Progress report

Spatial analysis Kibera

KB Feeding Cities and Migration (KB-35-002-001)

Bertram de Rooij[1], Jaap van Os[1] Valerie Janssen[2], and Katrine Soma[2]

[1] Wageningen Environmental Research
[2] Wageningen Economic Research

Introduction

Within the 2019-2022 KB programme *'Food Security and Valuing Water'*, the project '*Feeding Cities and migration settlements'* aims to gain a better understanding of, and therefore a better grip on, urban food systems while paying particular attention to the impact migration has on food security to create sustainable, resilient urban food systems. Besides the overall conceptual work, strategy and tool development, the project has three dedicated case studies which provide new insights and grassroot support which enhance the overall adaptation of the Food System Approach (Van Berkum, 2018) and transition pathways (Elzen, 2020) to the context of urban areas and city region food systems. Also the importance of the spatial environmental perspective was highlighted (De Rooij, 2020), including the call to work on a common understanding at different scales and finding correlations between different scales and themes.

The three case studies within the project are Uganda, Bangladesh and Kenya. Each case study has a different entry point, especially at scale and scope. In Kenya, the case study is dedicated to the Kibera slum in Nairobi. Worthy insights are already gathered through intensive research on primary needs and opportunities, stakeholder consultations and a large scale household survey.

To support the uptake of this household survey to valuable lessons about the geographical differences within Kibera, but also to link these outcomes to the wider city and regional scale to find crucial linkages, at the end of 2020 a start has been made to translate the outcomes of the survey geographically to maps.
Besides, also a preliminary inventory on data availability on the city and regional level on topics that can be linked to the household surveys has been carried out. The aim is to come to better insights about action perspectives at the right scale and interdependencies. These can be translated into initial narratives which will support strategies and actions.

In example, flooding is a major topic in the lower parts of Kibera. The question can be raised if one should reduce the vulnerability to flooding by direct actions in Kibera or more upstream. And how does this link to other opportunities, i.e. firewood and charcoal.

In this progress report the first results will be presented, but most of all provide an outlook for the next steps in 2021.

Objective

The objective of this activity is to translate the most important outcomes of the household consumer surveys based on the 380 interviews held in Kibera, to appealing maps which show the geographical differences and focal points in Kibera per theme/topic; and to place the specific outcomes also in a broader (geographical) perspective. By doing so, action perspectives and sustainability of actions can be improved.

Research questions:

- What are the geographical differences within Kibera per topic?
- How do these topic link to the broader geographical context?
- What lessons can be derived from these results towards action perspectives?

The main results of this activity:
- Thematic maps of Kibera
- Thematic maps of Kibera in broader context
- Initial narratives on themes, linkages and action perspectives

Progress

The starting point is the database of the household survey, which has been aligned with existing sources of the mapping of villages in Kibera. This mapping of the villages was then used to create maps of all key socio-economic characteristics, in order to determine for which variables the mapping is most interesting to be included in a paper.

Some examples of these maps, for key indicators can be found below (Figure 1).

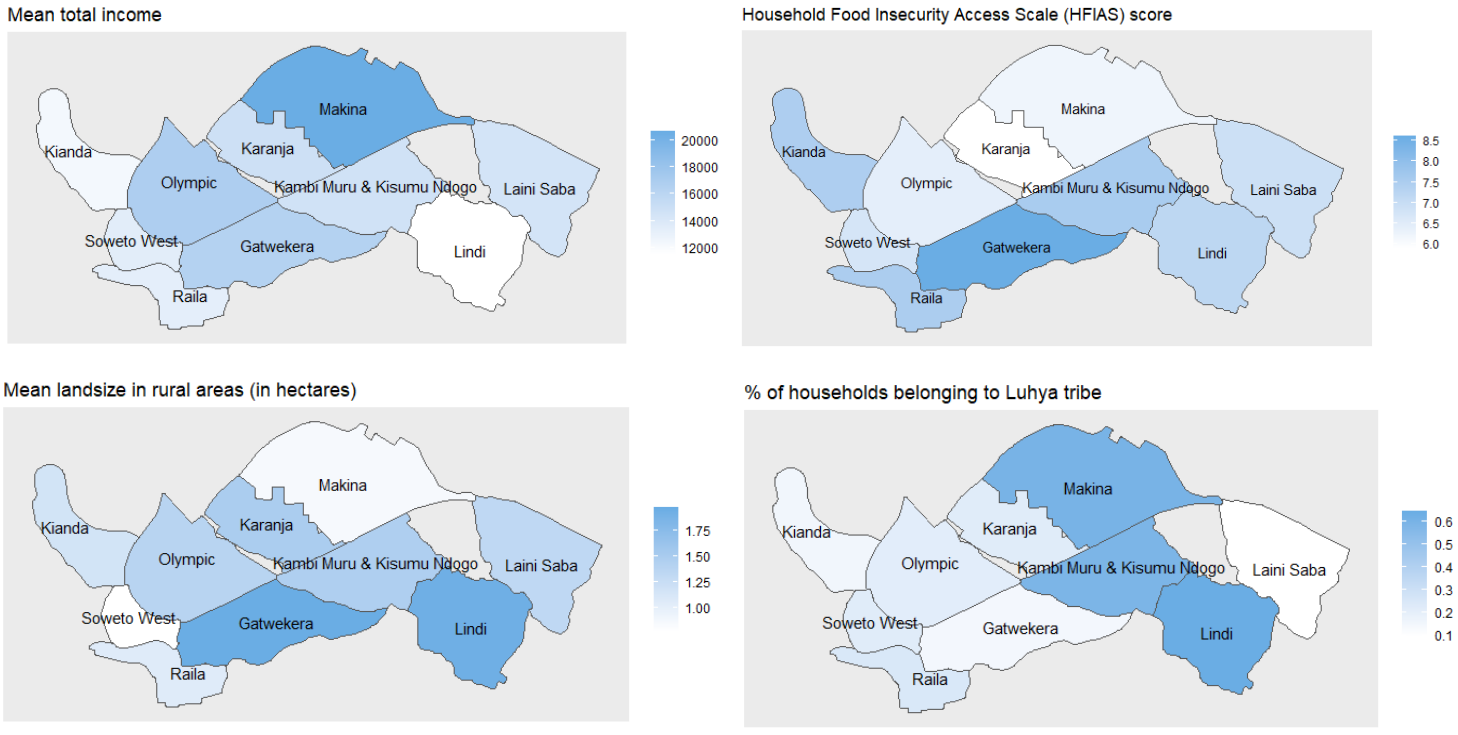

Figure 1 Examples mapping Kibera

We have put together some environmental characteristics of Kibera too: energy en and water sources, waste management and farming activities.

Energy and water sources

40 % of the households in Kibera uses Paraffin as energy source; 19 % use Charcoal and only 5 % is connected to the Electricity network. Firewood, LPG Gas or Solar energy are hardly used; but 36 % uses other sources, of which unfortunately only 1 has specified it: paraffin and jiko. The main sources paraffin and charcoal are used in all villages, except for charcoal in Laini Saba.

m6.1:energysource

	Frequency	Percent
1 Electricity network	20	5,2
3 Charcoal	72	18,7
4 Firewood	1	,3
5 Paraffin	152	39,5
6 LPG gas	1	,3
7 Other, specify	139	36,1
Total	385	100,0

Figure 2 Energy sources Kibera

With 78 %, water purchased from a vendor is the most important water source; 20 % of the HH have access to piped water. Other sources, like buying from a CBO, FBO, NGO, individuals, NMS occur together for only 1,5 % of the HH; one HH reported water from a bore hole. Piped water seems to be available in all villages of Kibera, except for Kianda (see the map); in some of them on a specific location.

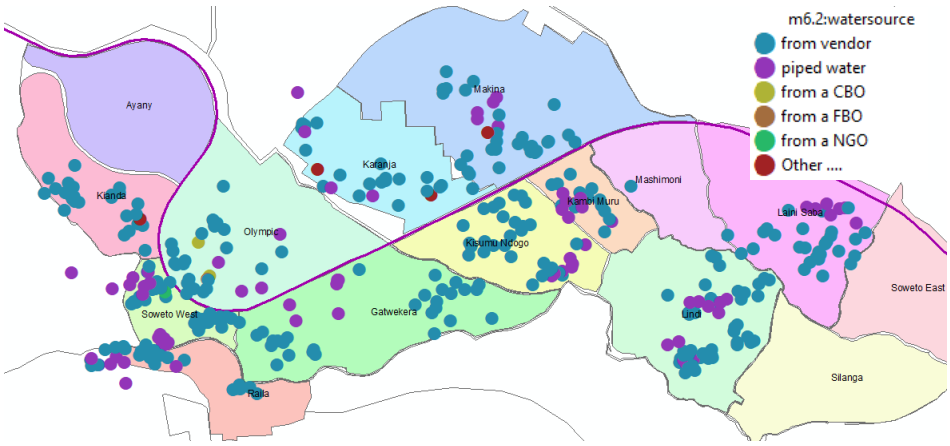

Figure 3 Water sources Kibera

Waste management

It seems that 35 % of the HH do not realize food waste; how do they manage this? Is it a result from good planning and storage, or is available food too little and all consumed every day? Most HH, 43 %, tells that poor storage is the main reason for food waste, contamination is a problem in 11 % of the HH and 8 % notice that food was bad or expired after buying. The second option: contamination by dirty water doesn't seem a reason for food waste. Sometimes food is noticed bad or expired, just after buying. Other reasons are often related to high temperatures during storage. Villages with a low score on storage have a higher score on other reasons, where warmth is the main reason: so storage of food at a high temperature seems the biggest reason for food waste in most villages.

	N	Minimum	Maximum	Sum	Mean
after buying	385	,00	1,00	33,00	,0857
poor storage	385	,00	1,00	167,00	,4338
dirty water	385	,00	1,00	1,00	,0026
contamination	385	,00	1,00	44,00	,1143
other	385	,00	1,00	62,00	,1610
Valid N (listwise)	385				

Figure 4 Reasons for food waste Kibera

Food storage in Kibera is for 85 % of HH in food containers; 30 % use open places too. The refrigerator is used by 6 % , and 1 % use salting. Four percent has other places, see table. The large use of food containers occurs in all villages.

	N	Minimum	Maximum	Sum	Mean
refrigerator	385	,00	1,00	23,00	,0597
salting	385	,00	1,00	5,00	,0130
open places	385	,00	1,00	114,00	,2961
food container	385	,00	1,00	334,00	,8675
other	385	,00	1,00	13,00	,0338
Valid N (listwise)	385				

Figure 5 Stoprage facilities Kibera

The main disposal place for waste in Kibera is throwing it in the water of springs and streams: 40 % of the HH. 29 % also pay persons for getting rid of waste. A formal designated waste area is used by 23 % of the HH, and 9 % uses the open spaces for waste disposal. Pets or livestock counts for less than 1 %. Other destinations are used by 12 % of the HH, mainly trenches and the water drainage, some HH uses the forest. If the formal areas and payed persons count for a responsible waste disposal, more than 50 % of the HH realize this; but more than 60 % use the local environment. Good examples of responsible waste disposal are Olympic, Karanja, Kianda, Makina, Soweto West and Kambi Muru.

		open spaces Mean	springs/streams Mean	formal waste area Mean	pay persons Mean	pet or livestock Mean	other Mean
m4:village	1 Makina	,07	,30	,20	,50	,00	,07
	2 Lindi	,07	,53	,05	,17	,03	,25
	4 Laini Saba	,09	,49	,20	,23	,00	,11
	5 Kianda	,00	,29	,23	,57	,00	,03
	6 Kisumu Ndogo	,10	,43	,23	,13	,00	,30
	8 Soweto West	,09	,34	,54	,14	,00	,03
	9 Gatwekera	,09	,49	,14	,20	,00	,20
	10 Raila	,20	,80	,06	,03	,00	,11
	11 Kambi Muru	,10	,37	,33	,37	,03	,03
	12 Olympic	,17	,03	,47	,37	,00	,03
	13 Karanja	,07	,20	,20	,63	,00	,03

Figure 6 Waste disposal sites Kibera

Farming activities

Land rent is not very common in Kibera: only 4 % of HH rent land, with an average of 1 acre/HH. Nearly 50 % of the households own land, with an average of 1.4 acre / HH. Especially in Lindi, Gatwekera, Karanja and Kambi Muru land ownership is above 1.7 acre / HH. Actual farming is done by only 21 % of the HH in Kibera; this is a yes / no question. The size of the farming activities is not asked. Villages with one third of HH in farming are Kambi Muru, Gatwekera and Lindi; those villages have a relative high land size too.

Urban farming is not very common in Kibera: only 7,5 % of the HH is involved in some kind of urban farming. Most frequent type is poultry keeping, which is deon by 5 % of the HH. Sack farming is done by 2 %, and other types by 1 % (gardens and duck), and only 1 household with goats. Pigs and rooftop farming are not found in our research population. The most western villages like Kianda, Soweto West and Raila are leading in poultry keeping.

		m7:landsize		m7:landsizerent		m7:farming	
		Valid N	Mean	Valid N	Mean	Valid N	Mean
m4:village	1 Makina	11	,83	0	.	30	,10
	2 Lindi	28	1,93	3	,58	60	,28
	4 Laini Saba	11	1,31	2	1,25	35	,17
	5 Kianda	24	1,10	3	,75	35	,17
	6 Kisumu Ndogo	15	1,03	0	.	30	,20
	8 Soweto West	18	,78	1	1,00	35	,20
	9 Gatwekera	22	1,97	0	.	35	,29
	10 Raila	18	1,11	2	,75	35	,11
	11 Kambi Muru	20	1,74	1	3,00	30	,37
	12 Olympic	15	1,43	2	,75	30	,23
	13 Karanja	10	1,85	1	1,00	30	,17

Figure 7 Land tenure Kibera

		1 sack	2 rooftop	3 poultry	4 pigs	5 goats	6 other
		Mean	Mean	Mean	Mean	Mean	Mean
m4:village	1 Makina	,00	,00	,00	,00	,00	,00
	2 Lindi	,02	,00	,00	,00	,02	,02
	4 Laini Saba	,00	,00	,06	,00	,00	,00
	5 Kianda	,06	,00	,17	,00	,00	,00
	6 Kisumu Ndogo	,03	,00	,07	,00	,00	,00
	8 Soweto West	,00	,00	,14	,00	,00	,00
	9 Gatwekera	,03	,00	,03	,00	,00	,00
	10 Raila	,06	,00	,09	,00	,00	,00
	11 Kambi Muru	,00	,00	,00	,00	,00	,00
	12 Olympic	,07	,00	,03	,00	,00	,03
	13 Karanja	,00	,00	,03	,00	,00	,07

Figure 8 Urban farming Kibera

Besides the aim is to develop environmental narratives supported by explanatory maps at different scales to link environmental issues in Kibera to the broader perspective (city scale and regional scale). To develop these narratives it is important to select the most relevant issues from the surveys and the webinars which were held in 2020. This is still subject to proper selection. Clearly, water (quality and quantity), energy, waste, infrastructure, land degradation, land use, tenure and regional produced commodities and proximity seem key elements

There are different GIS-sources available which could be of help, both for Kibera itself as for the wider region of Nairobi:

- https://mapkibera.org/theme/download/
- https://data.humdata.org/organization/map-kibera
- https://www.wri.org/resources/data-sets/kenya-gis-data
- https://www.opendata.go.ke/

The next step will be to put the insights derived from Kibera to the wider perspective in some clear narratives. As an example, an initial narrative for water quality and water quantity has been outlined (Box 1).

Box 1 **Initial narrative Water challenges Kibera and its wider context**

Water is one of the essentials of life and also clearly relates to food security and livelihood conditions. Worldwide averages show only 2 to 4 liters of drinking water is required per person per day, while 2000 to 5000 liters are required to produce food for one person per day. Not only the availability of water as drinking water, but also for cooking purposes is crucial also in terms of food security and food safety. Besides, the quality of water is also highly influenced by the way we land is used and waste management has been arranged. The quality of water and availability influences on its turn again the productivity of agriculture. Clearly, it's multifaceted. A clear understanding of (feedback) loops is important.

A first dive into Kibera and its wider surroundings, show that 78 %, of water is purchased from a vendor. This is clearly the most important water source. Interesting is also that in the survey, contamination by dirty water isn't noticed as a reason for food waste, but talking in terms of food safety and health this should be a topic. And water quality is an issue, as 40% of the households recalls that the main disposal place for waste in Kibera is throwing it in the water of springs and streams. This also explains current peaks in pollution in the surroundings of Kibera, as shown in the graph of Levels of organic pollution along the Ngong-Motoine Rive of the Nairobi River Basin Project (figure 9). This will definitely also burden downstream areas and also to the adjacent National

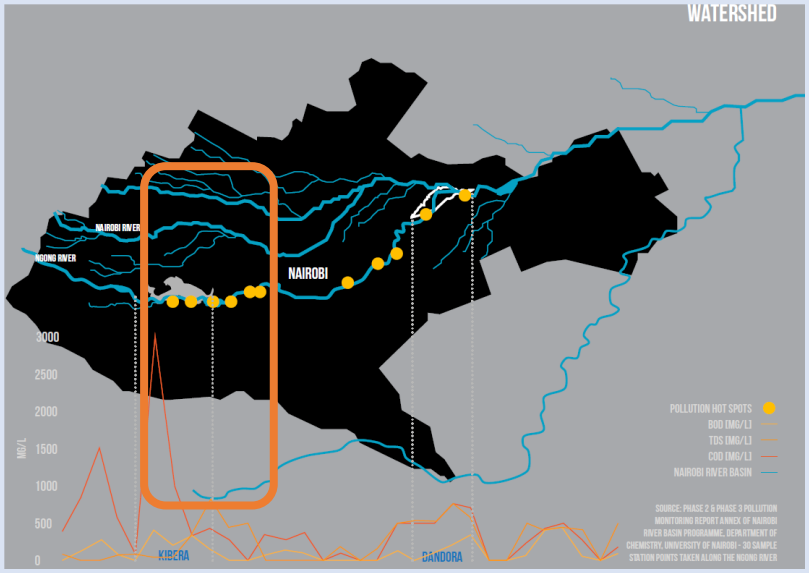

Figure 9 Levels of organic pollution along the Ngong-Motoine River

Polluted stream bank in Kibera, Nairobi, Kenya (Photo credits: Kibera slum, Nairobi, Kenya: UrbanHell, by Ann Hartman, 2014)

Polluted stream next to Kibera, Nairobi, Kenya (Photo credits: UNEP, Flickr.com, 2018)

Due to its specific location (figure 10), but also due to the before mentioned current practice in waste disposal flood risk (figure 11) with adverse consequences is a serious risk in Kibera. The relationship between upstream areas, regional water management and local conditions is something that should be sorted out, also in combination with runoff and erosion along the poor infrastructure and bare soils in Kibera.

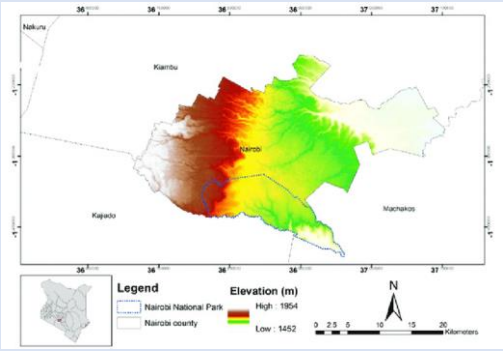

Figure 10 Elevation map of Nairobi County (Source: Ogega, 2019)

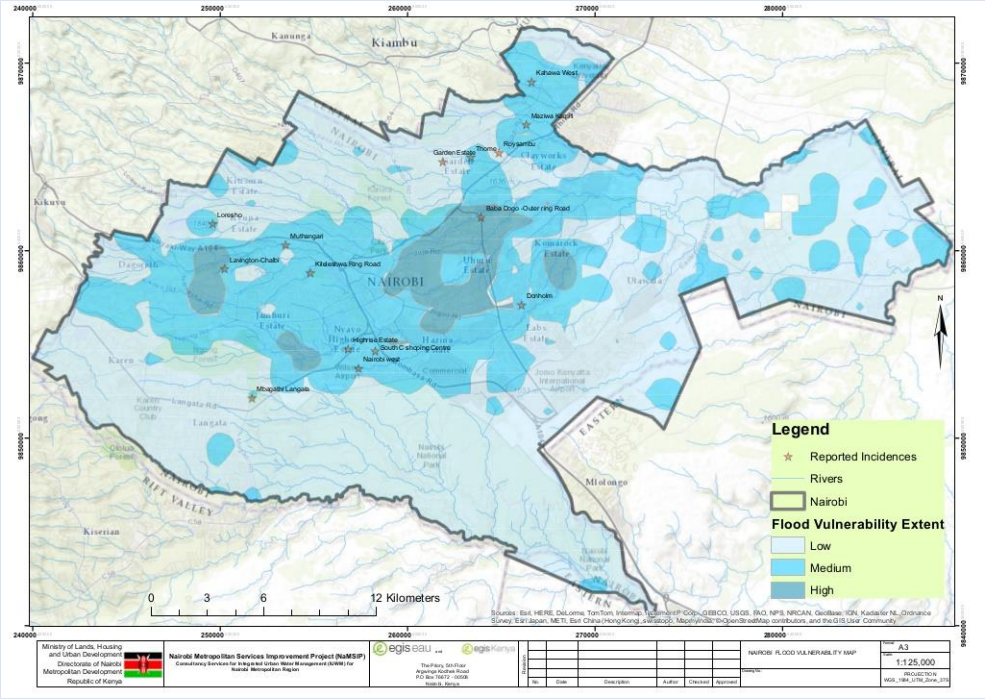

Figure 11 Nairobi Flood Vulnerability Map -NaMSIP/IUWM

Kibera floods 2019
(Photo credits:Cyprian Is Nyankundi Twitter)

Kibera after heavy rains 2012
(Photo credits: Abraham Kasambeli)

Next steps

The socio-economic maps and spatial analyses will be used to support the writing of a scientific paper in 2021.

At the end of 2020 we analyzed different variables of the Kibera HH survey, separately. Based on the overview of all important information which is gathered in this survey, we can analyze the integral picture of the region by searching for relations in the data and in a logical explanation of the interaction between the aspects of this survey.

Second step is placing the developments in Kibera in the perspective, both in relation to the city of Nairobi as in the wider environment where Kibera has relations on topics and the different feedback loops and interdependencies in a food system perspective:

- Food supply chains
- Agricultural production and land ownership
- Water supply and drainage
- Waste management

This will be presented in clear storylines supported by maps and graphs. As such, this spatial analysis will provide clear common grounds for action perspectives at multiple entry points and different levels.

References

Berkum, Siemen van, Just Dengerink and Ruerd Ruben (2018). Van Berkum, S., J. Dengerink and R. Ruben (2018). The food systems approach: sustainable solutions for a sufficient supply of healthy food. Wageningen Economic Research Memorandum 2018-064. Wageningen, Wageningen Economic Research.

Berkum, Siemen van, Jan Broeze, Marion Herens, Bertram de Rooij, Katrine Soma and Lotte Roosendaal (2020). Urbanisation, Migration and Food System Transformations; Concepts and methodologies for a better understanding of the dynamics of urban food systems and migration settlements. Report 2020-046. Wageningen, Wageningen University & Research. 30 pp.

Elzen, Boelie, Wim de Haas, Seerp Wigboldus, Bram Bos & Marijke Dijkshoorn-Dekker (2020). Transition pathways - contours of an analytical framework. Report WPR; no. 839. Wageningen: Wageningen Plant Research. 30 p.

NaMSIP/IUWM (2016), Nairobi Flood Vulnerabilty Map projections

Ogega, O.M. & Wanjohi, H., Mbugua, J. (2019), Exploring the Future of Nairobi National Park in a Changing Climate and Urban Growth

Rooij, L.L. de, Verweij, P., Agricola, H. (2020), Feeding cities and migration; Urban food systems in a spatial environmental perspective. Wageningen, Wageningen Environmental Research, Report 3002

This research was carried out by Wageningen University & Research within the context of the KB-motif 'Feeding cities and migration settlements' as part of the programme Food Security and Valuing Water (KB-35-002-001) and was subsidized by the Dutch Ministry of Agriculture, Nature and Food Quality