

Land Use and Spatial Planning Tools to address land degradation and Promote Land Restoration

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SUMMARY

Land use planning, a component of spatial planning, can be perceived as a future oriented activity consisting of policies and methods that can be used to define, shape and influence the future allocation of land including wetlands, amongst several competing land uses. Decision-making on the highest and best use of land parcels by planning agencies, can be more sustainable if they are guided by an integration of the potential of a particular land use type to trigger land degradation. This review paper highlights the importance of land use planning that considers the potential for land degradation in order to halt further degradation, prevent it and possibly reverse it. In order to holistically assess this global phenomenon of land degradation selected case studies are used to examine where planning has increased exposure and vulnerability of lands to degradation against situations where planning has reduced exposure and vulnerability of lands to degradation. We identify the need for Planning officials responsible for granting development permits that are based on environmental impact assessment of proposed development projects to be sufficiently knowledgeable connections between planning and degradation. The triple planetary crises coupled with uncontrolled degradation of lands and wetlands, presents an opportunity to mainstream land degradation systems thinking into spatial planning. This can result in planning policy and regulatory reforms that will help to halt, reduce or reverse land degradation particularly in urban areas. We align with the United Nations Convention to Combat Desertification (UNCCD) through its G20 Global Land Initiative's commitment to promoting policies and actions aimed at reducing land degradation and enhancing the conservation of terrestrial habitats. With an ambition to achieve a 50 percent reduction in degraded lands by 2040, we recommend that Land use planning and spatial planning policies and methods can be used as tools to realize this ambition.

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1 INTRODUCTION

Land degradation is the result of human-induced actions which exploit land, causing its utility, biodiversity, soil fertility, and overall health to decline (UNCCD, n.d.). Land degradation has reduced the productivity of nearly one-quarter of the global land surface, impacted the well-being of about 3.2 billion people and cost about 10% of annual global gross domestic product in lost ecosystem services (IPBES, 2018). It is also described along with the loss of biological diversity as the two of the most pressing environmental threats facing humanity, eroding the planetary life support systems on which the prosperity and well-being of current and future generations depend (Graham, 2019). Land degradation is quite worrisome as the progressive deterioration or loss of the productive capacity of soils for present and future—is linked to key aspects of human security and well-being: food, jobs, health, and livelihoods (The GEF, 2023). Deforestation, overgrazing, mining, and erratic cultivation are the main anthropogenic practices contributing to the formation of wastelands (Bhunia et al., 2021) Land degradation also manifests in the form of soil or gully erosion, deforestation, leading to loss of biodiversity and the need for reforestation and regeneration.

The World Bank estimates that some 56% of the world's population – 4.4 billion inhabitants – live in cities. This trend is expected to continue, with the urban population more than doubling its current size by 2050, at which point nearly 7 of 10 people will live in cities (World Bank, n.d.) It is estimated that about 70% of the world's population would very soon all be living in cities. Urban land consumption is on the rise which makes it imperative that it is given utmost consideration within the context of urban land use contribution to land degradation. According to the World Bank, the expansion of urban land consumption outpaces population growth by as much as 50%, which is expected to add 1.2 million km² of new urban built-up area to the world by 2030. Such sprawl puts pressure on land and natural resources, resulting in undesirable outcomes; cities represent two-thirds of global energy consumption and account for more than 70% of greenhouse gas emissions (World Bank, n.d.).

The implication of this is an increased demand for the conversion of natural forest reserves into both agricultural land and land for infrastructure and housing. All these user types do not sequester carbon but interfere with soil organic carbon deposits, create impermeable surfaces and this contributes to climate change. In order to meet insatiable and competing needs of mankind, the potential for planning authorities to allocate land use to areas that trigger large scale land degradation such as soil erosion or loss of biodiversity, is high. This review paper examined land degradation within the context of land use planning and spatial planning. It explored ways of leveraging on contemporary urban planning tools as a means to halt or reverse global land degradation trends particularly in urban environments. It suggests that land use planning policies and methods can be utilized as tools for addressing land degradation

challenges and promoting land restoration. These suggestions reinforce the aspirations of key global organizations that are working actively to promote land restoration such as the United Nations Convention to Combat Desertification (UNCCD) [G20 Global Initiative](#) on Reducing Land Degradation and Enhancing Conservation of Terrestrial Habitats (G20 GLI). The G20 GLI has as its ambition, to achieve a 50 percent reduction in degraded land by 2040 (G20 Global Land Initiative, 2022). Land use planning and spatial planning can offer some options and tools to make this ambition a reality.

2 LAND USE PLANNING AND SPATIAL PLANNING

Land use planning is recognized as a key instrument for identifying and ensuring sustainable land uses, improving the livelihoods of rural communities, and thereby achieving sustainable development. It is considered to have evolved from merely an expert approach to land suitability in the 1960s and 1970s to a more integrated approach involving planning experts, decision makers and ordinary citizens (Bourgoin et al., 2012). Land use planning is the systematic assessment of land and water potential, alternatives for land use, commercial and social conditions in order to select and adopt the best land use options with the main purpose to select and put into practice those land uses that will best meet the needs of people while safeguarding resources for the future (Metternicht, 2017a). A participatory approach to land use planning considers a more bottom-up approach than a top down approach where effective and sustainable planning can rarely be achieved by expert knowledge alone rather, the involvement of other key stakeholders to complement expert views (Kopáček, 2021), (Tennøy et al., 2016).

Land use planning is subsumed within and complimentary to the concept of spatial planning. Spatial planning is considered a key instrument for establishing long-term, sustainable frameworks for social, territorial and economic development both within and between countries (United Nations, 2008). This definition highlights the need for spatial planning to be done in conjunction with land registration where measures are taken to create new subdivisions of the land as well as new patterns of land use. Spatial Planning policies can be used as tools to protect nature and environment by creating a balance between human needs and ecosystem health. Economic instruments in the form of land restoration levies can be introduced in the planning approval process as a mitigation tool and used to fund conservation or restoration based on the environmental footprints of essential development.

Spatial planning is a policy tool to govern built up land expansion (He et al., 2021). The role of spatial planning in urban development hinges on expressed intentions, the means of implementation via government processes and consideration of influence of external conditions that affect the implementation of any spatial plan (Hersperger et al., 2018), it brings together economic, social and environmental aspects at different spatial scales and across various sectors (Bacau, 2021). Spatial planning is a process of plan-making, implementation and development control which helps to coordinate and improve the impact of sectoral policies on land use. It is a broad umbrella concept associated with land use planning (LUP), urban planning (UP), regional planning (RP), Town planning (TP) and more recently environmental planning (EP). In a broader context, sustainable land management (SLM) as a process, comprises land use planning, land use design and land development in (Metternicht, 2017b).

Land use planning and spatial planning policies help to regulate the use of land usually by a central planning authority or agency of government to produce social and environmental outcomes and a more efficient use of natural resources. In this regard, land use planning and urban planning can serve as tools to prevent, halt or reverse land degradation. Land use planning is essential to deal with several interests and competing demands for scarce land resources. It thrives on the notion of highest-and-best-use and formulates policies that facilitate the best land development. Land use policy can be at national, regional and local (state) levels. However, some communities may develop haphazardly without LUP resulting in land degradation and environmental pollution. LUP can also be described as a form of public sector policy interventions related to ordering and regulation of land use in an efficient, sustainable and ethical way.

Land use needs are multiple and varied as they include legitimate needs for housing, industry development, commerce, parks and recreation, transport, and development of community facilities. Multiple sectoral policies impact on the demand for land as each sector seeks to fulfil its mandate either by the provision of public infrastructure, housing, agricultural or industrial lands. Land use allocation is a normative modeling methodology which focuses on evaluating current land use patterns and introduces changes leading to increased compatibility of adjacent land uses, infill development, land use compactness and politically defensible redevelopment (Ligmann-Zielinska et al., 2008). A framework for land allocation amongst these competing land uses is where planning comes in. Due to the rapid urbanization, a large number of natural land (such as forest, grassland, and wetland) are converted into developed land (such as urban and cropland) and thus pressures on environment and ecosystem are increasing (Zang et al., 2011) cited in (Liang et al., 2017). Urbanization can be responsible for deforestation, habitat loss, and the extraction of freshwater from the environment, which can decrease biodiversity and alter species ranges and interactions (Cheng et al., 2023). In a broader context also, sustainable land management (SLM) as a process, comprises land use planning, land use design and land development cited in (United Nations Convention to Combat Desertification, 2022). Land use planning policies provide the framework for balancing competing land use needs and is essential to deal with several interests and competing demands for scarce land resources. Planning policies regulate the use of land at national, regional and local (state) levels. Land use allocation is a normative modeling methodology which focuses on evaluating current land use patterns and introduces changes leading to increased compatibility of adjacent land uses, infill development, land use compactness and politically defensible redevelopment ((Ligmann-Zielinska et al., 2008).

3 PLANNING AND LAND DEGRADATION

Globally, about 25 percent of total land area has been degraded and 3.2 billion people are affected by land degradation, especially rural communities, smallholder farmers, and the very poor (The GEF, 2023). Land degradation is on the increase globally and if left unchecked, can have severe consequences in terms of agriculture, food security and loss of livelihoods. Uncontrolled land degradation also contributes to climate change. There are a number of ways by which poor planning or the absence of planning altogether can contribute to land

degradation. For instance, where non-complimentary land user types are situated close to each other, there is the chance that the activities of these different users can have synergistic impacts on surrounding lands. Some cities in the global south suffer from poor planning or the absence of planning and experience difficulty in monitoring and enforcing of planning regulations or development control which contributes to land degradation. Land degradation may be one of the outcomes of the absence of planning or poor planning decisions, particularly when no sectoral cohesion or cooperation exists. Urban planning usually has to contend with population growth, rural-urban drift, urban expansion and into rural suburbs. In urban areas, the pressure to meet land needs for housing might lead to the allocation of land in sub-optimal locations.

Land degradation may be associated with poor planning decisions, lack of sectoral cohesion or cooperation and each authority operating in silo's. In order to meet competing land-related needs of mankind, the potential for planning authorities to allocate land to uses that trigger large scale land degradation, is rather high. Sometimes the pressures are from international investors with financial power make the bait even higher particularly in the global south. Urban planning also contends with rapid population growth, rural-urban drift, urban expansion and into rural suburbs and pressure to meet land demands for housing. This could result in the allocation of land in sub-optimal locations. Due to rapid urbanization, a large number of natural land (such as forest, grassland, and wetland) are converted into developed land (Zang et al., 2011). Urbanization can be blamed for deforestation, habitat loss, and the extraction of freshwater from the environment, which can decrease biodiversity and alter species ranges and interactions(Cheng et al., 2023).

In instances where planning actually exists and where planning authorities are established poor planning decisions can continue to be made if the responsible officers do not have the requisite training an understanding off the planetary crisis we face and how these are interlinked with planning. In such circumstances there is the likelihood that planning will remain business as usual planning authorities will be receiving requests for housing and other forms of physical infrastructure development, will undertake preliminary environmental impact assessment service, and will approve for developments without any restrictions or any mitigative measures in place for the consequences of that development. Local comprehensive plans also can be tailored to conform with State-wide planning goals in order to prevent land degradation. Planners should consider natural resources while developing land use plans which must compare loss of biodiversity and climate change of alternative land uses and choose the one with the least impact. Local comprehensive plans must be consistent with the state-wide planning goals (e.g., they must consider natural resources in developing land use plans

4 ADDRESSING LAND DEGRADATION AND RESTORATION

Land degradation can be halted by preventing the trend from going on unabated. It can also be reversed if the right tools are in place and the right knowledge and skills are made available to land managers, urban planners and local community guide decision-making on land use. Besides halting the trend in land degradation, the trend can also be reversed through actively promoting land restoration resulting in a reduced quantity of degraded lands overall. Often, planning tools cut across a wide spectrum from orthodox methods and planning policies to newer and more modern approaches based on artificial intelligence and other such

improvements in technology. Green cities concepts and sponge cities are also becoming popular planning approaches in urban development and reduce the negative consequences that the urban environment has on land.

4.1 Nexus Thinking

Nexus thinking and systems thinking are both important tools in land use planning that can help combat land degradation. It is important to think about the consequences of planning decisions not just on the immediate environment but how they contribute to the triple planetary crisis that the world currently faces. New requirements for planning approval and development control can aid restoration and help reduce the impact of degradation on climate change. Systems thinking can also apply in urban planning and can help planners take cognizance of the interconnectedness of environmental and urban systems. It should promote planning where the requirements for development permits and planning approvals should not be restricted to its environmental impact assessment of only the immediate environment. It should go beyond the immediate environment into the global arena and should consider issues such as climate change and loss of biodiversity as these are all connected to planning decisions.

4.2 Systems Thinking

To promote a systems thinking approach to land use planning specifically targeted at for reducing land degradation. With the present triple planetary crisis coupled with uncontrolled degradation of lands and wetlands, there is the need to mainstream land degradation systems thinking into spatial planning. London predation systems thinking makes it imperative that planners are fully informed on the land degradation system. Land degrades from natural causes such as weathering which is the gradual disintegration of the earth surface due to elements of the weather such as wind water insolation and there's very little that can be done about it so they're natural causes of land equitation. These natural causes may be aggravated by poor planning I'm a such then ordinarily ordinary gradual weathering maybe I celebrated if there is poor planning. For example, setting land types are prone to erosion and in such neighbourhoods it is not uncommon to find approvals and permits given for laterite extraction from these areas that are prone to erosion once laterite mining begins even though it's for reason such as the provision of housing it has been known to trigger of large scale erosion which not only destroys the landscape but also destroys the environment and ultimately destroy the infrastructure that was built. This can ultimately lead to planning policy and regulatory reforms that will halt, reduce or reverse land degradation by the year 2040. Systems thinking can promote policies that recognize the diversity and complexity of the natural environment and can target changes to different areas so as to radically improve land use in terms of agriculture and greenhouse gas emissions, recreation, and wild species habitat and diversity.

4.3 Green Cities and Sponge Cities

For instance, the decision to plant a tree and the type of tree that is to be planted, can be specified as part of urban planning methods to ensure that trees which sequester more carbon prioritized and planted. This can address global warming, and this can reduce the impact on climate change and subsequently the impact of climate change on land degradation. Urban planning which promotes green cities that promote climate-focused policies in order to address climate change. Urban planning can also promote sponge cities that emphasizes flood management using green infrastructures with natural areas such as trees, lakes and parks to absorb rain and prevent flooding instead of purely relying on concrete or other constructed drainage systems.

Again, there are tools such as drones which can now be used to monitor and actively follow the pattern of land degradation this can help local authorities and municipalities to assess just how much of the land within their jurisdiction is being lost to land degradation on an annual basis and what type or category of degradation is being experienced. When drone images are captured they can inform future restoration plans and LDN commitments by governments around the world.

4.4 Reviewing Historical Planning Decisions

Reviewing historical planning decisions which have served as a catalyst for land degradation - with examples. By mapping historical planning decisions that actually contributed to land degradation lessons can be learned and those lessons will ensure that the mistakes of the past are not repeated in the future. It is important that planning authorities take routine inspections within their neighbourhoods to identify instances where properly approved developments have turned out to be triggers and catalysts for land degradation. Planning approvals should not be final planning approvals should run through post approval development monitoring simply because at the time when approvals are given it is not entirely possible to fully assess the extent of its consequences on the immediate environment and microclimates.

4.5 Development Monitoring

Where there are provisions for further monitoring of a development when it is fully operational planning authorities should have the latitude to make corrective demands even where previous planning approvals have been given. For example, if the planning approvals were given without due regard to climate change it is possible that with a higher temperature for longer periods in the year currently being experienced around the world the approvals may not have taken that temperature level into consideration at that time. It is possible also that buildings may have been designed where ventilation and the ability to for heat exchange to be functional the head rooms within the buildings may have been low because there was no consideration about climate change or global warming. There needs to be a revisit of previous approvals in line with current environmental realities and this is another area in which planning authorities can help to reverse the trend.

It is crucial that provision is made for land restoration as part of an annual budget at states local government and federal government level. Similar to how planning for capital projects and maintenance of physical infrastructure, it is recommended that degrading natural infrastructure is also given the attention that it deserves by government. Adequate budgets can be provided within the context of planning and in line with global policies and in line with the National land degradation neutrality framework. This will ensure that governments around the world to take proactive steps to deal with and address land degradation within their boundaries. The G20 Global Land Initiative is committed to promoting policies and actions aimed at reducing land degradation and enhancing the conservation of terrestrial habitats with an ambition to achieve a 50 percent reduction in degraded lands by 2040(G20 Global Land Initiative, 2022). Land use planning and urban planning approaches can be used as tools in achieving this ambition.

4.6 Mainstreaming Land degradation systems thinking

Mainstreaming land degradation thinking into spatial planning can be an option for city planners. The question then is how this can be achieved. The rate of land degradation makes it timely for it to be mainstream into urban plan. It needs to be part of urban planning it needs to be thought about it needs to be listed as one of the considerations over and above how it has been in the past. Special consideration needs to be given the planning decisions and how they will impact on long beard wetlands I read lands or other forms of yeah how do planning decisions impact on their full screen it should not be an afterthought, it should not be discountenanced because it's a vital component of planning.

4.7 Land Degradation Mapping

Land degradation mapping involves the measurement, and monitoring of land at various space and time scales. This can be used as a vital planning tool to inform planning authorities and decision makers on what's going wrong and what action can be taken. It should be on-going. Planning officials responsible for granting development permits based on environmental impact assessment of proposed development projects, need to take stock on the degree to which previous planning decisions have served as drivers for land degradation. By mapping the trajectories of planning permits that triggered large scale land degradation, steps can be taken to reverse the trend through planning policy instruments. Reactive Planning. Planning policies can be designed such that they are also reactive and can mitigate previous planning permits that have triggered off erosion and landslides, or that have compromised coastal areas, future planning can prevent this from reoccurring. The way in which planning can be used to halt or reverse land degradation is by taking stock of historical planning decisions that have gone wrong and taking steps to prevent reoccurrence - a bold decision not to repeat earlier mistakes.

5 PLANNING TOOLS AND LAND DEGRADATION

A plethora of planning tools are available which can be used to reduce land degradation. The application of Ecosystems Services Values (ESVs) in decision-making in land use (Liang et al., 2017) Ecological observation in Land use planning. Planning to reduce land degradation can be done in different contexts. The geographic location of the site, the domain which is either rural, urban, peri-urban lands and the administrative/spatial scale referring to local/municipal, state, national, or regional plans. Using regional planning as a tool can provide adequate scale for considering the natural extent and significance of environmental assets which exist across administrative boundaries of state or municipalities. Planning which takes place strictly within official and/or administrative boundaries, can make it difficult to protect environmental assets within their natural extent. For instance, controlling soil erosion within locations that are mid-way along the trajectory without a regional plan that enables prevention at source, might be an effort in futility leading to increased land degradation than otherwise. Allocation of land across a landscape can be done in such a way that it maintains an optimal balance between economics, socio-cultural and environmental values. Generally, decision-making on land use by planning agencies, can be more sustainable if the potential for land degradation is given priority consideration and if the optimal land use is recommended (Liang et al., 2017). Some land use and urban planning policies and methods can be deployed as tools to prevent, mitigate, halt or reverse land degradation. To prevent repeat of our example, a number of options are suggested

5.1 Ecological Conservation

This approach weighs the effects of planning decisions on ecosystem services values (ESV's) against the risk associated with land use change to optimize allocation of investment in land to improve ecological benefit. Decision-makers need to control land use change and become more concerned about ecological benefit of land use. (Liang et al., 2017).

5.2 Land Degradation Mapping

Land degradation mapping involves the measurement, and monitoring of land at various space and time scales. This can be used as a vital planning tool to inform planning authorities and decision makers on what's going wrong and what action can be taken. Land degradation mapping should be on-going, and the analysis should inform subsequent interventions to halt land degradation including using nature. By mapping degradation trajectories, steps can be taken to reverse the trend through planning policy instruments. Stocktaking of historical planning decisions that have resulted in land degradation can lead to corrective action to prevent reoccurrence an policy reforms to avoid a repeat of earlier planning mistakes.

5.3 Regional Planning

Using regional planning as a tool can provide adequate scale for considering the natural extent and significance of environmental assets which exist across administrative boundaries of state or municipalities. Planning which takes place strictly within official and/or administrative boundaries, can make it difficult to protect environmental assets within their natural extent. For instance, controlling soil erosion within locations that are mid-way along the trajectory without a regional plan that enables prevention at source, might be an effort in futility leading to increased land degradation than otherwise. Planning at the regional scale also enables the cumulative impacts of future development on the natural environmental assets or Capital of a region to be considered, this way, the responsibility for protection and management across different jurisdictions can be assigned and ultimately reduce large scale land degradation.

5.4 Environmental Planning

Environmental planning can minimize land degradation. A paradigm shift from orthodox land use and urban planning to a combination with environmental planning, can halt or reduce land degradation (Beatley, 1995). Environmental Planning to halt land degradation. Land-use decisions can lead to losses of ecosystem services and the value of net losses can be quite significant. Ecosystem Assessment estimates the values of these net losses even though land-use decisions frequently neglect to consider the value of ecosystem services (Bateman et al., 2013). A planning authority or agency that is committed to minimize land degradation, can promote optimization where development permits are granted based on the least impact from alternative scenarios and locations.

A paradigm shift from orthodox land use and urban planning to a combination with environmental planning, can halt or reduce land degradation (Beatley, 1995). Environmental Planning to halt land degradation. Land-use decisions can lead to losses of ecosystem services and the value of net losses can be quite significant. Ecosystem Assessment estimates the values of these net losses even though land-use decisions frequently neglect to consider the value of ecosystem services (Bateman et al., 2013). A planning authority or agency that is committed to minimize land degradation can promote optimization where zoning and other planning tools approve developments that have the least impact based on alternative locations. The decision to promote housing or other forms of development within wetlands leading to deforestation can

be weighed against undertaking the same development elsewhere and decision-making based on the location which offers least degradation. Considering that the change from rural to urban use is usually irreversible, it is important that land use planning mitigates these impacts earlier on in the decision-making stages. Environmental planning can minimize land degradation. Nature can be used to provide important services for communities by protecting them against flooding or excessive heat, or helping to improve air, soil and water quality. When nature is harnessed by people and used as an infrastructural system it is called “green infrastructure”. Cities of the European Union and of Singapore are amongst those that have already begun to implement green infrastructure (i.e., parks and other green spaces, green roofs and walls, urban farms and forests) through policy and planning instruments, particularly spatial planning. This approach is not exclusive and could be used effectively in the global south.

5.5 Incorporating Ecosystem Services Into Planning Processes.

before a final decision is made to approve developments within certain contexts, a holistic assessment should be able to value the loss of ecosystem services and compare these to approvals in alternative locations. The site with the least footprints amongst these alternatives, can be approved albeit with a caveat to contribute to land restoration elsewhere. As part of local plans, lands requiring restoration such as borrow pits from which land has been mined for construction can be planned for and restored. This iteration can help reduce overall land degradation.

5.6 Regional Planning to Reduce Land degradation

Planning at the regional scale also enables the cumulative impacts of future development on the natural environmental assets or Capital of a region to be considered, this way, the responsibility for protection and management across different jurisdictions can be assigned and ultimately reduce large scale land degradation. Sustainable construction practices for instance, can prevent or mitigate runoff of construction debris into nearby water-bodies. Planning and building permits can include surcharges for estimated amounts of construction run-off associated with development. Such funds can be channelled to land restoration fund to mitigation of construction induced degradation at the source, pathway and receptor communities and towns.

6 CONCLUSION

Land use planning tools can prevent, halt or reverse the trends in land degradation. This can be done through the analysis of land degradation maps and mainstreaming them into future land use plans. Reactive planning can halt land degradation through interim monitoring of development projects can identify and mitigating unforeseen cases of land degradation as they occur. Land degradation trends can be reversed for instance by protecting land of agricultural significance from urban and peri-urban encroachment; capital from urban and peri-urban encroachment; ensuring land use reflects land capability; establishing appropriate buffers between development, and coastal estuaries, and water foreshores; floodplain management; protecting natural habitat from destruction and fragmentation. Local comprehensive plans need to conform with State-wide planning goals. Planners should consider natural resources in developing land use plans and must compare loss of biodiversity and climate change in alternatives and choose the one with the least impact.

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BIOGRAPHICAL NOTES

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2. Charles Etornam Atakora

Charles Etornam Atakora currently a Geodetic Engineer with a private firm in Dortmund, Vermessungsbüro Sommerhoff. His current role entails but not limited to Engineering survey, cadastre update and data processing for NRW region of Germany. He received his MSc. (2021) with a focus on Geodesy and Geoinformatics from the Leibniz University of Hannover, Germany. An MBA from the GISMA Business School in Hannover, Germany with a focus on International Business (2016). He completed his BA. in Geography and Resource Development

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