornweg et al., 2012). Population growth in Harare and Masvingo has outpaced investment in infrastructural development for proper waste collection and management

systems. The quantity of waste, including industrial effluent (as noted in Masvingo, where it is discharged directly into Mucheke river), affects the environment , water sources and living conditions in the surrounding communities. Since local authorities have failed to provide regular waste collection, residents and workers have resorted to burning or dumping waste in open spaces outside their homes, contributing to soil and water contamination and promoting multiple disease vectors. As already noted, these open dump spaces, together with designated landfills, have become the workplaces for informal waste pickers, where they are exposed to multiple hazards affecting their health and damaging the environment, due to spontaneous fires that produce toxic smoke and contribute to climate change as reported in section 3.3.

Multiple health and climate risks linked to unclean energy

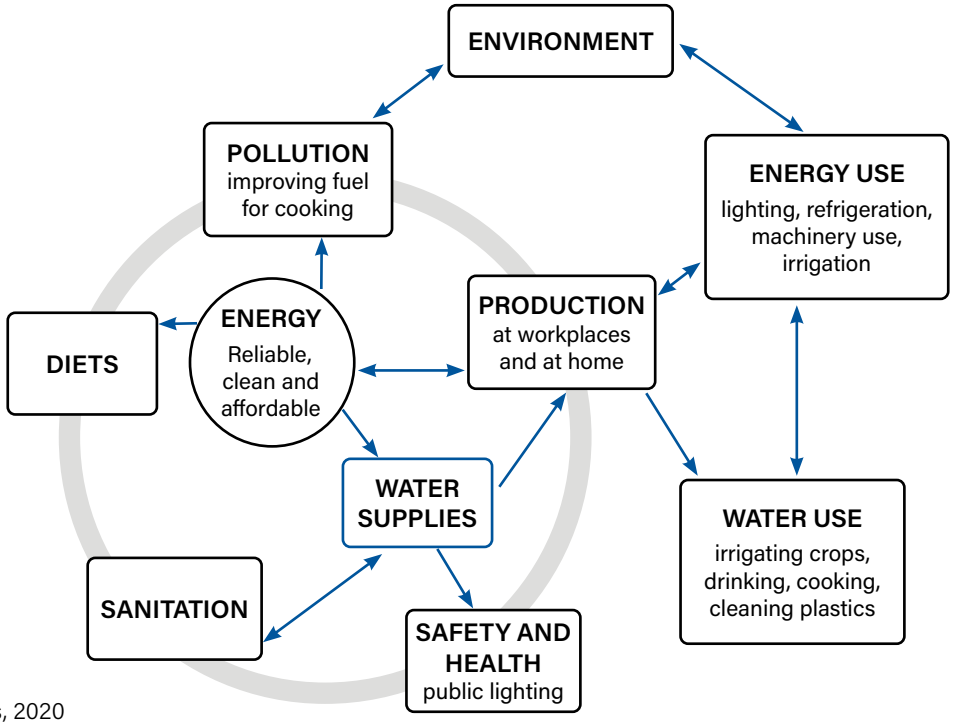
As reported in section 3.1, deficits in affordable clean energy lead many households in both survey areas to burn unclean energy sources for cooking, contributing to air pollution and exacerbating climate change and impacting on human health and increasing respiratory conditions. These materials are made from substances that emit carbon monoxide and other gases that affect people's health as well as generating short lived climate pollutants (SLCPs), methane, black carbon and tropospheric ozone, which are responsible for a substantial proportion of climate change and have detrimental health and environmental impacts (GOZ, 2014).

Black carbon is emitted by many common sources such as car and truck exhausts, biomass stoves, forest fires and some industrial facilities. It is a major component of soot, which warms the atmosphere by intercepting sunlight and absorbing it (GoZ,2014), disturbing the planet's radiation balance and increasing atmospheric warming. Black carbon and other pollutants also increase public health risks.

In the environments surrounding the study areas (especially where the land is not guarded), deforestation has increased with trees being cut down for firewood or cleared for farming, encouraging soil erosion, desertification and biodiversity losses and contributing to climate change. Trees also play a role in reducing air pollution by absorbing harmful airborne particles and gaseous pollutants.

The FGDs show that poor access to adequate clean energy also negatively affects household food choices and diets, and to unsafe water due to a lack of means to boil drinking water. Community safety is reduced by inadequate street lighting, also linked to limited energy supplies and wider dimensions of wellbeing as raised by all six FGDs and illustrated in *Figure 7*.

Figure 7: Central role of energy and water supplies to home and workplace conditions



Source: Authors, 2020

7.2. Positive synergies: responses and opportunities for 'win-win' approaches

The FGDs raised pertinent issues for ensuring a win-win situation in terms of priorities in addressing the myriad of challenges they face within their communities, as shown in *Figure 8*.

Figure 8: Priorities for responses raised by informal workers and residents

PRINCIPLES	**Equity:** In service provision, take into account needs of women, youths/children and those living with disabilities **Sequencing:** Prioritise actions with potential for wider benefits e.g. electricity **Collaborative:** Collaboration by all actors and clearer communication between all stakeholders

NATIONAL/ HIGHER LEVEL ISSUES	**ECONOMIC AND POLICY ISSUES**	**ENERGY**		**INFRASTRUCTURE**
	Economy and job creation Devolution and local economic resources management Conservation choices	Renewable e.g. Solar	Equity- access to existing energy, improved generation	For Water, for energy, for services, for supporting other areas

PRIORITIES FOR SPECIFIC AREAS: current conditions/ future generations	**Household conditions and risks**	**Work conditions and risks**	**Climate and environmental conditions and risks**	**Other services (e.g. health services)**
	Housing conditions Household food and nutrition Equitable, reasonable timing for water and energy supplies Options on management of solid waste and water supplies	**Urban agriculture** Climate adaptation and support for urban farmers Organised urban farming **Solid waste collection and recycling** Sector regulation, professionalization, standardisation, improved markets Shared, improved work- spaces Work organisation **Cross-cutting** Capacity building in enterprise and business management, value addition Participatory urban planning Improve safety at workplaces	Testing services for air and water Community led actions on addressing causes of pollution Participatory urban planning, reforestation programmes Environmentally friendly technologies in recycling, farming, energy Addressing pollution from vehicles	Education services to support the new curriculum including ECD, and on environment. **Heath services:** Accessibility, acceptability and quality - community centred services, infrastructure, NCDs, medicines and Child immunisation.

OVER-ARCHING ISSUES	**COMMUNICATION/ AWARENESS/ NETWORKS**	**POLICY ENFORCEMENT/ MONITORING AND REFORM**	**GOVERNANCE**
	Of Benefits, alternative options, services, information centers	such as environmental health, incentives for urban agriculture and SW recycling	Accountability on inputs within services

These priorities go well beyond health and environmental issues and touch on a number of interrelated areas depicted in the Sustainable Development Goals that address economic policies, environmental issues, governance, provision of infrastructure and services, social services, agriculture and other cross cutting issues.

Despite the huge challenges faced by residents and workers in both informal and formal settlements and those engaged in urban agriculture and solid waste management, communities' engagement in economic activities has enhanced their lives and contributed to their survival as marginalised communities in urban settings.

Urban agriculture has, for example, provided an important buffer in terms of food security, as the crops and vegetables they grow improve household nutrition. Besides guaranteeing their food security they are also able to provide for their families in terms of education, clothing and other basic needs as revealed in the survey and FGDs.

Workers involved in solid waste picking play a pivotal role in reducing waste in the environment by recycling and creating value chains through their activities, as shown by the women in Masvingo in section 6.1. However, they bear the brunt of climate change effects: droughts, flooding, extremes of heat and cold, and suffocating air and water pollution, all of which impact on their physical health and well-being, with frequent diarrhoeal diseases and respiratory illnesses as described in section 4.

Services provided at local clinics are insufficient to cover their overall health needs, but they have learnt to live with this and continue to hope that local authorities and government will intervene with polices that will economically empower them and support their physical and mental health and well-being.

8. Looking ahead: future priority areas

The findings from the literature review, survey and FGD reports synthesised here indicate that significant health and environment challenges within informal settlement areas revolve around the provision of basic social services including: affordable housing; safe drinking water, sanitation and hygiene; affordable and clean energy supplies; management of water resources, chemicals and wastes and resultant soil and air pollution; vector control; ; and food safety. These challenges are all exacerbated by unplanned urbanisation, uncontrolled urban population growth and migration, and increase pressure on already overburdened health systems and local authority infrastructure. These challenges will all become much greater as climate change impacts increase.

Informal workers and residents are affected by and exposed to a plethora of health and wellbeing challenges as a direct result of their living and working in informal settlements. The climatic factors – heat, drought, floods and winds – interact with these conditions to create further stress.

Survey respondents also suggest that enhanced access to services and infrastructure, such as improving access to safe water and clean energy, can have multiple impacts on health and environments and on the ability to respond to climatic changes. Given the multiplicity of challenges faced by residents and workers in informal settlements, a comprehensive holistic approach is needed to address the issues primarily at the policy and operational levels.

Evidence from the literature review (TARSC, ZCTU, ZCIEA, 2019) suggests the need for long-term plans to address the structural issues that lead to deficiencies in informal settings, with the goal of improving integration, social cohesion and democracy. Thus, informal sector responses should be an inclusive part of long-term plans to address structural issues such as democracy, governance and politics, yet these issues are rarely discussed, as actors focus on the immediate and more visible economic and social services. The important role of collective action through building coalitions and associations that allow affected people to act in solidarity is also evident.

A number of areas were prioritised, particularly in the FGDs, proposing immediate and longer-term actions to enhance the conditions of informal residents and enable socio-economic contribution in promoting community health and better managing and mitigating climate change-related risks.

The following principles to guide current and long-term actions have been raised:

- Ensuring equitable access to health and other social services with measures ensuring access for youth, women, people living with disabilities and other disadvantaged groups.
- Appropriately sequencing actions to prioritise those with wider impact, such as providing affordable renewable energy with its crosscutting impacts on pollution, water supply, street lighting, security and nutrition.
- Taking a collaborative 'whole of society'' approach to maximise synergies across actors.
- Ensuring legal recognition of all residents, so that all, including those in informal settlements benefit from these measures.

8.1. Recommendations

Given the broad principles above, the following specific actions are proposed and need to be supported by national and wider sectoral actions including:

a. Revitalising the national economy to provide a sustainable base for job creation, especially for youths, to address financial distortions that cause rising prices and increased cost of living.
b. Ensuring devolution of national resources and conservation choices, such as in land and water that support wellbeing and protect future generations.
c. Improving supply of and access to affordable energy/electricity, given the range of impacts it has on pumping water, nutrition and cooking, avoiding non-polluting alternatives and increasing security from public lighting.

The FGDs raised a need for a more equitable distribution of existing energy supplies and investment in 'quick win' solar solutions such as solar pumps for community boreholes, solar street lighting and support for clean solar and other energy for cooking. The FGDs also raised investment in long-term renewable sources of energy, which currently represents a missed opportunity for local authorities to invest in biogas systems to deal with increased, uncollected waste to provide clean, cheap energy for households as well as reducing the emission of greenhouse gases and air pollution.

d. Investing in infrastructure for improved rainwater harvesting for drinking and irrigation, including application of legal instruments to reduce pollution of water bodies by industry, and improved water treatment plants, as key for population health and to improve climate change adaptation, as well as in infrastructure for transport, communications and energy (as above) and in health and education service.

On follow-up dialogue, information sharing and interaction on the findings

Key cross-cutting issues are proposed for further discussion and follow-up in various policy platforms, including:

a. Promoting and enhancing **communication, awareness and networking** on the following key issues: registration and formalisation of plastic waste recycling and recyclers (one-stop shop concept), renewable energy solutions and practical measures to harness them, and to avoid mixed messages between local councils and other actors.
b. **Policy enforcement, monitoring and reform** including regular monitoring of air and water quality, introduction of a pollution policy for motor vehicle and sanctions for polluters; regularisation of land tenure for informal settlers; subsidies for renewable energy sources in the face of irregular power supplies; incentivising urban farmers and solid waste pickers and recyclers and regularising their work environments; and use of recycled water (red taps) for irrigation purposes in urban areas.
c. **Governance issues such as improving accountability** on inputs and resources within health and education services and de-politicising service provision. The FGDs also prioritised collaboration of all actors through joint platforms on issues and use of common messaging. Central and local government, through the office of the district administrator, were seen as strategically positioned to enhance co-ordination

8.2. Knowledge gaps and future research areas

As noted earlier, the informal economy sustains many urban dwellers. As the formal sector declines, it is inevitable that Zimbabwe's economic growth must be based in part on the development and growth of the informal economy. There is an opportunity to improve living and working conditions and environments in the sector and to benefit all through interventions such as enhanced access to water, energy and management of public spaces and services. Thus, for future research areas it is suggested to investigate the informal sector's potential to play a role in the following:

a. Expansion of green technologies, water harvesting, value-add recycling and other interventions that respond to the needs generated by climate change.
b. Mechanisms to support urban agriculture and solid waste recycling as these have potential to ensure food security, generate income for low-income urban communities and can contribute to sustainable environments.

8.3. Learning on building synergies between climate and health in the informal sector

There are long-term solutions to some of the challenges facing informal settlements, especially as these relate to investment in smart and clean technologies that enhance health benefits while protecting the environment and mitigating climate change. Investing in clean energy for informal residents and workers could open new opportunities for innovative technology use, enhance living conditions and production and improve communication and marketing, among other benefits. While residents and workers in both sites are eager to pay for energy supplies, their provision requires capital investments that are beyond their means, therefore institutional intermediaries such as local government and a structure for the financing mechanism that is aligned with feasible community inputs are needed.

9. References

1. Barata MML, et al. (2018) Urban Health. In Rosenzweig C, et al. (eds.), *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press. New York. 363–398.
2. Bartram J, Cairncross S (2010) Hygiene, sanitation, and water: forgotten foundations of health, *PLoS medicine,* 7(11), e1000367.
3. Charmes J. (2016) 'The Informal Economy: Definitions, Size, Contribution and Main Characteristics' in Kraemer-Mbula E and Wunsch-Vincert S (eds.) The informal economy in developing nations: Hidden Engine of Innovation, 1st ed, New York, Cambridge University Press, pp. 12–49.
4. Chen M, Roever S & Skinner C (2016). Urban livelihoods: reframing theory and policy. Environment and Urbanization, Vol 28(2): 331–34.
5. Chikodzi D (2013) Groundwater Resources of Zimbabwe: An Assessment of Fluctuations. 2: 629 doi:10.4172/scientificreports.629.
6. Davis R, Hirji R (2014) Climate Change and Water resources planning, development and management in Zimbabwe: An issues paper, World Bank and Government of Zimbabwe, Harare.
7. De Beer J, Fu K, and Wunsch-Vincent S (2016) 'Innovation in the Informal Economy' in Kraemer-Mbula, E. and Wunsch-Vincert, S. (eds.) The informal economy in developing nations: Hidden Engine of Innovation, 1st ed, New York, Cambridge University Press, pp. 53-87.
8. Dialogue on shelter for the homeless in Zimbabwe Trust, Zimbabwe Homeless Peoples' Federation, City of Harare (2014) Harare Slum profiles report (edition 2), Dialogue on Shelter for the homeless in Zimbabwe Trust, Harare.
9. Fagliano JA & Diez Roux AV (2018). Climate change, urban health, and the promotion of health equity. *PLoS Medicine*, 15(7), e1002621.
10. Fallavier P, Mulenga C and Jere, H (2005). Livelihoods, poverty and vulnerability in urban Zambia: Assessment of situation, coping mechanisms and constraints. Washington: Draft Document, World Bank.
11. FAO Regional Office for Africa (2020) Conservation Agriculture on a roll in Zimbabwe, FAO, Harare, available at: http://www.fao.org/africa/news/detail-news/en/c/1310531/
12. Government of Zimbabwe (2014) Zimbabwe's National Climate Change Response Strategy, GoZ, Harare.
13. Government of Zimbabwe (2015) National report for Habitat III, Government of Zimbabwe, Harare.
14. Government of Zimbabwe (2019) National Renewable Energy Policy of Zimbabwe, Ministry of Energy and Power Development, Zimbabwe, Harare March 2019.
15. ILO (1972) Employment, incomes and equality: A strategy for increasing productive employment in Kenya: Geneva: ILO, 1972.
16. International Monetary Fund (2017) Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?, IMF, Washington DC.
17. Lamond J, Bhattacharya N, Bloch R (2012) The role of solid waste management as a response to urban flood risk in developing countries, a case study analysis, *WIT Transactions on Ecology and the Environment,* 159, 193-204.
18. Lund, F, Alfers L & Santana V (2016). Towards an inclusive occupational health and safety for informal workers. New Solutions: A Journal of Environmental and Occupational Health Policy, 26(2), 190-207.
19. Machemedze R (2018) (ed) Informal Economy and Social Vulnerability in Zimbabwe, a research report, Friedrich Ebert Stiftung, Harare.
20. Misilu E, Shouyu C and Zhang Q (2010). Sustainable Urbanization's Challenge in Democratic Republic of Congo. Journal of Sustainable Development. 3. 10.5539/jsd.v3n2p242.
21. Moda HM, Minhas A (2019) Impacts of climate change on outdoor workers and their safety: some research priorities, *International journal of environmental research and public health*, 16(18), 3458.
22. Muller M (2007) Adapting to climate change: water management for urban resilience, *Environment and Urbanization*, 19(1), 99-113.
23. Pharoah R (2009) Fire risk in informal settlements in Cape Town, South Africa, In *Disaster Risk Reduction*, eds M. Pelling and B. Wisner (pp. 121-142). Routledge.
24. Pharoah R (2012). Fire risk in informal settlements in Cape Town, South Africa. *Disaster risk reduction: cases from urban Africa*, eds. M Pelling and B Wisner. Routledge.
25. Rockefeller Foundation (2013) Health Vulnerabilities of Informal Workers, Rockefeller Foundation, New York.
26. Satterthwaite D, Archer D, Colenbrander S, Dodman D, Hardoy J, Mitlin D, & Patel S (2020) Building resilience to climate change in informal settlements, *One Earth,* 2(2), 143-156.
27. Stein A & Moser C (2014). Asset planning for climate change adaptation: lessons from Cartagena, Colombia. *Environment and Urbanization*, 26(1), 166-183.
28. Tapfumaneyi R (2020) 'Sex for water in Mabvuku-Tafara,' New Zimbabwe.com, 27 October 2020, Harare.
29. TARSC, ZCTU, ZCIEA (2019) The health effects of climate change in informal workers and informal settlements in Zimbabwe: A literature review, TARSC, Harare.
30. TARSC, ZCTU, ZCIEA (2020a) Assessment of health and climate change in informal workers and settlements in selected areas of Zimbabwe: Report of a field survey, TARSC, Harare.
31. TARSC, ZCTU, ZCIEA (2020b) Climate change and the informal sector in Zimbabwe: mitigating risks and enhancing benefits: Report of findings from the focus group discussions; TARSC, Zimbabwe.

32. Tibaijuka AK (2005) Report of the Fact-Finding Mission to Zimbabwe to assess the Scope and Impact of Operation Murambatsvina by the UN Special Envoy on Human Settlements Issues in Zimbabwe, New York: UN.
33. UNDP (2018a) Climate change and food security, Policy Brief derived from Zimbabwe Human Development Report 2017, UNDP, Harare.
34. UNDP (2018b) Climate change and health, Policy brief derived from 2017 Zimbabwe Human Development Report 2017, UNDP, Harare.
35. United Nations Economic Commission for Africa (ECA) (2015) Contribution to the 2015 United Nations Economic and Social Council (ECOSOC) Integration Segment, 2015, UNECA. Available at https://www.un.org/en/ecosoc/integration/2015/pdf/eca.pdf
36. United Nations Intergovernmental Panel on Climate Change (UNIPCC) (2019) Special report: Impacts of 1.5°C of Global Warming on Natural and Human Systems, UN, New York available at: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Chapter3_Low_Res.pdf
37. WHO Regional Office for Africa (2014) The health of the people: what works – the African Regional Health Report 2014, WHO Afro, Brazzaville.
38. World Bank (2013) Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience, Report to the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics, World Bank, Washington DC.
39. Zimbabwe Homeless Peoples' Federation (ZHPF), City of Harare (2014) Dialogue on shelter for the homeless in Zimbabwe, ZHPF, Harare.
40. Zimbabwe National Statistic Agency (ZIMSTAT), 2012, Population Census National Report 2012, ZIMSTAT, Harare available at: http://www.zimstat.co.zw/sites/default/files/img/National_Report.pdf
41. Zimbabwe National Statistics Agency, ICF International (2016) Zimbabwe Demographic and Health Survey 2015: Final Report, Zimbabwe National Statistics Agency (ZIMSTAT), Harare and ICF International, Maryland, USA.

Acronyms

EMA	Environmental Management Authority
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IIED	International Institute for Environment and Development
MRCZ	Medical Research Council of Zimbabwe
NGO	Non-Governmental Organisation
TARSC	Training and Research Support Centre
SAP	Structural Adjustment Programme
ZCIEA	Zimbabwe Chamber of Informal Economy Associations
ZCTU	Zimbabwe Congress of Trade Unions
ZIMSTAT	Zimbabwe Statistical Agency

About the institutions

Training and Research Support Centre (TARSC) www.tarsc.org, registered in 1994, is a learning and knowledge organization that builds skills, evidence and capacities in public sector and in civil society towards advancing justice and progress in socio-economic development and sustained wellbeing. TARSC implements its vision through training, research and support services to develop capacities within state and civil society organisations internationally and within countries to interact on areas of social (including health) policy and socio-economic development. TARSC has over 30years of working with communities, membership based and solidarity oriented civil society and states to strengthen public –public links, that is, between community and state / government at all levels, when this is driven by the delivery on social and economic rights, wellbeing, justice and progress. TARSC' role is to build capacities within these actors, networking and dialogue across these actors, and the generation of evidence to inform dialogue on policy and practice. TARSC works in Zimbabwe and internationally. In the regional network for equity in health in east and southern Africa (EQUINET) www.equinetafrica.org we work within 16 countries.

The Zimbabwe Congress of Trade Unions (ZCTU) www.zctu.co.zw is an apex workers union consisting of 36 affiliated union organisations from various sectors of the economy in Zimbabwe. Within the ZCTU, the Occupational health and Safety department has trained occupational health and safety officers in its affiliate unions and shopfloor health and safety representatives in line national and international laws and guidelines. It has also carried out numerous research surveys on occupational health, occupational hygiene, environmental health and more recently on environmental policy. ZCTU is represented in the national Zimbabwe Occupational Health and Safety Council and has been involved in national level negotiations on reform of OHS law and practice, including to cover the informal economy.

The Zimbabwe Chamber of Informal Economy Association (ZCIEA) www.zciea.org.zw is an affiliate of the ZCTU and organises informal workers in small registered/ unregistered or un-incorporated enterprises and undeclared workers. It was formed by 22 informal traders associations in various areas and sectors and now has a membership of 198 466 (60% women 25% men and 15% youth) in 265 chapters and 30 territories on the country. The organization organizes, establishes, promotes and protects the interest of informal economy traders in Zimbabwe. Beyond its affiliation to ZCTU it is internationally affiliated to Streetnet International.

The International Institute for Environment and Development (IIED) www.iied.org is an independent research organisation that aims to deliver positive change on a global scale. Its mission is to build a fairer, more sustainable world, using evidence, action and influence, working in partnership with others.

Annex 1: Context of research sites and clusters

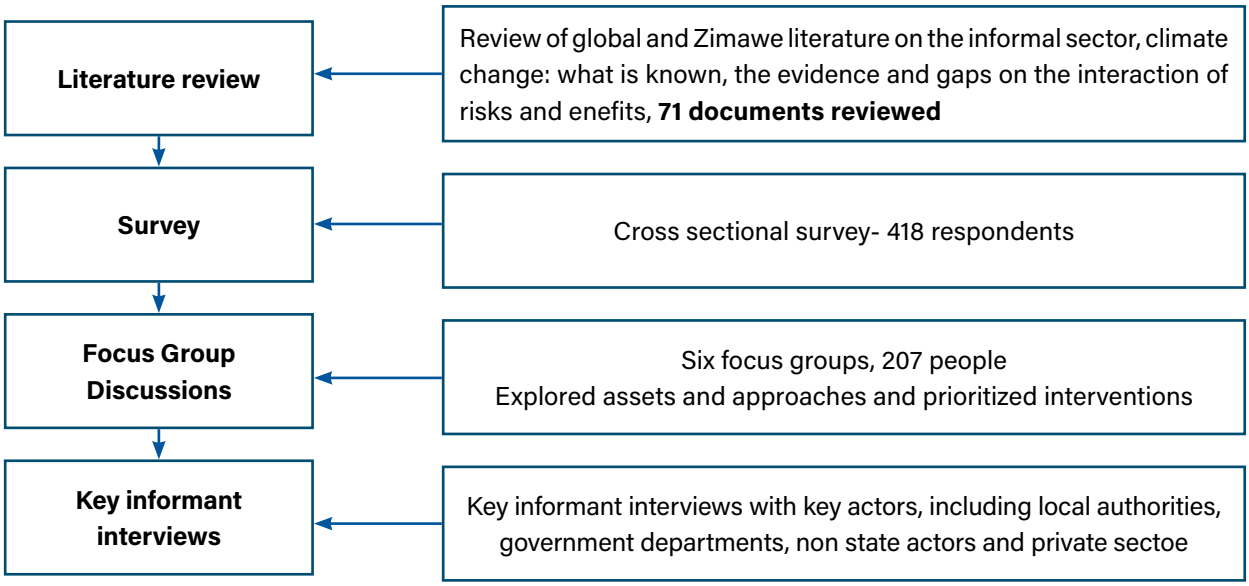
Harare	Masvingo
Location	
Province in north east of the country, high ground (+5000m above sea level) – the capital city	Province in south east of the country, city is the provincial capital
Population	
2,241,840	1,48,090
Setting/context	
Harare is the capital city of Zimbabwe and urban in-migration during the past three decades has resulted in a growth in informal settlements and challenges in provision of services and infrastructure, exacerbated by poor economic performance in recent decades. Harare was selected as the largest urban area in Zimbabwe with a high concentration of people in an informal economy that has existed for many years, and diverse forms of informal settlement (ZHPF and City of Harare, 2014). Climatically the city is at a high altitude with variable rainfall and moderate temperatures.	Masvingo is a city situated in south-eastern Zimbabwe, on the main commercial highway linking Zimbabwe and South Africa used by haulage trucks and buses for carrying cargo and travellers. Masvingo urban was selected as a smaller urban area to allow for comparison between large and small urban area experience. It has different climatic conditions to Harare, being at low altitude with low rainfall and high temperatures.
Share in the Informal economy	
Unemployment rate of 30% (2014) and human poverty index of 34%; +30% in informal economy carrying out a wide range of farm, vending, processing activities	+30% in informal economy carrying out urban farming, vending, processing activities
Nature of informal settlements	
Informal settlements, some registered some ad hoc, some on wetlands. Backyard shacks in formal suburbs, Informal lodging in formal suburbs	Informal settlements, some registered some ad hoc, Backyard shacks in formal suburbs. Informal lodging in formal suburbs
Study Clusters and their context	
Hopley is one of the many informal settlements in Harare. It was established in 2005 by government following countrywide evictions in Operation *Murambatsvina.* By 2014, the majority of housing in Hopley consisted of temporary to semi-permanent shacks ranging from plastic shacks t o unplanned structures built with 'green' bricks. A few houses have been built in Zone One using approved plans, and a large number of these structures were constructed by the then-Ministry of Local Government and Urban Development during a reconstruction exercise. Some of the polythene one-roomed shacks were provided by the International Organisation on Migration (IOM) under an emergency response to the *Murambatsvina* evictions in (ZHPF and City of Harare, 2014). The area has no piped water or refuse disposal services and residents rely on wells, rivers and boreholes for their water needs and use Blair ventilated toilets. With no grid electricity infrastructure, wood is used for cooking. The residents are involved in diverse informal sector economic activities including the collection of plastic waste, which they clean and sell to private industry buyers or middleman.	Mucheke, is one of Masvingo's oldest high density urban areas, and a formal high density residential area with both formal and informal lodgings, high population density with pressure on services. Residents are involved in diverse informal sector activities including informal farming along the Mucheke river and in some instances within designated areas, some vending and trading in informal markets and metal manufacture. The area was selected for its informal activities and pressure on access to water and sanitation in informal work places. Rukejo, also in Masvingo, is another urban high-density residential area with similar features to Mucheke, where some residents are involved in plastic waste recycling and others in urban agriculture. It has some non-permanent informal settlements where residents are involved in recycling saw dust.

Harare	Masvingo
Some are also involved in urban agriculture. Hopley was selected for being an informal settlement and also for its plastic waste collection and recycling informal sector activities. Mabvuku-Tafara is a formal high-density suburb in the east of Harare, with an estimated population of 30,000, with informal lodgings within formal house compounds. It has high population density, resulting in high stress on services. It has regular problems with pumping of water by the City of Harare and is among the last residential areas to receive piped water due to its topographical location, forcing residents to rely on boreholes, wells and other sources. The residential areas are connected to grid electricity. The area is close to a large cement manufacturing factory and is a site for diverse informal sector activities including urban farming, vending of food and other products and home metal industries. The area has wetlands that have in recent years been threatened by expansion of housing and urban agriculture. Mabvuku-Tafara was selected due to its involvement in urban agriculture against a background of perennial municipal water access challenges.	

Annex 2: Methods

We employed an explanatory sequential mixed methods study design as shown in Figure A1 below.

Figure A1: Explanatory sequential mixed methods design



We did not seek to include all informal sector activities in our study due to time and budget limitations, rather we used three entry points, namely:

a. Informal sector workers involved in plastic waste collection and recycling.
b. Informal workers in urban agriculture and food markets, and food marketing in informal settlements.
c. Water access and quality as a major environmental and health issue for both informal residents and workers, and for their health.

We purposively selected two sites, Harare and Masvingo for our research so as to include an area with a large concentration of people in the informal sector (Harare) and a smaller city with different climatic conditions (Masvingo) but similar residential and labour patterns to the first site. These sites also had ZCTU and ZCIEA structures to support data collection and mechanisms to follow through the recommendations and actions from the research. Within each site, we used purposive convenience sampling to select two clusters. Annex 1 summarises the features of each of the two sites and clusters within each site.

Literature review: We carried out an extensive review of 71 documents covering global and Zimbabwe literature on the informal sector, climate change and investigated what is known, the evidence and gaps on the interaction of risks and benefits between these dimensions. The reviewed sources included published literature (qualitative and quantitative) such as studies, policies, legislation, official documents, published materials from the UN, government and local authorities as well as research institutions, civil society and the mainstream media. The review is reported separately (TARSC, ZCTU, ZCIEA, 2019).

Field survey: A cross sectional field survey was conducted in 2020. It was done through an interviewer-administered questionnaire and collected data from a sample of workers in Harare and Masvingo in the informal sector and households living in informal settlements, and areas where informal residents and informal workers, intersect. The total number of respondents was 418 from a targeted sample of 420. *Table A1* shows the characteristics of respondents from the survey.

Focus Group Discussions: We analysed the findings from the survey above to assess trends, patterns and gaps in evidence and identified areas that required in-depth follow-up and validation from the same target groups that participated in the survey interviews through the FGDs. We developed and piloted the FGD questions that covered

these areas and those that required further investigation for interpretation of survey findings, and to address the core[1] questions and objectives for the FGDs. In all, six focus group discussions were conducted in Harare and Masvingo, with a total of 207 participants against a target of 210. *Table A2* shows the characteristics of the FGD respondents.

Ethics: We obtained permissions from the Medical Research Council of Zimbabwe (MRCZ/A/2467) and from City of Masvingo and City of Harare. We also got approval from the University of Warwick (BSREC REGO-2019-2340). We used a standardised individual informed consent form for our survey and a standardised group consent form for our FGDs. All our research data was treated with confidentiality and secured in password protected electronic devices.

Table A1: Survey respondent characteristics

Characteristic	No of respondents	Percent of respondents			
		Harare		Masvingo	
		Hopley	Mabvuku Tafara	Urban agric formal	SWM formal
Respondent characteristics					
Sex					
Male	127	26.6	35.5	26	54
Female	291	73.4	64.5	74	46
Age					
18-34	117	48.2	18.2	12	30
35-54	175	38.1	48.1	43	46
55-64	77	8.6	16.9	27	16
65+	49	5.0	16.9	18	8
Marital status					
Single	40	5.8	11.7	9	11
Married	227	61.9	59.7	48	42
Divorced/separated	26	4.3	6.5	6	14
Cohabitating	36	15.1	3.9	6	8
Widowed	89	12.9	18.2	31	25
Level of schooling					
No schooling completed	25	5.1	6.6	7	5
Primary	98	18.1	18.4	30	19
Secondary/High School but no diploma	245	73.2	61.8	43	70
Diploma or equivalent, trade/ technical/vocational training	35	3.6	9.2	13	5
Degree or higher	15	0.0	3.9	7	0
Average period (in years) respondent had lived in area		7	23	20	9

1 The FGDs assessed (i) the household and community assets and approaches that are available or being used to address health and climate change, (ii) the provision of services and inputs by local authorities, government, non-government and private sector organisations related to health and climate change and to the assets and approaches in communities and (iii) interventions prioritised by communities to address risks and enhance benefits.

Table A2: FGD Respondent Characteristics

Characteristic	Percent of respondents				
	Harare		Masvingo		TOTAL
	Hopley/ Informal/ Solid Waste	Mabvuku Tafara/ formal/Urban agriculture	Masvingo urban agriculture/ formal	Masvingo solid waste/ formal	
TARGET vs ACTUAL SAMPLE TOTAL NUMBERS					
Target sample	35	70	70	35	210
Actual Sample	34	75	65	33	207
Actual vs target (%)	97	107	93	94	99
RESPONDENT CHARACTERISTICS OF THE ACTUAL SAMPLE					
Sex					
Male	24	10	18	76	25
Female	76	90	82	24	75
Age					
18-34	20	24	12	30	21
35-54	76	68	66	33	63
55-64	4	5	15	30	12
65+	0	4	6	6	4
Marital status					
Single	20	9	29	18	18
Married	68	90	54	52	70
Divorced/separated	12	1	17	27	12
Level of schooling					
None	12	0	0	9	3
Primary	0	1	9	24	8
Secondary school	88	77	68	36	69
Diploma or higher	0	21	18	27	19
Degree or higher	0	1	5	3	3

Limitations (See section 1.5)

In the project 'From surviving to thriving: Learning from responses to the health effects of climate change in informal workers and informal settlements of Zimbabwe'

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