JOWHAR
RESILIENCE PLAN

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FOR A BETTER URBAN FUTURE

Jowhar Resilience Plan
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UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME
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Contents

1 INTRODUCTION

The Jowhar Resilience plan provides an overview of the main features related to resilience in the city and its surrounding landscape. It briefly analyses the current development challenges with a special focus on climate-related and environmental-related risks affecting vulnerable population.

It is a complementary technical document to several other planning studies and reports to shape the future of Jowhar in a more sustainable way, providing basic urban services to all communities and leaving no one behind.

This resilience plan provides an identification of the main existing processes currently taking place in the territory and the city, from the point of view of vulnerability. The vision and example interventions are focused in reverting, at least partially, those processes.

This document is a first approach to drafting a resilience plan. Given the lack of available information from all spheres –social, environmental, economic, etc– it is currently difficult, if not impossible, to draft a full scope document.

However, this document does propose a clear methodology that can be later developed. Firstly, a regional and urban scale analysis identifies hazards (1), vulnerable areas (2) and current resilience elements (3). With this information, an interdependence assessment is conducted (4), through the problem tree analysis (inverted). This analysis identifies the process(es) that are in the root of the main hazards perceived across different scales. Once the processes have been identified, a complete vision (5) can be proposed, focused on modifying the main damaging process(es) and not spending energy on solving side sympthoms. This method aims to reduce the hazards and vulnerabilities of Jowhar on the long term.

Reverting the main damaging processes is an endeavor that requires, in general, large-scale, long-term environmental strategic plans, which include continuous monitoring and evaluation from the local authorities. This document does not develop such plans. What it does is propose examples of specific interventions (6) –bottom-up– that local administrations and individuals can undertake to increase urban and regional resilience. These actions are chosen according to their simplicity and based on their effectiveness (drawn from scientific literature descriptions). It would be advisable to present alongside the interventions a monitoring and evaluation plan, so as to ensure their being effective.

The UN has developed more comprehensive, local tools for resilience planning, such as CityRAP Tool, that would be advisable to develop on the field involving local participatory processes. It would also be advisable to conduct a Vulnerability and Risk Analysis (VRA) on the field to make for a more complete vision of the current processes.

It is hoped that this working paper contributes to the necessary public discussion on Jowhar's future development and facilitates decision-making by local, regional, state and federal authorities.

Reference is being made to other studies and data updates undertaken by UN agencies and other international stakeholders, such as: SWALIM (Somalia Water and Land Information Management), World Bank-FAO and CCCM Cluster.

This Resilience plan was drafted with support from the local Core Facilitation team of Midnimo II (Unity) project: "Support for the Attainment of Durable Solutions in Areas Impacted by Displacement and Returns in Galmudug and Hirshabelle States."

Midnimo II is jointly implemented by The United Nations Development Programme (UNDP), International Organization for Migration (IOM) and the United Nation Human Settlements Programme (UN-Habitat) and funded by United Nations Peacebuilding Fund.

HAZARDS

The first part of this resilience plan identifies hazards, based mainly on those related to environmental issues, such as droughts, water pollution, floods, etc. This identification is twofold, taking place on both regional and urban scale.

VULNERABILITY

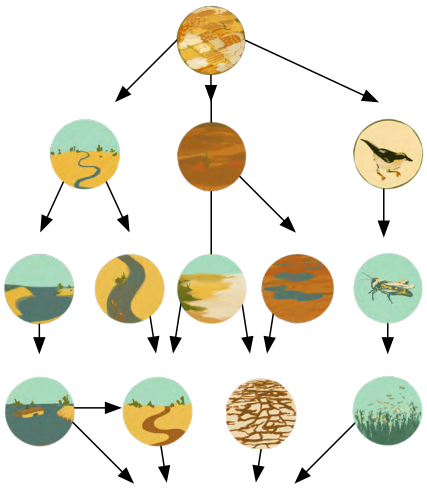
The second part of this resilience plan identifies vulnerable areas. Due to the lack of updated information, vulnerability is not assessed from an agricultural crop loss point of view. Instead, the assessment identifies social vulnerable elements, mainly IDP camps, according to exposure and sensitivity. This identification takes place on regional scale, briefly, and on urban scale, with higher detail.

RESILIENCE ELEMENTS

The third part of this resilience plan identifies the current elements that provide resilience, both on regional and urban scale.

SIMPLIFIED INTERDEPENDENCE ASSESSMENT

Using the problem tree analysis, hazards are presented (on a simplified format) with causal relations, providing a vision of the processes taking place currently in the city and its surrounding region. This method helps identify the root processes in the origin of the different hazards.



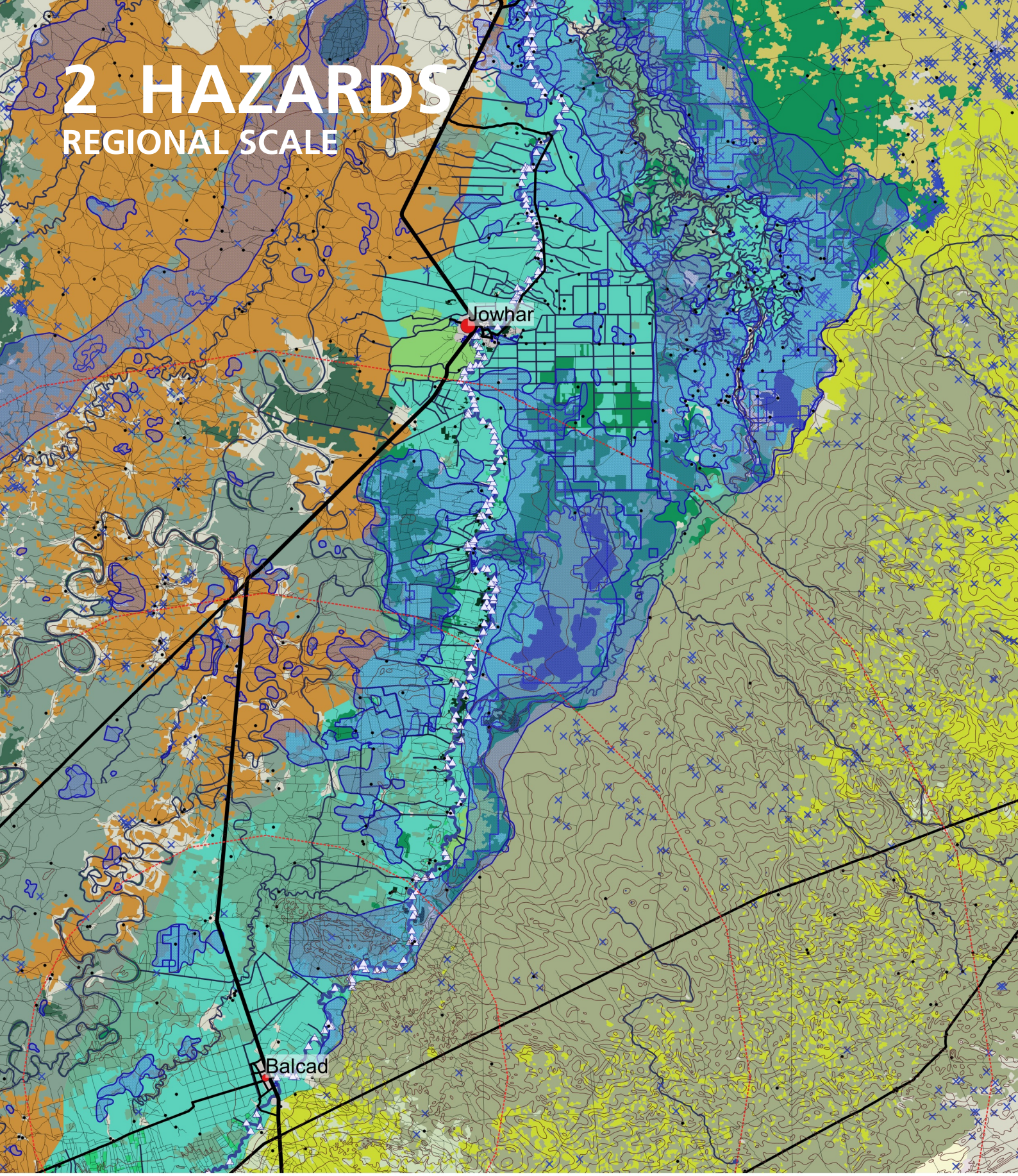
VISION

By reversing key elements previously identified on the problem tree, the causal relations between them are also reverted. This results on a vision for an improved future resilience that tackles the root elements of the damaging processes.

EXAMPLE INTERVENTIONS

Lastly, this resilience plan proposes tactical solutions and examples of specific interventions –bottom-up– that local administrations and individuals can undertake to increase urban and regional resilience. These actions are chosen according to their simplicity and based on their effectiveness (drawn from scientific literature descriptions). It would be advisable to present alongside the interventions a monitoring and evaluation plan, so as to ensure their being effective.

2 HAZARDS
REGIONAL SCALE



△ River breakages recorded in 2020
Area that has been flooded in last recorded floods:
2020 Deyr
2020 Gu
2019 Deyr
2018 Gu
River and wetland
× Water well

Episodically inundated flood or alluvial plain
Woodland - Low schubland
Woodland - Schrubland

Rainfed fields | Sorghum, cowpea, sesame

Frequently inundated floodplain
Low schrubland
Schrubland

Irrigated crop fields | Orchards
Irrigated crop fields | Rice fields
Irrigated crop fields | Other

Coastal plain
Low Schrubland
Schrubland

Rainfed crop fields | Cowpea, casava
Rainfed crop fields | Maize, cowpea, millet

Coastal dunes
Sparse vegetation

Scale: 1:300.000

N 0 2,5 5 7,5 10 km

Projections under a low-mitigation **climate change** scenario for Somalia suggest temperatures may increase 3° to 4°C by 2080.[1] The sea level along the coast is rising at approximately 1.3 mm/year.[2] Global climate models for the region predict overall precipitation to increase in future decades.[3] Eight of the last ten years have seen chronic droughts in East Africa, including Somalia, and persistent droughts are likely to continue.[4] This will further threaten livelihoods and food security. Climate change could lead to loss of biodiversity and soil fertility, and increase the prevalence of pests and disease, threatening agriculture and human health and increasing rates of urban migration, thus exacerbating conflict in Somalia.[5] Climate change is a worsening factor in all hazards described below.

climate change

Jowhar is located in the Hirshabelle river floodplain, an area that is susceptible to **floods** in times of high water discharges from the adjacent rivers and bursting, poorly maintained irrigation channels.[6] While the town itself is not located on the most flood prone area, torrential rains and floods turn Jowhar into an island accessible only by boat from Balcad, south, as recently as November 2020.[7]

floods

The Shabelle river is the main source of water for daily use such as irrigation, food production and sustaining livestock herds. The absence of dependable water resource management institutions due to ongoing conflict has led to severe **degradation of water resources**.[8] In addition to clashes between clans over access to water, there have been instances where Al-Shabaab has exercised control over access to water, blocking access to rivers, poisoning wells or destroying water infrastructure.[9] Bad water quality causes water-borne diseases and triggers related health crisis.

degradation of water quality

Droughts are frequent and devastating, and the lack of water availability cause crop loss, livestock loss and affect human health. They are one of the most prevailing reasons for internal displacements of population and force the farmers to depend on humanitarian resources and other relief providers, including Al-Shabaab, for survival.[10]

droughts

The increasing number of dust storms and droughts, stronger winds, and notably hotter temperatures over the past four decades[11] make **locust plagues** hard to predict and control. For example, in late 2019, Cyclone Pawan and severe floods in the Horn of Africa created ideal conditions for desert locust breeding. Strong winds in 2020 helped to spread locusts across the region; in March/April and November/December, Somali farmers faced two infestations that led to the loss of approximately 20% of national crop yields. New infestations in 2021 are likely.[12]

locust plagues

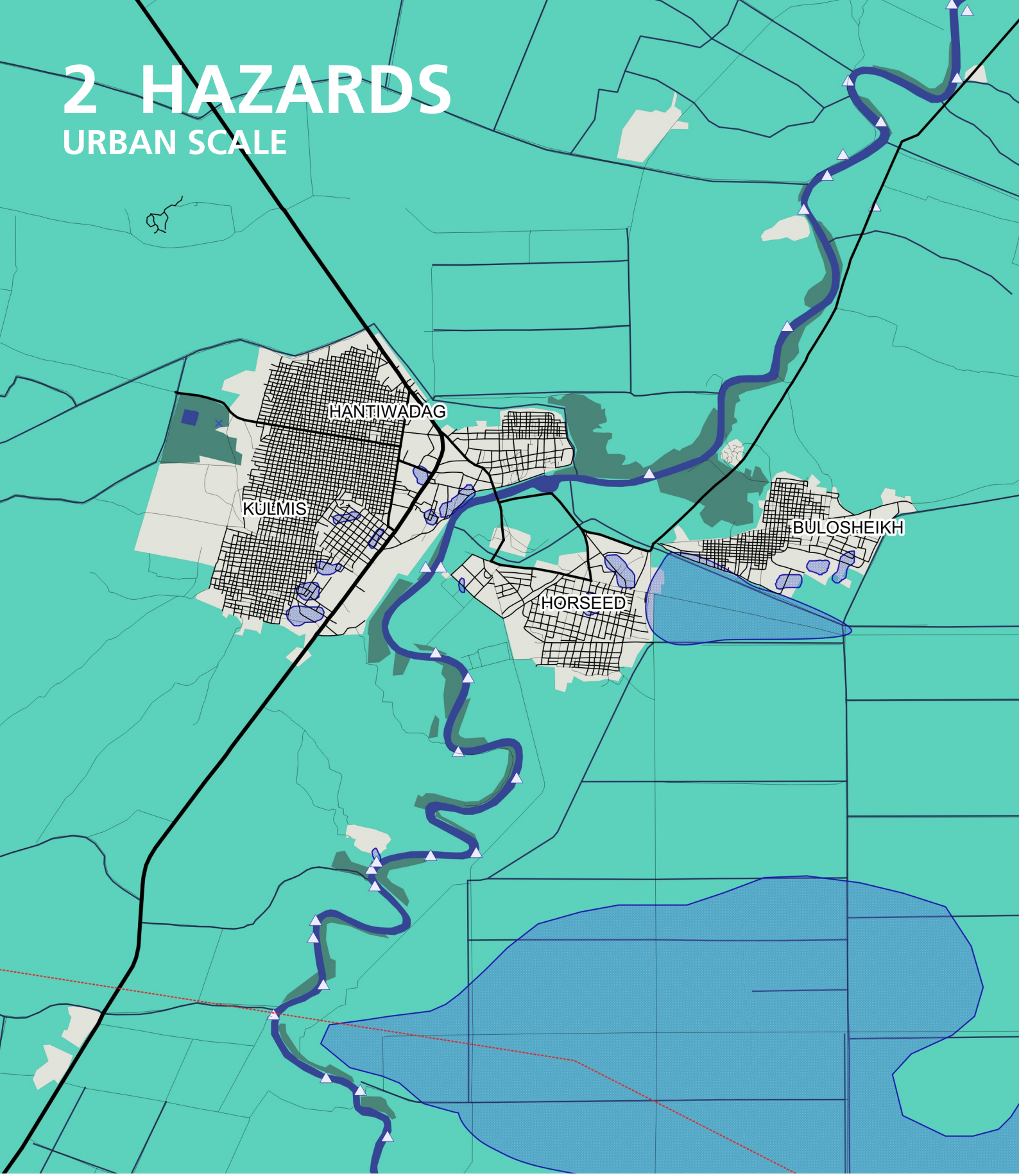
Severe deforestation and **soil degradation** from poor agricultural practices, overgrazing of rangelands and climate change threaten not only the growth prospects but also the viability of Somalia's traditional nomadic pastoralism and rain-fed crop cultivation.[13]

soil degradation

These hazards affect on a regional scale bringing high impacts to vulnerable zones: Systematic crop loss, forced internal displacement due to lack of resources, and a destabilization of the basic means of survival.

1 World Bank-FAO Future Climate Predictions, 2019 http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Africa&ThisCcode=SOM
2 National Adaptation Plan (NAP) Stocktaking Report, 2017
3 IPCC 2013; World Bank-FAO Future Climate Predictions, 2019
4 Carty, Oxfam: A Climate in Crisis: How climate change is making drought and humanitarian disaster worse in East Africa, 2017
5 Federal Republic of Somalia: Ministry of Natural Resources, Somalia National Adaptation Programme of Action to Climate Change, 2013. http://unfccc.int/resource/docs/napa/som01.pdf
6 European Environment Agency, Flood risks and environmental vulnerability, 2016
7 Puntland Post, November 2020 https://puntlandpost.net/2020/11/17/jowhar-cut-off-by-flood-water/
8 Houghton-Carr, H. A., Print, C. R., Fry, M. J., Gadain, H. & Muchiri, P. (2011). An assessment of the surface water resources of the Juba-Shabelle basin in southern Somalia. Hydrological Sciences Journal 56(5), 759-774. https://doi.org/10.1080/02 626667.2011.585470
9 Strategic Foresight Group. (2019). Water and Violence: Somalia (Blue Peace Bulletin vol. 5/2019)
10 Middleton, Born, Nordqvist & Eklöw, 2018; UN (2018). UN Strategic Framework Somalia 2017-2020. https://unsom.unmissions.org/un-strategic-framework-somalia-2017-2020-0
11 Ministry of National Resources, 2013.
12 FAO. Desert Locust Crisis Somalia Action Plan. January-December 2020. (April update).https://fscluster.org/sites/default/files/documents/fao_somalia_action_plan_desert_locust_crisis_appeal_april_update_.pdf
13 World Bank-FAO 2018, Somalia 2019

2 HAZARDS
URBAN SCALE



Hydrography and flood risks
- River and wetland
- Water well
- River breakages recorded in 2020
- Area that has been flooded in last recorded floods:
  2020 Gu
  2018 Flooded agricultural areas

Land use
- Irrigated crops
- Riparian forest
- Urban area

Scale: 1:30.000

N 0 0,25 0,5 0,75 1 km

As stated before, projections for **climate change** suggest a rise of global temperatures, while climate models for the region predict overall precipitation to increase in future decades.[14,15] Higher air temperatures will increase transpiration from soil, tree canopies, and water bodies, affecting urban areas especially and increasing the heat island effect. The increment of temperature combined with higher rainfall increase the prevision of flood frequency and persistency, which combined with current drought trends are likely to become a chronic feature of the region. The effects of those risks will further threaten livelihood, food security, biodiversity and soil fertility, enhancing the prevalence of pests and water-borne diseases. Climate change is a worsening factor in all hazards described below.

climate change

While the city of Jowhar itself is not situated on the most flood-prone area, **urban floods** do take place in times of high water discharges from the adjacent rivers and bursting, poorly maintained, shallow irrigation channels.[16,17] It is apparent that flood risk in Jowhar is twofold, being caused by river overflow and lack of rainwater management. When it rains, the livestock market is often flooded and moved to the stadium in Kulmis Village. The floods disrupt communication with Mogadishu as the main road is situated on a flooded area. Urban floods, in addition to leading to crop loss, also leave the farmers unable to transport their produce to outside markets, cuts off access to outside resources such as specialized health facilities, and overall greatly disrupts the livelihood in town.[18] According to HEC-RAS terrain model analysis for flood risk maps (page 17), flood prone areas are larger and more urban than the zones that are currently being flooded. This reveals the protection role that wetlands and other resilience elements may be providing in flood mitigation (page 15). To help enhance protection, it woul be necessary to establish no-build zones in town and expanding the riparian riverfront vegetation (page 24).

urban floods

Lack of waste management, burning of solid waste and dust particles from eroded landscape areas make for a poor air quality and create **air pollution**. **Water pollution** is mainly caused by infiltrated waste into the river water, worsened by the accumulation of silt and rubbish in the river channels, which in turn causes increasingly frequent bank over-topping and damage to surrounding farmland.[16] **Soil pollution** is in turn caused by infiltration of polluted water into the soil, and by the loss of soil filtration properties to manage contaminants.

air, water and soil pollution

Climate is only becoming more extreme, with an increasing number of dust storms and droughts, stronger winds, and notably hotter temperatures over the past four decades.[19] The effects of **meteorological extreme events** are devastating (famine, health crisis, etc), moreso when combined in vulnerable areas, and they are one of the most prevailing reasons for internal displacements of population. Lack of mitigation resources and strong dependence on favorable weather conditions force the farmers to depend on humanitarian resources and other relief providers.

extreme weather

These hazards affect on an urban scale bringing high impacts to vulnerable zones: Disruption of livelihoods, dependence on outside resources and destabilization of the basic means for survival.

14 World Bank-FAO Future Climate Predictions, 2019 http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Africa&ThisCcode=SOM
15 IPCC 2013; World Bank-FAO Future Climate Predictions, 2019
16 Jowhar Urban Profile, 2020
17 Carty, Oxfam: A Climate in Crisis: How climate change is making drought and humanitarian disaster worse in East Africa, 2017
18 Puntland Post, November 2020 https://puntlandpost.net/2020/11/17/jowhar-cut-off-by-flood-water/
19 Ministry of National Resources, 2013.

3 VULNERABILITY

REGIONAL SCALE

Vulnerability

Sensitivity

Sensitive settlements
Settlements have been identified by CCCM Cluster,
Direct observation on field or on aerial view.

IDP Camps or other vulnerable settlements

Flood exposure

Level of exposure has been evaluated throught:
-historical data about IDP Camps (CCCM Cluster 2020)
-distance to registered river breakages
-distance to registered flooded areas

Probably affected by river breakages or floods

Affected by registered river breakages or floods

Scale: 1:45.000

N

0 0,25 0,5 0,75 1 km

Aerial view of flooding in Jowhar, 2013, AU UN IST Photo / Tobin Jones

Vulnerability is identified according to two factors: Sensitivity (structural risk) and Exposure (proximity to hazard).

As far as sensitivity, **IDP camps** are identified as one of the most vulnerable structures, given their lack of physical sturdiness. They are also, generally, very exposed to flood points as their location tends to be near the river, which makes them highly vulnerable to river breakages.

Identification of **river breakage points** is key to planning. It is observed that river breakage points coincide with areas where the riparian vegetation around the river is absent. These are points where the water floods unconstrained by riverside vegetation, increasing exposure on already sensitive living structures. When the riparian forest is thicker, the vegetation seems to hold water, mitigating the extension of the flooded area, protecting the living structures on the area. Locating IDP camps on strategic positions is essential to reduce their vulnerability: Close enough to the river so as to have water access and buffered by a no-build area of riparian vegetation. The **conservation of riparian forest** is considered essential to reduce IDP camp vulnerability.

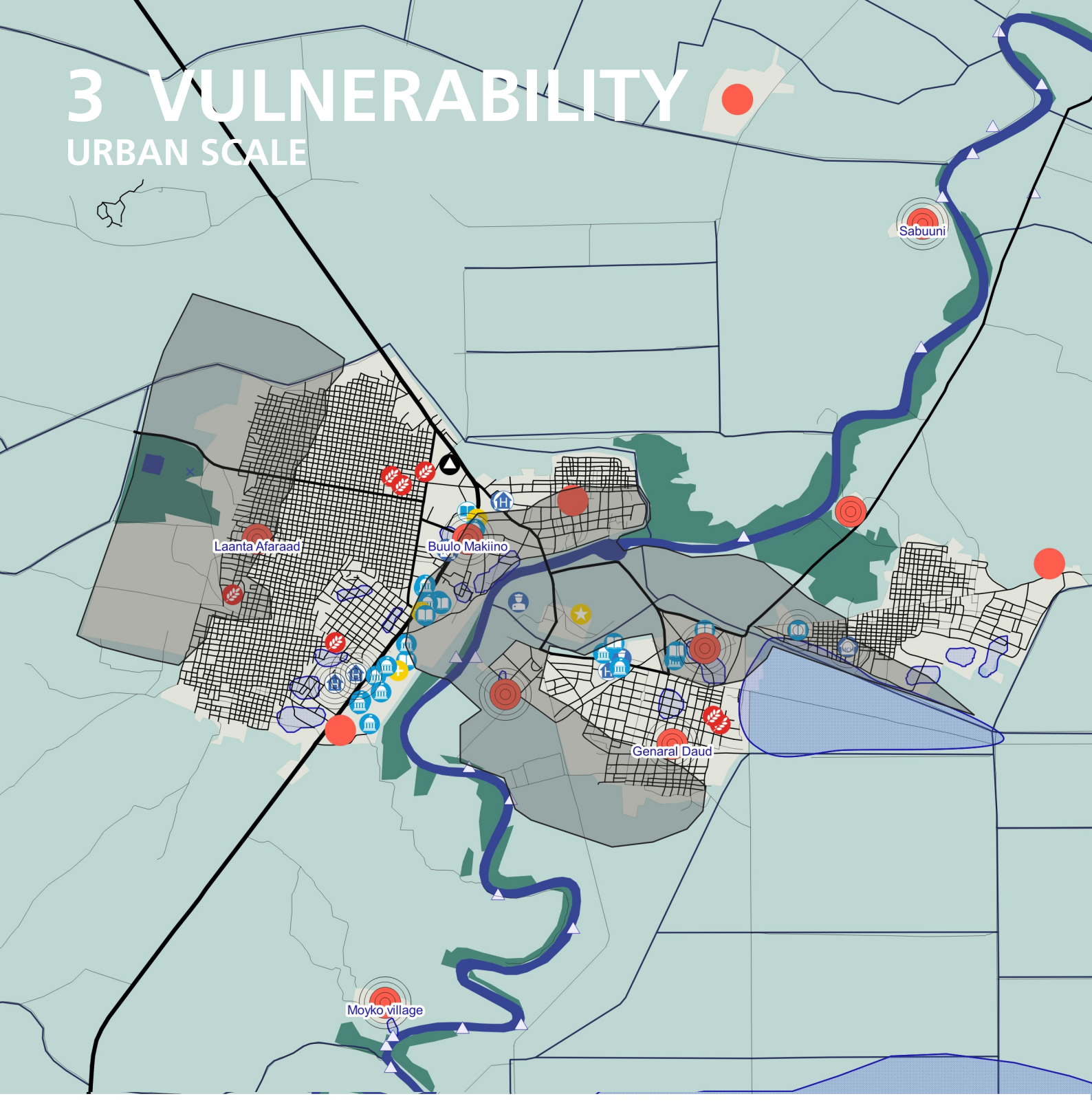
This map does not cover the whole region. A more exhaustive mapping of IDP camps on regional scale is advisable in order to fully tackle the IDP vulnerability issue.

Sheikh-Omar IDP camp, 2019. File photo/Radio Ergo

IDP camp in Jowhar, 2013. AU UN IST PHOTO / Tobin Jones

3 VULNERABILITY

URBAN SCALE



Vulnerability

Sensitivity

Sensitive settlements
Settlements have been identified by CCCM Cluster,
Direct observation on field or on aerial view.

IDP Camps or other vulnerable settlements

Sensitive facilities

- Hospital
- MCH
- Prison
- Market
- School
- University
- Government
- Police station

Flood exposure

Level of exposure has been evaluated through:
-historical data about IDP Camps (CCCM Cluster 2020)
-distance to registered river breakages
-distance to registered flooded areas

Probably affected by river breakages or floods

Affected by registered river breakages or floods

Areas of the city that may have been flooded in the past according to data evaluated on HEC-RAS model, Jowhar pictures (both avalaible on Jowhar Urban profile) and IDP camps past floods (CCCM Cluster 2020).

Scale: 1:25.000

N 0 0,25 0,5 0,75 1 km

While the town of Jowhar itself is not on the most flood prone of the valley, there are **flooding spots in town** that affect communications, livelihoods and health conditions.

Identification of **river breakage points** is key to planning. It is observed that river breakage points coincide with areas where the riparian vegetation around the river is absent.[20] These are points where the water floods unconstrained by riverside vegetation. When the riparian forest is thicker, the vegetation holds water and mitigates the extension of the flooded area, protecting the living structures on the area.

Other vulnerable elements are **public facilities**, of which many are concentrated around the main road going south on the edge of Kulmis settlement. On this urban area, the river and the road run parallel for a stretch. The concentration of public facilities and the proximity to the river make it a highly vulnerable zone, as the structures are sensitive elements that play an essential role during hazards.

IDP camps have been studied to understand their vulnerability in terms of poor sanitation and health conditions. The health concerns are mainly water-borne diseases, caused by poor water and waste management.

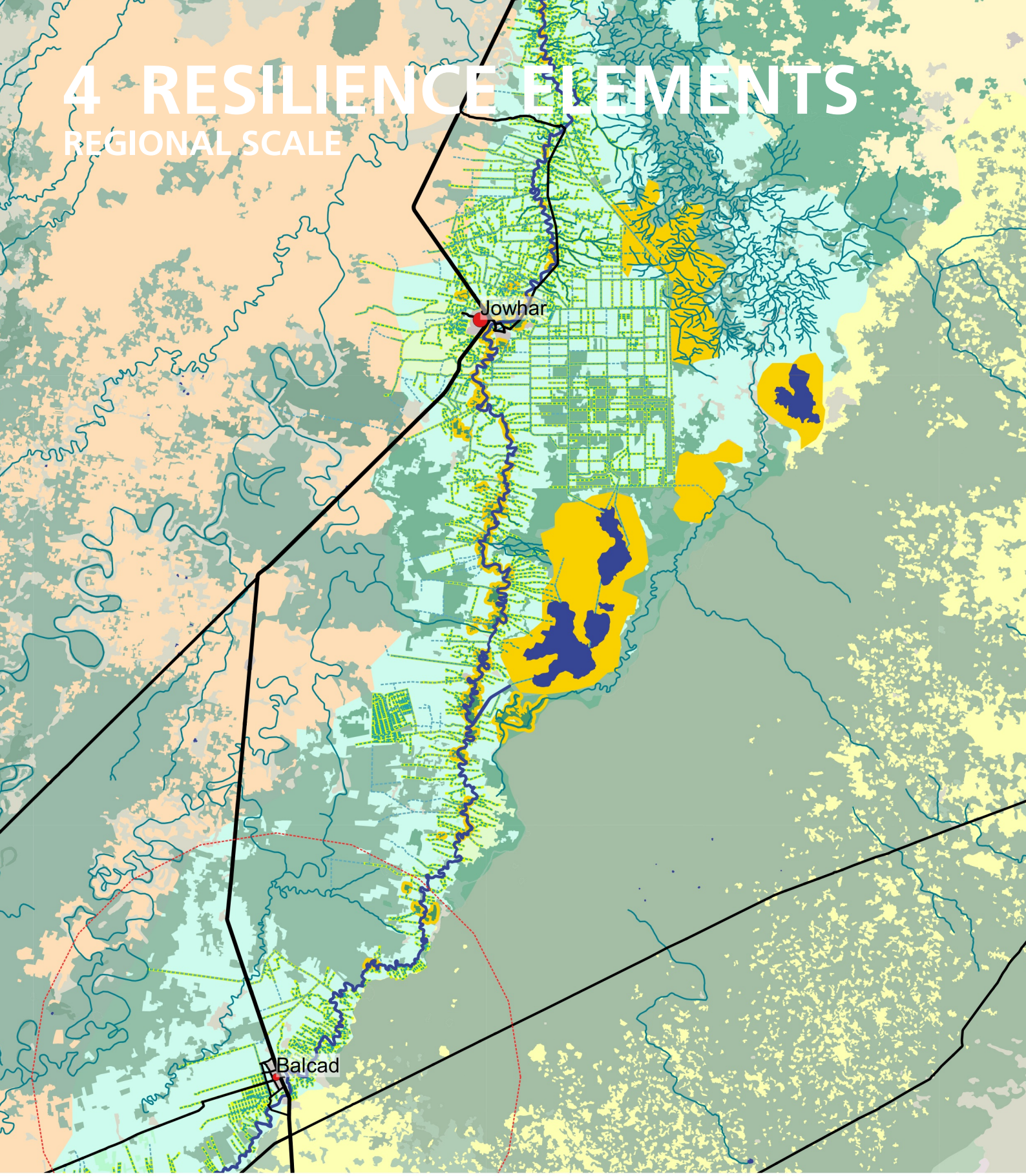
There is available information on three of the main IDP camps in Jowhar town [21]:

Name	**Genaral Daud**	**Buulo Makiino**	**Laanta Afaraad**
Type	**Planned IDP Camp**	**Planned IDP Camp**	**Planned IDP Camp**
Population	**6512**	**2472**	**15055**
Households	**814**	**412**	**3011**
Main diseases	**cholera, malaria**	**cholera, malaria, polio, diphtheria**	**malaria**

20. SWALIM, Status and Impacts of Open River Points along the Shabelle River in Jowhar, Balcad and Afgooye Districts, December 2020
21. Source: CCCM Cluster, 2020.* Laanta Afaraad is no longer represented as an IDP camp on CCCM Cluster online and the total population number may need revision.

4 RESILIENCE ELEMENTS

REGIONAL SCALE



Existing resilience elements

Ecosystems
that may be functioning as flood mitigators

Floodplain ecosystems with riparian vegetation
- Perennial rivers
- Wetlands
- Riparian vegetation

Infrastructures
that may be functioning as flood mitigators

Irrigation canals
- Irrigation canals

N

0 2,5 5 7,5 10 km

Scale: 1:300.000

The resilience elements that are currently present in the Jowhar region are twofold: Natural ecosystems and built infrastructures:

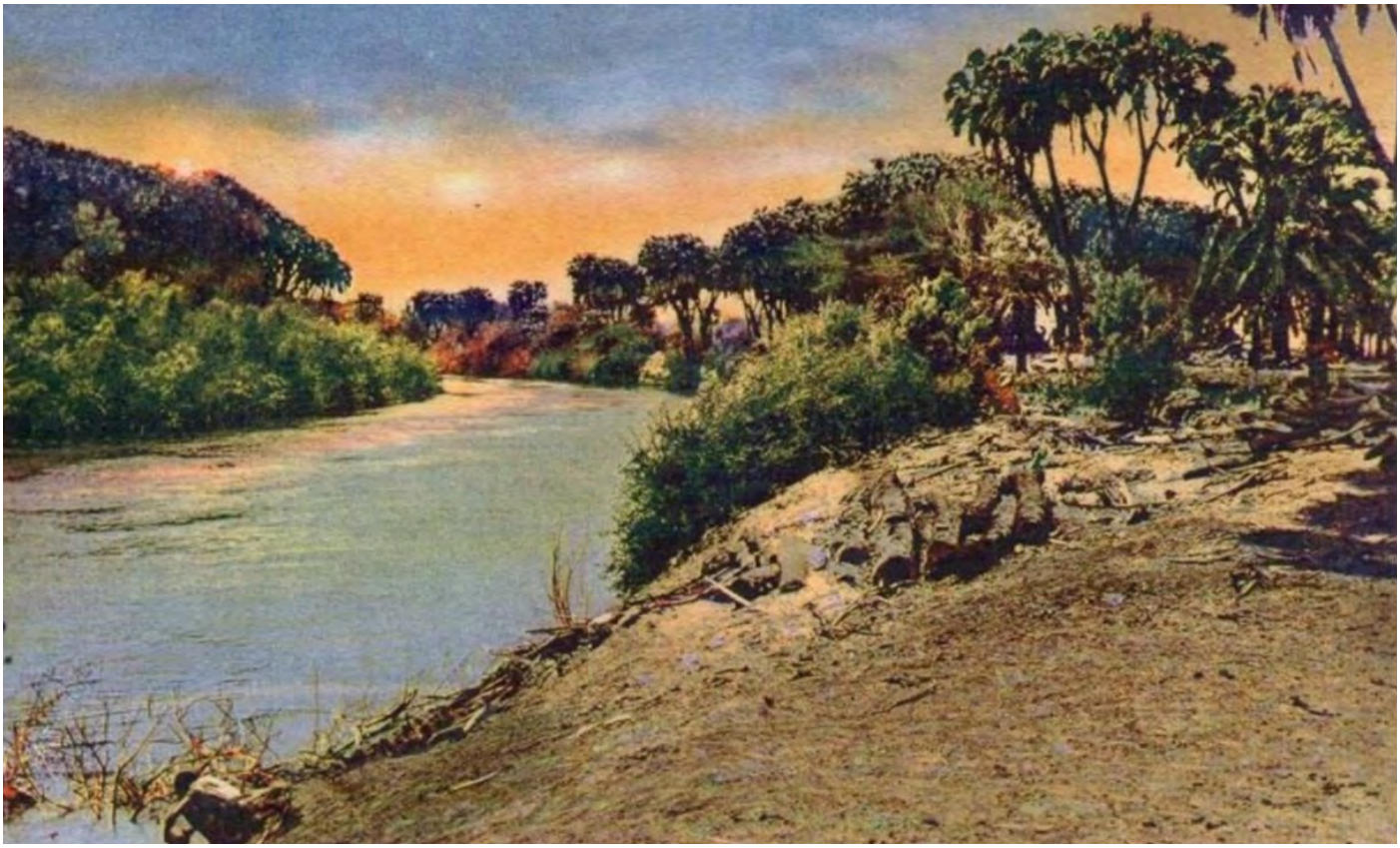
Riparian vegetation refers to vegetation directly adjacent to rivers and streams. The riparian forest extends laterally from the active channel to the uplands, thereby including active floodplains and the immediately adjacent terraces. These help control sediment, reduce the damaging effects of flooding and aid in stabilizing stream banks.[22] Riparian forests can deliver a number of benefits including filtering capacities; stabilizing eroding banks; providing shade, shelter, and food for fish and other aquatic organisms; providing wildlife habitat and corridors for terrestrial organisms and protecting cropland and downstream communities from flood damage.[23]

As stated above, the river breakage points coincide with areas where the river bank was bare of vegetation, which seems to prove the role of riparian vegetation in holding water and mitigating the extension and damage of floods.

Wetlands are areas of marshes or swamps that can be found south of town and east of the Shabelle river. They function as flood control, provide ecosystemic services of water filtration and mitigate water loss to evaporation in dry seasons. Their importance seems to be essential in buffering towns from the damage of floods, in this case for Jowhar and also for Balcad, downstream.

It would be advisable to conduct more detailed analysis of the ecosystemic services provided by the wetlands and riparian vegetation in the area, in order to further understand their role in flood and drought mitigation and how to enhance it.

Irrigation channels may also be functioning as flood mitigators, given their capacity to divert water on flood periods towards floodplains.



"Io Uebi Scebeli: The leopard river": Illustration of riparian forest in historical italian document "Villabruzzi, ovvero il sogno di Luigi Amedeo" by Vincenzo Meleca (date unknown)

22. Scholz et al. 2012, Ökosystemfunktionen von Flussauen - Analyse und Bewertung von Hochwasserretention, Nährstoffrückhalt, Kohlenstoffvorrat, Treibhausgasemissionen und Habitatfunktion. (Ecosystem services in floodplains - analysis of flood water detention, nutrient retention, carbon storage and habitat provision)

23. Barth and Döll, Assessing the ecosystem service flood protection of a riparian forest by applying a cascade approach, Ecosystem services, 2015

4 RESILIENCE ELEMENTS

URBAN SCALE

Existing resilience elements

Ecosystems
that may be functioning as flood mitigators

Floodplain ecosystems with riparian vegetation
- Perennial rivers
- Wetlands
- Riparian vegetation

Infrastructures
that may be functioning as flood mitigators

Irrigation canals
- Irrigation canals

No-build zone

Scale: 1:25.000

N 0 0,25 0,5 0,75 1 km

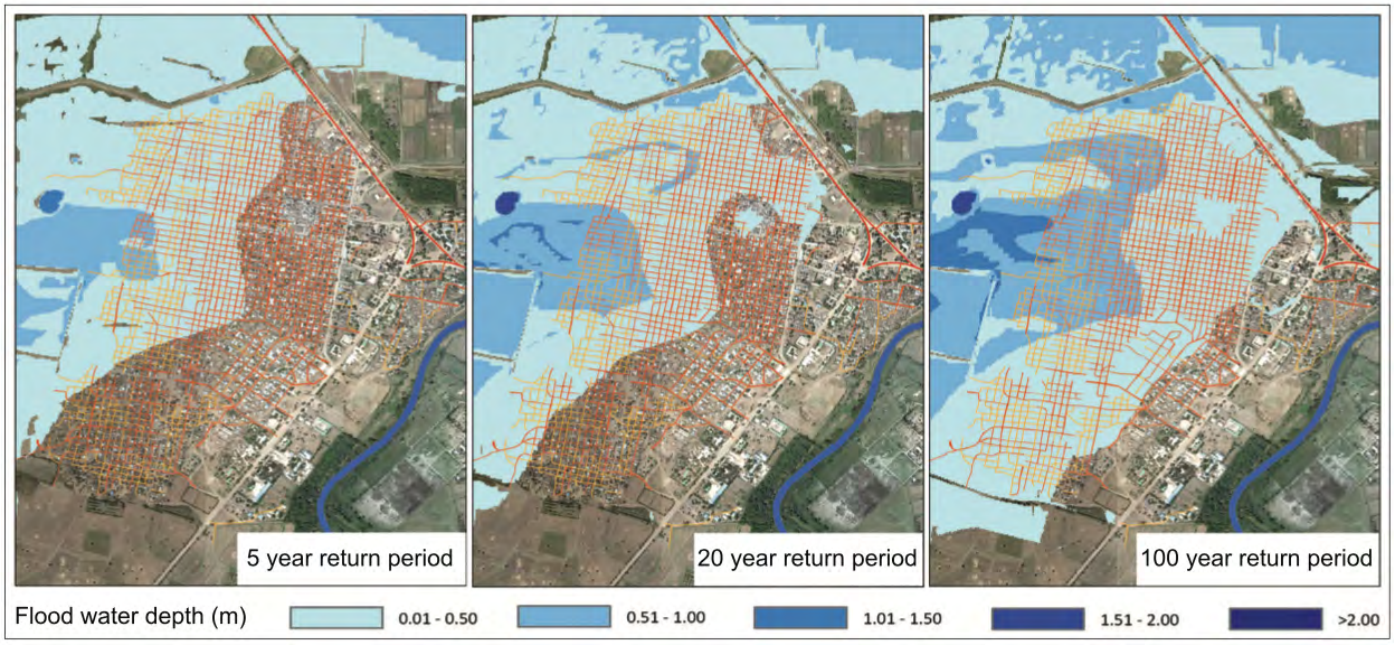
On an urban scale, the same scheme is observed to be taking place as on the regional resilience scale: A combination of natural ecosystem elements and built infrastructures.

The **strategic position** of Jowhar seems to be a current element of resilience. Its disposition on both sides of the river seems to be avoiding the most frequently flooded areas.

Topographically, the HEC-RAS modeling shows flood-prone areas according to terrain height and morphology. This computer analysis does not seem to be concurrent with the recorded flooding zones, which have less extension in the urban areas. This discrepancy may reveal the extend of the water-retention properties of both the existing riparian forests and wetlands, which the HEC-RAS modeling does not seem to take into account.

The ecosystemic services provided by the wetlands north and east could be identified as the buffer that is currently preventing devastating floods in town. As the model seems to be indicating, if the wetlands and riparian vegetations were to disappear, then the level of flooding in town might be much higher than it currently is. This seems to indicate that **the key current environmental resilience elements of Jowhar are riparian forests and wetlands**. Expansion of riparian forest by means of creating a riparian buffer could be advisable, leading the river to overflow in areas where vegetation can hold the excess water.[24]

Finally, the fact that Jowhar mainly has **low-height buildings** could also be a favoring resilience factor, given the fact that there are not currently many hard infrastructures present in town. This enables a degree of reversible building that has been mentioned as mitigating factor for climate change hazards in scientific literature. [25,26]



Jowhar hydraulics modelization from terrain height dataset with HEC-RAS, showing flood-prone areas according to terrain morphology. This model does not take into account the water-retention services provided by wetlands and other current ecosystem elements. Atlas of the Juba and Shabelle Rivers in Somalia, SWALIM 2010

24. Schindler et al. (2014) Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners.
25. Chen, Nan & Graham, Peter. (2011). Climate Change as a Survival Strategy: Soft Infrastructure for Urban Resilience and Adaptive Capacity in Australia's Coastal Zones. Resilient Cities: Cities and Adaptation to Climate Change-Proceedings of the Global Forum 2010. 1. 10.1007/978-94-007-0785-6_38.25.
26. Proverbs, David & Lamond, Jessica. (2017). Flood Resilient Construction and Adaptation of Buildings. Natural Hazards. 10.1093/acrefore/9780199389407.013.111.

5 INTERDEPENDENCE ASSESSMENT
REGIONAL SCALE

INTERDEPENDENCE ASSESSMENT | REGIONAL VULNERABILITY

The interdependence assessment provides information about the causality relation between key elements that create environmental vulnerability in a regional scale. Different hazards are inter-related and derive from different causes that may not be considered as threats themselves, but that have a considerable effect on landscape resilience.

This methodology, the problem tree, is chosen in this case as an available approach to process the information at hand. It would be advisable to conduct a more complete field analysis with local participation and updated data, such as the aforementioned Vulnerability and Risk Analysis (VRA) or CityRAP tool.

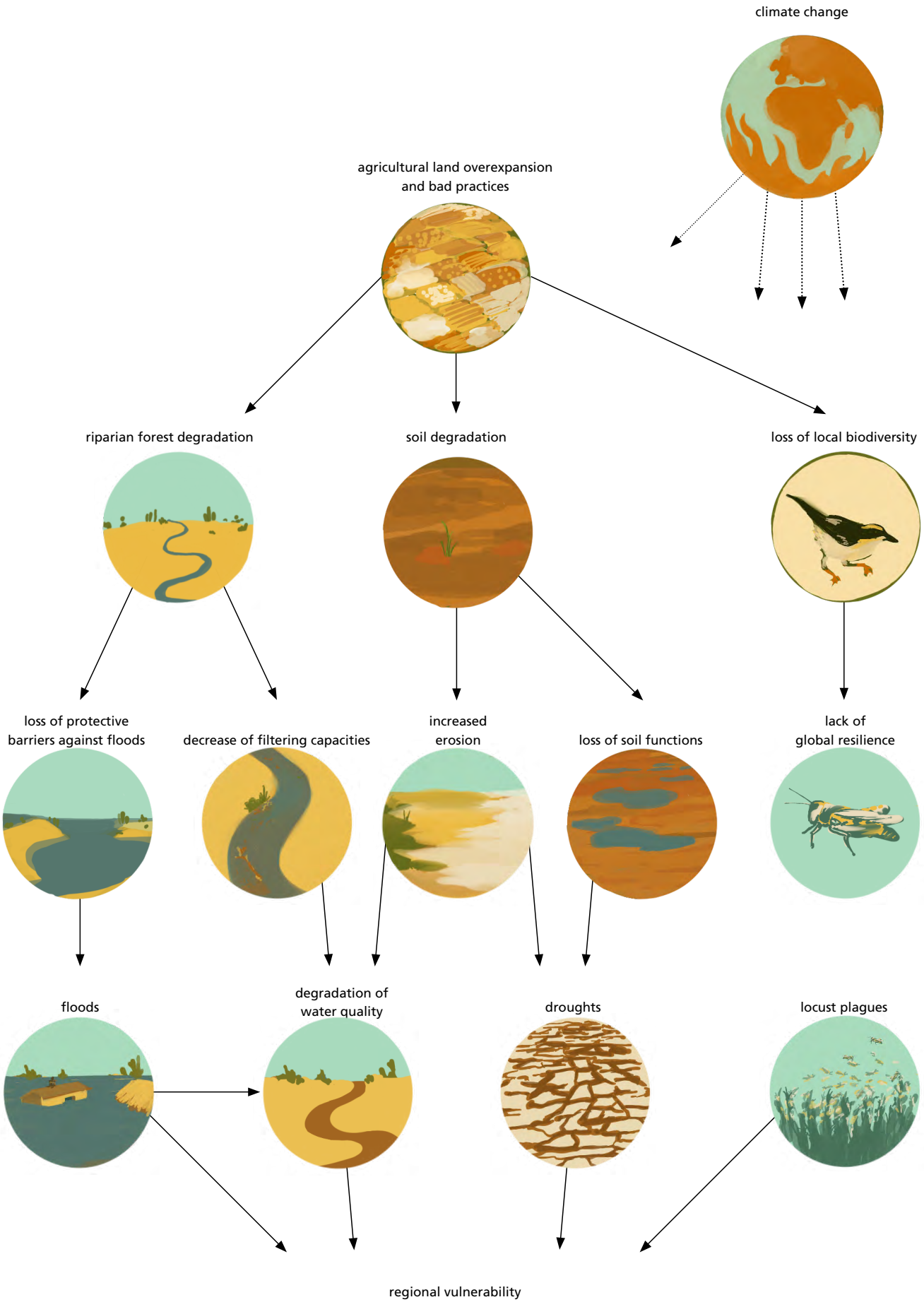
At a regional scale concerning Jowhar, it is considered that overexpansion of agriculture and bad agricultural practices may suppose a mayor hazard to resilience. This is determined after the fact that different environmental risks seem to be directly related to agricultural management. This is in connection with local political issues such as conflict for land ownership.[27]

The current management of agricultural land seems to be in conflict with the conservation of some natural floodplain ecosystems, and, more specifically, with the riparian forests and wetlands, which play an essential role in flood control.[28] It is possible that the current farming methods reduce some of the soil functions and are being affected by erosion processes.

One other possible consecuence of agricultural pressure is biodiversity loss, which comes with simplifying the land structure by prioritizing the development of specific crops.

These three processes seem to be favoring a highly vulnerable agriculture, exposed to the previously identified risks. Climate change amplifies those processes and their derived impact.

27. Abass Kassim Sheikh: Conflict Assessment Report. Hirshabelle State, Somalia. Berghof Foundation, 2017
28. Scholz et al. 2012, Ökosystemfunktionen von Flussauen - Analyse und Bewertung von Hochwasserretention, Nährstoffrückhalt, Kohlenstoffvorrat, Treibhausgasemissionen und Habitatfunktion. (Ecosystem services in floodplains - analysis of flood water detention, nutrient retention, carbon storage and habitat provision)


climate change
agricultural land overexpansion
and bad practices
riparian forest degradation
soil degradation
loss of local biodiversity
loss of protective
barriers against floods
decrease of filtering capacities
increased
erosion
loss of soil functions
lack of
global resilience
floods
degradation of
water quality
droughts
locust plagues
regional vulnerability

5 INTERDEPENDENCE ASSESSMENT

URBAN SCALE

INTERDEPENDENCE ASSESSMENT | URBAN VULNERABILITY

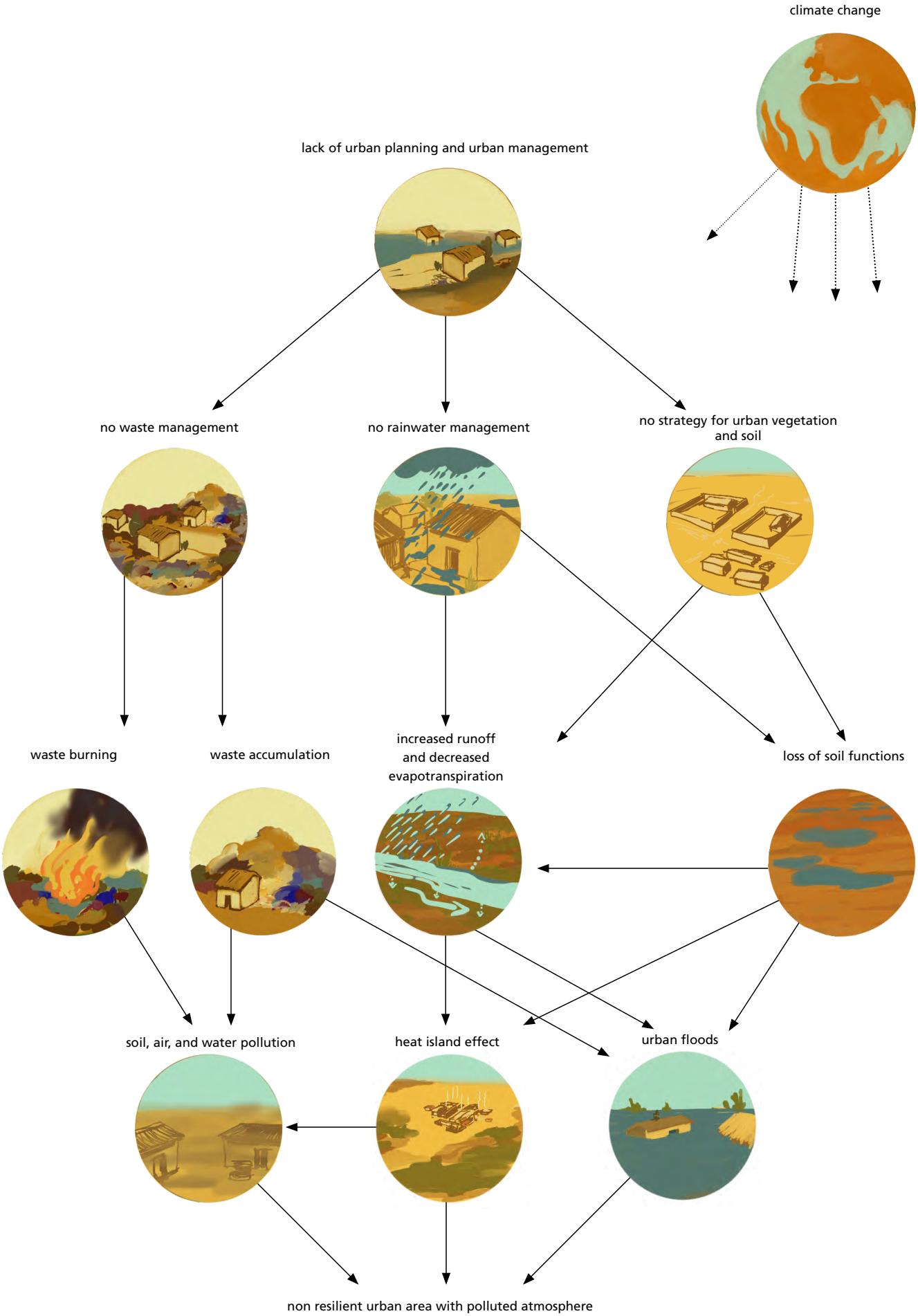
The interdependence assessment provides information about the causality relation between key elements that create environmental vulnerability in a regional scale. Different hazards are inter-related and derive from different causes that may not be considered as threats themselves, but that have a considerable effect on landscape resilience.

This methodology, the problem tree, is chosen in this case as an available approach to process the information at hand. It would be advisable to conduct a more complete field analysis with local participation and updated data, such as the aforementioned Vulnerability and Risk Analysis (VRA) or CityRAP tool.

In Jowhar city, it is observed that insufficient urban planning and management may suppose a mayor hazard to urban resilience, as indicated by the fact that environmental risks seem to be strongly aggravated by the form and management of the city itself. Consistent governance is a major challenge in Somalia, and it is possible to consider the hazards impacting Jowhar as part of the visible symptoms of the situation.

In this sense, the current city management seems to not have taken significant steps towards basic issues of the urban environment: Waste management, rainwater management, soil and vegetation management. This situation creates multiple impacts on the environment -pollution, floods, extreme weather conditions- which in turn impact the urban and regional population unevenly.

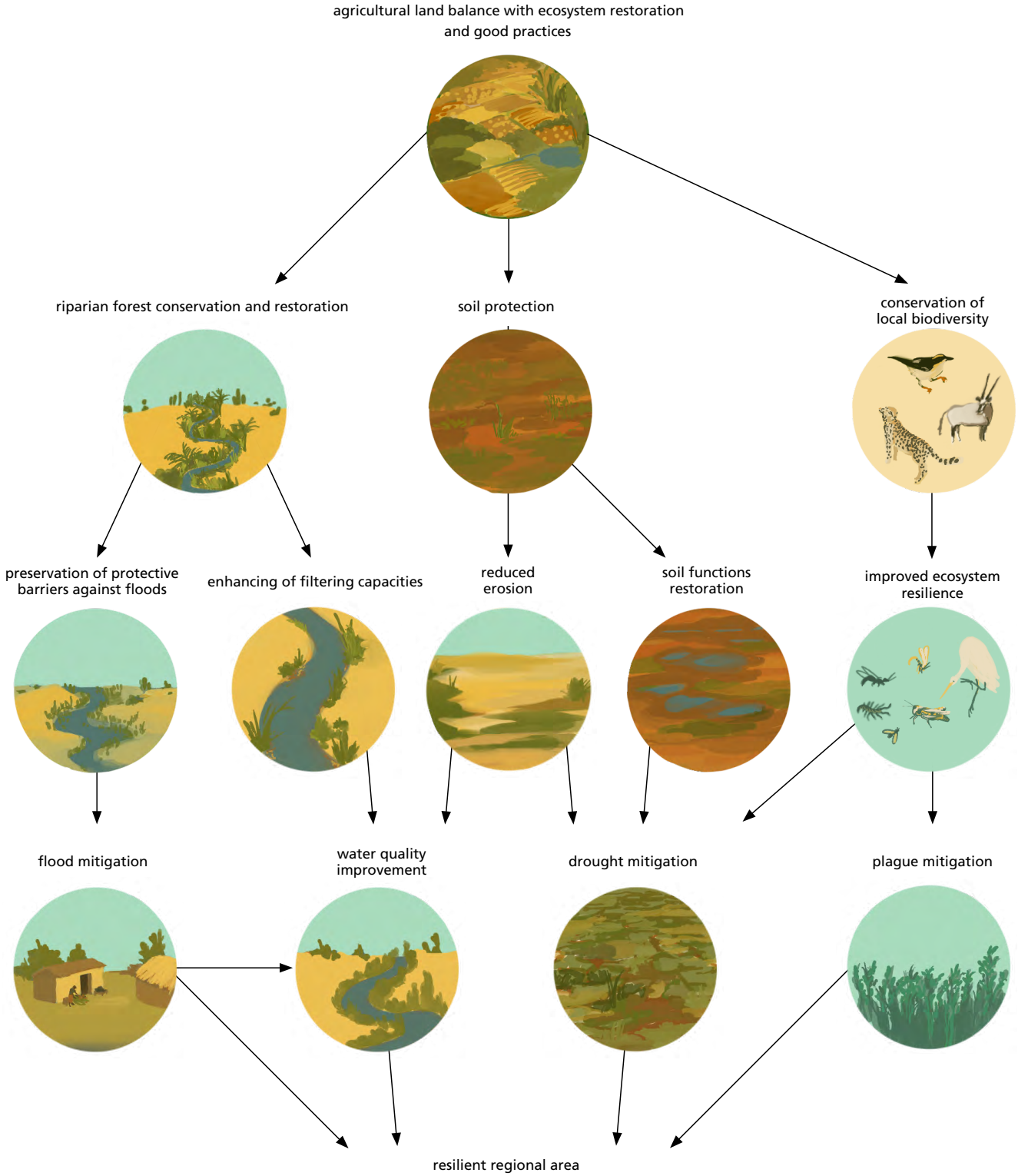
It is important to identify the interactions between those effects to create "cascading" problems. For example, a draining system that is not coordinated with waste management could perpetuate or even amplify water pollution, affecting downstream populations.


climate change
lack of urban planning and urban management
no waste management
no rainwater management
no strategy for urban vegetation and soil
waste burning
waste accumulation
increased runoff and decreased evapotranspiration
loss of soil functions
soil, air, and water pollution
heat island effect
urban floods
non resilient urban area with polluted atmosphere

6 VISION
REGIONAL + URBAN SCALE

Vulnerability mitigation is achieved through an inversal of the conditions, by reversing key factors of the causal tree. In the regional scale, this could mean balancing agriculture with environmental conservation. In the urban scale, the reversal could mean improving urban governance. The combined cascading effect of those changes increases the overall resilience of the town and its surroundings, mitigating the damaging impacts.

The proposed vision suggests, on a regional scale, putting environmental conservation and restoration at the forefront of interventions. Environmental restoration strongly improves the multifunctionality of the landscape and causes win–win situations, enhancing the ecosystem services supplied such as regulation, maintenance, cultural, and provisioning services.[29] On an urban scale, it suggests creating



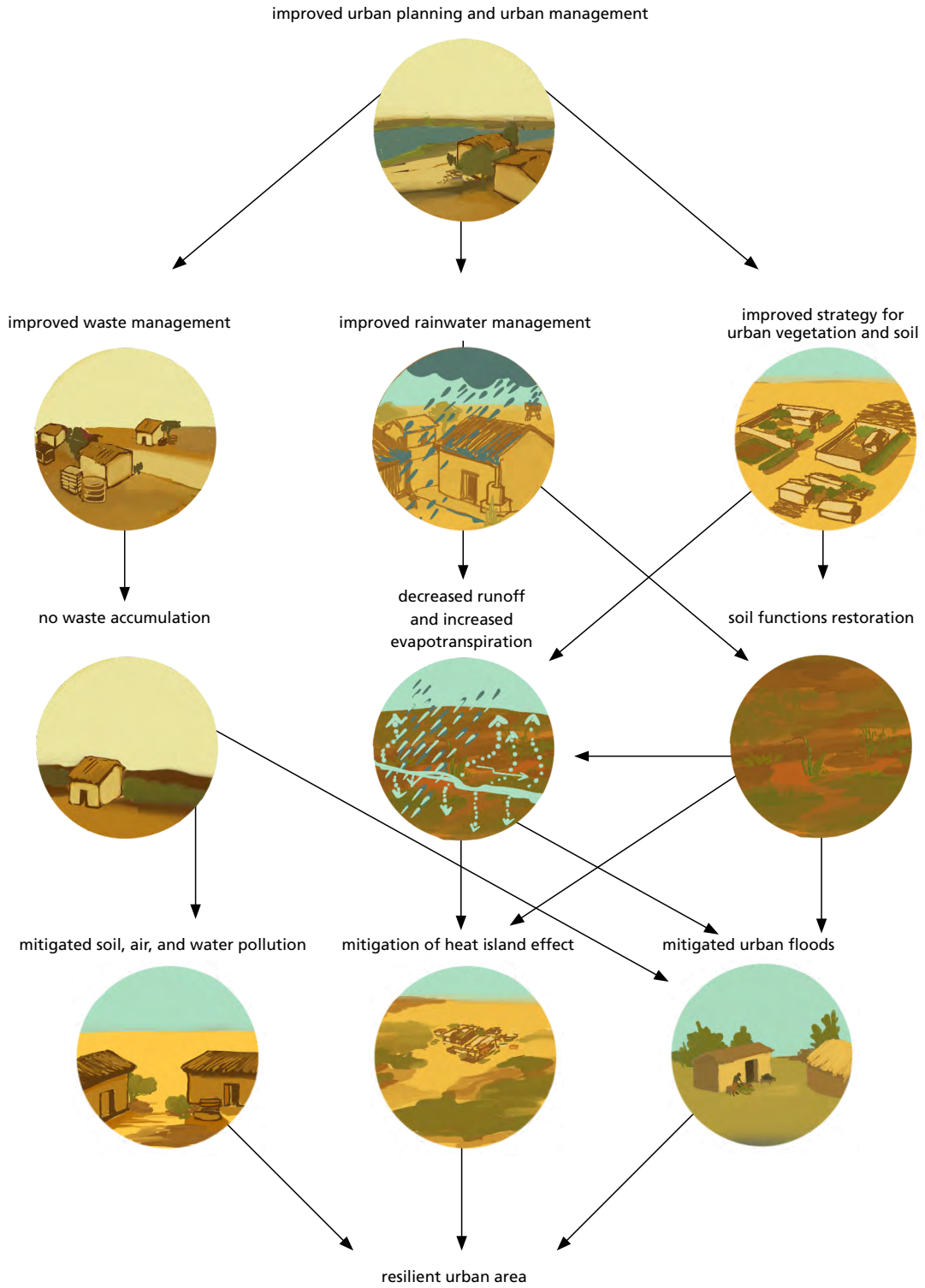
decentralized infrastructural systems that do not require costly inversions.

The complexity of management in both scales, with highly dynamic ecosystems and long-term socio-economic pressures, requires holistic approaches in which scientific evidence and expert knowledge are operationalised for policy needs[30]. This document does not contain such approach.

This document proposes tactical solutions and examples of specific interventions –bottom-up– that local administrations and individuals can undertake to increase urban and regional resilience. Complete implementation plans are not suggested here.

While hard infrastructures may be effective against certain threats, hazard management policies are increasingly more focused on ecosystem functions[31], considering sustainable management as a form of invisible infrastructure.

29. Schindler et al, 2014 Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners
30. European Environment Agency, Flood risks and environmental vulnerability, 2016 ISSN: 1977-8449
31. Barth and Döll, Assessing the ecosystem service flood protection of a riparian forest by applying a cascade approach, Ecosystem services, 2015



7 EXAMPLE INTERVENTIONS

RIPARIAN FOREST BUFFERS

Where:
Around rivers streams, with special attention to areas along the river that are very frequently flooded.

What:
Conservation

Main ecosystem services provided:[32,33]

-Flood control (Gregory et al. 1991)
-Water quality
-Habitat for fauna and flora, wildlife corridor and feeding reserve.
-Biodiversity conservation and connectivity
-Aesthetic and recreational services.

32. Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php
33. Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. USDA Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture

HEDGEROW NETWORK

Where:
Around actual crops.

What:
Enhancing a hedgerow network on the borders of agricultural crop lands.

How to*:
Avoiding agricultural activities on the plots to allow native and wild vegetation colonization.
If a natural growth cycle does not take place, it may be necessary to conduct a planned planting of native species.

Main ecosystem services provided:[32,33]

-Habitat for fauna and flora, wildlife corridor and feeding reserve.
-Seed dispersal
-Climate regulation
-Erosion control
-Water
-Pest control
-Flood effects mitigation

**It would be advisable to include this intervention within a complete strategic plan, including monitoring and evaluation.*

32. Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php
33. Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. USDA Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture

SUSTAINABLE URBAN DRAINAGE NETWORK (SUDs)

Where:
Open spaces all around the city.

What:
Ditches, Detention basins, Retention ponds, Water tanks for roof runoff water harvesting. The goal is to increase global permeability of urban surfaces with different techniques.

How to*:
Building ditches, detention basins, retention ponts and water tanks to encourage infiltration and evapotranspiration.

Main ecosystem services provided:[32.33]

-Flood control
-Habitat for fauna and flora
-Aesthetic and recreational services

**It would be advisable to include this intervention within a complete strategic plan, including monitoring and evaluation.*

32. Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php
33. Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. USDA Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture

URBAN "GREEN" AREAS and URBAN TREES

Where:
Dispersed open spaces all around the city, preferably spaces occasionaly flooded and along different streets.

What:
Creation of shadow areas that avoid extreme urban temperatures. The goal is to increasingly prevent high temperatures and create leisure areas.

How to*:
Promoting vegetation in different streets and open areas in order to multiply shadow areas.

Main ecosystem services provided:[32,33]

-Temperature control
-Flood control
-Habitat for fauna and flora
-Aesthetic and recreational services

**It would be advisable to include this intervention within a complete strategic plan, including monitoring and evaluation. It can developed together with the SUDs strategy.*

32. Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php
33. Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. USDA Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture

WASTE MINIMISATION

Where:
Consumption points, shops, markets, households.

What:
Promoting the 5 Rs –Rethink, Reduce, Reuse, Recycle and Refuse the use of single-use items, to derive maximum value from waste.

How to*:
Promoting returnable packaging, Home composting, Community composting and other waste management good practices.

**It would be advisable to include this intervention within a complete strategic plan, including monitoring and evaluation. Waste Wise Cities Tool provides a methodology for this purpose.*

FLOOD ADAPTED BUILDINGS

Where:
Public facilities and private buildings

What:
Adapting new public and private buildings in order to make them resilient to floods.

How to*:
-Sloping the plot towards a green area, to increase the water absorption rate.
-Building elevated houses, set on a platform or plinth to raise the floor level above the water level during flooding.
-Reinforcing the structural elements of the house, including roof and walls, to prevent it from collapsing under the force of water.
-Protecting the walls with waterproof materials to prevent them from being washed out by water.
-Building elevated latrines, keeping them closed and clean.
-Rainwater harvesting can provide access to water which can be critical during floods.

**It would be advisable to include this intervention within a complete strategic plan, including monitoring and evaluation.*

Your comments to consolidate this paper are highly appreciated. Please send us your feedback.

Talada aad ku xoojinayso buug-yarahan aad baan u soo dhawaynaynaa. Fadlan fikirkaaga nala wadaag.

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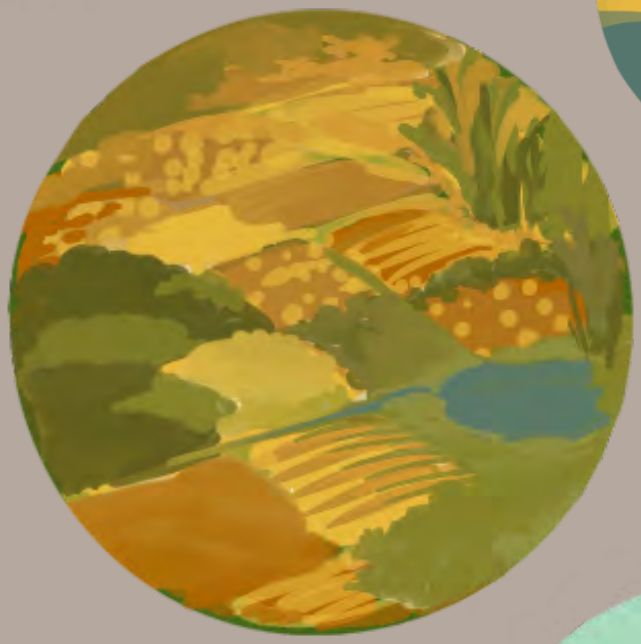

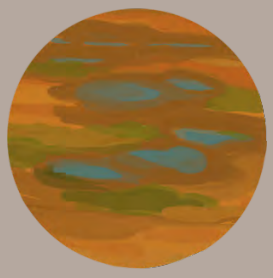

UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME
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