Methodology for mainstreaming Climate Change consideration into spatial planning, with a focus on National Spatial Plan

REPORT 02: RECOMMENDATIONS FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS INTO SPATIAL PLANNING WITH A FOCUS ON NATIONAL SPATIAL PLAN

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SUMMARY

This report (Report 02) is part of the efforts of UNDP to support the integration of climate change considerations into spatial planning especially the National Spatial Plan of North Macedonia. Three reports will be delivered as part of this effort.

Report 01, focuses on best practices and case studies to mainstream climate change considerations into spatial planning.

Report 02, focuses on recommendations to mainstream climate change considerations into the spatial planning framework of North Macedonia with a focus on the National Spatial Plan. It also suggests specific recommendations with respect to latest climate change assessment report of North Macedonia.

Report 01, elaborated best practices and case studies from across the world with focus on EU on how countries are mainstreaming climate change considerations into spatial planning. Some of the key overarching take-aways from the review of the best practices and case studies were;

- Spatial identification of vulnerability and risks for existing and future scenarios of extreme events and climate change
- Develop spatial strategies; to mitigate risks, enhance resilience and lower emissions. This is anchored on strengthening and facilitating ecosystem series performed by landscapes across scales and habitats including urban areas.
- Emphasis on better management of landscape systems and natural systems across scales (from national, regional to urban and local) from unscientific urbanisation, industrialisation or land conversions
- Need for integration and coordination among various scales of spatial plans

These key takeaways (Refer to page 8.) form the basis for Report 02.

This report (Report 02), provides recommendations for integrating climate change considerations into the larger spatial planning framework, followed by methodology, spatial components and mechanisms for mainstreaming climate change considerations into spatial planning with a focus on National Spatial Plan of North Macedonia.

This report is structured into two broad Parts;

I) Guiding Principles and Contextual factors to be considered for mainstreaming Climate Change considerations into Spatial Planning. It also elaborates how the

recommendations for mainstreaming climate change considerations can be integrated into the larger spatial planning methodology and the National Spatial Plan.

II) Recommendations (and Content) for mainstreaming Climate Change considerations into Spatial Planning with a focus on National Spatial Plan

It further elaborates, critical tasks that has to be undertaken to facilitate the integration and implementation of the recommendations. These include tasks like establishing and strengthening the spatial data and analysis platform, developing protocols for plan preparation, validation, review and approval.

Identifying and assigning roles and responsibilities to appropriate organisations is important to help mobilise action and to operationalise the National Spatial Plan. The report provides suggestions with this regard to this as well.

Extended details to support the main content of the report is provided in the Annexure. A list of important reference and learning documents to support further learning and understanding is also provided at the end of the report.

While the report focuses on recommendations for the National Spatial Plan, it also provides recommendations for integrating Climate Change considerations into lower level plans for cities/towns/villages (Annexure V). Spatial planning cuts across scale and sector. The larger context and driving forces which emerge at global, national and regional scales influence and impact communities locally and differently. Similarly, the combined and cumulative role of many different local actions; correlate, interact and influence the larger systems.

The methodology for mainstreaming climate change considerations into spatial planning is tied around the integration of the recommendations of this report into the National Spatial Plan. The success of this endevour depends on how the recommendations (related to the larger planning framework/process, scales of plans, specific recommendations suggested for the National Spatial Plan as well as those related to mechanisms of implementation and institutional arrangements), is carried out. Some of the recommendations are viable to be carried out immediately while some require more time, owing to the limitations in the institutional capacity. The success of these recommendations will also rely on timely adoption and viable implementation.

REPORT STRUCTURE

PART I. GUIDING PRINCIPLES AND CONTEXTUAL FACTORS TO BE CONSIDERED FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS INTO SPATIAL PLANNING

PART II. RECOMMENDATIONS (AND CONTENT) FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS INTO SPATIAL PLANNING WITH A FOCUS ON NATIONAL SPATIAL PLAN

PART I. GUIDING PRINCIPLES AND CONTEXTUAL FACTORS TO BE CONSIDERED FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS INTO SPATIAL PLANNING

The conventional and traditional spatial planning process doesn't consider the climate change risks and additional vulnerabilities or impacts. It doesn't integrate climate change factors as a determinant in spatial planning. This is because climate change phenomenons are relatively new compared to established planning practices world over.

Given that the spatial planning system and processes are strongly linked to institutional and legal instruments of governance and administration, any shift from traditional practice means, re-examining this traditional planning system holistically.

The Spatial Planning System in its entirety has to be examined and addressed. This means not only doing spatial assessments associated with climate change aspects and recommending strategies to address the findings, but also examining the spatial planning process, decision making mechanisms and tools as well as institutional capacity and responsibilities.

"Planning has to be re-framed from being a tool creating a fixed future to become a visionary adaptive tool of dynamic states in evolution."[1]

[1] *"Geospatial analysis and living urban geometry" by Pietro Pagliardini, Sergio Porta & Nikos A. Salingaros (https://www.academia.edu/188975/Geospatial_Analysis_and_Living_Urban_Geometry?email_work_card=view-paper)*

The Spatial Plans should be able to advocate planning practices that are climate-change sensitive and provide valuable information to other lower level plans. The type of spatial assessments suggested are;

1. **Natural Potential and Capacity based spatial assessments**
2. **Vulnerabilities and Impact Analyses which are specific and cumulative**
3. **Assessing Suitability of Land for different types of interventions (agriculture, urbanisation, industrial development, mining, etc.)**
4. **Landscape systems and maintaining their functional capacities**
5. **Compatibility of different land uses and development types**

Key Takeaways from Best Practices and Case Studies from across Europe and the world

The study of various global best practices gives a variety of approaches that directly and indirectly consider climate change aspects in Spatial Planning processes.

It is evident from the various best practices that, it is critical to address the entire spatial planning framework, from plan preparation, legal and institutional capacity, implementation mechanisms/tools to management and monitoring to develop a good methodology and framework for mainstreaming climate change considerations into spatial planning.

The objective is therefore to viably and contextually integrate as many of the best practices into the spatial planning framework of the Republic of North Macedonia.

Most of the EU nations, USA, and Canada have certain components in their spatial planning system that integrate strategies for building resilience and reducing vulnerabilities. On the other hand, Netherlands as early as 2007 adopted a more direct and explicit agenda and programme called, “National Programme for Spatial Adaptation to Climate Change (ARK)”.

The table below list down the key takeaways from various case studies and best practices that can inform the Methodology and Framework fro mainstreaming climate change considerations into spatial planning.

No.	KEY TAKEAWAYS	ASPECTS OF SPATIAL PLANNING*	CHARACTERISITCS
1	The four pillars that are fundamental to integrate climate change considerations into spatial planning are; - Vulnerability and Risk Assessment for existing and future scenarios - Mitigation measures to reduce/prevent risks - Adaptation measures to enhance Resilience - Adaptation measures to lower emissions	Guiding Pillars for every phase of spatial planning process	Inter-sectoral Spatial and non-spatial
2	Shift from sector - oriented planning to location/territory specific strategising and planning using landscape-based territorial development approaches.	Guiding principle for spatial planning process	Spatial (translate and identify spatial characteristics in data/information)
3	There is a need for coherence and integration between various levels of Plans (National/ Regional/Local Plans). Larger Plans should be able to inform local plans and local plans should align with the larger spatial guidelines and mandates suggested in the larger plans (Both Top-Down and Bottom Up)	Guiding principle to enable integration in the spatial planning system	Spatial Planning process and governance (applicable to the entire process and every phase)
4	It is important to have an indicator based framework to examine and read, specific threats, thresholds and consequences. This is an important decision making tool for active and continued assessment of vulnerabilities, risks and threats	Active Vulnerability and Risk Assessment (Relevant to all phases of planning)	Spatial (Real-time and geospatial) and Non-Spatial (Checklist)
5	Use geo-spatial tools and ICT technologies for risk and vulnerability evaluation, given the dynamic nature of rapidly changing scenarios. This will ensure that the spatial plans are less static or outdated and thus align closer with the changes on ground	Active Vulnerability and Risk Assessment (Relevant to all phases of planning)	Spatial (translate Non-Spatial data into spatial wherever viable)
6	Data (qualitative, quantities, spatial) and information (references, guidebooks, or decision making tools) repository that is organised and curated and which can be easily accessed by all parties/stakeholders (government and non-government)	Data and Information repository for Planning, governance and knowledge sharing	A repository that is web-based or otherwise, accessible to all (a one stop point to other data sources as well)

7	There is a need to adopt a multi-dimensional landscape approach that incorporates natural resource management (NRM) governance and tenure concerns within the design of land use (This is reflected in the best practices and most of the country case studies)	Preparation, Implementation and management phases	Spatial Maps that can inform Policy and land governace
8	Mapping areas of impacts for climate change scenarios based on scenario projections	Data for Plan Preparation phase	Spatial Maps that can fed into spatial assessments
9	Land Vulnerability, Land Suitability and Capability assessment methods has to be evolved to guide Land use plans, urban plans, sectoral plans and local plans (These spatial assessments have to be informed by global, regional and local factors/ drivers of climate change and geographic conditions and should be done for the different regions)	Plan Preparation Phase Applicable at National and Regional levels	Spatial (geo-referenced and enabled by geo-spatial tools)
10	Land based and activity based mapping of emission s (carbon and other pollutants) is important in informing Spatial Plans (including decision making tools/outputs of plans such as; maps, design and regulations)	Plan Preparation Phase Applicable at local level to inform local plans and sectoral plans	Spatial data supported by non-spatial qualitative and quantitative data
11	Landscape Structure Plans at national, regional and local levels should hold precedence and inform all sectoral development plans as well as land use plans	Plans and Plan Preparation component	Spatial Maps that are geo-referenced and accessible to all decision makers
12	Visualising impacts and risk areas for awareness and capacity building	Decision making supplementary tools	Spatial and Three-Dimensional)
13	All spatial planning phases (especially plan preparation, implementation tools/ mechanisms, management and monitoring tools/guidelines) has to be evaluated based on terms and conditions for climate change considerations and sustainable development before been approved for use.	Applicable to Plan Preparation, Implementation tools/ mechanisms, Management and monitoring tools/ guidelines and can be used as the approval mechanism	Evaluation for Quality assurance of various aspects of spatial plan preparation

14	Some important Plan Implementation and management tools/mechanisms are; Zoning codes and regulations, land sub-division codes and controls, incentive based covenants and easements, development and design regulations and controls	Plan Implementation tools and mechanisms for land governance	Policy, regulation and rules that are obligatory, guidelines that are non-obligatory and incentivising mechanisms
15	Natural resource based valuation of land to inform land tenure and governance is critical to ensure that ecosystem services and natural capacity of landscapes in mitigating risks/building resilience/reducing impacts etc. are protected and valued	Land tenure and governance	Land valuation techniques and methods
16	Clarity in roles and responsibilities of various government departments/agencies for every stage of planning process (plan preparation, approval, implementation, monitoring and management). Each of these phases and its outputs has to be evaluated by an independent set of experts (guided by a set of evaluation criteria/ parameters/terms/conditions)	Governance	Governance related protocols and institutional mandates
17	Collaborate and partner with counterparts in other countries; - Between government departments and agencies - Between expert institutions and non-government organisations-local and international (to facilitate community engagement, to be updated about best practices etc.)	Developing and iterating Plans (Plan Preparation phase)	Collaborative efforts (formal and informal) through conferences, workshops, combined exercises
18	Capacity building (skills and man-power) to enable better planning practices and adoption of new methodologies is important.	Institutional development	Training exercises
19	Community/citizen engagement and awareness is vital in realising various plans on ground. this is fundamental as they are the key stakeholders and beneficiaries of any planning intervention.	Community Awareness	Participatory and representative
** Aspects of Spatial Planning Framework referred to here are; Plan Preparation Phase, Plan Approval Phase, Plan Implementation Phase, Plan Management and Monitoring Phase*			

Climate Change principles in Spatial Planning

Climate Change considerations can be broadly classified under; Vulnerability and Impact Assessment for current and future scenarios, Mitigation measures to reduce future impact and future developments, Adaptation measures to built resilience and lower emissions.

Broad strategies for integrating Climate Change considerations into Spatial Planning are;

1. **Climate Change and Extreme events preparedness through Risk Identification, Risk Reduction and Mitigation**
2. **Adaptation strategies for resource security in future scenarios of resource risk**
3. **Protecting natural resources of national importance and value**
4. **Conserving and Rejuvenating Regional Landscapes and Resource regions**
5. **Integrating regional and localised plans through adaptation recommendations for urban and rural areas**

Decision making regarding development choices, intensity of development, type of development etc. has to be informed by the findings of spatial assessments and evaluation that considers climate change and other extreme events[2].

Climate Change has to be understood broadly as nexus of cause and consequence. The cause being an imbalance in the green house gases emitted into the atmosphere which has triggered a systemic and cyclic shift in normal atmospherical processes resulting in changes in Global weather patterns. Such rapid changes in weather patterns affect both regional and local landscapes/ecosystems/biodiversity. This is because local systems struggle to adapt and evolve given the margins of unpredictability of climate change

[2] *The reason why some extreme events assessments are also recommended to be included along with climate change variables is because climate change variables has direct and indirect influence on extreme events (natural disasters or man-made).*

triggered extreme events. Hence any approach in spatial planning should seek to understand and address concerns such as;

- Which factors of Global Climatic variables are going to affect the country and its regions ? How are these going to affect the country at large ?
- How will different geographic regions, different types of ecosystems, local landscapes be affected by the Global Climate Change Variables ?
- Which other location specific anthropogenic factors or entities could exasperate local impacts ?
- Which are the most vulnerable landscapes and regions ?
- How well-equipped are such vulnerable regions, in addressing such risks ?
- What are the spatial implications of predicted climate change trends ? How does these implications affect any given region or locality ?
- What preventive or mitigative measures can be taken to reduce the degree of impact ?
- What proactive measures can help regions and localities strengthen its resilience to such extreme and unforeseen risks ?
- How can communities and governments be prepared for extreme events ?
- How can new development choices be more climate change resilient ?
- How can existing landscapes and human habitats adapt and be more resilient ?
- How can the ecosystem services provided by natural systems be utilised to strengthen resilience of settlements and landscapes ?

The multi-sectoral and multi-scalar Nexus of Climate Change (cause and impact)

Climate Change as a phenomenon is evidently influenced by anthropogenic actions and interventions. This influence and associated consequences affect the environmental and climatological processes. Humans are an integral part of the environment and our influence cuts across multiple realms. Development choices and decisions on how human

habitats; be it growth of city/town/village, building of dams, clearing of forests, reducing or increasing pollution and emissions etc., has short term and long term impacts.

Development intensity over the past decades has lead to;

- higher rates of consumption of natural resources and energy which has cost us, the ecological security and its services,
- increased rate of environmental destruction which is either beyond the rejuvenative capacity of nature.

This trend continues and involves almost all sectors of development. Cultivation practices/agriculture, consumption patterns and trends, increased consumption of energy, increased transportation needs, trade-offs between environmental and ecological destruction over mega-development projects etc., are only some examples of cross-sectoral causes of higher GHG emissions and ecological footprint. Each of these examples, affect and influence other sectors and hence are inter-dependent.

Economic decisions and policies influence consumption and demand patterns and trends which in turn drive production. Production guidelines and trade-offs across various interdependent industries or agriculture, determine the intensity and impacts related to ecological footprint or emissions. The availability and condition of water resources or food resources or other ecological services, is influenced by the trade-offs between other competing sectors. The planning policies, real estate, land use choices and regulations influence how much an individual need to travel for various purposes and thus influence transportation and associated emissions. These cases demonstrate this interdependency between various sectors.

Due to the interdisciplinary nature of spatial planning, this sector can consider the impacts of climate change across different sectors. In that respect, spatial planning has to harmonise or balance varying interests and put spatial provision concepts at the beginning of risk avoidance chains.

In order to adapt the use of space to the changing climate, the data and knowledge base for planning needs to be improved. The systematic consideration of adaptation aspects ("climate proofing") ensures that plans and programmes support adaptation to climate change.

- Climate adaptation in spatial planning, Umwelt Bundesamt

Given this complexity of the nexus linked to climate change and human actions/ interventions; it is critical that a system based assessment practice is adopted for spatial planning. Planning being a cross-sectoral and multi-scalar practice, is best suited to functions as a platform that can bring together this interdependency between sectors.

System based planning and assessment frameworks are hence important in planning practice and associated research. One of the most effective system based assessment framework is the DPSIR[3] framework. This combined with SWOT can help identify dependencies, critical factors and determinants in planning and spatial or non-spatial development studies.

[3] *According to the DPSIR framework there is a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical, chemical and biological) and 'impacts' on ecosystems, human health and functions, eventually leading to political 'responses' (prioritisation, target setting, indicators). Describing the causal chain from driving forces to impacts and responses is a complex task, and tends to be broken down into sub-tasks, e.g. by considering the pressure-state relationship.*

Context: Climate Change and Spatial Planning in North Macedonia

What are the Climate Change Risks and Vulnerabilities for North Macedonia ?

Republic of North Macedonia and UNDP are collaborating to carry out various Climate Change assessments for the country. These studies, details out Climate Change projections and vulnerability in terms of intensity, frequency and viabilities for specific location along with sectoral impacts[4].

Climate change is predicted to impact different geographic regions of North Macedonia slightly differently in term of; intensity, frequency and duration of rainfall; temperature changes/variables in terms of duration, intensity.

To apply these studies into spatial planning, the impacts and consequences of these on landscapes, ecosystems, human settlements, infrastructure etc., has to be examined. In doing so it is also critical to assess how context and location specific factors exasperate these climate change variables or implications.

Spatial identification and mapping of vulnerable and impacted areas enables informed decision making and allows for a more tangible integration of climate change considerations into spatial plans. Further this section elaborates;

- critical findings of the latest available studies and research on Climate Change predictions for the country,
- implications of these climate extremes, and
- regional/local land and landscape conditions/parameters that can increase the CC impacts and risks

SUMMARY OF FINDINGS FROM THE REPORT AND PRESENTATION ON “CLIMATE EXTREMES PROJECTIONS FOR MACEDONIA UP TO 2100”[5]

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[4] *First Biennial Update Report on Climate Change - MoEPP, Govt. of North Macedonia with Technical and Financial Support of UNDP and GEF,*
3rd National Communication on Climate Change-MoEPP, Govt. of North Macedonia with Technical and Financial Support of UNDP and GEF,
UNFCC Portal of North Macedonia (http://www.unfccc.org.mk/Default.aspx?LCID=207 , http://www.unfccc.org.mk/Default.aspx?LCID=261)

[5] *Source: https://klimatskipromeni.mk/article/406#/index/main, https://www.youtube.com/watch?v=awVg0kTmEMY&t=12s, https://www.youtube.com/watch?v=Fzqv_RI95Fg&feature=youtu.be*

by Dr. Vladimir Djurdjevic, associate professor at the Department of Meteorology at the Faculty of Physics, at the University of Belgrade

A. Temperature
    - Temperature Increase (average, minimum and maximum)
    - Increase of hot extremes
    - Decrease of cold extremes
B. Precipitation
    - Annual Decrease (for RCP8.5 scenario)
    - Redistribution in annual cycle
    - Less summer precipitation (risk of drought)
    - Increase in number and intensity of extremes (risk of floods)

Detailed references from this report is made in Part II of this report, where specific recommendations for mainstreaming climate change considerations into National Spatial Plan is suggested.

<u>VARIOUS IMPLICATIONS OF THESE CLIMATE CHANGE PROJECTIONS FOR NORTH MACEDONIA</u>

1. Drought can result in **loss of cultivable lands and changes in cultivation periods/ seasons**
2. Drought can cause **changes in sub-surface water levels** especially water table. It can also affect ground water resources both un-confined and confined aquifers
3. **Changes in soil salinity, moisture and drainage capacity** caused by drought
4. **Drought can also cause changes in shoreline of lakes and water-bodies.** Perennial water bodies can see drying caused by lowering water tables. Non-perennial water bodies which are dependent on rainfall can also dry up due to extended dry spells, but at the same time cause flash floods when there are extreme rainfall events (The risk of such flash floods are higher in urban landscapes with non-permeable surfaces as this will result in increased run-off and reduced time of concentration).
5. **Flooding of rivers** and in long run **change in river morphology** in areas with predicted increase in rainfall.

6. **Catchment capacity changes** caused by increased run-off which can mean additional storage needs for Dams, possible risks of dam breach due to extreme precipitation events
7. **Flash floods** and depending on where these flash floods happen there is **additional erosion and landslide risks**
8. **Water resource variabilities** (changes in incident rainfall, seasonal changes in rainfall, extreme rainfall events leading to flash floods)
9. **Glacial melting and snow destabilisation** that may increase risks of avalanches in new areas
10. **Heat Waves can increase the risks of heat exhaustion especially for people in urban landscapes with added heat island** effects, it can also affect the flora landscapes, plant health and cultivation.
11. **Health risks and human fatality** are some direct impacts. There is also greater risks of **emergence of new diseases**.
12. **Reduced Frost days would mean arrival of early spring**. This means plant blooms and other ecosystem life-cycle changes
13. **Changed cultivation periods and productivity** due to drought (pH changes, nutrient losses/salinity) and redistribution of annual cycles of precipitation
14. **Increase in cases of pests and diseases** (risks to humans and for agriculture)
15. **Species migration changes in terms of both spatial and temporal shifts**
16. **Habitat regions can change with altering weather and shift in flora spread** (new regions may become preferred habitats for different species, some other hot-spots and habitats may no longer be preferred habitats for species)
17. **Disasters triggered by extreme events of floods, dam breach, landslides, glacier melts**. Eg; Leaching from mining lands caused by flash floods or altered river inundation. This can pollute productive lands, ground water etc.
18. New vulnerable zones may emerge with the changes in climate variables. **Disasters related to leaks and failures of chemical and other high risk industries** which are located in landslide risk zones, seismic zones, dam breach zones etc. This can result in loss of life, loss of habitats, cause health hazards etc.

WHAT ARE THE REGIONAL/LOCAL LAND AND LANDSCAPE CONDITIONS/ PARAMETERS THAT CAN INCREASE THE CC IMPACTS AND RISKS ?

- **Natural Terrain and Topography:** Valleys surrounded by mountains and hills can have regional climatic changes and consequences, Alpine regions will have different implications and risks, floodplains and water bodies along with the catchment areas will have different local impacts and will be driven by various location specific parameters. Continental plains may have different and localised implications and consequences especially w.r.t drought and agricultural landscapes.
- **Degree of Slope:** The steeper slopes in regions where rainfall increases are predicted will be more vulnerable.
- **Soil stability:** Soils which are inherently less stable because of its structural properties on slopes which are subject to intense rainfall especially with new changes in rainfall distribution would make previously less vulnerable regions more vulnerable.
- **Soil type** (whether with low drainage capacity etc. which can cause increased water retention that may further destabilise the land)
- **Land cover w.r.t whether permeable or non-permeable**: Non-permeable areas will cause increased rate of run-off and reduce the time of concentration of water in reaching the sink. Catchments with non-permeable surfaces are at more risk to flooding or flash floods. Permeable lands allow percolation and reduce the run-off rate and increasing the time of concentration of water in the sink, thus reducing risk of flash floods
- **Land cover w.r.t whether vegetated/planted or not:** Planted and vegetated surfaces allow water retention and percolation reducing run-off rates and thus flash floods in catchment areas
- **Valley areas in proximity to landslide prone hills/slopes**: These low lying areas will also be affected by landslides and soil deposition.
- **Flood plains:** Flood plains are highly dynamic areas which are subjected to inundation with varying water in the river and lake. With changes in precipitation extremes and seasonal changes, the run-off from catchment will change due to increase in incident rainfall, thereby changing inundation patterns and floodplain extents.

- **Dry vegetation and areas with forest fire risks:** Those landscapes with dry vegetation and in dry climatic regions will be more prone to increased forest fires if these areas are found to have more increased temperatures and hot days.
- **Altered natural terrain resulting from construction activities:** Altered terrain affects surface water flow dynamics. This can cause flooding in new areas. Such local and regional interventions can further the impact of extreme precipitation events.
- **Fragmentation of surface drains or natural streams** by artificial/man-made obstructions: By blocking natural drains the upstream areas will be at risk of back flow of accumulated water, it can cause saturation of soil causing it to wash off and destabilise the land. When streams are obstructed the downstream water needs and soil moisture is affected adding to the drought like situation and depending on the type of stream it can also deplete the sub-surface water dynamics.
- **Storage capacity of dams** in cases where catchment may receive increased rainfall: The altered run-off quantity generated in catchments of dams where changes in precipitation extremes are predicted is important to estimate. (Eg: some areas are predicted to see upto 60% increase in number of days with rainfall above 40mm/day and with 20% increase in daily maximum precipitation accumulation.)
- **Design and capacity of storm water drains**: Often storm water drains, storm water canals and channels are designed for average. But with changes in the average and extreme rainfall events the design capacity of storm water channels/drains/canals will have to be compensated by either enhancing the design capacity or by taking passive design measures to reduce the load on the drains. Some such passive and landscape infrastructure measures includes increasing permeable surfaces in the catchment, installation of green infrastructure such as rain gardens, bio-sales etc.

Spatial Planning in North Macedonia

Types of Development Plans: Spatial Plans, Regional Plans and Special Plans,Urban Plans and City level Land use plans, Local Area Plans/Land use Maps.

Current Planning Process and Institutional Structures (Preparation-Approval-Implementation): Ministry of Environment and Physical Planning, Spatial Planning Agency, Municipal Governments

Existing Legal Instruments: Law on Spatial and Urban Planning, Law Implementing the Spatial Plan of the Republic of North Macedonia, Amendments and Revisions underway

Responsibility for dealing with CC at local or regional levels is not foreseen in the Law on Environment, nor is it provided by the Law on Local Self-Government. The authority which prepares the National Plan for CC is only entitled to give a mandate to municipalities for the implementation of measures and actions adopted at central level, but not for local policy-making on CC. In conclusion, the positive legislation of the Republic of Macedonia imposes no obligation on municipalities (or forms of inter-municipal cooperation) to adopt a local / regional planning document that refers solely to CC. Alternately, Norms associated with CC are included in several sectoral laws that focus on various aspects related to mitigation or adaptation.

Source: ASSESSMENT OF LOCAL ACTION FOR MITIGATING AND ADAPTING TO CLIMATE CHANGE IN THE VARDAR AND SOUTHEAST PLANNING REGIONS, Authored by Biljana Puleska, PhD for MoEPP and MoLSG through UNDP (Skopje) and UNDP (Oslo)

- **The government is in the process of finalising the amended Law on Spatial and Urban Planning.**
- **The Republic of North Macedonia is developing a Law on Climate Action so it is not yet codified in a single legal document.**

For successful implementation of recommendations for mainstreaming climate change considerations in spatial planning, it is critical that the recommendations align with the legal frameworks and all applicable laws.

The following National Strategies should also be considered as additional references while integrating climate change considerations into the National Spatial Plan;

- The National Spatial Plan preparation method and structure of chapters
- National Strategy for Nature Protection 2017-2027
- National Biodiversity Strategy and Action Plan 2018-2023
- Water Strategy for the Republic of Macedonia
- Biodiversity Strategy and Action Plan of the Republic of Macedonia
- Environmental Monitoring Strategy, Environmental Communication Strategy, Environmental Awareness Strategy and Environmental Data Management Strategy

Mainstreaming Climate Change considerations into the larger Planning Process

Spatial planning cuts across scale and sector. The larger context and driving forces which emerge at global, national and regional scales influence and impact communities locally and differently. Similarly, the combined and cumulative role of many different local actions; correlate, interact and influence the larger systems differently. This impact-response cycle cuts across scales and differently influence and react to local conditions. This is very much systemic and dynamic.

When dealing with such dynamic conditions of cause and consequences of human actions/human response and environment change/environment reaction, plans also have to be adaptable and flexible. This flexibility and adaptability in planning process can be achieved only when there is continuous knowledge updation and preparedness for managing any aspect of development and extreme events.

Technological advancement in spatial assessment and documentation, provides the opportunity to efficiently evaluate and respond. For this, establishing a well functioning digital data and mapping platform based on geographic information system is critical. Even then, certain development choices that can harm and affect the health of habitats and settlements cannot be allowed to be compromised.

There is a clear need to enable flexibility in spatial planning without compromising critical aspects that are fundamental to achieving the objectives of spatial planning/development. Identifying these critical and fundamental aspects, continued assessment and change detection, guiding responses to take development planning decisions and choices, becomes critical when we talk about a well-structured spatial planning or development planning framework.

MIND-MAP SHOWING THE ENTRY POINTS OF CLIMATE CHANGE INTEGRATION IN THE OVERALL PLANNING FRAMEWORK

The mind-map illustrates the layout of proposed components in the framework of spatial planning. The framework proposes that climate change consideration for spatial planning be integrated across different scales, from country to region to city and village to neighbourhood level.

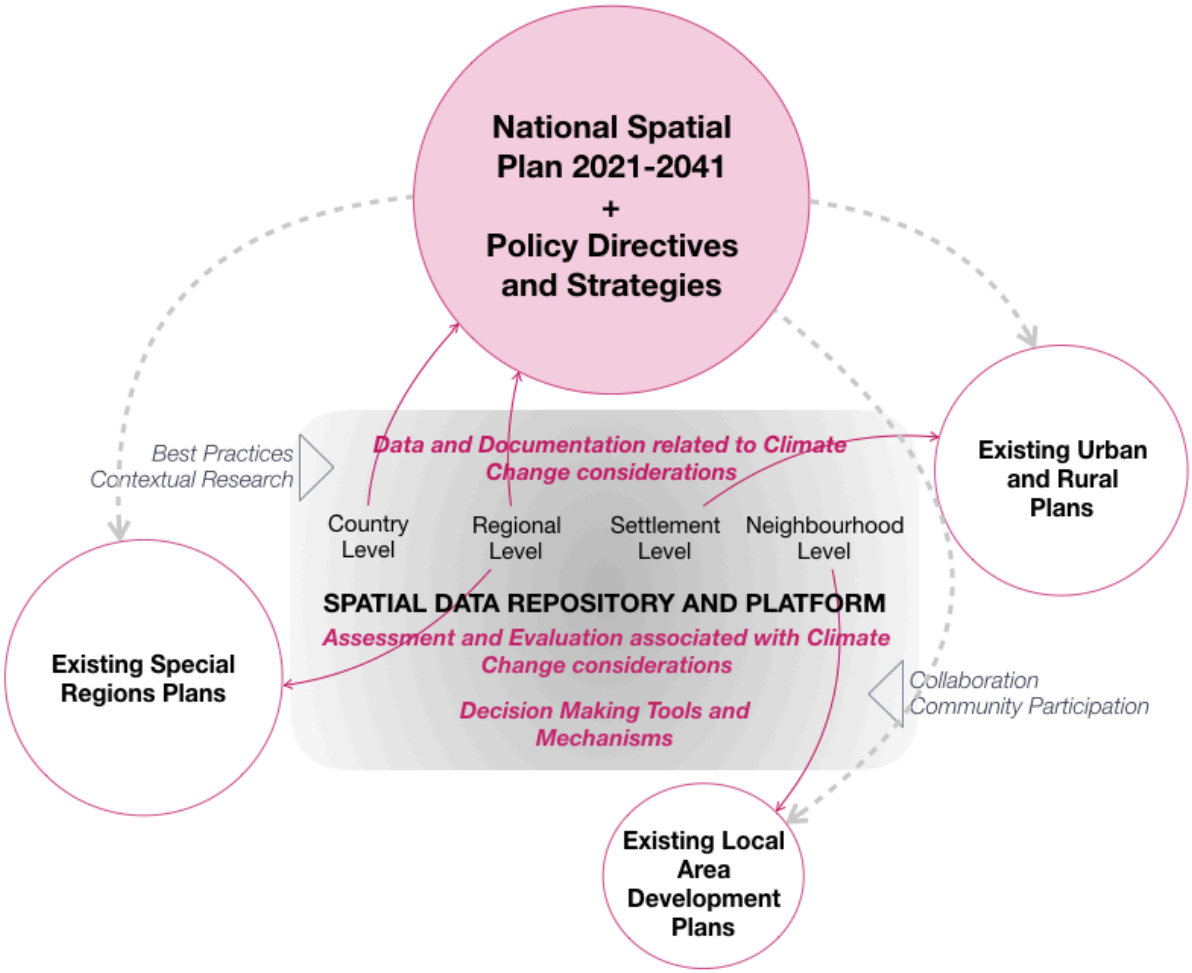

Figure: *National Spatial Plan within the Spatial Planning Framework and points of entry for lower level Plans to integrate Climate Change considerations*

The recommendations for lower scales of spatial plans are provided as ***Annexure V.*** *These recommendations for lower scales of spatial plans are not intended for the work of the National Spatial Plan or Agency for Spatial Planning. The scope of work for Agency for Spatial Planning is limited to the recommendations prescribed for National and Regional scales.*

INTER-SCALAR PLANS AND THE INTER-DEPENDENCE

	Plans and Levels	Components and Purpose
I	**NATIONAL SPATIAL PLAN** (For the country)	- Maps informed by documentation and assessment information for guiding national authorities and decision makers - Strategies and Protocols for management of various spatial planning aspects related to hazard zones, resource regions, Eco-sensitive and special areas which supported by national level documentation and assessment information
		- Region specific spatial planning components and maps supported by regional level and context specific data and assessment - Zoning regulations and special areas regulations so as to take pro-active measures for prevention and mitigation of risks, protection of critical natural resources and ecosystem functions
II	SPATIAL PLANS AT MUNICIPAL LEVEL (For Cities/Towns/ Villages)	- Settlement specific plans and designs for various aspects of city and village habitats (for built areas and un-built landscape areas) - Checklists, guidelines and criteria for planning components (plans, designs, land use allocation, density allocation)
III	LOCAL AREA PLANS (For Neighbourhoods)	- Locality specific design and planning tools for urban form, building design and form, access and mobility, emergency response, aimed at creating liveable, and safe healthy neighbourhoods (for built areas and un-built landscape areas) - Identifying and developing community engagement interfaces and opportunities - Designing tools and mechanisms for community engagement in neighbourhood management

The recommendations at level II and III are ideal for consideration in lower level plans like urban or city plans and local area plans. Annexure V. provides detailed recommendations for lower level plans. As demonstrated in the mind-map, the data repository with data at various scales can be referred to while developing each level of spatial plan. The higher level plans when required, can refer to local and nuanced data, thus enabling formulation of context sensitive guidelines at higher levels of plans.

Evaluation of available data and studies relevant for mainstreaming climate change considerations into the National Spatial Plan

A listing and preliminary evaluation of available spatial information and scientific studies related to climate change in North Macedonia is made (Refer to Annexure II. to see a detailed listing of the required data/assessment maps and correspondingly the availability and source for each of data listed). Official departmental websites, institutional websites and studies carried out by UNDP were searched. Nearly 70% of the enlisted data seemed to be available and accessible.

These are the required data and analysis for developing the recommended Decision making tools and strategies (Refer Chapter II in Part II) in the National Spatial Plan so as to mainstream climate change considerations. Such an inventory which is updated regularly, is equally important and will keep all users of these studies and data up to date.

Gaps in the existing planning framework that needs to be addressed

Some of the gaps are related to institutional arrangements and may be political and systemic in nature. But there is scope for utilisation of studies from multiple sources and institutions, in the spatial planning process across. Opportunities for collaboration and sharing of data and information is fundamental to evolving a more comprehensive spatial plan. While considerable data and studies exist, some supporting requirements that are important for the spatial planning framework are;

1. Need for climate actions and strategies in the lower level spatial plans
2. Need for connect between higher level plans and lower level plans in terms informing each other for policy making. While there is a need for independence
3. Importance of the role of communities, citizens and other relevant organisations in the process of spatial plan preparation at various levels (in higher level and lower level plans)
4. Need for updated demographic data for the plan preparing agencies and organisations at various levels. This data is relevant to the larger planning process. In case of climate change studies and impacts, demographic data allows to

estimate; carbon footprint, carrying capacity, resource need etc. These assessments could inform strategic actions with respect to;

a) need and availability of resources,
b) estimation of per capita ecological footprint and carbon footprint which can inform prioritised measures at various levels (from individuals to communities within any territorial limits)
c) accounting of emissions

5. Need for clarity on the decision making process to determine allocation of land/ area for various development projects especially with respect to addressing conflicts with land use plans or spatial plans. Does the project approval process require environmental, social and climate change impact and vulnerability assessments studies?

Integrating the recommendations into the country's spatial planning framework

How to ensure viability of establishing a planning framework that mainstreams climate change considerations ?

The way forward in this context of various opportunities and constraints linked to availability of data, legal framework, etc. is to;

i. Vet and utilise relevant existing studies and data (refer to the spatial components in Part.II and Annexure II. of this report for the list of data, analysis and tools required for mainstreaming climate change into the larger spatial plan)

ii. Prioritise critical aspects in the proposed framework of mainstreaming climate change

iii. Align and utilise existing and applicable laws and national strategies

iv. Extract specific recommendations for the NSP 2021-2041 w.r.t above three aspects

v. Phase-out the establishment of non-critical aspects of the spatial framework for future implementation

Based on the principles, contextual factors and preliminary viability assessment; specific recommendations for mainstreaming climate change considerations into spatial planning with a focus on the National Spatial Plan is elaborated in the next Part (Part II) of this report).

Structuring the recommendations of this report into the National Spatial Plan 2021-2041

Based on discussions and deliberations, a preferred structure for the National Spatial Plan maybe evolved.

It has been agreed that, in the National Spatial Plan, climate change considerations should be provided within the corresponding chapters, wherever relevant.

The integration of the recommendations of this report into the larger methodology of spatial plan preparation is equally critical to ensure that the National Spatial Plan mainstreams climate change considerations.

Key Steps to ensure integration of climate change aspects into the spatial plan preparation process

1. Incorporate Climate Change considerations into the larger Methodology of Spatial Planning
2. Include spatial data on climate change implications into the spatial data infrastructure (SDI) and INSPIRE platform
3. Parameters for evaluation of spatial plan for Climate Change integration
4. Perform Spatial analysis and comprehensive assessments of Climate Change parameters and Implications using tools like GIS, DPSIR and SWOT
5. Include spatial strategies for Climate Change management (mitigation, adaptation and resilience building)
6. Integrate CC considerations into decision making related to spatial plan (Prioritisation, trade-offs etc.)
7. Evaluate Final Spatial Plan to examine integration of Climate Change considerations/ assessments
8. Use recommendations to inform land management and land regulations and policies at national, as well as local level

CONTENT TABLE for PART II of the Report

PART II. RECOMMENDATIONS FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS INTO SPATIAL PLANNING WITH A FOCUS ON NATIONAL SPATIAL PLAN

I. CLIMATE CHANGE MANAGEMENT OBJECTIVES FOR NORTH MACEDONIA

As mentioned earlier the climate change considerations to be integrated into the spatial planning process are anchored on;

1. Directing and guiding development towards a more sustainable one
2. Ensuring safety and security of communities and individuals
3. Ensuring preservation and protection of environmental resources and services
4. Preparing and adapting communities and land to cope with climate change extremes and disaster events
5. Taking development decisions and actions to enable resilience in human habitat
6. Awareness building and community engagement for action and implementation
7. Improving and enabling efficient and informed decision making
8. Integrating and embedding climate change considerations and preparedness for unforeseen circumstances

Such goals can help manage climate change impacts and consequences in a targeted manner. The role of spatial planning is to identify areas and locations that would be most

affected so as to take proactive precautionary measures with respect to development planning, adopt planning strategies that can integrate and assimilate the resilience of natural environment into human settlements/systems and take proactive adaptation measures (sectoral and spatial) so as to be prepared for the changed future.

II. SPATIAL COMPONENTS AND IMPLEMENTATION MECHANISMS FOR MAINSTREAMING CLIMATE CHANGE CONSIDERATIONS

A. Spatial Components for National Spatial Plan: Decision making tools and Strategies at Country and Regional scales

The section identifies;

1. Specific spatial implications and elevated risks associated with Climate Change projections in North Macedonia
2. Decision Making Spatial Tools and Strategies

Under each; several recommendations are provided which can be used to inform spatial strategies for climate change management at National and Regional scales.

To identify specific spatial implications and to prepare each of the recommended strategies, several spatial documentation and analysis components are required. An exhaustive list of the documentation components and analysis components at country and regions scale can be referred to in the **Annexure.II.**

The spatial aspects of **Climate Change determinants** are identified to align with the objectives of risk identification, vulnerability reduction, prevention, mitigation and adaptation to ensure resilient and climate sensitive spatial management which cuts across all sectors.

Some of the recommendations maybe included as part of the NSP 2021-2041 document, some could be taken up as short term or long term programmes/projects involving governmental and non-governmental agencies.

Identification of specific spatial implications and elevated risks associated with Climate Change projections

The following spatial assessments and outputs integrates spatial aspects related to specific climate change risks based on projections for North Macedonia in the next 100 years.

CCI.1: Areas with elevated drought risks triggered by CC: Reference maps for overlay analysis;

- Temperature variability prediction map for country (for three scenarios) - *Available in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*
- Aridity index map for the country - *Refer to Agro-ecological atlas of the Republic of North Macedonia-2020,FAO; http://www.fao.org/3/ca7519en/CA7519EN.pdf*
- Sub-surface water (aquifer) condition map (areas with degraded or and depleting aquifer/ground water)- *Available with MoAFWE – Ministry of agriculture, forestry and water economy*

CCI.2: Areas with higher Heat wave risks triggered by CC predictions: Reference maps for overlay analysis;

- Future annual change in tropical nights - *Available Fig.10 in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*
- Annual change in extreme heat waves (WSDI index) - *Available Fig.11 in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*
- Future annual change in consecutive dry days - *Available Fig. 15 in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*
- Areas with low vegetation cover and low tree density distribution

CCI.3: Areas with additional Flood risks triggered by CC: Reference maps for overlay analysis;

- Future annual change in number of extreme precipitation events - *Available Fig.13 in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*

- Flood prone areas w.r.t rivers (Floodplains and drainage areas with catchments/basins boundaries) - *Available with MoAFWE, CUK or MoEPP*
  Dam spills and associated flooding risk map - Partially Available with MoAFWE – Ministry of agriculture, forestry and water economy, CUK – Crisis management center, DZS – Protection and rescue directorate

- Valleys and Ridges Map - *Available with AREC – Agency of real estate cadaster, NASA, SRTM - DEM cartography*

CCI.4: Areas with additional Landslide and Avalanche risks triggered by CC:

Reference maps for overlay analysis;

- Future annual change in number of extreme precipitation events - *Available Fig.13 in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*

- Relief map (which also showing topography or contour lines) - *Available with APP - Space Planning Agency, Digital Elevation Model 30m*

- Slope analysis Map - *Available with Kaplan – 30m map (*possible 5m map), Institute of Agriculture (new soil maps), AREC Agency of real estate cadaster (DEM cartography), *NASA, *SRTM – DEM cartography*

- Valleys and Ridges Map - *Available with AREC – Agency of real estate cadaster, NASA, SRTM - DEM cartography*

- Land cover Map - *Available with MoEPP – Ministry of Environment and Physical planning, *EEA, Corine – Land cover, MES - in the frame of the Nature Conservation Programme – Phase 2*

- Mining areas map - *Available with MES – Macedonian ecological society has maps on industrial and mining areas without type of hazards*

- Seismicity map which shows fault lines - *Available with APP - Space Planning Agency, Center for earthquakes, IZIIS - https://msz.iziis.ukim.edu.mk/*

CCI.5: Habitat vulnerability triggered by CC: Reference maps for overlay analysis;

- Temperature variability prediction map for country (for three scenarios) - *Available in the Report on climate change projections and changes in climate extremes for Macedonia by Dr.Vladimir Djurdjevic*
- Wildlife habitat map (water and land habitats and ecosystems) - *Generalised maps available*
- CCI.4 Areas with additional Landslide and Avalanche risks triggered by CC
- Relief/Terrain map with contours and elevation data - *Available with APP - Space Planning Agency, Digital Elevation Model 30m*

This overlay can help identify regions close to existing habitats which are at higher elevations, into which the tree and flora line may shift. This information is useful is proactively protecting these regions by possibly including them into conservation areas. CCI.3 also will help identify hazard/risk areas that may fall within Wildlife habitat areas.

CCI.6: Areas of industrial disaster risks elevated by CC implications: Reference maps for overlay analysis;

- CCI.3 Areas with additional Flood risks triggered by CC
- CCI.4 Areas with additional Landslide and Avalanche risks triggered by CC
- Mining areas and areas of industrial pollution (including chemical, nuclear and manufacturing industries with information on type of industry) - *Available with MES – Macedonian ecological society has maps on industrial and mining areas without type of hazards*

CCI.7: Catchments with elevated risks for Dam breach triggered by CC risks of increased precipitation

Dams location-catchment and downstream drainage area mapping w.r.t various models of incident rainfall in the catchment

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Decision Making Spatial Tools and Strategies at country (Nc) and region (Rc) scale

The suggested decision making tools mainly comprises of decision making spatial maps, regional landscape structure plans, strategies, protocols, policy suggestions, development control regulations etc.

These tools can be derived based on cumulative analysis of various spatial maps which help identify intrinsic land and space based risks, which can help identify critical spaces and landscapes that can built resilience, require adaptation or need restoration and protection.

Nc1. National Special Regions Maps: These map will be a useful reference for management and decision making for national authorities and has to be supported by detailed legends and qualitative/quantitive spatial and non-spatial information.

- **National Comprehensive Hazard[6] Zonation Map**: Reference maps to prepare this map are;

Natural disaster events and extreme events of past (map showing areas prone to all types of disaster like landslides, earthquakes fault-lines and epicenters, flooding, Avalanches) - *Available with CUK – Crisis management center, DZS – Protection and rescue directorate*

Seismicity map which shows fault lines - *Available with APP - Space Planning Agency, Center for earthquakes, IZIIS - https://msz.iziis.ukim.edu.mk/*

Soil erodibility map (Soil maps showing most erosion prone soils) - *Available ar MASIS - www.maksoil.ukim.mk, Institute of Agriculture, contact prof. Blinkov, and prof Milevski respectively) -*

Relief map (which also showing topography or contour lines) - *Available with APP - Space Planning Agency, Digital Elevation Model 30m*

Mining areas and areas of industrial pollution (including chemical, nuclear and manufacturing industries with information on type of industry) - *Available with MES – Macedonian ecological society has maps on industrial and mining areas without type of hazards*

Dam spills and associated flooding risk map - *Partially Available with MoAFWE – Ministry of agriculture, forestry and water economy, CUK – Crisis management center, DZS – Protection and rescue directorate*

Map showing all existing human settlements (Cities/villages, agriculture-plantation areas, heritage sites, transport corridors/networks etc.) - *Available*

[6] *This is a comprehensive hazard zonation map which considers Climate change triggered and other extreme events triggered risks and vulnerabilities*

*with APP - Space Planning Agency, Kaplan - Maps for 1900, 2000, 2014 (*can be made for 2019)*

Map showing all know future development (known projects, developments proposed for future) - *Not available*

- **National Resource Management Regions Map:** Reference maps to prepare this map are;

Productive Landscapes suitable for Agriculture and Cultivation - *Refer Corine https://land.copernicus.eu/ , FAO – GIS catalogue of agriculture, land and productivity assessment + vulnerability, MoAFWE – Ministry of agriculture, forestry and water economy.*

Ecosystems Map (Map showing existing forests, wetlands, woodlands, grasslands and other critical ecosystems/habitats of environmental conservation value) - *Refer MoEPP, *EEA, Corine – Land cover, MES - in the frame of the Nature Conservation Programme – Phase 2*

Water Resources Map (Surface water bodies, glaciers, sub-surface water bodies) - *Refer Space Planning Agency's, Cadaster (Hydro-graphic map), Kaplan, MoAFWE - Ministry of agriculture, forestry and water economy*

Mineral Resource regions map - *Available at Space Planning Agency's, MoE – Ministry of Economy, http://www.geol.gov.mk/*

Map showing Rivers and Stream networks (Rivers, its tributaries and streams along with Basin, sub-basin and watershed boundaries) - *Refer Kaplan – can be prepared, AREC – Agency of real estate cadaster, SPA, MES, *NASA*

- **National Adaptation Regions Map:**These are those regions which has any development that may be under risks associated with Climate Change and other extreme events or those which may negatively affect resilience of the regions by causing damage to natural systems that are important for mitigation of climate change risks. The maps CCI.1, CCI.2, CCI.3, CCI.4, CCI.5, CCI.6, CCI.7, along with Nb4.1, Nb4.2, Nb5.1 and Rb4.1, Rb5.1 can inform the delineation of these priority regions for adaptation.

Nc2. Development Suitability[7] and Suitability based Strategies for sectoral development:

- Deduce areas falling under Hazard zones, Resource regions and Adaptation regions from the country map
- The areas would be most preferred for any future development and expansion. Lower level spatial plans could use this reference to avoid areas of risk and vulnerability while planning.
- Sectoral policies and sectoral plans could refer to this spatial information to inform there respective policy making. (This is especially relevant for those sectors which do not have specific spatial assessments related to risks and vulnerabilities associated with climate change)

Reference maps:

Areas of low vulnerability to disasters and extreme events - *Refer Map.1 to identify areas with least hazard risks*

Areas of low agri suitability - *Refer to Agro-ecological atlas of the Republic of North Macedonia-2020,FAO; http://www.fao.org/3/ca7519en/CA7519EN.pdf*

Areas of low environmental resource value - *Refer to Map.2 to identify areas which have lesser environmental resource value*

Areas of existing development - *Available with APP - Space Planning Agency, Kaplan - Maps for 1900, 2000, 2014 (*can be made for 2019)*

Nc3. Spatial strategies and protocols/guidelines for National Reserves/Parks/ Sanctuaries Management:

- These could include strategies for conservation and protection of these areas, identification of responsible authorities, institutions in charge as well as management strategies for individual National Parks/Reserves/ Sanctuaries.

[7] *Suitability Analysis is the process and procedures used to establish the suitability of a system – that is, the ability of a system to meet the needs of a stakeholder or other user.*
Before GIS (a computerized method that helps to determine suitability analysis) was widely used in the mid to late 20th century, city planners communicated their suitability analysis ideas by laying transparencies in increasing darkness over maps of the present conditions. This technique's descendant is used in a GIS application called multicriteria decision analysis.

- Further it could provide information on various protocols/guidelines for any activity having any spatial implications associated with tourism sector, forest management, habitat and species management/monitoring etc. (if such protocols doesn't exist, these will have to be prepared and approved by concerned authorities)

- These strategies and protocols will have to be evolved through a joint exercise in collaboration with Ministry of Environment and Physical Planning, Agency of Spatial Planning and Management authorities in-charge of national reserves/park/sanctuaries

Nc4. National spatial strategies and protocols/guidelines for Hazard Zone Management:

- These could be derived through collaborative efforts involving disaster management authorities. The spatial output map, "**National Comprehensive Hazard[8] Zonation Map" under Nc1** is the supporting reference map for developing appropriate strategies and guidelines of management of these regions.

  (other reference maps may include Nb1.1, Nb1.2, Nb1.7, Nb1.8 (Annexure II) as well as mapping data listed in Na1.1, Na1.2, Na1.3, Na1.7, Na1.8 (Annexure II)

- These national level protocols or guidelines could also consider regional differences and hence along with the overarching protocols, specific protocols for unique and regional differences could also be integral in these protocols.

Nc5. National spatial strategies and protocols/guidelines for Climate Change related Risk Management and Adaptation: These can be derived through collaborative efforts with experts and concerned authorities. National level adaptation and risk management strategies will have to be evolved with reference to best practices from across the world and will have to be articulated to suit to the social, environmental, and administrative strengths unique to the country. The spatial output map **"National Adaptation Regions Map" under Nc1** is the supporting reference map for developing appropriate strategies and guidelines of management of these regions.

[8] *This is a comprehensive hazard zonation map which considers Climate change triggered and other extreme events triggered risks and vulnerabilities*

Nc6. National spatial strategies and protocols/guidelines for Resource Regions Management:

- **For Food Security and Management:** These strategies should serve as mechanisms to protect highly productive lands (Refer to Nb2.1 in Annexure II) which are most suited for agriculture and cultivation. Apart from ensuring that these landscapes are protected, strategies for sustainable agriculture should be in place. The strategies should also aim to prescribe preferred agricultural practices for various soil types and terrains.
- **For Water Security and Management:** These strategies should serve as mechanisms to protect water resource regions, areas with high risk to pollute critical water resources as well as adaptation needs to revive those water resource regions which are degraded. The spatial documentation and assessment maps (refer to Na2.2, Na3.2 in Annexure II), can inform identification of regions, areas which need to have special measures, strategies and mechanisms.
- **For Mineral resource Management:**These strategies should serve as mechanisms to regulate regions which are mineral rich. This includes delineation of mineral resource regions, information on mineral resource availability in various reserves, phasing of mineral exploration, extraction, prescribing limits to extractions of minerals, prescribing allowable methods for extraction depending on risks associated with extraction and exploration activities to other natural resources, landscape, land etc. Refer to maps listed in Na2.3 and Nb2.4 (Refer Annexure II) to support strategies and decision making regarding this.

Nc7. Recommendations to inform sectoral strategies to address climate change related risks: These recommendations are to be evolved with reference to identification of specific climate change implications that are spatial in nature for any given sector.

For sectors especially, agriculture, water, forestry, industries etc. such recommendations would enable, better informed sectoral management decisions.

For example; in the case of Agriculture sector, some findings from spatial assessment and CC implication studies that can inform decision making are elaborated below.

IDENTIFICATION OF IMPLICATIONS

- Identification of the regions with high susceptibility to crop failure due to reduced precipitation during growing seasons. The Maps[9] on predicted changes in rainfall will help identify areas with reduced precipitation.
- Identification and evaluation of crops and cropping pattern and practice in regions with high susceptibility of failure due to reduced precipitation
- Identification and evaluation of irrigation and water management practices in regions
- Further detailed drought vulnerability spatial assessment[10] can be carried out to enable more targeted strategies.
- The FAO report, "Agro-ecological Atlas of the Republic of North Macedonia-2020"[11] provides detailed assessment and spatial data along with important conclusive assessments such as AGRO-ECOLOGICAL ZONING MAPS, CROP SUITABILITY MAPS and CROP YIELD, INCOME POTENTIALS AND YIELD GAP MAPS. The Atlas provides is an important reference for sectoral interventions. The spatial maps can be overlaid with CC predictions on precipitation reduction and drought risks to identify specific areas which are especially susceptible to climate change risks. The National Spatial Plan 2021-2041 may incorporate strategic recommendations for spatial management of these agricultural landscapes against climate change risks.

STRATEGIES FOR MITIGATION AND ADAPTATION

- Adopt drought resilient native plant species and agro-forestry practices to enable more resilient agricultural landscapes
- Explore local knowledge and traditional water management practices that can be modelled in collaboration with local communities
- Based on proximity of regions with positive and negative precipitation changes, strategies for water re-distribution through revival of watershed and catchment management can be applied.
- If precipitation variation exists within a given catchment or basin landscape/blue-green infrastructure or bio-engineered interventions can be adopted for distribution of irrigation water.
- Water efficiency practices for irrigation and adoption of water efficient crops and cropping patterns should be promoted for the most susceptible regions/areas in urgency.

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[9] Refer to CC projections and variables Maps for NM in the report, "CLIMATE EXTREMES PROJECTIONS FOR MACEDONIA UP TO 2100" by Dr. Vladimir Djurdjevic, associate professor at the Department of Meteorology at the Faculty of Physics, at the University of Belgrade.

[10] Some of the factors that are relevant for a more detailed vulnerability assessment include; a) precipitation, b) evapotranspiration, c) soil water content, d) soil depth, e) artificial drainage, f) depth to water table, g) runoff accumulation, and h) saltwater intrusion zones.

[11] Aksoy, E., Arsov, S., Mincev, I., Fang C. 2020. Agro-ecological atlas of the Republic of North Macedonia. Rome, FAO. Link to the report: http://www.fao.org/3/ca7519en/CA7519EN.pdf

Nc8. Recommendations to inform Disaster Management Authorities[12] and emergency Protocols/guidelines for different sectors: The objective should be to enable the mobilisation of different sector including industries and skilled workers for emergency production and services in case of any extreme events (eg: the recent CoVID-19 pandemic has shown the need to establish protocols for such extreme events). To enable every sector to be capable of handling emergency protocols, enough preparedness training and regular drills are critical. The spatial planning components related to extreme events and climate change consideration across scales can provide useful spatial information for emergency management.

Rc1. Regional Landscape Structure (Master) Plan: Geo-referenced mapping and delineation of the regional landscape network system with detailed classification of landscape types is the heart of the regional landscape structure plan. These could also include landscapes and areas with hazard risk. Further, this could be supported by special regulations to manage any activity that may affect these regional landscape resource. Reference Maps for developing regional landscape structure plan are; Ra3.1 to Ra3.6 and Rb3.1 to Rb3.4 (Annexure II).

Rc2. Buffer Zone Delineation and Buffer Regulations for the regional landscape system: Delineate and earmark a regulatory buffer around the regional landscape system (Refer to **Rc1** for the spatial spread of these regional landscape systems). This buffer zone should be managed through its special regulations. Buffers should be delineated to ensure protection to the core habitat and core landscape. Buffer requirement for forests, lakes and rivers may different as each are affected differently from external forces. Buffer width and characteristics may be decided based on the functions, buffer performance requirement and ecosystem type. These functions may include;

- Damping of sound and light pollution
- Filtration of run-off pollutants seeping into the landscape or soil from surrounding areas
- Stopping anthropogenic activities or human access

[12] *CUK – Crisis management center*

Rc3. No-Development Zones and Regulations: Areas with high vulnerability and areas with high ecosystem value or resource value should be protected from urbanisation, industrialisation or any other intense/harmful activities.

- Areas close to mining and heavy industries or chemical or nuclear industries are present should be declared as no development or safety zones
- Scenario based modelling exercise as suggested in the spatial assessment section will help identify areas with high risk.
- Habitats and resource areas of high value within the regional landscape system has to be declared as no development zones (Refer Rb2.1, Rb2.2, Rb2.3 and Rb3.1, Rb3.2, Rb3.3, Rb3.4 in Annexure II)

Reference maps:

Highly vulnerable areas, high risk areas w.r.t hazards - *Refer Map 1.National Comprehensive Hazard Assessment and Zonation*

Areas downstream and upstream of dams which are high risk zones in cases of extreme rainfall - *Partially available with MoAFWE – Ministry of agriculture, forestry and water economy, CUK – Crisis management center, DZS – Protection and rescue directorate*

Core Habitat areas, Rivers and lakes - *Generalised maps available*
Regional Landscape Systems - partially available; MES – Macedonian ecological society (for Brown Bear ecology)

Rc4. Regulated Development Zones and Regulations:

- Certain activities related to nature tourism, and other recreational activities could be permitted under regulatory conditions. These may mean restricting number of people, duration and regulating access.
- Areas identified with low probability of risks and hazards may not be classified as no-development zones, but such regions may have time bound regulations. These may include restricting access and activities especially during the year when the risk is high.(Eg: Regions with flood risk maybe regulated by allowing limited/temporary activities during non-monsoon seasons)

Rc5. Guidelines for Density Management for each Region: The human carrying capacity assessment (suggested in Rb4.2 in Annexure II) allows estimation of number of people that can be supported within the intrinsic water resource potential and food productivity potential for a given geographical area. Intrinsic potential here means, the quantifiable resource available naturally, within a given geographic extent in this context.

This information allows authorities to have an understanding of which regions are most viable to sustain human population as population grows. In certain cases, some regions may already be stressed in terms of human carrying capacity, such regions may not be preferred to be densified. Further, with measures such as water harvesting, agro-forestry, urban farming and other green infrastructure the resource potential of the region can be enhanced, thus allowing higher densities and population.

Refer to **List of Reference** to find literature on how to calculate human carrying capacity with respect to water resource potential or food productivity potential. While influencing existing population densities may not be viable, proactive management of population densities based on carrying capacities in newly developing or urbanising areas will enable sustainable resource management and reduce resource related risks.

Rc6. Recommendations and directives to Urban/Rural Areas and Municipalities for mainstreaming climate change considerations into their urban/rural and local area plans. Refer to **Annexure V.** for detailed recommendation of spatial components to be integrated into lower level plans. This is to ensure that climate change considerations are part of lower level plans as well.

B. Mechanisms for Implementation of Strategies, Policies, Plans and Designs

1. **Land parcel Ownership Mapping:** To ensure and enable application of right tools for implementation, it is important to know ownership of land parcels. Every municipality should be encouraged to document the ownership of land parcels within their administrative limits. For areas falling outside municipal or city/town/village administrative limits, a responsible organisation may be identified to document and track land ownership. This mechanism/tool is applicable for lower level plans and relevant for the approval process of various projects.

2. **Adopt Land and Development Management tools:** Identify and brainstorm on use of various land use and land management tools from best practices that can be adapted in North Macedonia's. Some of the internationally used land management tools are listed below;

    - Covenants and Easements: Agreements can be recached by groups of land owners in regions which may be in close proximity to special zones and buffers, to practice specific cultivation or construction practice depending on the prescribed land use so as to improve the health of the region. Within such agreements some such covenants can include agreements to rotate certain activities between the participating land owners so as to reduce the intensity of impact.

    - Polluters pay principle[13] for lands: This means those individual land owners will be responsible to pay for remedial measures if the land use and activity on their site/ land causes pollution or any other environmental issues. Apart from payment for remedial measures the polluters should be held responsible to carry out the remedial measures.

    - Allocating lands of environmental value and importance as urban commons[14] or common pool resources, which can host revenue generating mechanisms for the land owners or community owning it, while within the strict compliance of the applicable land use regulations, zoning regulations and activity regulations

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[13] In environmental law, the polluter pays principle is enacted to make the party responsible for producing pollution responsible for paying for the damage done to the natural environment.

[14] Urban commons, defined as physical urban spaces or services which are considered "community goods" or "local common goods" (Kassa 2008; Foster 2011; Harvey 2012; Iaione 2012) could be perceived as moving beyond the narrow definition of dichotomous state/private property rights.

- Incentivising through reduced land or revenue taxes, if additional environmental sensitive and sustainable practices are adopted by the owners of the land/building/ development
- Supporting local and indigenous communities in Land management of regions of high environmental and ecological value by educating these communities about the prescribed and applicable regulation and rules
- Promoting agro-forestry and agro-forestry based revenue generation in land parcels by providing incentives and support to practice these

3. Projects, Site Development and Building Construction Approval Protocol and Process

- Any new projects be it at any scale will have to comply with the National Spatial Plan and related Policies, applicable Regional Plans and related Zoning regulations, applicable Urban/Rural Area Plans and associated regulations and protocols, as well as applicable Local Area Development Plans and associated regulations and protocols
- Any large infrastructure project proposals (dams, large transport infrastructure etc.), industrial area development projects, will also have to include environmental and social impact assessment. It should also be in compliance with any regulations applicable w.r.t vulnerability related disasters or climate change and ecologically sensitive areas.

III. LIST OF ENABLING TASKS FOR INTEGRATING RECOMMENDATIONS

A. Preparatory Tasks to initiate the integration of recommendations for mainstreaming climate change considerations across all levels of plans

Task 1: Creating a centralised data and information repository which allows sharing of spatial and non-spatial data across government departments, organisations etc., and is accessible to all decision makers, planners, concerned personnels and citizens

	RECOMMEDED SUB-TASKS	RESPONSIBILITY
1	Create a repository of Spatial data, Assessment maps, Output maps as well as curated Best Practice references: Guidelines, Toolkits, Technical Documents or papers/articles which mainstream Climate Change considerations into Spatial Planning	MoEPP, and Spatial Planning Agency
1)	Identify all data and information sources in relation to planning, natural systems and climate change (from government, research institutions, and organisation (national, international etc.)) as well as its accessible links. Make an exhaustive list along with its accessible links organised	
2)	Identify and enlist all data from various sectoral and intersectional ministries, departments and government agencies	
3)	Identify and enlist all non-governmental organisations and institutions working in the field of environment, land, transport, energy, resources, etc that may have any implication in development planning in North Macedonia	
4)	Identify an appropriate hosting platform: The repository can be hosted in the National Geo-portal Platform.	

Task 2: Continued collaboration with EU nations for knowledge exchange regarding Spatial Planning processes

	RECOMMEDED SUB-TASKS	RESPONSIBILITY
1	Connect with EU nations for continued knowledge exchange regarding the task. (Suggestions: Netherlands, Croatia, Finland, Denmark, Sweden, Germany)	MoEPP, and Spatial Planning Agency
2	Partner with spatial planning departments of EU nations to conduct focus group workshops (remote and field based) with planning staff (Spatial Planning Agency and MoEPP)	MoEPP, and Spatial Planning Agency

3	MoEPP and Spatial Planning Agency of North Macedonia facilitate partnerships with Spatial Planning Institutions of EU nations (Universities, Organisations such as IFHP, IHS) and Institutions in North Macedonia (universities, other relevant institutions)	MoEPP, and Spatial Planning Agency

B. Tasks to support the Plan Preparation Phase

Task 1: Prescribe the protocol/guidelines for preparation of plan at each level

These may include general and specific protocols prepared based on the recommended spatial aspects/components listed for each level of plan

- This protocol/guideline may include checklist of items/content that has to be part of the National Spatial Plan (Refer to Chapter II. and Annexure V.)

C. Tasks to support Plan Validation and Adoption

Task 1: Prescribe guidance note for the review of prepared plans

Climate Change aspects that have spatial impacts as well as spatial components that can contribute in mitigation and adaptation to climate change risks and vulnerabilities has to be made part of the protocols for plan validation and adoption process.

The protocol to review the various plans at national, regional, urban/rural levels and local levels should include protocols/guidance notes related to review process, qualification and choice of panel of experts, time frame within which review process has to be completed.

The protocol/guidance note may include checklist of content and outputs that has to be part of the plan for it to be validated and approved. To make this checklist, Refer to the section: Spatial Components at various levels of plan in Chapter II. and Annexure V. of this report.

Task 2: Prescribe guidance note for plan approval

The protocol/guidance note could include the approval process and minimum time frame (time-bound) within which a plan has to be approved. If it is under the ambit of the elected representative, it has to list out critical decision making information that the plans have so as to ensure informed decision making by the elected representatives.

- Approval of the higher level plans (National Spatial Plan and Regional Spatial Plans) prepared by the team of spatial planning experts will have to undergo primary review

and approval at the Spatial Planning Agency followed by approval by an independent group of experts which includes academicians, external spatial planning experts (UNDP experts, other international experts etc.), GIS analyst, and representative experts from MoEPP and Spatial Planning Agency.

- In cases where legislative assembly has to approve, simplified outputs, policy and regulatory proposals and possible implications that emerge out of each plan will have to be provided to legislative members before been discussed in the legislative assembly.
- First level of approval for Urban and Rural Area Plans and Local Area Development Plans could be done by the Municipality w.r.t to approval protocols. This review could be lead by the expert lead on spatial planning within each Municipality (As part of the recommendations on role of Municipality, it is suggested that every Municipality hire an expert team within its office)
- Second level and final approval for Urban and Rural Plans and Local Area Development Plans could be done by the Spatial Planning Agency

D. Tasks to integrate CC recommendations at various levels

AS A PRIORITY THE CONCERNED AUTHORITIES MAY TAKE UP THE INTEGRATION FOR THE FOLLOWING:

- **Integration of proposed CC considerations into National Spatial Plan 2021-2041**
- **Integration of proposed CC considerations into Skopje City Plan**
- **Integration of proposed CC considerations into a Local Area Development Plan for an identified local area within Skopje City.**

1. Constitute team of experts and man-power
2. Constitute an Expert Committee to monitor the progress of integration and provide necessary coordination and support
3. Estimate the infrastructure needs
4. Initiate spatial assessment and planning exercise as suggested in Chapter II. and Annexure V.
5. Update the current spatial plans of Skopje City and the local area selected in light of the spatial assessments and findings

6. Revise and approve the updates to these plans

7. Initiate on-ground implementation of various recommendations from the updated plans

These suggestions will have to be vetted and discussed among the concerned authorities. The intent is to enable better coordination and integration between various levels of plans.

IV. SUGGESTED ROLE OF INSTITUTIONS TO SUPPORT IMPLEMENTATION OF THE RECOMMENDATIONS

This chapter lists the role that various institutions could play in the planning process and integration of recommended Climate Change considerations into the National Spatial Plan 2021-2041 as well s other lower level plans.

A. Institutional Capacity

GENERAL

- Manpower and capacity building for MoEPP, Spatial Planning Agency and Municipalities on Climate Change considerations in spatial planning
- A spatial data platform and repository along with skilling of the above institutions in carrying of GIS based assessment and analysis is critical to move forward
- Skilled man-power to carry out surveys, ground data (wherever necessary), spatial data (Satellite data) and monitoring

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Ministry of Environment and Physical Planning

Suggested Role with respect to the proposed framework of Spatial Planning;

1. Coordinate various efforts related to planning, policies, strategic projects and actions related to environment and physical planning by enabling collaboration, sharing of information etc, between responsible proponents preparing these.
2. Constitute the required technical teams in consultation with the Agency of Spatial Planning to carry out the integration of climate change considerations into the pilot spatial plan at each level.
3. Prepare Policy Directives emerging out of the National Spatial Plan with reference to various laws of environment, natural resources, disaster management, agriculture and laws pertaining to other sectors.
4. Constitute/Assign Special Teams for management of Special Regions Plans
5. Source technical and funding assistance for Preparation and updation of various plans to align with recommendations related to climate change considerations in the National Spatial Plan

6. Estimation of skill, capacity and man-power requirement for preparation of National Spatial Plan, updation and integration of plans at lower level (in consultation with Spatial Planning Agency)
7. Devise funding mechanisms for Capacity Building at the Agency of Spatial Planning and Municipalities

Spatial Planning Agency

1. Carry out and lead the implementation of Tasks listed in Chapter III.
2. Lead the preparation of the National Spatial Plan with compliance to climate change considerations, and updation of lower level plans to integrate climate change considerations in collaboration with MoEPP and respective municipal authority
3. Host, manage and take necessary actions from time to time to establish and update the Spatial Data Platform and Infrastructure. The platform could host documentation and analysis data. It (documentation, analysis and output data) should also be accessible and available to all municipalities with the option to carry out their own analysis using the platform.This may be taken up as a project in a long term basis.
4. Listing and notifying all Cities, towns, villages and any settlements about preparation/ updation of spatial plans in alignment with climate change considerations.
5. Assist municipalities when necessary in integration of CC adaptation and resilience building strategies as suggested in the National Spatial Plan.
6. Carry out regular training for the technical expert/lead on spatial planning posted in every municipality
7. Identify expertise required for the preparation and updation of Spatial Plans in consultation with MoEPP.
8. Prepare protocols and tools to assist plan preparation and updation in consultation with MoEPP (list of tools protocols can be found under Output and Decision making tools under each level of Spatial Planning Components in this report)
9. Function as a nodal agency to monitor the plan preparation and updation process at various levels
10. Function as a nodal agency in carrying out review and approval processes for various plans.

Municipal Governments[15]

1. Chair the integration and updation of climate change considerations into their respective urban or rural area plans
2. Carry out primary review of updated Urban/Rural area plans and local area plans before sending for review and approval to Agency of Spatial Planning
3. Float and manage competitions based on recommendations to Local Area Development Plans
4. Carry out capacity building and training among staff in order to implement climate change related recommendations suggested for the Urban/Rural Area Plans and Local Area Development Plans (Refer Annexure V)
5. Develop a calendar to systematically implement and phase the implementation of the prescriptions in the Urban/Rural Area Plans for integration of climate change considerations (Refer to Annexure V)
6. Assist various teams preparing Local Area Development Plans in community engagement during implementation of projects related to climate change integration
7. Facilitate Community Engagement initiatives prescribed in various Local Area Development Plans

B. Role of Communities and Elected Representatives[16]

1. Communities have greatest role to play in directly involving in the Local Area Development Plan preparation. Trained volunteers can involve in carrying out surveys, documentation as well as awareness building campaigns. Door to Door campaigns updating citizens about the Local Area Development Plan preparation and associated discussion forums can result in more involvement from citizens.
2. Representatives of every Local Area/Neighbourhood within a city should also be engaged in reaching out to their communities in the case of Habitat Development Plan.

[15] These recommendations may not be part of the National Spatial Plan. These are suggestions for the MoEPP and planning organisations responsible for preparing municipal level plans and urban plans.

[16] These recommendations may no be part of the National Spatial Plan. These are suggestions for the MoEPP and planning organisations responsible for preparing municipal level plans and urban plans and more importantly local area plans or neighbourhood level plans.

This may involve encouraging citizens to be part of open houses and discussions about the Habitat Development Plan before its approval.

3. The participative body within the Municipal Council could function as the interface between communities and the Municipalities and lead all necessary community engagements.

4. The participative body can also interface with local schools and other educational institutions or organisation and encourage them to participate and volunteer once in a while. They could also assist the team preparing Local Area Development Plan with specific tasks related to the preparation of these plans. Some examples for to involve communities on a regular basis are;

    - Campaigns like cleaning activities around parks and green spaces
    - Awareness based camping activities, campaigns on tree counting
    - Campaigns on demonstrating emergency route protocols to follow with reference to the prescriptions in the Local Area Development Plan
    - Demonstration classes with experts to show sustainable practices at household level
    - Cycling and walking tours to the public places in the locality or in the city

V. GOALS TO HELP CARRY OUT SPATIAL PLANNING RECOMMENDATIONS RELATED TO CLIMATE CHANGE CONSIDERATIONS

One Year Goals for Climate Change Adaptation and Resilience Building

It is recommended that the National Spatial Plan for 2021-2041 set goals for every year w.r.t Climate Change Adaptation and Resilience Building.

Yearly goals could include;

GOAL Y(1) 1: Updating the data repository and spatial data, every year w.r.t new developments, new studies and spatial analyses procured from other research/ professional institutions and organisations.

GOAL Y(1) 2: Status Report on Implementation of the Climate Change considerations recommended in the National Spatial Plan for every year

GOAL Y(1) 3: Aim to hold a joint 'Learn and Grow Programme (could be web-based exercise)' in partnership with one identified partner City for Climate Change Adaptation, Mitigation and Resilience Building (this could involve researchers and professionals from both the partnering cities)

GOAL Y(1) 4: For the first year (i.e, 2021-2022), aim to complete the Tasks listed in section III. (A. Preparatory Tasks to initiate the integration of recommendations for mainstreaming climate change considerations across all levels of plans, B. Tasks to support the Plan Preparation Phase, C. Tasks to support Plan Validation and Adoption, D. Tasks to initiate Pilots for integrating CC considerations recommended at various levels)

Five Year Goals for Climate Change Adaptation and Resilience Building

GOAL Y(5) 1: Update and amend the National Spatial Plan 2021-2041 every five year w.r.t changes in planning and development scenarios.

GOAL Y(5) 2: Aim to integrate recommended climate change considerations into urban / rural plans and implement recommended action for all 84 Municipalities.

ANNEXURE

Annexure I. Activities of the Department of Spatial Planning as per the Law

The Ministry of Environment and Physical Planning, through its **Department of Spatial Planning**, is mandated to manage and implement the policies and monitor the processes of space shaping in the Republic of Macedonia.

Spatial planning is multi-disciplinary activity aimed at long-term projection of space development from all points of view.

Spatial planning ensures balanced spatial development, rational planning and use of space, conditions for human living and work for citizens, as well as designing of measures for environment and nature protection and improvement, protection against military destructions, natural and technological accidents, etc.

Spatial Planning is continuous process implemented through permanent production and adoption of Spatial Plans, as well as coordination of their implementation and implementation itself.

The activity of spatial planning is of public interest regulated by:

- Law on Spatial and Urban Planning and
- Law implementing the Spatial Plan of the Republic of Macedonia

The enforcement of the said laws is a responsibility of the Ministry of Environment and Physical Planning – Department of Spatial Planning, the latter being organized into **three units**:

- Unit for plan and spatial policy
- Unit for spatial plans implementation
- Division for strategic environmental assessment

Activities of the Department under the Law:

- it coordinates the procedure of spatial plans development;
- it carries out the procedure for their adoption;
- it monitors the implementation (through preparation of annual reports on the Plan implementation);

- it issues conditions for space planning (Decision on space planning conditions);
- it takes part in the preparation of laws and bylaws;
- it provides professional opinion on compliance of the plans at lower level with the National Spatial Plan;
- it prepares estimate and biannual programme for implementation of the Spatial Plan of the Republic of Macedonia;
- it provides opinions in the area of spatial planning;
- it coordinates and implements policies related to the implementation of the procedure for strategic environmental assessment;
- it makes analysis and strategic environmental assessment and issues opinion on report and decision for strategic environmental assessment implementation;
- it prepares documents and proposes laws and provides the required technical assistance in relation to strategic environmental assessment.

Other activities – international and cross-sector cooperation:

- it implements international conventions in the area of spatial planning;
- it exercises cross-sector and international cooperation;
- it takes part in the preparation of programmes for cooperation with neighbouring countries in transboundary context;
- it cooperates with EU (EU Territorial Agenda and other documents in the area of spatial planning);
- it cooperates with European Environment Agency (EEA);
- it cooperates with the Council of Europe (CEMAT) etc.

Source: MoEPP website; http://www.moepp.gov.mk/?page_id=3512&lang=en

Annexure II. Listing of Spatial Documentation-Mapping Data and Assessment relevant to inform Climate Change aspects at the level of National Spatial Plan.

a) Spatial Documentation and mapping data (Na and Ra) relevant to inform Climate Change aspects at the level of National Spatial Plan[17]

N a	Documentation Mapping at Country scale		
1	**Vulnerability Aspects** related to disasters/extreme events and Climate Change		**Sources**
1.1	Geo-Climatic Regions Map	Y	APP - Space Planning Agency
1.2	Terrain/Landform/Relief Maps (with altitude data and topography)	Y	APP - Space Planning Agency, Digital Elevation Model 30m
1.3	Seismic Maps (with fault lines)	Y	APP - Space Planning Agency, Center for earthquakes, IZIIS - https://msz.iziis.ukim.edu.mk/
1.4	Rainfall and Snow fall intensity and extremes across years and seasons supported by MET data, Rainfall extremes and changes as per IPCC predictions	Y	APP - Space Planning Agency, Satellite data 2010>
1.5	Heat waves events of past supported by MET data, Temperature extremes as per IPCC predictions	Y	UHMR - National Hydrometeorological Service, worldclim.org
1.6	Storms and extreme events of the past, Wind extremes and changes as per IPCC predictions	Y	UHMR - National Hydrometeorological Service
1.7	Soil Type Map	Y	APP - Space Planning Agency, Institute of Agriculture https://esdac.jrc.ec.europa.eu/resource-type/european-soil-database-soil-properties

[17] *Availability and reference sources for these spatial documentation components (maps and spatial data) will be examined with the various agencies so as to make an inventory of spatial data that can be used for the preparation of the National Spatial Plan.*

N a	Documentation Mapping at Country scale		
1.8	Disaster and extreme events map (Showing all types of disasters and extremes events with location for every such event in the past) *(Annexure II.provides a template for a data repository on information regarding extreme events and disaster events)*	Y	CUK – Crisis management center, DZS – Protection and rescue directorate
2	**Natural Resource and Ecosystem Functions related aspects**		
2.1	Flora Type Map (Map showing existing forest flora types, wetland flora, agricultural flora, shrub lands, deserts etc.)	Y	APP - Space Planning Agency, MoEPP- Ministry of Environment and Physical Planning, Corine – Land cover
2.2	Water Resources Map (Surface water bodies, glaciers, sub-surface water bodies)	Y	APP - Space Planning Agency, Cadaster (Hydro-graphic map), Kaplan, MoAFWE - Ministry of agriculture, forestry and water economy
2.3	Mineral Resources Maps - Mineral Resource Regions Map - Mineral Resource Potential Map - Mining Areas map	Y	APP - Space Planning Agency, MoE – Ministry of Economy, http:// www.geol.gov.mk/
2.4	Solar Insolation Map	Y	https://globalsolaratlas.info/download/north-macedonia, Free GIS service data
3	**Landscape System/Structure aspects**		
3.1	Ecosystem type map (Forests-Woodlands-grasslands-Alpine-agricultural ecosystems- wetland-rivers-lake ecosystems)	Y*	MoEPP – Ministry of Environment and Physical planning, *EEA, Corine – Land cover, MES - in the frame of the Nature Conservation Programme – Phase 2
3.2	Valleys and Ridges Map	Y*	AREC – Agency of real estate cadaster, NASA, SRTM - DEM cartography
4	**Existing Development aspects**		
4.1	Map showing all existing human settlements and interventions (Cities/villages, agriculture-plantation areas, mines, industrial areas, mines, dams, heritage sites, transport corridors/networks etc.)	Y	APP - Space Planning Agency, Kaplan - Maps for 1900, 2000, 2014 (*can be made for 2019)

N a	Documentation Mapping at Country scale		
4.2	Land Ownership Map: This mapping exercise may be an extensive depending upon the availability of well-documented information. It will require consolidation of information spread across different government agencies. (Government owned, privately owned lands and common resources with no designated ownership will all have to be recorded and delineated on Geo-referenced real time mapping platform)	Y	AREC – Agency of real estate cadaster (Digital cadaster of real estate)
5	**Future Development aspects**		
5.1	Map showing all know future development (known projects, developments proposed for future)	*	APP - Space Planning Agency should be able to make it.

**The commons is the cultural and natural resources accessible to all members of a society, including natural materials such as air, water, and a habitable earth. These resources are held in common, not owned privately. Commons can also be understood as natural resources that groups of people (communities, user groups) manage for individual and collective benefit. Characteristically, this involves a variety of informal norms and values (social practice) employed for a governance mechanism. - Basu, Soutrik; Jongerden, Joost; Ruivenkamp, Guido (17 March 2017). "Development of the drought tolerant variety Sahbhagi Dhan: exploring the concepts commons and community building". International Journal of the Commons. 11 (1): 144. doi: 10.18352/ijc.673*

R a	Documentation Mapping at Regional scale		
1	**Vulnerability Aspects** related to disasters/extreme events and Climate Change		**Sources**
1.1	Slope analysis Map (with10m and 5m interval topographic map)	Y*	Kaplan – 30m map (*possible 5m map), Institute of Agriculture (new soil maps), AREC – Agency of real estate cadaster (DEM cartography), *NASA, *SRTM – DEM cartography
1.2	Local Wind movement Map	Y	UHMR - National Hydrometeorological Service, Worldwide free services (free map generation tool), * Agency of real estate cadaster -DEM cartography, *NASA, *SRTM – DEM cartography

1.3	Map showing point and areas sources of Water Pollution, Air Pollution and Noise Pollution (Refer to Ra1.4, Ra4.4, Ra4.5)	Y	Kaplan -Day satellite data (NO2, CO, O3 etc.), *Water pollution map can be made out of satellite data, MoEPP – Ministry of environment and physical planning
1.4	Fertilizer type and use based map	Y	MoAFWE – Ministry of agriculture, forestry and water economy, Faculty of agriculture and food sciences, Institute of agriculture
2	**Natural Resource and Ecosystem Functions related aspects**		
2.1	Forest type map Forest condition map (identify those which are degraded/severely affected by logging/ forest fires etc.)	Y	APP - Space Planning Agency, MoEPP – Ministry of environment and physical planning, Corine – Land cover, Faculty of forestry and landscape architecture
2.2	Crop type map	Y	LPis documents at MoAFWE - Ministry of agriculture, forestry and water economy, Faculty of agriculture and food sciences, Institute of agriculture, FAO – catalogue
2.3	Mineral resource availability map (show location of mineral resources where availability is exhausting-w.r.t data)	Y	APP - Space Planning Agency, MoE- Ministry of Economy
3	**Landscape System/Structure aspects**		
3.1	Regional Landscape System Map (Delineate patches, corridors and stepping stones based on landscape type)	Y	MES – Macedonian ecological society (for Brown Bear ecology) Defining the core areas, stepping stones and corridors is species dependent. On a national level, the Macedonian National Ecological Network is the only available dataset that gets closest to the description.
3.2	Habitat map for all types of fauna with their status as threatened/vulnerable/endangered	*	Habitat maps for some species exists
3.3	Habitat map of all threatened/vulnerable/endangered flora	*	Generalised maps available.
3.4	Habitat map showing all invasive species of Flora and Fauna	N	

3.5	Wildlife spotting maps (across a year) for different species along with their habitats (Wildlife hotspots map)		
3.6	Map showing Rivers-their tributaries and streams along with Basin, sub-basin and watershed boundaries	Y*	Kaplan – can be made, AREC – Agency of real estate cadaster, SPA, MES, *NASA
4	**Existing Development aspects**		
4.1	Mining grounds Map (Map showing areas which were mined in the past and abandoned + areas where mining is ongoing)	Y	APP - Space Planning Agency, Cadaster, Corine
4.2	Areas where hydro-power and dam projects exist and those under construction	Y	APP - Space Planning Agency
4.3	Map showing all activities within and near each of the special regions (National Parks/Sanctuaries/Wildlife parks/Open Zoos/Lakes/ Rivers etc.)	N	
4.4	Map all industries based on their type and possible hazards		MES – Macedonian ecological society has maps on industrial and mining areas without type os hazards
4.5	Water Pollution and Contamination areas w.r.t surface water bodies and sub-surface water sources (springs/ aquifer)- Map showing landfill sites, waste discharge areas, sewage treatment plants, towns/cities etc. that are not covered by waste management etc.		
5	**Future Development aspects**		
5.1	Mapping of all known future projects and plans including information on the project - this has to be updates as and when proposed as well as approved.		

b) Spatial Assessment (Nb and Rb) that relevant to inform Climate Change aspects at the level of National Spatial Plan[18]

N b	Assessment at Country scale		
1	**Vulnerability Aspects** related to disasters/extreme events and Climate Change		**Sources**
1.1	**Cumulative Disaster Vulnerability** Simple overlay of; natural disaster events and extreme events of past (Na1.8) + Soil erodibility map (Na1.7) + Relief map (Na1.2)	Y	CUK – Crisis management center, DZS – Protection and rescue directorate

[18] *Availability and reference sources for these spatial assessment components will be examined with the various agencies so as to make an inventory of available assessments that can be used for the preparation of the National Spatial Plan.*

N b	Assessment at Country scale		
1.2	**Cumulative Risk Assessment**; Simple overlay of; Nb1.1 + Na4.1 + Na5.1 (The map should be able to show vulnerable areas with risk to existing settlement and future development)	Y	DTM at the Ministry of agriculture, forestry and water economy, CUK – Crisis management center, DZS – Protection and rescue directorate
1.3	**Cumulative Climate Change Risk Assessment:** Simple Overlay of weather extremes of the past and as per IPCC (Na1.4 + Na1.5 + Na1.6)		
1.4	**Assessment of health risks** directly and indirectly linked to climate and weather extremes (indirect hazards include disease vulnerabilities)	Y	UHMR - National Hydrometeorological Service, Institute of Public Health
1.5	**Spatial - temporal mapping and analysis** of heat waves, extreme temperature events in the past 10 years, in past 50 years with daily temperature averages and peak daily temperatures.		UHMR - National Hydrometeorological Service, worldclim.org
1.6	**Spatial - temporal mapping and analysis** of storms, extreme wind events in the past 10 years, in past 50 years (with daily averages and peaks)		UHMR - National Hydrometeorological Service
1.7	- Soil Fertility Map (Derived from Soil type map and soil characteristics info,) - Soil Erodibility Map (Derived from soil type map and soil characteristics info.) These maps can be extracted from the soil data and soil type map.	Y	MASIS - www.maksoil.ukim.mk, Institute of Agriculture, contact prof. Blinkov, and prof Milevski respectively) - Soil fertility can be presumably generated from the soil type
1.8	This mapping is important to identify areas which has seen frequent disaster or extreme events.		CUK – Crisis management center, DZS – Protection and rescue directorate
2	**Natural Resource and Ecosystem Functions related aspects**		
2.1	**Agricultural land Suitability Assessment** Simple overlay of Soil Fertility Map Na1.7 + Na4.1 (grade the various development types for their scope for cultivation-highest value for existing agricultural areas) + Na2.2 (simply overlay the map) The cumulative assessment will value areas within proximity to waterbodies and with high to medium water table as most suited for cultivation/agriculture	Y	Corine https://land.copernicus.eu/ , FAO – GIS catalogue of agriculture, land and productivity assessment + vulnerability, MoAFWE – Ministry of agriculture, forestry and water economy.
2.2	**Environmental Resource Assessment:** Simple overlay of Na1.7 + Na2.1 + N2.2 + Na2.3. The overlay will allow to see areas with multiple resources.		

N b	Assessment at Country scale		
2.3	**Ecosystem Service (ESS) Potential Map**- Based on literature and other researches grade each ecosystem types for the number of ecosystem services that they provide. (refer Na3.1, Na2.1, Na2.2, Na1.7 for information regarding the ecosystems)	*	MoEPP – Ministry of environment and physical planning (SDC project for the "Bregalnicki" region) *check their mapping manual, EEA, Corine – Land cover, MES - in the frame of the Nature Conservation Program – Phase 2, Farmahem - Program for nature conservation in Macedonia
2.4	**Risk Assessment and Zoning Map for Mines and Minerals Extraction Areas**		
3	**Landscape System/Structure aspects**		
3.1	**Patch Matrix and stepping stone** delineation for large ecosystems	N	
4	**Existing Development aspects**		
4.1	**Development Suitability Assessment:** Areas of low agri suitability (Nb1.4) + Areas of low environmental resource value (Nb1.5) + Areas of existing development (refer Na4.1)	N	
4.2	**Compatibility Assessment:** The compatibility is examined between existing development activities (refer to Na4.1) with respect to their proximity to environmental resource areas (Nb1.5) and disaster vulnerability (Nb1.1)	N	
5	**Future Development aspects**		
5.1	**Compatibility Assessment Matrix:** The compatibility is examined between future projects (refer to Na5.1) with respect to their proximity to environmental resource areas (Nb1.5) and disaster vulnerability (Nb1.1)	N	

R b	Assessment at Regional scale		
1	**Vulnerability Aspects** related to disasters/extreme events and Climate Change		**Source**
1.1	**Detailed Landslide Vulnerability and Risk Assessment** Overlay analysis with soil erodibility (Na1.7) + Ra1.1+ Na4.1	Y*	Can be generated with DEM cartography, contact prof. dr – Ivica Mileski

1.2	**Detailed Seismic Vulnerability and Risk Assessment** Overlay analysis with Na1.3 + Ra1.1+Na4.1		
1.3	**Industrial Disasters Risk Assessment** Scenario based assessment of risks related to hazardous industries (chemical/mining processing/ energy etc.) - scenarios considered may include aggravated risks triggered by other natural disaster/extreme events - Impact prediction maps scenarios of different disasters (additional factors may include regional wind patterns) Overlay analysis using Ra1.2+Ra4.4+Ra4.1	Y*	MoEPP – Ministry of environment and physical planning (in data if not in maps)
1.4	**Dam break and Flooding risk map** Scenario based Dam break modelling to track and map water flow in case of dam break/leak etc.) - scenarios may include aggravated risks triggered by seismic / landslide events - Impact areas mapping for the scenarios based on downstream conditions Overlay analysis using Na1.2+Na4.1+Na5.1+Ra4.4	Y	MoAFWE – Ministry of agriculture, forestry and water economy, CUK – Crisis management center, DZS – Protection and rescue directorate
1.5	**Pollution hazard risk assessment for each type of pollution** (water, air, noise, soil etc.) Scenario based analysis for discharge of large amount of pollutants Overlay Ra1.3+Ra1.4+Ra4.1+Na2.2+Ra4.4+Ra4.5	Y*	MoEPP – Ministry of environment and physical planning (in data if not in maps)
1.6	**Real time view of data from pollution monitoring stations regarding air, water and noise pollution shown on map** (on the Geographic information platform). In case of noise pollution it is most relevant w.r.t national parks, or wildlife sanctuaries etc.	Y*	MoEPP – Ministry of environment and physical planning (GIS service that generates existing measures in realtime, *this map can be generated)
2	**Natural Resource and Ecosystem Functions related aspects**		
2.1	**Sub-surface water (aquifer) condition map** - This requires delineating on map all the areas and locations where the sub-surface water is polluted and depleting	Y	MoAFWE – Ministry of agriculture, forestry and water economy
2.2	**Incident Water Potential Assessment** (Estimate the water potential for each watershed within each sub-basin)— This can be done by calculating the incident rainfall against the surface area) Refer to Ra3.6	Y*	MoAFWE – Ministry of agriculture, forestry and water economy, MoEPP – Ministry of environment and physical planning, State Environmental Inspecotrate

2.3	**Agricultural Water Stress Assessment:** This is to understand in which areas incompatible cropping and cultivation practices exists, causing stress on its water resource. Overlay the crop type map (Ra2.2) + Rb2.1 and Rb2.2		
3	**Landscape System/Structure aspects**		
3.1	**Patch Matrix Corridor Analysis** using Ra3.1 (with reference to Na3.1 + Na3.2): This requires delineation of different landscape networks with distinction of patches (large areas of undisturbed contiguous landscapes), corridors (linear forms of landscapes and ecosystems) and stepping stone (usually scattered parcels of landscapes/ecosystems that are smaller in size and in between larger patches) Use the valleys and ridges map as a base layer can help delineate landscape networks	N	Has to be prepared
3.2	**Buffer area delineation for Fauna habitats** (This requires delineation of required buffer area around all fauna habitat - this can be done with reference to other biodiversity studies and research which prescribed minimum and maximum buffers for each type of fauna habitat around the habitat maps (Ra3.2,Ra3.3,Ra3.4,R3.5)	N	Has to be prepared
3.3	**Buffer area delineation for Rivers, Lakes, springs and other natural water sources**	N	Has to be prepared
3.4	**Buffer area delineation for artificial water structures - Dams and water detention structures** (This has to be done both upstream and downstream of the dams with reference to Rb1.4		
4	**Existing Development aspects**		
4.1	**Detailed Compatibility Assessment for Habitat areas** (Ra3.1,Ra3.2,Ra3.3,Ra3.4,Ra3.5) falling near existing development listed in Ra4.1,Ra4.2,Ra4.3,Ra4.4, Ra4.5. Compatibility Assessment must identify and describe specific concerns related to poor compatibility.	N	
4.2	**Human Carrying Capacity Assessment** for each region based on water resource potential and food production capacity within the area of the Region	N	
5	**Future Development aspects**		
5.1	**Detailed Compatibility Assessment**: Case to case basis assessment for every new project or development proposed over time w.r.t its location and in reference to Ra3.1 to 3.6 and Rb3.2 to 3.4	N	

UNEP spatial data projects: STAR 5 project deliverables, to be completed by end of 2020

- Erosion map using EPM
- Erosion map USLE/RUSLE
- Drought sensitivity map
- Working maps created for:
  - Average annual sums of precipitation for period 1981/2010
  - Average annual Aridity Index for 30 year period 1981/2010
  - Flowering of few species - spatial maps in GIS environment for averaged 20year period
- Map with identified High nature value forests
- Herpetofauna and 14 vascular plants - distribution maps (http://redlist.moepp.gov.mk)
- Distribution map for A.uva-ursi - for internal use/delivered to MOEPP
- Maps for selected/pilot regions:
  1. Soil organic matter Strumica/Pelagonija/Ohrid region
  2. Soil sealing rate for 20 years period Strumica/Pelagonija/Ohrid region
  3. Forest vegetation map Maleshevo region

Important scientific studies on Climate Change in North Macedonia

The information on the following studies are mostly sourced from the website **Klimatski Promeni** (https://klimatskipromeni.mk/#/index/main). These existing studies are important sources of data and has important findings which can inform the National Spatial Plan.

1. **CLIMATE EXTREMES PROJECTIONS FOR MACEDONIA UP TO 2100** authored by *Dr. Vladimir Djurdjevic, associate professor at the Department of Meteorology at the Faculty of Physics, at the University of Belgrade:* The report was prepared as part of the project for preparing the Third Biannual Climate Change Report, which is being implemented by the Ministry of Environment and Physical Planning (MoEPP) with technical and financial support from UNDP and GEF (Source: https://klimatskipromeni.mk/article/406#/index/main).

2. **Presentation on the latest climate change mitigation scenarios, conducted in the Fourth National Communication on Climate Change and the Third Biennial Update Report (TBUR**): The climate change mitigation scenarios were conducted in

the Fourth National Communication on Climate Change and the Third Biennial Update Report (TBUR), which are being implemented by the Ministry of Environment and Physical Planning (MoEPP) with technical and financial support from UNDP and GEF. The scenarios include detailed analysis of 47 combined measures and policies (32 in the energy sector, 11 in agriculture, forestry and other land use, and 4 in the waste sector). More than 60% of the measures are win-win, meaning that they do not only contribute to GHG emissions reduction, but are also financially feasible.

3. **National Communications for Climate Change**: (Source: https://klimatskipromeni.mk/article/32#/index/main)
4. **Agro-ecological atlas of the Republic of North Macedonia by, FAO**: (Source: http://www.fao.org/3/ca7519en/CA7519EN.pdf)
5. **National GeoPortal of North Macedonia:** (Source: http://nipp.katastar.gov.mk/geoportal/catalog/main/home.page)
6. **Adaptation to Climate Change through Transboundary Flood Risk Management in the Western Balkans**: (Source: https://www.giz.de/en/worldwide/29000.html)
7. **Urban Resilience Guidance Papers** under UNDP initiatives (Eg: Tetovo)

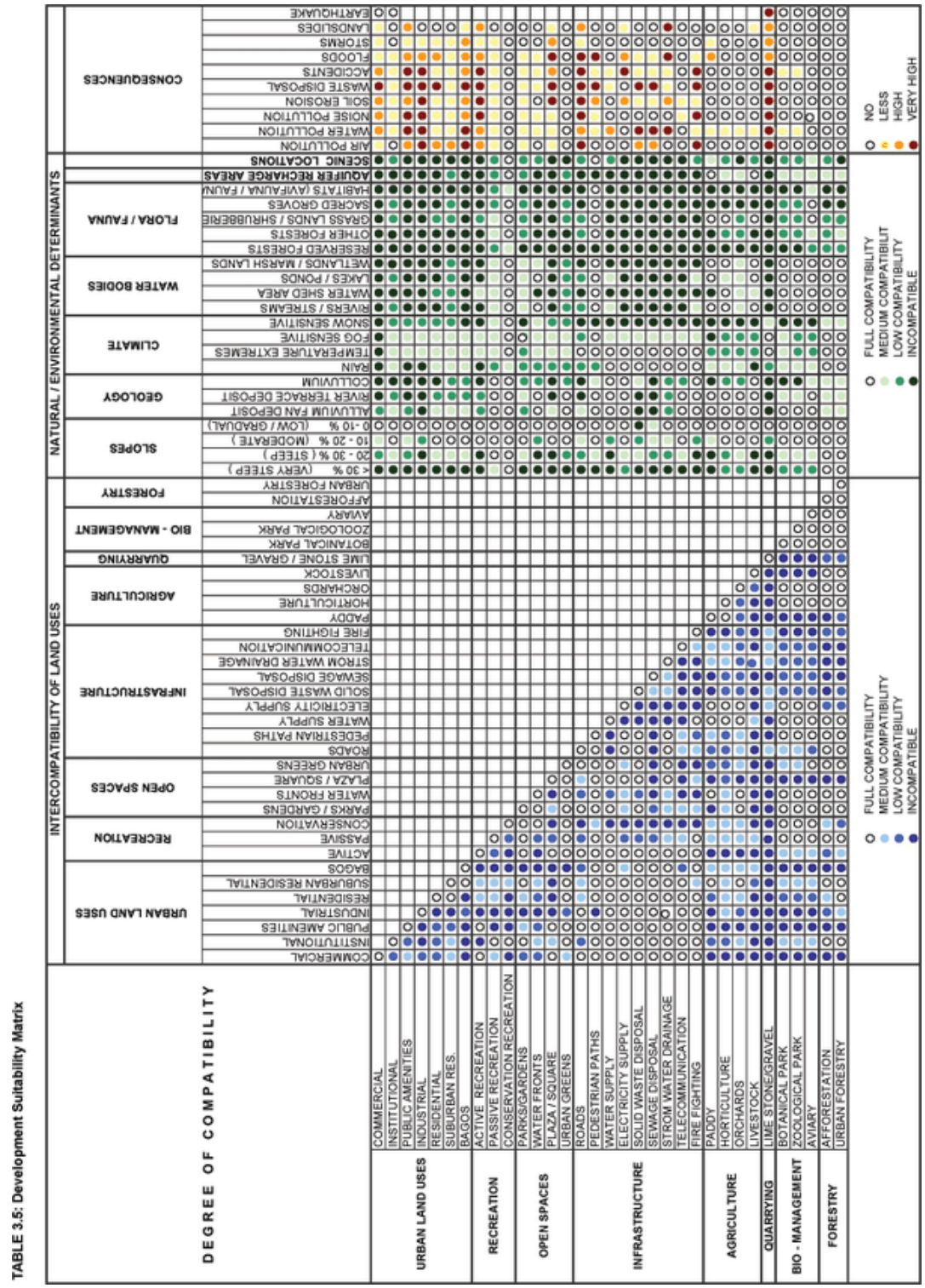
Annexure III. Different types of Landscape based Green Infrastructure that can be used in landscape plans and design

Green Infrastructure Elements	Preferred Locations to Install these Elements
Landscaped animal crossings	In areas where animal habitats are fragmented by existing development, or as remedial measure in cases where certain critical infrastructure that may fragment such habitats cannot be avoided.
Agro-forestry patches	In agricultural and plantation areas as patches at various intervals. Such patches improve the health of soil and the micro-ecosystem of agricultural areas.
Detention ponds	In the buffers to water bodies/low lying areas/all LI patches based on viability
Bio-remediation ponds	In the buffers to water bodies/low lying areas/all LI patches especially around outlets of STPs, communities where segregated management of storm water and sewage water is absent and industrial areas or any such areas which has an identified risk of causing pollution.
Vegetated Bio-swales	A part of drains and water channels to carry run-off from road surfaces, areas in close proximity to STPs, communities where segregated management of storm water and sewage water is absent and industrial areas or any such areas which has an identified risk of causing pollution.
Permeable Pavement/ Pathways	For pedestrian areas, public spaces instead of impermeable surfaces
Planter Boxes	Along the roads, or built landscapes to capture rain water from roof top which can be directed to the road drains or allowed to percolate into soil directly.
Green roofs	On flat roof areas, balconies terraces of all building types. Building regulations can integrate a clause to seek allocation of 50% of the roof area as green roof in government and institutional buildings to start with.
Rain barrels/Sculptures	Along with larger bioengineered systems like bio-remediation ponds, detention ponds. Can be installed in lower order streams to regulate water flow velocity and alter time of concentration in the higher order streams.
Vegetated Filter Strips	Street edges wherever viable (mostly on the non-vehicular movement paths especially parking spaces and edges of vehicular moment areas) At the edges of water bodies and channels

Interceptor Units like Silt/ Sediment trap/(Gross Pollutant Trap)	At the points where the lower hierarchy road drains flow into higher hierarchy road drains. At inlet and outlet points of water channels flowing into or out of another water body.
Rain gardens	For parks and public spaces
Roof Gardens	For individual buildings
Green Walls	For buildings, wall separating buildings/land parcels

Source: Compiled by author from multiple sources.

Annexure IV. Reference for a Land Use Compatibility Matrix



Source: Conference paper published at ResearchGate; Citation: Darshak, Mehul & Bhandari, Manthan & Zala, Rajansinh & Kumar, Shashikant. (2017). Land Suitability Analysis for UrbanPlan Preparation Using Remote Sensing and GIS A Case of Anand-Vidyanagar-Karamsad Development Plan. 10.29007/xcm1.

Annexure V. Spatial Components for mainstreaming climate change considerations into Spatial Planning at City/Town/ Village and Neighbourhood level

At Settlement Level for Urban/Rural areas (comprising of Cities/Towns/ Villages)

S a. Documentation and Mapping

	S a - Documentation Mapping
1	**Vulnerability Aspects**
1.1	Mapping of all past events of anthropogenic disaster or natural disasters/extreme events that may happened in various location in the settlement.
1.2	Mapping and delineation of all historic events of localised urban flooding (w.r.t year and seasons)
2	**Natural Resource and Ecosystem Functions related aspects**
2.1	Mapping of all smaller water bodies, lakes, river spaces, traditional water harvesting structures etc.
3	**Landscape System/Structure aspects**
3.1	Map open green and blue spaces (including information on vegetation type and health- whether polluted or degrading or fragmented etc.)
3.2	Mapping of edge spaces (upto 100 meters landward from the edge of the water body) of all river, lake, springs, wells, or any other water sources
3.3	Mapping of all stream orders as per surface flow
4	**Existing Development aspects**
4.1	Mapping of Built and Un-Built Areas (with differentiation of road networks, green - blue spaces, streets, other open spaces)
4.2	Mapping of Urban Form (3-D)
4.3	Mapping of existing terrain (as altered w.r.t built development)
4.4	Mapping of all areas /land which is impermeable (cemented, constructed, roads/ pavements etc. and Building footprint)
4.5	Mobility Network Map: Information concerning mobility and transport that may be procured from the concerned mobility plan.This map should therefore show; - Multiple modes of transport (motorised and non-motorised) - Transport infrastructure, hubs and nodes - High traffic zones on regular days, High traffic zones during special events
5	**Future Development aspects**
5.1	Mapping of all new development, redevelopment, improvement, site development, urban design and infrastructure development projects

S b. Assessment

	S b - Assessment
Vulnerability Aspects	
1.1	Disaster Scenario based Assessment for City preparedness and adaptation (These may include heat waves-heat islands, urban flooding, fires, explosion and chemical leaks, construction or building collapses etc.)- The impact of wind movement, and alteration of local weather conditions due to CC related variables and urbanisation variables has to be integrated into the scenario assessment
1.2	Verify high to low risk areas w.r.t to ground assessment to the mapping areas (examine surrounding terrain, inflow and outflow point of water, non-functional storm drainage systems or sewerage network etc.) (Refer Sa1.2,Sa1.3 Sa3.3, Sb3.3, Sa4.3, Sa4.4)
Natural Resource and Ecosystem Functions related aspects	
2.1	Human Carrying Capacity for the settlement area (for city territory and each local area territory) - intrinsic natural resources
2.2	Human Carrying Capacity of each city territory w.r.t (for city territory and each local area territory) - urban infrastructure (demand-supply of housing, coverage of urban infra.)
2.3	Calculating the total area under green cover and trees at; - Settlement level as whole - For each of the local area This can be down by reading satellite imagery and also verify through ground surveys
Landscape System/Structure aspects	
3.1	Delineate networks of green spaces with information on vegetation type, terrain and soil
3.2	Grading and monitoring mechanism for water quality, edge conditions (activities)
3.3	Fragmentation assessment of surface water networks/flow: A simple overlay analysis of Sa4.1 map over Sa3.3 map will help identify point and stretches where the streams are fragmented or obstructed.
Existing Development aspects	
4.1	Detailed Development suitability mapping: - Deduce areas with vulnerabilities (refer to Sb1.1, Sb1.2, Rb1.1, Rb1.2, Rb1.3, Rb1.4, Rb1.5) - Deduce the network of green spaces (refer to Sb3.1) - Deduce areas falling under various buffers (refer to Rb3.2, Rb3.3, Rb3.4) - The areas that have been deduce shouldn't be considered for urbanisation, industrial development or any built development. - Areas with high agricultural potential and natural resources areas if falling within settlement limits should also be avoided For this Refer to Nb4.1 (country level development suitability map) - The remaining areas within the settlement boundary may be considered for urbanisation or built development or industrial development with reference to land use compatibility matrix

	S b - Assessment
4.2	Land use compatibility assessment: With reference to the land use compatibility matrix (refer to c2 in the following section) developed by the concerned authority the existing land use on ground has to be verified and evaluated for compatibility. Based on the findings, remedial measures to resolve issues arising due to adjacency of non-compatible land uses has to be facilitated by the local authorities to the land owners.
Future Development aspects	
5.1	Impact assessment and SWOT analysis of new projects (time-bound assessment and review) - This assessment/review should be able to inform and improve the new projects

S c. Output and Decision Making Tools (in no particular order)

1. Suitability based Urbanisation Strategy: The plan should prescribe the phasing of urban development for the city/village area/limits. It should be informed by;
   - Development suitability assessment Map (Refer to Sb4.1)
   - Population density distribution criteria (Refer to Sc6)
   - Suitability for industrial development
   - Strictly agricultural areas based on agricultural suitability
   - No-development areas/zones
   - Presence of ecologically important and vulnerable areas within or in close proximity to villages or hamlets or Urban areas
2. Land use compatibility matrix[19]
   - A land use compatibility matrix is a very useful tool which can help planners and developers in ensuring that compatible land uses are placed adjacent to each other
   - This may be developed by the concerned authority (Spatial Planning Agency)
   - Based on this compatibility matrix the land use plans should be evaluated before formalisation. In cases where non-compatible land uses are adjacent and in proximity, alternate use or change is use is recommended wherever viable. In cases, where it is not critical to change or is not viable, design or land use management measures or special regulations should be prescribed.

[19] Refer to Annexure IV. for a sample reference of compatibility matrix

3. Land use allocation criteria
    - Clearly list down the different land use terminology and definitions: Land use classification at city level may include intensity based differentiation of a particular land use as well (For e.g; residential land uses could have high rise/mid-rise/low-rise residential use differentiation, similarly commercial land uses or public land uses could carry more information regarding the type.)
    - Prescribe future land use for areas based on compatibility of use and activities
    - In cases where non-compatible land uses may be already be in close proximity, implement buffers and other impact management measures
    - Identify areas where mixed land use is required and viable: decisions on mixed land use maybe taken for neighbourhood nodes
    - Refer to Mobility Map (Refer Sa4.5) to inform land use and density allocation. This map will also help inform the design for non-motorised mobility networks (cycling) and pedestrian networks from motorised transport hubs to destinations.
4. Urban Design (UD) regulations and guidelines: These may include mandatory parameters and prescription which will be required to follow. These UD regulations and guidelines will have to be formulated based on the findings of spatial assessment. Parameters to be considered for Urban Design Regulations include;
    - Orientation of Buildings for different areas
    - Distance between Buildings at different location, between streets etc.
    - Width of Streets w.r.t Hierarchy of Streets
    - Orientation of Streets w.r.t Hierarchy of Streets
    - Existing City Centres and Urban Areas which doesn’t comply with proposed guidelines
5. Landscape Development and Design Guidelines
    - Land and Soil improvement measures for green spaces and landscape systems (regional level and local level)

- Allowable activities and constructions with reference to the Landscape structure (master) plan at region level
- Landscape maintenance and management routines and activities
- Prescription and preference of native and non-invasive plants, planting catalogues based on climatic regions and ecosystem types

6. Population density distribution criteria: Deciding population density distribution based on human carrying capacity analysis for an existing settlement limit as a whole and for each local area within the settlement is a very pragmatic approach to allocate population density.
    - If the city/town/village administrative area, already has a population more than the estimated carrying capacity, it indicates that measures should be take to increase the resource and ecosystem service capability of the region by; 1) increasing the green cover and tree count through plantations, 2) increasing the permeable surfaces 3) Designing additional landscape infrastructure related to water management like bio-sales etc. Further densification may not be preferred in such situations.
    - If the city/town/village area has an existing population below the human carrying capacity, then increasing the population density instead of expansion of city/settlement limits could be preferred. Thus sprawl can be avoided in a logical and scientific way. Calculating human carrying capacity for each neighbourhood area can give a more granular information for density distribution and allocation.
7. Location and Hazard action protocols for city/town/village management: The purpose is to have a set of action protocols
    - for any of the extreme events (Heat waves, water scarcity, flash floods, storms)
    - for vulnerable areas within the city/town/village (floodplains and areas adjoining floodplains of rivers and lakes, areas with seismic risk, areas with landslide risk, areas with fire risk, areas with industrial hazard/contamination risk)
    - These should be informed by spatial information on hazard zones and should be prepared in collaboration with Crisis Management Agency

8. Pollution mitigation checklist and spatial tools
    - Traffic Pollution mitigation and management: Prescribe pollution mitigation measures such as sound buffers, vegetated buffers and tree planting along traffic routes
    - Industrial Pollution mitigation and management: eg; Allocating of necessary buffers,
    - Incentivising mechanisms to encourage non-polluting methods of waste management
    - Adopt non-polluting methods of municipal waste disposal
    - Utilise landscape infrastructure and green technology for non-hazardous waste management

At Local Level

L a. Documentation and Mapping

	La-Documentation and Mapping
1	**Vulnerability Aspects**
1.1	Community based documentation of localised water logging events, garbage and waste management issues, and other issues
1.2	Parameters (Spatial, building construction, infrastructure, movement and accessibility, safety parameters) for identifying and creating safe houses w.r.t different types of disaster event or stress events for a neighbourhood
1.3	Mapping of emergency services (location and specialities (Medical emergency services-hospitals, Fire emergency services, etc.)
2	**Natural Resource and Ecosystem Functions related aspects**
2.1	Recording and collection of resource consumption, energy usage, small urban farms and other household level vegetable gardens, rainwater harvesting, use of solar energy etc.
3	**Landscape System/Structure aspects**
3.1	Landscape Infrastructure Identification and Delineation at Neighbourhood Level
3.2	Community based documentation and identification of neighbourhood green /landscape resources, urban micro habitats, species mapping and spotting exercise- to be lead by community based organisations or other institutional partners (universities, students etc.)
4	**Existing Development aspects**
4.1	3D and 2D mapping and documentation at street and neighbourhood level (The mapping should include street trees, trees and vegetation in each complex/site etc.)

	La-Documentation and Mapping
4.2	Mapping of existing walking and bicycle routes (non-formalised and formalised) along with location of all modes of transport.
4.3	Traffic mapping across days and special events days
4.4	Mapping of possible safe houses at neighbourhood level - Refer to Parameters for determining and creating safe houses in events of disaster and stress (Refer to Sa1.2)
4.5	Mapping and updation of building conditions
5	**Future Development aspects**
5.1	Mapping of all proposed and approved projects including redevelopment projects and infrastructure projects - these has to be regularly uploaded and updated in the spatial data platform

L b. Assessment

	Lb-Assessment
Vulnerability Aspects	
1.1	Micro-climate models at ground level w.r.t street trees, water bodies, reflective/non-reflective/absorptive surfaces) - For existing development - For future development (Reverse modelling w.r.t various possible forms such that there is better micro-climate conditions in various seasons)
1.2	Regular valuation and condition assessment of identified safe houses (refer to Sa4.4) w.r.t parameters identified (refer Sa1.2)
1.3	Regular evaluation of emergency requirements w.r.t to possible disaster and other extreme events (as predicted and modelled at city and region level)
Natural Resource and Ecosystem Functions related aspects	
2.1	Calculate carbon footprint of individual families and at community level - a community level awareness and knowledge building (sharing pamphlets, once in a month exercise)
Existing Development aspects	
4.1	Wind tunnel effect and modelling, assessment of wind movement and wind movement obstruction caused by existing buildings
Future Development aspects	
5.1	Wind tunnel modelling, wind movement obstruction assessment and modelling w.r.t various build form models at neighbourhood level and city level build form
5.2	Impact assessment and SWOT analysis of new projects (time-bound assessment and review) - This assessment/review should be able to inform and improve the new projects

L c. Output and Decision Making Tools

1. Building Regulation and guidelines for sustainable, low emissions and low footprint living;

- Decision on number of floors in a building (informed by location and precincts such that wind movement is not affected, sunlight is not obstructed etc.)
- Decision of Land Area within Site that has to be maintained as permeable (% of site area that has to be left permeable)
- Orientation of Windows and Openings (for optimal internal temperature
- Roof Characteristics and use (most climatically suitable roof structures/form and incentivising green roofs and balcony gardens)
- Material specifications (depending on seismic risks, flood risks, sun path etc.)
- Buildings with Structural Risks: Clearly identify areas within the local area land use map, which require special structural regulations owing to various aspects such as seismic risks, water logging risks, soil conditions, wind etc. The source and reference link to corresponding documents related to detailed regulations has to be provided as an index to this map.
- Identify/enlist all existing buildings and sites that doesn't comply with guidelines related to construction in seismic regions or any other special regulations

2. Detailed Land Use Map for the local area: This land use map should be able to show detailed use and activities prescribed as per the land use plan of the city. The detailed Land use map for the local area should also show landscape infrastructure elements, basic infrastructure as well as emergency infrastructure. This should be put up at public places for citizen awareness.

3. Non-motorised mobility Network Plan and Design (pedestrian, cycling, and other non-motorised vehicle movement): Non-motorised mobility and connectivity minimises carbon emissions while improving multi-modal connectivity. This will require placement of infrastructure for non-motorised vehicles, especially cycling pathways and networks as well as pedestrian paths which are shorter and safer to use than other motorised options.

   These network of pathways should be shaded naturally and integrated with the public spaces and open green spaces or landscape networks. These networks should also provide ancillary infrastructure such as safe parking facility, resting

and picnic spots, benches etc. The intent should be to create well shaded paths along green networks.

- Mobility Map (Refer Sa4.5) can inform the design for non-motorised mobility networks (cycling) and pedestrian networks from motorised transport hubs to destinations.

- Design conditions and guidelines for pedestrian pathways, cycling routes, planting alongside the paths/routes, ensuring proper drainage and permeable surfaces while laying pathways, lighting etc..

- These guidelines should be referred to when approving any design proposed

4. Public/open spaces network Design: The design could be finalised through a competition or a design lab/workshop where community engagement is mandatory in the design process. The guidelines for the design competition should mandate considerations such as; landscape systems, vulnerable areas, important ecosystems and mobility networks (motorised and non-motorised).

5. Landscape and Landscape Infrastructure Design: The design could be finalised through a competition or a design lab/workshop where community engagement is mandatory in the design process. The final design should be based on appropriate spatial assessment maps (provided by the spatial assessment platform) and terms of references. The final design could include;

    - Delineation of a contiguous network of open green spaces and waterscapes within the local area/neighbourhood. This can be done by linking existing parks, playgrounds and other public open spaces. Connecting individuals patches may require identification of connecting pedestrian or cycling routes, or even streams and stream buffers. The natural drainage flow paths, smaller water bodies such as ponds and wetlands will all have to be integral part of the landscape infrastructure network.

    - Specific interventions in terms of improving the functioning of the green spaces can be taken up by designing bio-swales, detention ponds, bio-filters, reed beds, edge planting, etc. where appropriate. Annexure III. provides a reference list of various types of landscape based green infrastructure

    - Permissible Activities: Activities such as felling of trees or removal of plants, waste disposal or any other harmful shouldn’t be allowed, the

- Type of Built Development Permissible: Only temporary structures such as kiosk may be allowed as long as the total footprint of all kiosks doesn't occupy greater than 1% of the total area of the landscape infrastructure area within the local area.
- Planting choices: Shade providing native tree species, flowering and fruiting plants, etc. are preferred. Planting should include trees as well as shrubs. Low maintenance and low water requiring sturdy native plants and trees should be most preferred. Depending on the landscape trees and plants may be chosen; Areas with loose soil and on steeper areas should be planted with shrubs and trees which have dense root structure.
- Land and Soil improvement measures: These may prescribe measures like use of organic manure instead of fertilisers, number of time the soil must be tilled, need for taking soil test, slope stabilisation, improving permeability of soil etc.
- Specific treatment of edges/borders: This may include how the edges and border of landscape areas/landscape infrastructure components must be treated. Edges/borders that interface with other land uses/transportation networks, water bodies etc. will have to be differently treated and these interfaces will have profound impact on the condition and health of both land uses.
- Identifying access points/areas to these landscape networks: while some landscaped areas and landscape infrastructure could be made accessible to public and thus share such spaces as public spaces as well, some landscape infrastructure components and areas may have to be restricted in terms of public access for the safety of people as well as safety of the infrastructure. Such areas will have to be designed and managed carefully and the landscape design should consider these and prescribe additional protocols wherever necessary and notify the landscape management agency/authority about it.

6. Delineate and earmark areas for emergency services, and emergency infrastructure specific to each type of emergency scenarios. Should be developed in a collaborative with Crisis Management Agency, local governments and citizens. Work with disaster management authority or concerned authorities to

identify viable areas for emergency functions as well as critical and high risk areas within a neighbourhood.

7. Emergency Contingency Plan:

    - The local area plan should also identify emergency exits or route plans for public places (mobility hubs/markets/operas/theatres/town halls etc.) and places where large group of people gather in case of emergencies like earthquakes, fire, etc.

    - To enable smooth emergency services the city and local authorities may collaborate with emergency service agencies to chart out strategies and contingency plan. The intent is to ensure that emergency services can function smoothly and without any spatial or accessibility constraints. Some aspects may include prescribing building and urban design regulations related to access to buildings and public spaces, minimum width of streets etc.

    - The concerned authorities may take measures to clearly mark out these directions on ground or through signages.

8. Initiating and mobilising grassroots level community engagement for neighbourhoods: This should evolve as a regular practice and should become integral to communities. Such grass root level community engagement practice is a vital in management of any crisis and emergency situation. These grassroots level engagements can evolve to include regular interactions with government agencies, peoples representatives etc. In many parts of the world such practices have bee supported by local governments although these self help groups function independently.

9. Identify and train volunteers from community and locality to assist and carry out contingency plans as and when required by concerned authority. Once the grass root level self help groups are established, this task of training members of community for emergency situation as well as other initiatives will become well-organised.

10. Identify various vulnerable groups in communities;

    - Socio-economically vulnerable groups who may be most affected in various crisis situation

- Age groups and people who require special care and assistance

This exercise can be carried out in collaboration with local government, local self-help groups, Non-Governmental Organisations or Community based Organisations. Local self-help groups can play a vital role in leading such initiatives.

LINKS TO REFERENCE/LEARNING DOCUMENTS

Document Title	Source	Website Link
SPATIAL AND URBAN PLANNING FOR CLIMATE CHANGE MANAGEMENT		
Climate change adaptation and disaster risk reduction in Europe: Enhancing coherence of the knowledge base, policies and practices	European Environment Agency	https://circabc.europa.eu/sd/a/0d6aee10-ecac-4153-af99-f753745385c5/Climate%20change%20adaptation%20and%20disaster%20risk%20reduction%20in%20Europe.pdf
Guidance on Low Emission Land Use Planning	USAID LEAF program & USFS International Program	https://www.leafasia.org/library/guidance-low-emission-land-use-planning
Planning for Climate Change: A strategic, values-based approach for urban planners	UN-HABITAT	https://unhabitat.org/planning-for-climate-change-a-strategic-values-based-approach-for-urban-planners-cities-and-climate-change-initiative
Guiding Principles for City Climate Action Planning	UN-HABITAT	https://unhabitat.org/guiding-principles-for-climate-city-planning-action
SPATIAL AND URBAN PLANNING FOR DISASTER MANAGEMENT		
Reducing disaster risk by managing urban land use: Guidance notes for planners	ADB (Asian Development Bank)	https://www.adb.org/sites/default/files/publication/185415/disaster-risk-urban-land.pdf
A Guide to Measuring Urban Risk Resilience: Principles, Tools and Practice of Urban Indicators	Earthquakes and Megacities Initiative	https://www.cedim.kit.edu/download/Guidebook_URR_ME-July-2015.pdf
Risk-informed development From crisis to resilience	Overseas Development Institute, UNDP and SDC	https://www.odi.org/sites/odi.org.uk/files/resource-documents/12711.pdf
SPATIAL ANALYSIS USING GEOGRAPHIC INFORMATION SYSTEM		
Using Spatial Data to Support the Development of National Policies in the Post-2020 Global Biodiversity Framework (Stand alone Webinar)	Learning for Nature (Learning for Nature is a premier e-learning programme brought to you by the United Nations Development Programme (UNDP)	Webinar available in the ‘Learning for Nature’ Website and on Youtube under its title

Using National Spatial Data Platforms to Guide Policies on Nature (Stand alone Webinar)	Learning for Nature (Learning for Nature is a premier e-learning programme brought to you by the United Nations Development Programme (UNDP)	Webinar available in the 'Learning for Nature' Website and on Youtube under its title
RESOURCE CAPACITY ANALYSIS		
Guidance document on the application of water balances for supporting the implementation of the WFD-Technical Report - 2015 - 090	European Commission	https://climate-adapt.eea.europa.eu/metadata/guidances/guidance-document-on-the-application-of-water-balances-for-supporting-the-implementation-of-the-wfd/11309477
Technical Material for Water Resources Assessment: Technical Report Series No.02	World Meteorological Organization (WMO)	http://www.wmo.int/pages/prog/hwrp/publications/Technical_report_series/1095_en_4_Web.pdf
World Agriculture Towards 2030/2050: ESA Working Paper No. 12-03	Agricultural Development Economics Division Food and Agriculture Organization of the United Nations (FAO)	http://www.fao.org/3/a-ap106e.pdf
Food Production and Consumption: City Regions between Localism, Agricultural Land Displacement, and Economic Competitiveness	MDPI (Portal for open access scholarly publications)	https://www.mdpi.com/2071-1050/9/1/96 (download link to PDF)
COURSE 2: Increase Food Production without Expanding Agricultural Land	World Resource Institute (WRI)	https://wrr-food.wri.org/sites/default/files/2019-07/D_REP_Food_Course2_web.pdf
GREEN INFRASTRUCTURE PLANNING AND DESIGN		
Strategic Green Infrastructure and Ecosystem Restoration: Geospatial methods, data and tools	European Commission	https://ec.europa.eu/jrc/en/publication/strategic-green-infrastructure-and-ecosystem-restoration
Tools to support green infrastructure planning and ecosystem restoration	European Environment Agency	https://www.eea.europa.eu/themes/biodiversity/green-infrastructure/tools-to-support-green-infrastructure
Better planning and methods needed to restore nature	European Environment Agency	https://www.eea.europa.eu/highlights/better-planning-and-methods-needed

Building a Green Infrastructure for Europe	European Commission	https://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_broc.pdf
Urban Green Infrastructure Planning: A Guide for Practitioners	EU FP7 Project Green Surge	https://greensurge.eu/products/planning-governance/UGI_Planning_Guide_Sep_2017_web.pdf