

Income-generating activities (IGAs) and climate change vulnerabilities

Kerina Tull

University of Leeds Nuffield Centre for International Health and Development

1 December 2020

Questions

- *How has climate change affected income-generating activities (IGAs) for urban/peri-urban dwellers in fragile and conflicted affected states?*
- *Are there any IGAs that are climate resilient/adaptive?*
- *Are there any IGAs that exacerbate vulnerabilities?*

Contents

1. Summary
2. Climate change vulnerabilities
3. Climate change challenges for urban dwellers in FCAS
4. Climate resilient/adaptive income-generating activities (IGAs)
5. Climate change impact on IGAs for vulnerable urban groups
6. IGAs that exacerbate vulnerabilities
7. References

The K4D helpdesk service provides brief summaries of current research, evidence, and lessons learned. Helpdesk reports are not rigorous or systematic reviews; they are intended to provide an introduction to the most important evidence related to a research question. They draw on a rapid desk-based review of published literature and consultation with subject specialists.

Helpdesk reports are commissioned by the UK Foreign, Commonwealth, and Development Office and other Government departments, but the views and opinions expressed do not necessarily reflect those of FCDO, the UK Government, K4D or any other contributing organisation. For further information, please contact helpdesk@k4d.info.

1. Summary

Climate change has affected a number of income-generating activities (IGAs) for vulnerable groups, such as low-income urban and peri-urban dwellers, women, youth and disabled people. Therefore, it is important to understand how adaptation and mitigation of the detrimental effects of extreme climatic events can counter the impact of climate change on their livelihoods (Rashamol & Sejian, 2018).

Fragile and conflict affected states (FCAS) include low- and middle-income countries (LMICs) which are vulnerable to ongoing multiple shocks, therefore this rapid review will focus on small selection of IGAs in FCAS (Afghanistan, Somalia/Somaliland, and Yemen). Lessons learned are also taken from LMIC vulnerable groups affected by climate changes in the Middle East (Lebanon), Latin America (Colombia, Ecuador, Mexico) and Africa (Ethiopia, Rwanda, South Africa, Tanzania, and Uganda).

Key points to highlight:

- *Effect of climate on IGAs:* Seawater greenhouses in Somaliland have been designed to produce vegetables and salt which are commercially viable, **however, as the region is not politically stable all profits were taken up by security** (Watts, 2019). Brick production (the main economic activity in Mexico and Columbia) **benefited with fewer rainy days** because their work can be extended during more of the year (Soto-Montes-de-Oca & Alfie-Cohen, 2019).
- *Climate change resilient/adaptive IGAs:* A number of these are related to **small-scale urban and peri-urban agriculture (UPA) adapting to heat stresses** – e.g. rooftop gardening generated USD378 per annum in Lebanon for Palestinian refugees (Anera, 2013). Adding stimulant crops (e.g. alcoholic beverage crops) in urban gardening in Tanzania provided 46-78% extra income per household (Baker, 1994) and an extra USD246 per household in Ethiopia (Legesse et al., 2016). However, changing to non-farm income IGAs allowed more to be spent on other basic needs in Ethiopia (Zerai & Gebreegziabher, 2011; Adem et al., 2018).
- *Achieving resilient/adaptive IGAs:* **Valuable assets** suitable to generate income include house land, financial capital to start up a business (even petty trade), means of transport (vehicle, rickshaw, motorbike, donkey cart), computers and mobile phones that are used frequently as productive tools (Lovon, 2016). **Combinations** of crops/livestock can be viable IGAs, e.g. honey production and other services such as educational tours or modern beehive production, as in South Africa (Cadwallader et al., 2011). Policy, infrastructure, finance, training, and awareness are some of the key areas that could prove helpful in strengthening UPA in urban areas (Shukla, 2019). Some cities (e.g. in Somalia) rely more on non-agricultural IGAs, as urban household income could change from day to day (Lovon, 2016).
- *Benefits of resilient/adaptive IGAs:* Most available evidence on impact is for UPA. As well as modest additional annual incomes, urban households involved in IGAs are less reliant on fuelwood, which is an environmental benefit (Ndayambaje, 2013).
- *Non-resilient/adaptive IGAs:* Animal husbandry has produced 60-70% income among half of small farmer households in peri-urban Ethiopia (Ali & Neka, 2012) - however, it is to the detriment of the environment (Foeken et al., 2004). Production of the stimulant Qat in

Yemen is not a climate change resilient IGA as it depletes scarce water resources and replaces essential food crops. The use of wastewater in vegetable crop production in drought effect areas has **both positive and negative impacts** on crop production, public health, soil resources and ecosystems (Ethiopia). Although forests play a role in ecosystem adaptation, deforestation for to cope with droughts (as in Rwanda, Tanzania, Somalia, Uganda) has already been banned by the United Nations.

- *Effect of resilient/adaptive IGAs on vulnerable groups:* Most countries have developed agricultural IGAs as a solution to heat stresses and urban food insecurity. Urban dwellers with space for a garden could be guided on how to use it effectively for growing vegetables and fruits (Shukla, 2019). Gender is also an important aspect of urban and peri-urban agriculture as many, and frequently the majority of, urban farmers and producers are women. Urban agriculture is not only **offering women new opportunities** but new ways of **combining** work, family and personal life (ILO, 2013). IGA interventions include those specific for women (e.g. by People in Need [PIN] in Afghanistan), although non-beneficiary households living in the area have also benefited. Extreme weather may discourage travel: although tour guide jobs provide good additional income, this is only in cities with longstanding 'good' tourism (Mngumi, 2019). Tourism can also offer work opportunities for people with disabilities (ILO, 2013), however, the evidence for young people is not completely positive.
- *Strength of evidence:* Data is available from grey literature and academic outputs. Although climate change and its effect on livelihoods and income is recognised, there is **no specific definition available for climate resilient/adaptive IGAs**. The resilient IGAs listed are not particularly linked to climate change (i.e. they are not stated as adapted to climate change), or explicitly stated as climate resilient (apart from beekeeping- Mngumi, 2019). There is also **a lack of literature on such IGAs in FCAS**. In terms of vulnerable groups, gaps in literature are specifically income generating opportunities for urban dwellers in Asian areas, as well as for young and disabled FCAS urban dwellers.

Researchers have drawn generalisable causal inferences tying climatic events to social outcomes (Carlton & Hsiang, 2016). However, a recent literature review on climate change–conflict literature confirms that **scholarly attention on urban areas is very limited** (Plänitz, 2019). **Most evidence that is available is for UPA IGAs**. Research shows that it is possible to help poor people cope with food scarcity and hunger through climate resilient IGAs such as: the growing of plants, community gardening (Afghanistan), rooftop gardening (Lebanon), urban forest gardening (Ethiopia, Rwanda), and urban beekeeping (South Africa, Tanzania). They also offer the urban poor a viable income (Shukla, 2019). However, IGAs related to animal husbandry (e.g. dairy farming/milk production) within and around cities are not climate change resilient.

2. Climate change vulnerabilities

Effect on urban infrastructure

Recent literature (Salimi & Al-Ghamdi, 2020) shows the social and economic aspects of the challenges in cities due to climate change, such as damaged infrastructure (e.g. animal

dwellings, plant or animal processing buildings linked to farms, etc.), heat-related mortality, energy shortage, and food and water scarcity.¹

Climate change impacts can exacerbate existing development challenges in fragile and conflict-affected states (FCAS).² Climate change and extreme geophysical and meteorological events – slow onset, such as increased temperatures and reduced solar radiation, as well as increased frequency and intensity of rainfall and cyclones, storm surges, and tsunamis (sudden onset) – pose additional threats to energy infrastructure sustainability.³

Effect on urban populations

The vulnerability of cities to extreme climatic events results from their dense populations and the varying resilience of the infrastructure. That vulnerability is experienced most severely by already marginalised city dwellers; the safety of women and children causes particular concern (Alber et al., 2017). Rural-urban migration is increasing in most LMICs and this trend is expected to continue in the coming decades. Climate change can impact on rural-urban migration indirectly and directly.

In predominately agricultural-dependent settings, high temperatures can damage crops and inflate electricity demand. However, agricultural effects cannot explain many patterns in the overall economic response to climate change, leading to the hypothesis that effects on labour are another important channel of influence (Hsiang, 2010). A growing body of evidence now supports this theory (Heal & Park, 2015).

Precipitation extremes (in terms of both excess and deficient rainfall) can harm economies and populations (Carleton & Hsiang, 2016). Tropical cyclones can also damage assets and reduce economic output for long periods (Rashamol & Sejian, 2018). Therefore, adaptation and mitigation of the detrimental effects of extreme climatic events plays important role to counter the impact of climate change on livelihoods (Rashamol & Sejian, 2018).

As there is no clear definition of climate resilient income generating activities (IGAs)⁴ they can be considered climate resilient if they can be adapted to the surroundings, or if incomes can be diversified as climate change has negatively impact livelihoods. These examples can explain the need for diverse IGAs to improve livelihoods and food security in response to climate change impacts (Adem et al., 2018).

¹ See Bolton (2020) for details of water infrastructure in FCAS.

² Asia Clean Energy Forum. (2020). Track 3: FCAS and SIDS: Resilience in the Face of Fragility and Conflict - Asia Clean Energy Forum: <https://www.asiacleanenergyforum.org/faq/track-3-fcas-and-sids-resilience-in-the-face-of-fragility-and-conflict/>

³ The Intergovernmental Panel on Climate Change (IPCC): <https://www.ipcc.ch/sr15/chapter/chapter-3/>

⁴ IGAs consist of small businesses managed by a group of people to increase their household income through livelihood diversification. They include financial tools and training to empower entrepreneurs to build businesses, support their families, and transform their communities. See: Communities for Development (2018). Income generating activities. <https://communitiesfordevelopment.org/what-we-do/our-approach/income-generating-activities/>

3. Climate change challenges for urban dwellers in FCAS

Ongoing conflicts present similar challenges and potential devastation to that of climate change. Therefore, it is important that tailored solutions and regional and cross-sectoral approaches beyond “business-as-usual”, in order to tackle the real and present danger head-on, are explored.⁵

Low income countries make up 51% of FCAS, and all of these are International Development Association (IDA) eligible or “blend” countries⁶, while 34% are lower middle-income, and 14% are upper middle-income countries (WHO, 2017). Using information from the Fund for Peace’s Fragile State Index⁷ evidence for this rapid review is included for cities in the following FCAS: Afghanistan (score 102.9, 2020 rank 8), Somalia (score 110.9, 2020 rank 2), and Yemen (score 112.4, 2020 rank 1).⁸ There is also information on countries recovering from prior conflicts or with unstable economies such as Lebanon (score 84.7, 2020 rank 40); and those in Africa [Ethiopia (score 94.6, 2020 rank 21), Rwanda (score 86.0, 2020 rank 35), South Africa (score 70.1, 2020 rank 83), Tanzania (score 78.1, 2020 rank 59), and Uganda (92.8, 2020 rank 24)] and Latin America [Colombia (score 76.6, 2020 rank 65), Ecuador (score 69.4, 2020 rank 87, Mexico (score 67.2, 2020 rank 98)].

Although climate change impacts directly on urban/peri-urban dweller, many of the challenges highlighted here are indirectly impacted by climate change, exacerbating underlying issues.

Work efficiency of urban/peri-urban dwellers

Urban dwellers are particularly susceptible to climate change impacts, especially **temperature rises and air pollution**⁹ (Grote, 2019). One impact of heat waves includes decreasing work efficiency (Kjellstrom et al., 2016). Heat stress can lower work intensity, reduce cognitive performance, and voluntarily shorten work hours in sectors of the economy most exposed to outdoor temperature, such as construction and agriculture (Seppanen et al., 2006; Graff Zivin et al., 2015; Graff Zivin & Neidell, 2014). A key contributor to heightened levels of particle matter in urban settings is the combustion of solid and liquid fuels for power generation, domestic heating, cooking or lighting and in vehicle engines (Avis et al., 2018: 15).

⁵ Asia Clean Energy Forum 2020: <https://www.asiacleanenergyforum.org/faq/track-3-fcas-and-sids-resilience-in-the-face-of-fragility-and-conflict/>

⁶ Eligibility for IDA support depends first and foremost on a country’s relative poverty, defined as Gross National Income (GNI) per capita below an established threshold and updated annually (USD1,185 in the fiscal year 2021). ‘Blend’ countries (e.g. Nigeria, Pakistan) are those that are eligible for IDA funding based on per capita income, but which are at the same time deemed credit-worthy by the markets.

⁷ The Fragile States Index (FSI) measures the vulnerability in pre-conflict, active conflict and post-conflict situations. The index comprises of twelve conflict risk indicators. The higher the value of the index, the more “fragile” the country is. For comparison, the world average in 2020 based on 176 countries is 65.58 index points.

⁸ Fragile state index – Country rankings: https://www.theglobaleconomy.com/rankings/fragile_state_index/

⁹ Air pollutants have a complex relationship with climate change. Some pollutants, such as black carbon and ozone, increase warming by trapping heat in the atmosphere, while others, such as sulphur dioxide forming light reflecting particles, have a cooling effect on the climate (see Air Pollution and Climate Change: https://ec.europa.eu/environment/integration/research/newsalert/pdf/24si_en.pdf).

Gender inequalities in finding income

Climate change is expected to exacerbate current gender inequalities (CARE International, 2020). Climate extremes may mean more men are leaving to try to find income elsewhere, and that puts additional burden on the women who stay back and try to earn money while taking care of the family (Rowling, 2020). Depletion of natural resources and decreasing agricultural productivity may place additional burdens on women's health and reduce time available to participate in decision making processes and IGAs (Harold et al., 2012: 12).

Reduced job options for young, displaced or refugee workers

Climate change is affecting where and how young people want to live. It is also affecting decisions they are making about career choices. In FCAS, although the literature does not directly link climate change and conflict¹⁰, the young are at risk of militia who recruit young people, as well as groups that exploit youth and engage in human trafficking (Darden, 2019: 4; Ndung'u et al., 2017). Gender relations and roles within internally displaced persons (IDPs), refugee, returnee and migrant families are also changing, with the new division of labour between men and women possibly challenging traditional views (FAO, 2018a: 17).

Lost opportunities for disabled workers

People with disabilities are at increased risk of the adverse impacts of climate change. Climate change impacts intensify the barriers faced by persons with disabilities in the world of work, for example when job opportunities are lost because of the economic impacts of climate disasters, or when heat stress causes manual labour to be hazardous (ILO, 2019: 4). Environmental degradation often affects marginalised workers the most (ILO, 2018). Indigenous persons with disabilities who are small-scale agricultural producers risk losing the possibility of independent living, owing to climate change impacts that undermine agricultural production and thereby their livelihoods (ILO, 2019: 2).

4. Climate resilient/adaptive income-generating activities (IGAs)

Although climate change can affect certain jobs and decrease incomes, there are climate resilient/adaptive activities that are income generating. However, it is important to note that what works in some cities might not work elsewhere due to differences in climate change, as well as other factors:

Adaptive urban farming IGAs

Adaptive **urban agriculture** includes urban and peri-urban agriculture (UPA), or urban and peri-urban agriculture and forestry (UPAF). UPA includes urban gardening – i.e. the growing of plants, trees, food and other agricultural products (herbs, pot plants, fuel, fodder) and animal husbandry (raising of livestock or fisheries) within the built-up area or on the fringe of cities.

¹⁰ Although there are – see Kelley et al. 2015 (<https://doi.org/10.1073/pnas.1421533112>) and Welch 2015 (<https://www.nationalgeographic.com/news/2015/3/150302-syria-war-climate-change-drought/>)

UPAF includes production systems such as horticulture, (agro-) forestry and aquaculture and input supply, processing and marketing activities. Like climate change, **income generation is another major force driving UPA** (ILO, 2013: 18). UPA stimulates the development of related micro- and larger agro-enterprises, such as those related to agricultural inputs (e.g. production of compost from urban organic wastes, bio-pesticides, small-scale irrigation equipment), product processing (cooking, frying, drying), packaging and marketing and other services (for example animal health services, transport) (ILO, 2013: 18).

Research shows that it is possible to help poor people cope with food scarcity and hunger through: the growing of plants, community gardening, rooftop gardening, urban forest gardening, animal husbandry, and urban beekeeping. It will also offer urban poor a viable income during climate changes (Shukla, 2019), as the following examples show:

Urban gardening

Case study: Afghanistan

Afghanistan is one of the most vulnerable countries in the world to climate change, and one of the least equipped to handle what's to come. Experts say drought, flood, avalanches, landslides, extreme weather, mass displacement, conflict, and child marriage – all of which already plague Afghanistan – are set to worsen. As the population in urban and peri-urban areas of Afghanistan grows at an alarming rate, so does poverty and vulnerability (PIN, 2017).

Urban areas account for about a quarter of the population.¹¹ The latest Afghanistan Living Conditions Survey¹² estimates that the slum population living in urban areas is approximately 5.0 million people, which is 72.4% of the total urban population. Cities are home to a disproportionate number of youth (aged between 15 and 24 years), who constitute nearly a quarter of the urban population (23.6%) (UN-Habitat Afghanistan & Government of the Islamic Republic of Afghanistan, 2015: viii).

Aid agencies implement formal IGA livelihood support programmes (UNHCR, 2006). Grants and micro-credits are often used to help refugees set up a small business or IGAs. Social capital helps to increase women's productivity, improving their access to IGAs. Gender inequality is a major challenge in Afghan cities, with women and girls facing significant structural barriers to their full social and economic participation in urban life (UN-Habitat Afghanistan & Government of the Islamic Republic of Afghanistan, 2015: viii). People in Need (PIN), with funding from the European Union and the Czech Development Agency, responded to the growing poverty in urban and peri-urban areas of Mazar-i-Sharif in northern Afghanistan.¹³ Their 28-month project focused specifically on women with particularly limited access to IGAs. After the training, beneficiaries accounted that their **economic situation was better** compared to the time before joining the project; most of them managed to open their own business, more than a half stated

¹¹ Afghanistan Living Conditions Survey (ALCS) 2013/14.

¹² ALCS 2016-2017. *Analysis report draft version*. Afghanistan Living Conditions Survey. Islamic Republic of Afghanistan Central Statistics Organization: <https://www.ilo.org/surveyLib/index.php/catalog/2114/related-materials>

¹³ <https://reliefweb.int/report/afghanistan/over-1100-afghans-living-urban-areas-improved-their-lives-through-vocational>

that they could buy more goods (such as meat, oil or eggs), and more than a third said they can save more money. In total, 520 beneficiaries benefited from the agricultural component of the initiative (including introduction of low-cost innovative technologies to the farmers, such as greenhouses, rainwater harvesting mechanisms or vertical gardening). Given the urban context, people had very small plots – 10-15 square meters – however, all of them reported high harvest rates. Motivated by the success of their neighbours, some non-beneficiary households living in the area also tried the innovative concept of urban gardens themselves as an IGA (PIN, 2017).

Case study: Ethiopia

Ethiopia faces numerous development challenges that exacerbate its vulnerability to climate change, including high levels of food insecurity and ongoing conflicts over natural resources. Ethiopia is currently facing a civil war between government forces and troops in its northern Tigray region. Although this may cause migration from cities, data from The World Bank has shown that the urban population in Ethiopia is expected to triple to 42.3 million over the next twenty years.¹⁴ Climate change is pushing millions of people into cities like Addis Ababa: this city has already experienced a rapid rate of urban growth over the past decades (Veolia Institute, 2019: 22). These urban areas demonstrate the importance of agriculture in the large conurbations of the southern hemisphere, contributing both to the livelihood of their inhabitants and to the resilience of urban systems in the face of economic, social and environmental crises (Veolia Institute, 2019: 5):

Any effect on agriculture will significantly affect the Ethiopian economy. However, it is predicted that changes in climate will lead to recurrent droughts and heavy rainfall in different parts of the country, reducing the amount of land that can be used for agriculture and decreasing crop productivity. Generally, marketing of **home garden products** – especially fruits and vegetables provides households with a regular source of income. The activity provides employment not only for the household heads and their partners, but also for the children and other household members, and for other people like daily labourers and sellers of horticultural products (Legesse et al., 2016: 26). Research from Mekelle city stated that the net average mean income per household reached 9,411.19 birr (USD246). The range of net income from home garden per household was from 1,657.00 up to 38,000.00 birr (USD43-994). However, sustainability of urban home gardens depends on water availability, seed availability, pests/insects, as well as extension of government support, if necessary (Legesse et al., 2016: 29).

Urban forest gardening

Case study: Rwanda

Since the civil war in 1994, Rwanda has been a fragile state. From 1971 to 2016 the mean temperature has increased between 1.4°C and 2.5°C. Climate change has brought prolonged

¹⁴ Alemayehu, A. (2019). Why should Ethiopians care about urbanization? Jobs, infrastructure, and formal land and housing. 27 March 2019. <https://blogs.worldbank.org/africacan/why-should-ethiopians-care-about-urbanization-jobs-infrastructure-and-formal-land-and-housing>

droughts followed by intense rainfall, the impacts of which threaten both human safety and economic development.¹⁵

Research shows that agriculture is the most important source of income for 80% of urban and rural households involved with IGA (Ndayambaje, 2013: 135). Of these, 25% diversified their income sources through the selling of **tree products**. Only 9% of households sold avocado, mango, papaw, guava and citrus fruit. Annual income generated from the selling of tree products was less than 10,000 Rwandan Francs (FRW) (USD17). Urban households usually use more fuelwood than others for energy (Abebaw, 2008). However, with increased household involvement in off-farm IGAs, households are less reliant on collected fuelwood, therefore making them more climate resilient (Ndayambaje, 2013: 107).

Urban rooftop gardening

Rooftop gardening needs little space. As an IGA, the economic viability is still theoretical more than practical, but theoretically it can support a three-member family in worse case scenarios (Reuters, 2020):

Case study: Refugees in Lebanon

Unlike other FCAS, Lebanon has relatively lower poverty levels (Malaeb, 2018: 4). Although Lebanon eliminated a ban on Palestinians holding most clerical and technical positions, provided they obtain a temporary work permit from the Labour Ministry, more than 20 high-level professions remain off-limits to Palestinian refugees. A pilot urban agriculture project in Ein el Helweh refugee camp, in southern Lebanon, had the goal of exploring the viability of rooftop gardens for food production for other marginalised and overcrowded refugee camps.¹⁶ The average 50 square meter space available on a rooftop could generate **an income of as much as USD378 a year**. That would be a welcome resource for struggling Palestinian refugee families whose average monthly income is less than USD400 (Anera, 2013). With one vertical wall kit, an average family should be able to save a minimum of USD50 on food costs each month – a significant sum when the monthly average income for Syrian refugee households in Lebanon is USD165 (Alabasta, 2016).

Peri-urban/urban beverage crops

Case study: Tanzania

One study of the peri-urban interface in Tanzania found that two out of five farmers in and around the city of Biharamulo included alcoholic beverage crops in their product mix (Baker, 1994). **The income generated by these crops ranged from 46-78% of the farmers' total income**. The most common type of beverage was beer made from bananas, the second was distilled spirits. Production was strictly divided by gender – all beer was made and sold by women, while all spirits were produced by men. Most significantly, the households that **combined alcohol**

¹⁵ USAID (2012). Climate Change Adaptation in RWANDA.

https://www.climatelinks.org/sites/default/files/asset/document/rwanda_adaptation_fact_sheet_jan2012.pdf

¹⁶ <https://www.anera.org/stories/rooftop-gardening-nahr-el-bared-refugee-camp-lebanon/>

production and sale with other agricultural crops had a constant cash flow to meet the household budget.

Peri-urban seawater greenhouses

Case study: Somaliland

Somaliland has endured regular cycles of drought for the past 20 years, therefore water is a scarce commodity. Seawater greenhouses are custom-designed to fit the economic and climate conditions of a particular region to decouple drought in the region from food-shortages and famine. They use desalination and evaporative cooling for this aquaculture, but have nets rather than a traditional greenhouse. The first seawater vegetable crop near the capital and coastal city of Berbera was harvested in October 2018.¹⁷ The Somaliland greenhouse can produce 300 to 750 tonnes of tomatoes per hectare. This, and the salt (which contributes some 10% to the profit of the enterprise), make it commercially viable – **or it would do if the region were politically more stable**. As it is, the project has to employ three armed guards at a price that absorbs much of the scheme's profit (Watts, 2019).

Urban beekeeping and services

Case study: South Africa

South Africa was named the most unequal country in the world in 2019 by the World Bank in terms of economic development (Dlamini, 2019). The country also fell into recession in late 2018, while the issue of inequality has been attributed to lack of service delivery to the marginalised.

Beekeeping, or apiculture, is the art of raising and harvesting bees for the purpose of collecting honey and other beekeeping products such as bees wax. Beekeeping is stated “as one of the inherent ecosystem-based climate friendly livelihood options with potential for building community resilience against climate change effects” (Mngumi, 2019). Since honey is a valuable product and there is an existing market for it worldwide, exploitation of this discipline may lead to potential income generation for the various South Africans that partake in it (Cadwallader et al., 2011: 8).

Besides being an IGA, beekeeping is also **a fairly easy to maintain occupation**. Beekeeping is not a rigorous activity, unlike most agricultural efforts. Only a few hours a day are needed to check the state of the hive and make sure that everything is going smoothly. It also does not require the same financial investment as the planting of crops does. However, **in order to survive, the beekeepers must offer additional services** (pest control, pollination, educational tours, modern beehive production, processing and packaging technologies and practices such as equipment and facilities for honey collection, processing and wax production) besides honey production to gain an edge against the competition. The combination of honey production and

¹⁷ See Akinaga et al. (2018) for model design examples optimised for the climates in Iran (Ahwaz) and India (Gujarat, Ahmedabad) where natural seawater is fed to the cooling process, enhancing salt production in solar salt works.

services should serve as a motivation to further pursue beekeeping as an IGA (Cadwallader et al., 2011: 12).

Non-agricultural IGAs

As agriculture is nature dependent and the common jobs of small-holder farmers, it is usually characterised by different problems such as poor fertility of the soil, volatile rainfall, crop and livestock diseases, price shocks for crop and livestock products and other related conditions which lead to generating low income and gradually results in food insecurity and poverty (Adem et al., 2018). Research shows that **urban households derive most of their income from sectors that are largely unaffected by climate change** (Breisinger et al., 2011: 27).

House land is one of the most valuable assets for IGAs, as house ownership brings stability, security and opportunities to run a business or generate income. Other type of valuable assets are those suitable to generate income such as: **financial capital** to start up a business (even petty trade), **means of transport** (vehicle, rickshaw, motorbike, donkey cart), **computers and mobile phones** that are used frequently as productive tools (Lovon, 2016: 21). Therefore, some urban dwellers/cities use these to focus more on finding non-agricultural IGAs:

Case study: Ethiopia (government non-farming IGA schemes)

Although the peri-urban smallholder farmers are involved in diverse livelihood activities, their participation in non-farm and/or off-farm activities is influenced by complex and yet empirically unidentified factors and it is not clear why some households participate in different IGAs while other participate in farming only (Zerai & Gebreegziabher, 2011 in Adem et al., 2018). Zerai and Gebreegziabher (2011) studied the effect of non-farm income on household food security in eastern Tigray to examine the effect of non-farm employment. Findings indicate that **non-farm employment provides additional income that enables farmers to spend more on their basic needs** (e.g. food, education, clothing, and health care). In Addis Ababa, the government has adopted income generating schemes through promoting micro and small enterprise (MSE) for women and youth. The major types of IGAs are non-farm employment, such as construction, manufacturing (e.g. metalwork, woodwork, food preparation), service, and trade, and therefore climate resilient (Gelanew, 2013).

Case study: Mexico (craft production)

In 2017, Mexico was the most worsened country in terms of the Fragile State Index – due to a decline in Mexico’s economy, the deteriorating status of refugees, and prevalent political corruption had pushed the country to the 88th position.¹⁸ However, in a surprising twist, in 2018 Mexico recovered to become the Fragile State Index’s sixth-most improved country.

Agriculture is still happening in Mexico, but with less quality due to warmer weather, water extracted from deeper depths with lower quality, more salt, and less rain (Soto-Montes-de-Oca & Alfie-Cohen, 2019). Soto-Montes-de-Oca and Alfie-Cohen (2019) analysed impacts of climate change on peri-urban communities that are at risk of drought. The study focused on two Mexican

¹⁸ Fragile State Index (2018). Resilience Drives a Remarkable Bounce Back for Mexico. 23 April 2018: <https://fragilestatesindex.org/tag/mexico/>

cities, Aguascalientes (central Mexico) and Hermosillo (northwest Mexico), and their respective peri-urban communities (Los Pargos in Aguascalientes City, and San Pedro-El Saucito in Hermosillo City), to highlight the shared awareness of increased temperatures as well as rainfall decrease in income choices. Vulnerability experienced by both communities differed by dimensions, like exposure and sensibility to the climate variability. Participants from the Hermosillo community reported experiencing acute changes in their environment, indicating a higher exposure to climate change compared to the community near Aguascalientes, who reported moderate changes in temperature extremes and changes to precipitation levels.

A main consequence of the heat is that the people went to the city to look for work because there are no “milpas” (mixed crops and traditional form of agriculture) anymore. The situation of vulnerability was higher for those who are still engaged in these activities, indicating that still about 100 people are engaged in agriculture (Soto-Montes-de-Oca & Alfie-Cohen, 2019). Though Los Pargos participants recognised the effect of weather variability, they said that **brick production (their main economic activity) benefited with fewer rainy days, because their work can be extended during more of the year** (Soto-Montes-de-Oca & Alfie-Cohen, 2019).

5. Climate change impact on IGAs for vulnerable urban groups

Past scholars of climate-society interactions were limited to theorising on the basis of anecdotal evidence. Advances in computing, data availability, and study design now allow researchers to draw generalisable causal inferences tying climatic events to social outcomes (Carlton & Hsiang, 2016). However, a recent literature review on climate change–conflict literature shows that scholarly attention on urban areas is still limited (Plänitz, 2019). The following is a list of evidence showing how climate change has affected IGAs for certain groups living in cities in a variety of ways:

Workforce diversity and production

Particular focus by the International Labor Organization (ILO) is given to job creation and income generating opportunities for self-employed farming family households, hired waged agricultural labourers, youth and women, and cooperative organisations (ILO, 2013). Research shows that IGAs also result in a higher self-esteem, enhanced self-management capacity and more interactions with other actors in the urban society (Houessou et al., 2020).

More female urban dwellers

Both women and men working in natural resource sectors, such as agriculture, are likely to be affected by climate changes.¹⁹ During extreme weather such as droughts and floods, women tend to work more to secure household livelihoods. This will leave less time for women to access training and education, develop skills or earn income. UPA offers **new opportunities for women** to combine food production with child-care and other household activities (ILO, 2013: 5):

¹⁹ ILO (2008). Report of the Committee on Employment and Social Policy, Employment and labour market implications of climate change, Fourth Item on the Agenda, Governing Body, 303rd Session (Geneva), p. 2.

Case study: Afghanistan (new IGA opportunities)

In 2019, 25.75% of Afghanistan's total population lived in urban areas and cities.²⁰ The Aga Khan Development Network (AKDN) has been pioneering micro-hydroelectric power (MPH) units and solar power in Afghanistan since 2004.²¹ Renewable energy reduces the use of polluting fuels such as diesel or petrol, and reduces the unhealthy effects of woodsmoke and other fumes in the house. In addition, **electricity opens up new opportunities for other IGAs**, whether carpet-weaving, tailoring, or other small-scale businesses. However, the urban labour market is still characterised by skills mismatch and problems of job quality in both the informal and the small formal sectors (ILO, 2012: 3).

More young workers

Market-oriented UPA provides relatively easy access to the urban job market for youth, and low start-up costs for new enterprises. However, the evidence on this is not completely positive:

Case study: Ethiopia

In Gambella city, the current coping strategy to flood, erratic rainfall, wildfire, is sending children for work to urban areas to sell charcoal and firewood, etc. (Federal Democratic Republic of Ethiopia, 2019: 54).

More disabled workers

UPA, because of its low-entry costs, flexibility, and proximity to places of residence, could offer work opportunities for people with disabilities (ILO, 2013: 44). However, the evidence is scarce:

Case study: Ecuador

Although not currently a conflict-affected state, Ecuador still faces chronic human rights challenges, including poor prison conditions, laws that give authorities broad powers to limit free speech and judicial independence, and far-reaching restrictions on women's and girls' access to reproductive health care.²² Ecuador also faces a variety of climate change risks associated with changes in temperature and precipitation, as well as possible alterations to ocean currents.

The mountainous location of the capital Quito makes it highly vulnerable to landslides, which occur more frequently due to higher temperatures, less rainfall, and extreme rains associated with climate change (Rodríguez Dueñas, 2019). In a mission to promote urban agriculture in order to further food security, gender equality, social inclusion, and IGAs in Quito a municipal programme has been set-up. **Quito's Participatory Urban Agriculture Project (AGRUPAR)** is strongly backed by the city and a wide range of partners. It particularly targets the empowerment of women and children, vulnerable communities (people with disabilities and the unemployed; but

²⁰ Statista (2019). Afghanistan: Urbanization from 2009 to 2019: <https://www.statista.com/statistics/455773/urbanization-in-afghanistan/>

²¹ AKDN: <https://www.akdn.org/project/clean-and-green>

²² Human Rights Watch (2019). World Report 2019: Ecuador: <https://www.hrw.org/world-report/2019/country-chapters/ecuador>

also the elderly, people in rehabilitation, and minorities such as indigenous people, refugees, migrants, etc.). Forty-eight community banks and several Collectives of Urban Farmers have also been created, offering better commercialisation opportunities for their 3,000 members. **Participants have seen a USD175 increase in their monthly income**, achieving an average income of USD3,100 a year (Rodríguez Dueñas, 2019). The programme has also led to the creation of around 340 jobs and 180 small enterprises, which are mostly formalised.

6. IGAs that exacerbate vulnerabilities

There is some controversy about the impact of income diversification on food access: in the short run participating in income diversification or non/off-farm activities, raising the cash is important to fill the food deficit; however, the controversy comes from the long run effect of income diversification or participating non/off-farm activities may reduce the availability of food and gradually it leads to food insecurity (Adem et al., 2018). Some of the alternative IGAs people are turning to in FCAS are also worsening climate change through either producing significant greenhouse gas (GHG) emissions or exacerbating vulnerabilities:

Deforestation for construction/manufacturing and energy

With continued urbanisation in several FCAS, there is a need for research into a wide range of topics around sustainable urban energy futures, including on urban energy planning, comparative life cycle analyses for different fuels, and on the economic and social impacts of different energy scenarios for human health, employment, and the environment (Doggart et al., 2020). It is also an important source of cash income for people in both urban and rural areas (Ndayambaje, 2013: 3). Charcoal is going to be a part of the energy mix for the foreseeable future; therefore there is a need to get behind the development of charcoal to transform it into a modern fuel supplied from well-managed woodlands, providing further employment opportunities, sold to consumers in ways that protect their energy rights, and used by consumers in ways that minimise exposure to pollution and maximise energy efficiency (Doggart et al., 2020).

Case study: Columbia (brick fabrication)

Brick fabrication is the most important economic activity in Latin American countries, including in fragile states such as Colombia, which saw its worst year-on-year change in the history of the Fragile State Index in 2020 (Fiertz, 2020). Many families in Colombia have their own production unit based on traditional techniques. However, **the industry uses inefficient technology and high fuel consumption** (e.g. using charcoal fuel for brick kilns) that leads to significant emissions of GHGs, particulate matter (PM), black carbon (BC) and other pollutants (Bickel, 2015; Soto-Montes-de-Oca & Alfie-Cohen, 2019).

Case study: Somalia (charcoal production)

Converting Acacia trees, which often grow in swampy areas or near water, into charcoal reduces the land available to herders and limits their ability to cope with droughts. Thus this type of deforestation was banned by the UN in 2012 (Ro, 2019).

Organic plant and animal material provide over 95% of primary energy for households in Somalia, either as firewood or charcoal (UNEP, 2018). Somalia has a **huge opportunity to**

diversify its energy sources through reduction of reliance on charcoal and firewood in favour of alternatives like wind, solar, liquefied petroleum gas, biogas, hydro and high-efficiency thermal generation and distribution systems (UNEP, 2018). Despite possessing untapped reserves of numerous natural resources such as uranium, iron ore, tin, gypsum, bauxite, copper, salt and natural gas, **Somalia's energy sector remains grossly under-developed**.

Case study: Uganda

Though Uganda's Fragile State Index fluctuated substantially in recent years, it tended to increase through 2005 – 2019.²³ Climate change is likely to impact on large proportions of the urban populations in Uganda, resulting in increased social polarisation of communities as a result of urban poverty, environmental degradation and increasing burdens (sanitation, flooding, waste accumulation, public health, and disasters).²⁴

New economic practices for generating money are both causing climate change (such as through **tree-cutting within Jinja and in surrounding peri-urban areas**) and violating past generations' standards of behaviour and environmental responsibilities (McQuaid et al., 2018: 20). Deforestation is feeding both construction (fuel for brick kilns, or wood for house-building) and energy (firewood and charcoal) demands. For example, streets, marketplaces, and small harbours bustle with people earning a livelihood from self-initiated, unregulated, often illegal, and environmentally unsustainable strategies in Jinja, southern Uganda (Lince, 2011: 74). These IGAs include **tree-cutting for charcoal** to either sell or consume (the most commonly cited environmental problem by Jinja's residents), small-scale fishing – particularly of juvenile fish stocks, and hawking fruit and vegetables, clothes or other household necessities, with little hope of accumulating any savings. Many of these activities – in contrast to the economic transformations widely associated with urbanisation and engagement in higher value-added work and production – are partly or wholly dependent on the natural environment, and are thus highly sensitive to changes in weather (McQuaid et al., 2018: 5).

Animal husbandry and dairy farming

Among the climatic variables, **heat stress** seems to be the most significant factor which negatively affects livestock production (Rashamol & Sejian, 2018). Animal numbers must be reduced to produce the same amount of animal source food, to mitigate detrimental effects of livestock on the environment, in particular on climate change (Woldegebriel et al., 2017). However, research shows that this is not occurring:

Case study: Ethiopia (livestock production)

Ethiopia is estimated to have the largest livestock population in Africa with almost 60 million cattle (UNDP, 2018). Frequent and extensive droughts in the country have a considerable effect on Ethiopia's livestock because decreased rainfall shrinks available water resources and reduces the productivity of grassland and rangeland.

²³ <https://knoema.com/atlas/Uganda/topics/World-Rankings/World-Rankings/Fragile-states-index>

²⁴ https://unfccc.int/files/adaptation/knowledge_resources/databases/partners_action_pledges/application/pdf/un-habitat_furtherinfo5_060511.pdf

Urban and peri-urban livestock production constitutes an important sub-sector of the agricultural production system in Ethiopia (Tegegne et al., 2002). Therefore, it is important to find IGAs that have adapted to the detrimental effects of extreme climatic events, or can counter the impact of climate change on livestock production (Rashamol & Sejian, 2018). IGA research on peri-urban livestock farming in West Gojjam shows that it contributes 60-70% income among the 51.25% households of small farmers (Ali & Neka, 2012). There are gender differences: findings describe 51.6% contribution of females in livestock husbandry for barn (e.g. poultry) and cleaning, while men performed 71.5% marketing activities. More than 87% agricultural operations were conducted by men using livestock. However, global warming is expected to alter the feed intake, mortality, growth, reproduction, maintenance, and production of animals (Gashaw et al., 2014: 40). This will also have adverse effects on meat quality due to both declining forage quality and increased ambient temperature, as well as milk production, making it an unreliable IGA for the future.

Case study: Tanzania (milk production)

Though its score in the Fragile State Index has fluctuated substantially in recent years, Tanzania's score tended to decrease through 2005 – 2019.²⁵ Climate change has resulted in congestion, pollution and flooding in urban areas.²⁶ These are significant challenges to the future of farming.

The majority of women in the peri-urban Arumeru district consider dairy farming as their major source of income, followed by production of crops such as vegetables, bananas, maize and beans. However, some women also have to engage in non-agricultural activities though at a small-scale, these include; tailoring, owning small shops and selling second-hand clothes (Kimaro et al., 2013).

Selling milk was found to be particularly rewarding if organised on a certain scale (Mlozi & Hella, 2001 in Foeken et al., 2004: 136-137). Dairy production integrated into rural, peri-urban and urban smallholder mixed farming systems may increase and stabilise farm incomes and act as a catalyst for agricultural development and improved standards of living (Swai & Karimuribo, 2011). However, current figures (September 2020) show that milk production per day in Tanzania is 265,000 litres; this is far too low and does not keep pace with the actual demand, as smallholder dairy farming is only widespread in parts of Tanzania where the climate is appropriate – which is changing rapidly.²⁷

Crop production

Crop cultivation is usually felt to be less damaging to the urban environment, although many regard the use of chemical inputs as harmful to the air, soil and groundwater (Foeken et al., 2004: 99):

²⁵ <https://knoema.com/atlas/United-Republic-of-Tanzania/topics/World-Rankings/World-Rankings/Fragile-states-index>

²⁶ Africa Talks Climate (2010: 13). Research Report TANZANIA.

<https://assets.publishing.service.gov.uk/media/57a08b0740f0b64974000906/10-Tanzania-Talks-Climate.pdf>

²⁷ <https://dailynews.co.tz/news/2020-09-305f74116af4025.aspx>

Case study: Ethiopia (coffee/vegetable production)

After livestock, grain production is the second most important sector in the country's agriculture-based economy. Grain consumption, especially for wheat and wheat-based products like biscuits, bread and pasta, continues to climb as incomes rise and more people move to urban centres (ITA, 2020). However, the impacts of climate change on the environment could also reduce the national income from the export of agricultural products such as pulses and flowers. Of particular concern is the possible impact on Ethiopia's famous Arabica coffee, which is exported all over the world. **Coffee plants are very sensitive to climate change** and there are concerns that Arabica coffee production could become impossible in Ethiopia by the end of this century.²⁸ A biophysical projection of climate impacts on Arabica coffee in Ethiopia suggests that if current climate trends continue, by 2080 somewhere between 65% and almost 100% of current coffee-growing areas will be unsuitable for production (Davis et al., 2012).

Although recycling water should be seen as a positive, **use of wastewater in agriculture for production of vegetables is controversial** due to its benefits and negative health impacts (Gashaye, 2020). Despite the great importance of irrigating vegetable crops with wastewater, as a food source for the urban community and as income generation, it is subject to numerous constraints and is causing high health risks like cholera, typhoid, etc., among consumers of wastewater-irrigated produce.

Case study: Yemen (qat production)

Since 2014, the ongoing multi-sided Yemeni Civil War has resulted in Yemen becoming the highest ranked fragile state.²⁹ Yemen is one of the countries most affected by climate change, ranging from shifting seasons and unpredictable rainfall to soaring temperatures and fiercer, more frequent cyclones.³⁰ Climate change is causing increased periods of drought and unpredictable rainfall (FAO, 2018b: 15). Yemen's natural resources are under pressure on account of demographic changes, weak and poorly managed institutions and governance, and instability and a deteriorating economic situation brought on by the current conflict and the impacts of climate change. Frequent droughts and flooding have affected livelihoods and income generation for a large percentage of the population.

The livestock sector is an integral component of peri-urban livelihoods in Yemen, where households mainly keep sheep, goats, cattle, camels and poultry, and rely on the consumption and sale of their products (FAO, 2018b: 12). Women-headed households in particular, depend on income generated from the socially and environmentally damaging, but financially lucrative, production of qat (FAO, 2018a:11) which is grown in peri-urban and urban areas such as

²⁸ Study Session 11 Impacts of Climate Change in Ethiopia - 11.3 Climate change effects on agriculture, livestock and the Ethiopian economy:
<https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=79973&printable=1#:~:text=Therefore%2C%20any%20effect%20on%20agriculture,agriculture%20and%20decreasing%20crop%20productivity>

²⁹ https://www.theglobaleconomy.com/rankings/fragile_state_index/

³⁰ Earth Day (2020). GROUPS IN YEMEN FIGHT CLIMATE CHANGE. 10 February 2020:
<https://www.earthday.org/yemen-fights-against-climate-change/#:~:text=February%2010%2C%202020,and%20fiercer%2C%20more%20frequent%20hurricanes>

Sana'a. **Qat has been found to deplete scarce water resources, and replace essential food crops and agricultural exports.**

Low grade service industry work

Case study: Mexico (tourism industry)

Although climate change is transforming Mexico's geography, the peri-urban area of Los Pargass still receives tourists from the city of Aguascalientes. However, most of women surveyed by Soto-Montes-de-Oca & Alfie-Cohen (2019) did not perceive any benefit of this. In fact they complained because tourists brought too much garbage. Although this can create other IGAs, it is to the detriment of the environment.

Case study: Mexico (motor industry)

In San Pedro, the acute effects of climate change have changed agriculture and livestock production, and transformed into a rapid change in the economic dynamic of the area, leading people to find other sources of income. The option of finding jobs in the city has also improved or compensated their economic alternatives (Soto-Montes-de-Oca & Alfie-Cohen, 2019). The Nissan motor company hires a lot of people from the surrounding areas of Aguascalientes city. Research study findings reflect that having a job with the company has advantages because it is less hard-work than brick production, since typically employees are not exposed to heat and diseases. However, dwellers also complain that these are too low paid jobs. Also, as the motor industry has always been a significant contributor to global GHG, these IGAs will not be sustainable.

Case study: Somalia (casual/formal trade)

Somalia is currently the second highest ranked fragile state in 2020.³¹ It topped the failed state index, according to the Fragile States Index of 2016, even though it was the focus of world aid and attention. In a global ranking of vulnerability to the impacts of climate change, Somalia ranked 7th out of 233 countries and regions (UNEP, 2018), Along with a decades-long civil war, Somalia is also on the front line of vulnerability to climate change.

Income sources in urban areas are based on **trade at different scales** (petty trade and larger-scale activities, including trade of crops and livestock products), casual or more formal employment, self-employment (craft making: bricklaying, masonry, carpentry etc.), remittances or other type of family/community support, and other IGAs such as rental of services (i.e. means of transport) or urban infrastructure.³² **Direct involvement in agricultural production, livestock rearing or cultivation is relatively low among urban families**, particularly in Mogadishu (i.e. the Mogadishu Food Security & Nutrition Situation Trends shows that only 12% of urban households keep any type of livestock). However agricultural production and livestock rearing can be more significant in other cities in the country. For instance in the South, urban areas are

³¹ https://www.theglobaleconomy.com/rankings/fragile_state_index/

³² According to the various urban food security assessments reviewed, casual labour is the main income source for around 30-50% of households, petty trade for 10-15%, self-employment for 12-15%, while 15-40% of households receive remittances (Lovon, 2016: 12).

surrounded by huge agricultural lands, meaning that significant number of families engage in farming as farmers themselves or laborers. Significant numbers also keep animals for milking, others invest in livestock to increase their wealth and also to fall back on in bad years (Lovon, 2016: 12). **Urban households' income could change from day to day**, while periods with lower employment or income generating opportunities are not well defined and depend on the specific income source; this could vary greatly over time and among households with the same income sources. In general, there are temporary, seasonal and unstable income sources (Lovon, 2016: 12-13).

Case study: Tanzania (tourism industry)

The tourism industry, which includes cultural tourism (food tourism, arts and craft tourism and nature/eco-tourism), is one of the viable economic activities identified by a study of the Pugu and Kazimzumbwi socio-ecological system, which is looking at forest reserves and providing response diversity to climate change effects (Mngumi, 2019). However, those serving as tour guides are lowly paid, to the extent that they cannot support themselves through entirely depending on tourism, for example: Kisarawe tourism industry is not as developed as in northern urban and peri-urban regions such as Arusha, Kilimanjaro, Manyara, and Tanga where tour guides are well paid (Mngumi, 2019). Also, as tourism and the travel sector are developing higher dependencies on high energy transport and activities, as well as more luxurious accommodations, this further decreases eco-efficiency.³³

7. References

Abebaw, D. (2008). Household Determinants of Fuelwood Choice in Urban Ethiopia: a Case Study of Jimma Town. *Journal of Developing Areas*, 41(1), 117-126.
DOI: [10.1353/jda.2008.0009](https://doi.org/10.1353/jda.2008.0009)

Adem, M., Tadele, E., Mossie, H., & Ayenalem, M. (2018). Income diversification and food security situation in Ethiopia: A review study. *Cogent Food & Agriculture*, 4:1. DOI: [10.1080/23311932.2018.1513354](https://doi.org/10.1080/23311932.2018.1513354)

Akinaga, T., Generalis, S.C., Paton, C., Igobo, O.N., & Davies, P.A. (2018). Brine utilisation for cooling and salt production in wind-driven seawater greenhouses: Design and modelling. *Desalination*, 426, 135-154. <https://doi.org/10.1016/j.desal.2017.10.025>

Alabasta, O. (2016). *Syrian refugees find solace in rooftop gardens*. 2 September 2016.
<https://www.aljazeera.com/news/2016/9/2/syrian-refugees-find-solace-in-rooftop-gardens>

Alber, G., Cahoon, K., & Röhr, U. (2017). Gender and urban climate change policy: Tackling cross-cutting issues towards equitable, sustainable cities. In *Understanding climate change through gender relations* (pp. 64-86). Routledge.

³³ Eldis (2007). The impact of tourism on climate change. <https://www.eldis.org/document/A43261>

Ali, M., & Neka, M. (2012). Livestock Husbandry and Economic-Sustainability of Small Farmers in Peri-Urban Areas: A Case Study from West Gojjam Region, Ethiopia. *AJOL*, 5(2), 207-217. DOI: [10.4314/ejesm.v5i2.13](https://doi.org/10.4314/ejesm.v5i2.13)

Anera. (2013). *Rooftop Gardening in Nahr El Bared Refugee Camp, Lebanon*. American Near East Refugee Aid. <https://reliefweb.int/report/lebanon/rooftop-gardening-nahr-el-bared-refugee-camp-lebanon>

Avis, W. Mariga, S., & Singh, A. (2018). *Air Pollution Exposure in Low Income Households in Kampala*. ASAPEast Africa Vulnerability Scoping Study no. 6. Birmingham, UK: University of Birmingham. <https://static1.squarespace.com/static/5a6b5aad12abd97ed4679071/t/5e56a8f3672e8272382f76ff/1582737656154/ASAP++East+Africa++Vulnerability+Scoping+Study++Low+Income+Households+in+Kampala.pdf>

Baker, J. (1994). Survival and Accumulation Strategies at the Rural-Urban Interface in North-West Tanzania. *Urban Perspectives*, 4:12-17. <https://journals.sagepub.com/doi/pdf/10.1177/095624789500700103>

Bickel, J. (2015). *Energy efficiency in the brick sector: a path to mitigate climate change*. 2 December 2015. <https://beamexchange.org/community/blogs/2015/12/2/energy-efficiency-bricks/>

Bolton, L. (2020). *Water infrastructure in fragile- and conflict-affected states*. K4D Helpdesk Report 912. Brighton, UK: Institute of Development Studies. https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/15802/912_Vulnerabilities_in_water_infrastrucutre_in_fragile_and_conflict_affected_states.pdf?sequence=1

Breisinger, C., Ecker, O., Al-Riffai, P., Robertson, R., Thiele, R., & Wiebelt, M. (2011). *Climate Change, Agricultural Production and Food Security: Evidence from Yemen*. Kiel Working Paper No. 1747. https://www.ifw-kiel.de/fileadmin/Dateiverwaltung/IfW-Publications/Manfred_Wiebelt/climate-change-agricultural-production-and-food-security-evidence-from-yemen/KAP_1747.pdf

Cadwallader, A., Hewey, V., Isaza, S., & Simsek, E. (2011). *Supporting Urban Beekeeping Livelihood Strategies in Cape Town*. 21 December 2011. <https://cpb-us-w2.wpmucdn.com/wp.wpi.edu/dist/f/266/files/2011/11/CT11-Bees-Final-Report.pdf>

CARE International. (2020). *EVICTED BY CLIMATE CHANGE - CONFRONTING THE GENDERED IMPACTS OF CLIMATE-INDUCED DISPLACEMENT*. <https://careclimatechange.org/wp-content/uploads/2020/07/CARE-Climate-Migration-Report-v0.4.pdf>

Carleton, T.A., & Hsiang, S.M. (2016). Social and economic impacts of climate. *Science*, 353(6304). <https://science.sciencemag.org/content/353/6304/aad9837>

Davis, A.P., Gole, T.W., Baena, S., & Moat, J. (2012). The Impact of Climate Change on Indigenous Arabica Coffee (*Coffea arabica*): Predicting Future Trends and Identifying Priorities. *PLoS ONE*, 7(11), e47981. <https://doi.org/10.1371/journal.pone.0047981>

Dlamini, K. (2019). *FRAGILE STATES INDEX 2019 – SA IN THE WARNING ZONE*. 4 Jun 2019. Corruption Watch. <https://www.corruptionwatch.org.za/fragile-states-index-2019-sa-in-the-warning-zone/>

Doggart, N., Ruhinduka, R., Meshack, C.K., *et al.* (2020). The influence of energy policy on charcoal consumption in urban households in Tanzania. *Energy for Sustainable Development*, 57, 200-213. <https://doi.org/10.1016/j.esd.2020.06.002>

FAO (2018a). *Yemen, Plan of Action – Strengthening resilient agricultural livelihoods (2018–2020)*. Food and Agriculture Organization of the United Nations. Rome. 68 pp. <http://www.fao.org/3/I9054EN/i9054en.pdf>

FAO (2018b). *Yemen Emergency Livelihoods Response Plan 2018*. Food and Agriculture Organization of the United Nations. https://reliefweb.int/sites/reliefweb.int/files/resources/web_I9019EN_YEMEN_ELRP2018.pdf

Fiertz, N. (2020). *Colombia's Peace Deal Unravels*. Fragile States Index. 10 May 2020. <https://fragilestatesindex.org/2020/05/10/colombias-peace-deal-unravels/>

Foeken, D., Sofer, M., & Mlozi, M. (2004). *Urban agriculture in Tanzania: issues of sustainability*. African Studies Centre. <http://hdl.handle.net/20.500.12018/2810>

Gashaw, T., Asresie, A., & Haylom, M. (2014). Climate change and livestock production in Ethiopia. *Advances in Life Science and Technology*, 22, 39-42. <https://core.ac.uk/download/pdf/234686975.pdf>

Gashaye, D. (2020). Wastewater-irrigated urban vegetable farming in Ethiopia: A review on their potential contamination and health effects. *Cogent Food & Agriculture*, 6(1), pp1-17. <https://www.tandfonline.com/doi/pdf/10.1080/23311932.2020.1772629?needAccess=true>

Gelane, B. (2013). *The Role of Income Generating Activities for Livelihood Improvement of Women and Youth in Addis Ababa: The Case of Yeka Sub-City*. PhD thesis. <http://etd.aau.edu.et/handle/123456789/283?show=full>

Graff Zivin, J.S., Hsiang, S.M., & Neidell, M.J. (2015). *Temperature and human capital in the short-and long-run*. NBER Working Paper 21157. <https://www.journals.uchicago.edu/doi/abs/10.1086/694177>

Graff Zivin, J., & Neidell, M. (2014). Temperature and the allocation of time: Implications for climate change. *J Labor Econ*, 32, 1–26. DOI:10.1086/671766doi:10.1086/671766

Grote, R. (2019). The impact of climate change will hit urban dwellers first – Can green infrastructure save us?, *Climanosco Research Articles*, 2. <https://doi.org/10.37207/CRA.2.2>

Harold, M., Agrawala, S., Steele, P., *et al.* (2012). *Poverty and Climate Change - Reducing the Vulnerability of the Poor through Adaptation*. The World Bank. <http://www.oecd.org/env/cc/2502872.pdf>

Heal, G., & Park, J. (2015). *Goldilocks economies? Temperature stress and the direct impacts of climate change*. NBER Working Paper 21119.

Houessou, M.D., van de Louw, M., & Sonneveld, B.G.J.S. (2020). What Constraints the Expansion of Urban Agriculture in Benin? *Sustainability*, 12, 5774. DOI:[10.3390/su12145774](https://doi.org/10.3390/su12145774)

Hsiang, S.M. (2010). Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America. *Proc Natl Acad Sci USA*, 107, 15367–15372. DOI:[10.1073/pnas.1009510107](https://doi.org/10.1073/pnas.1009510107)

ILO. (2019). *Persons with disabilities in a just transition to a low-carbon economy*. Policy Brief. International Labour Organization. https://www.ilo.org/global/topics/disability-and-work/WCMS_727084/lang--en/index.htm

ILO. (2018). *The employment impact of climate change adaptation*. Input document for the G20 Climate Sustainability Working Group. August 2018. <https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/The%20Employment%20Impact%20of%20Climate%20Change%20Adaptation.pdf>

ILO. (2013). *Labour Issues in Urban and Peri-Urban Agriculture: Information and Resource Guide*. International Labour Organization, Geneva, Switzerland. <https://www.cityfarmer.org/WEBLabour.pdf>

ILO. (2012). *Afghanistan: Time to move to Sustainable Jobs Study on the State of Employment in Afghanistan “Summary Report”*. May 2012. https://www.ilo.org/wcmsp5/groups/public/---asia/--ro-bangkok/documents/publication/wcms_182252.pdf

ITA. (2020). *Ethiopia - Commercial Guide*. International Trade Administration. <https://www.trade.gov/knowledge-product/ethiopia-agricultural-sector>

Kimaro, E.G., Mlangwa, J.E.D., Lyimo-Macha, J., & Kimaro, J.G. (2013). The influence of women groups on income obtained from small-scale dairy cattle production: A case of Arumeru district, Tanzania. *Livestock Research for Rural Development*, 25(4). <http://www.lrrd.org/lrrd25/4/kima25060.htm>

Legesse, A., Tesfay, G., & Abay, F. (2016). The Impact of Urban Home Gardening on Household Socio-economy. *Arts and Design Studies*, 39, 21-30. <https://core.ac.uk/download/pdf/234686085.pdf>

Lince, S. (2011). The Informal Sector in Jinja, Uganda: Implications of Formalization and Regulation. *African Studies Review*, 54(2), 73-93. DOI: <https://doi.org/10.1353/arw.2011.0029>

Lovon, M. (2016). *Urban Case Study: Adapting Tools and Methods to Assess Food Security in Urban Areas of Somalia Lessons Learned from Phase I*. Somalia Food Security Cluster/ World Food Programme. https://reliefweb.int/sites/reliefweb.int/files/resources/adapting_to_an_urban_world_somalia_urban_assessment_report_somalia_fsc_0.pdf

Malaeb, B. (2018). *State fragility in Lebanon: Proximate causes and sources of resilience*. <https://www.theigc.org/wp-content/uploads/2018/04/Lebanon-country-report.pdf>

Mlozi, M.R.S., & Hella, P.J. (2001). *Urban animal agriculture: Linkage between poverty alleviation and damage on the environment*. Report submitted to the Tanzania Commission for

Science and Technology, Dar es Salaam. Morogoro: Sokoine University of Agriculture, Department of Agricultural Education and Extension.

Mngumi, L.E. (2019). Socio-ecological resilience to climate change effects in peri-urban areas: insights from the Pugu and Kazimzumbwi forest reserves of Dar es Salaam, Tanzania. *GeoJournal*, pp1-17. <https://doi.org/10.1007/s10708-019-10071-9>

Mngumi, L., Shemdoe, R., & Liwenga, E. (2014). Community dependence on forest resources and its bearing on REDD initiative in Pugu and Kazimzumbwi forest reserves, Tanzania. *African Resources Development Journal*, 1–19.

Ndayambaje, J.D. (2013). *TREES AND WOODLOTS IN RWANDA AND THEIR ROLE IN FUELWOOD SUPPLY*. PhD thesis. <https://edepot.wur.nl/272116>

Ndung'u, I., Salifu, U., & Sigsworth, R. (2017). *Violent Extremism in Kenya*. UN Women Africa. <https://africa.unwomen.org/en/digital-library/publications/2017/12/violent-extremism-in-kenya>

PIN (2017). *OVER 1,100 AFGHANS LIVING IN URBAN AREAS IMPROVED THEIR LIVES THROUGH VOCATIONAL TRAINING, SELF-HELP GROUPS AND URBAN GARDENS*. 6 January 2017. People in Need. <https://www.clovekvtisni.cz/en/over-1-100-afghans-living-in-urban-areas-improved-their-lives-through-vocational-training-self-help-groups-and-urban-gardens-3818gp>

Plänitz, E. (2019). Neglecting the urban? Exploring rural-urban disparities in the climate change–conflict literature on Sub-Saharan Africa. *Urban Climate*, 30. <https://doi.org/10.1016/j.uclim.2019.100533>

Rashamol, V.P., & Sejian, V. (2018). Climate Resilient Livestock Production: Way Forward. *Dairy & Veterinary Sciences*, 5(5), pp1-2. DOI: [10.19080/JDVS.2018.05.555673](https://doi.org/10.19080/JDVS.2018.05.555673)

Reuters. (2020). *Syrian builds rooftop farm to beat economic hardship*. 11 May 2020. <https://www.reuters.com/video/watch/idOVCDHT65J>

Ro, C. (2019). *Climate Change Is Benefiting Terrorists In Somalia*. 27 October 2019. <https://www.forbes.com/sites/christinero/2019/10/27/climate-change-is-benefiting-terrorists-in-somalia/?sh=3a2287a51016>

Rodríguez Dueñas, A. (2019). *How the municipality of Quito supports vulnerable city dwellers through urban agriculture*. *Journal of Field Actions*, 20, 26-31. <https://journals.openedition.org/factsreports/5641#authors>

Rowling, M. (2020). *Why climate change increases gender inequality*. 15 July 2020. World Economic forum. <https://www.weforum.org/agenda/2020/07/climate-change-environment-women-equality-inequality-parity/>

Salimi, M., & Al-Ghamdi, S.G. (2020). Climate change impacts on critical urban infrastructure and urban resiliency strategies for the Middle East. *Sustainable Cities and Society*, 54. <https://doi.org/10.1016/j.scs.2019.101948>

- Seppanen, O., Fisk, W.J., & Lei, Q. (2006). *Room temperature and productivity in office work*. Lawrence Berkeley National Laboratory. <https://escholarship.org/content/qt9bw3n707/qt9bw3n707.pdf>
- Shukla, J. (2019). *Rwanda: Promoting Urban Agriculture for Food Security*. 5 March 2019. <https://allafrica.com/stories/201903050090.html>
- Soto-Montes-de-Oca, G., & Alfie-Cohen, M. (2019). Impact of climate change in Mexican peri-urban areas with risk of drought. *Journal of Arid Environments*, 162, 74-88. <https://doi.org/10.1016/j.jaridenv.2018.10.006>
- Swai, E., & Karimuribo, E.D. (2011). Smallholder dairy farming in Tanzania Current profiles and prospects for development. *Outlook on Agriculture*, 40(1), 21-27. DOI: [10.5367/oa.2011.0034](https://doi.org/10.5367/oa.2011.0034)
- Tegegne, A., Tadesse, M., Alemayehu, M., & Woltedji, D. (2002). *Scoping Study on Urban and PeriUrban Livestock Production in Addis Ababa, Ethiopia*. DFID. <https://assets.publishing.service.gov.uk/media/57a08d26e5274a31e0001696/ZC0201c.pdf>
- UN-Habitat and Islamic Republic Government of Afghanistan. (2015). *The State of Afghan Cities 2015, Vol 1*. United Nations Human Settlements Programme and Government of the Islamic Republic of Afghanistan, Kabul. <http://unhabitat.org/books/soac2015>
- UNDP. (2018). *Enhancing the productivity of Ethiopia's Livestock Sector*. 27 November 2018. United Nations Development Programme. <https://www.et.undp.org/content/ethiopia/en/home/presscenter/articles/2018/11/27/enhancing-the-productivity-of-ethiopia-s-livestock-sector-.html>
- UNEP. (2018). *How Somalia's charcoal trade is fuelling the Acacia's demise*. 21 March 2018. United Nations Environment Programme. <https://www.unenvironment.org/news-and-stories/story/how-somalias-charcoal-trade-fuelling-acacias-demise>
- UNHCR (2006). *Refugee livelihoods - A review of the evidence*. United Nations High Commissioner for Refugees. <https://www.unhcr.org/4423fe5d2.pdf>
- Veolia Institute. (2019). *Urban agriculture: another way to feed cities. THE VEOLIA INSTITUTE REVIEW - FACTS REPORTS*. <https://ruaf.org/publications/>
- Watts, G. (2019). *Farming in the desert*. Article - Issue 80. <https://www.ingenia.org.uk/Ingenia/Articles/0dcfbb73-b634-487a-93ec-669c2f3ac2bc>
- Woldegebriel, D., Udo, H., Viets, T., van der Harst, E., & Potting, J. (2017). Environmental impact of milk production across an intensification gradient in Ethiopia. *Livestock Science*, 206, 28-36, <https://doi.org/10.1016/j.livsci.2017.10.005>
- WHO (2017). *Fragile and conflict-affected states Health and WHO Country Presence Profile*. World Health Organization. <https://apps.who.int/iris/bitstream/handle/10665/255801/WHO-CCU-17.06-eng.pdf;jsessionid=560205381CC74B5236F314A615CD81CE?sequence=1>
- Zerai, B., & Gebreegziabher, Z. (2011). Effect of nonfarm income on household food security in Eastern Tigray. *Ethiopia: An Entitlement Approach*, 1.

https://www.researchgate.net/publication/228443549_Effect_of_Nonfarm_Income_on_Household_Food_Security_in_Eastern_Tigray_Ethiopia_An_Entitlement_Approach

Acknowledgements

We thank the following experts who voluntarily provided suggestions for relevant literature or other advice to the author to support the preparation of this report. The content of the report does not necessarily reflect the opinions of any of the experts consulted.

- Juan Pablo Rud, Royal Holloway University of London
- Roz Price, Institute of Development Studies (IDS)

Key websites

- Seawater Greenhouse Somaliland: <https://www.sgsomaliland.com/story>
- Syrian rooftop gardening: <https://www.reuters.com/video/watch/idOVCDHT65J>

Suggested citation

Tull, K. (2020). *Income-generating activities (IGAs) and climate change vulnerabilities*. K4D Helpdesk Report 928. Brighton, UK: Institute of Development Studies.

About this report

This report is based on six days of desk-based research. The K4D research helpdesk provides rapid syntheses of a selection of recent relevant literature and international expert thinking in response to specific questions relating to international development. For any enquiries, contact helpdesk@k4d.info.

K4D services are provided by a consortium of leading organisations working in international development, led by the Institute of Development Studies (IDS), with Education Development Trust, Itad, University of Leeds Nuffield Centre for International Health and Development, Liverpool School of Tropical Medicine (LSTM), University of Birmingham International Development Department (IDD) and the University of Manchester Humanitarian and Conflict Response Institute (HCRI).

This report was prepared for the UK Government's Foreign, Commonwealth and Development Office (FCDO) and its partners in support of pro-poor programmes. It is licensed for non-commercial purposes only. Except where otherwise stated, it is licensed for non-commercial purposes under the terms of the [Open Government Licence v3.0](#). K4D cannot be held responsible for errors, omissions or any consequences arising from the use of information contained in this report. Any views and opinions expressed do not necessarily reflect those of FCDO, K4D or any other contributing organisation.



© Crown copyright 2020.