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A Framework Based on Sustainability Transitions and Nexus Thinking

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A Framework Based on Sustainability Transitions and Nexus Thinking

Summary

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Objectives

This paper develops a new conceptual framework of **Nexus Transformations** to support regional sustainability and peacebuilding efforts. It makes several contributions to **incorporating notions of sustainability into security and peace studies** and adjacent policy fields. At the same time, the paper will be of interest to a wide range of stakeholders concerned with the fundamental question of our age: **how to contribute to transforming existing conflictual and detrimental systems into more stable and sustainable systems conducive to peaceful conditions** – in the Middle East region and beyond.

First, the paper introduces two of the most prominent approaches in the academic study of sustainability and in the fields of environmental and climate policy: **Sustainability Transitions** (ST) and **Nexus** approaches. It offers a brief and accessible introduction to the main concepts and themes of these two approaches – intended to researchers in security and peace studies, as well as to policymakers and practitioners working in post-conflict reconstruction or in sustainable development more broadly.

Second, the paper offers a conceptual yet practical synthesis of the Sustainability Transitions and Nexus approaches. Despite common concerns and potential synergies, these two influential approaches have thus far been addressed separately in the academic and policy literature. However, there could be advantages to combining them in different policy domains and in real world applications. The Nexus approach is concerned with the interrelations between **systems** (e.g. energy, water) that require integration to become more sustainable. It focuses on ***what to transform***, and offers technical, infrastructural, and spatial insights. Sustainability Transitions is concerned with processes and offers a **theory of change**. It focuses on ***how to transform***, and adds important organizational, institutional, social-economic, political, and temporal insights. The paper therefore introduces an integrated framework of Nexus Transformations as a method to simultaneously

address these interrelated questions of how to transform and what to transform.

Third, the Nexus Transformations framework offers an expanded and holistic articulation of nexus approaches, interconnecting the **FEW nexus** of food, energy, and water systems, critical at the urban scale, with the **MORE nexus of regional mobility, economic, and ecological systems, and with the PLENTY nexus** of security, prosperity, and peace within planetary boundaries. Nexus Transformations thus frames seemingly local and site-specific sustainable development challenges, including post-conflict reconstruction, as multi-level and multi-scale opportunities for systemic transformation.

1. Sustainability Transitions: *How to Transform?*

Sustainability Transitions (STs) is an influential academic and policy field that is central to debates on sustainability in the last two decades. STs are **long-term, structural changes in socio-technical systems** – such as energy, transportation, or food production – towards configurations that are environmentally sustainable, economically viable, and socially equitable. Socio-technical systems are complex assemblages that combine physical infrastructures, technologies, markets, policies, organizational forms, user practices, and cultural meanings. STs are not limited to technological innovation alone but involve changes in regulation, business models, political priorities, social norms, and behavior.

A central challenge in changing socio-technical systems is their **path dependency**. Past investments, existing infrastructures and institutional arrangements, established ways of thinking and doing – generate inertia or 'lock-in' in a system that is no longer beneficial. ST offers a systemic "theory of change" that highlights how coordinated interventions can gradually reconfigure entrenched systems to align with sustainable goals. At its core, it conceptualizes transformation as a reconfiguration of key system elements – technologies, infrastructures, regulations,

markets, practices, and cultural norms – so that they become mutually reinforcing around sustainability goals. This is often formulated through the analytical framework of the Multi-Level Perspective (MLP), which explains large-scale transitions through interactions across three levels: landscape, regime, and niche:

- **Landscape (macro context)**: encompasses the broader, exogenous environment that influences socio-technical systems. It includes long-term trends such as climate change, demographic shifts, or geopolitical dynamics. Landscapes usually provide a stable backdrop for regimes, but abrupt shocks – wars, pandemics, economic crises – can exert pressure on existing systems and open windows of opportunity for change.
- **Regime (meso context)**: encompasses the established and stable elements of a socio-technical system, including dominant technologies, infrastructures, markets, regulations, and social practices. Regimes are characterized by durability, existing institutional arrangements, and mutual reinforcement among their components, which tends to favor incremental change and resist radical alternatives.
- **Niche Level (micro context)**: protected environments where innovations can emerge and mature. Niches serve as experimental spaces allowing new technologies, practices, and organizational models to be developed away from the pressures of markets and regulations. Through processes of experimentation, learning, and coalition-building, niche innovations can gain momentum and challenge regime dominance.

Overall, the ST and MLP frameworks offer **strategy guidance to policymakers** by highlighting where interventions might be most effective to achieve transformation.

2. Nexus Thinking: *What to Transform?*

Nexus thinking is an analytical and governance framework concerned with understanding and managing interdependencies among systems that are often treated separately. While mostly associated with natural resource management, nexus thinking increasingly incorporates social, economic, political, and spatial dimensions. The term nexus emerged in policymaking in the late 1980s as a response to growing concerns over resource scarcity, environmental degradation, and the limitations of siloed policies. It gained global prominence following the 2011 Bonn Conference, which framed the **Food-Energy-Water (FEW) nexus** as a prerequisite for sustainable development. Since then, it has been widely adopted by international organizations, development agencies, and national and urban policymakers, including in the **UN Sustainable Development Goals**.

Nexus thinking critiques sectoral policymaking and governance. Policies designed within institutional silos seek to optimize outcomes in one domain while shifting costs, risks, or resource pressures to others. However, multiple overlaps between food, water, energy, agriculture, and other systems, necessitate coordinated strategies to avoid policy mismatches and ensure resource sustainability. Nexus approaches seek to promote more coherent, cross-sectoral decision-making, highlighting **synergies, co-benefits, cascading effects, and trade-offs**, and thus enhance sustainability and resilience in and across systems.

Over time, the scope of nexus thinking has expanded significantly in both research and policy debates and it is increasingly applied to compound global challenges, including climate change, ecological degradation, economic instability, and violent conflict. While the FEW nexus remains foundational, researchers have proposed additional nexus formulations incorporating additional infrastructural systems and industries; social domains such as health; the specific attributes of the **urban nexus**; ecological systems and climate change (e.g. the Water–Food–Energy–Climate nexus); and political processes, conflict,

security, and peacebuilding (e.g. the **Humanitarian–Development–Peace (HDP) nexus**, the **Peace–Sustainability nexus**, and the **Climate–Conflict nexus)**. This expansion reflects growing recognition that nexus approaches are critical for sustainability governance, urban contexts, and conflict-affected settings. By fostering holistic understanding and integrated action across sectors and socio-technical systems, nexus thinking offers a powerful approach for addressing 21st-century challenges. In this way, it complements sustainability transitions by insisting on **multi-system and multi-sector transformations** to address contemporary polycrises.

3. Nexus Transformations: From FEW to MORE to PLENTY

The Nexus Transformations framework integrates an expanded notion of the nexus with the multi-level perspective of sustainability transitions to address the following scales and dimensions of sustainable development and reconstruction:

FEW Transformations: Focus on the local scale and niche level

FEW transformations are the "natural" starting point for practitioners of sustainable development and reconstruction. They align with the prevalent policy focus on the food, energy, and water nexus, but should also include closely connected waste and wastewater treatment systems alongside local planning and community-based projects. Local level initiatives could set up these essential systems where they are missing, deficient, or destroyed, and design them from the outset as an interrelated set of systems; or they could transform existing, inefficient, and unsustainable systems by studying and enhancing their nexus interrelations to minimize trade-offs and enhance synergies. These transformations should focus on the community and urban scales but would necessarily connect also to regional systems. FEW systems include:

- **Food**: promote local food security, sustainable agriculture and food production, community gardens and urban agriculture; reduce food waste and promote composting, reuse and recycling facilities; support local and artisanal food businesses; connect to agri-tech and food-tech hubs.
- **Energy**: design and apply community-managed renewable energy systems, including rooftop solar and other local decentralized generation systems; set up microgrids at the scale of communities or city districts; minimize GHG emissions and aim at achieving net-zero energy; connect to energy-tech and climate-tech hubs.
- **Water**: design and apply micro- and local water generation, collection, and reuse systems (including collection of rain, recycling of gray water, local desalination facilities); allow for wells and aquifer replenishing; use local wastewater treatment to enable reuse for local agriculture; connect to water-tech hubs.
- **Construction materials**: remove, reuse, and recycle construction debris (from war or redevelopment); support urban mining processes; remediate land contamination using biological and ecological solutions; connect to construction-tech hubs.
- **Community**: design and build the above systems with local communities through processes of co-production to support sustainable and socially rich community life; support a continuum of rural and urban lifestyles and local commerce based on small- and medium-sized enterprises (SMEs); develop accessible and lively public spaces.
- **Urban planning**: promote local transit-oriented development (TOD) in connection to regional transit; plan to boost accessible and safe walkability and biking options; enhance street shade and plant locally adapted trees, develop green and blue infrastructures to tackle heat and pollution; integrate planning with the above systems; **promote** "smart city" plans adapted to local conditions and community needs.

- **Local health**: these different systems should contribute to active lifestyles, individual wellbeing, a healthy local environment free from any forms of locally produced pollution, and a public health system integrated at the community level.

The transformation of FEW local systems is centered on the **niche level** of the MLP framework. It requires identifying and promoting actors with transformative potential, including "newcomers" that could bring innovation and motivation, while also bringing on board "incumbents" that are ready to explore new sustainable paths. Local/Urban Living Labs (LLLs/ULLs) could experiment with technological and social innovations on the ground and allow for their rapid and realistic scale-up. The **time scale** of FEW transformations prioritizes **short-to-mid-term initiatives**, from emergency and rapid interventions, through interim solutions, up to a planning and implementation horizon of five to fifteen years.

MORE Transformations: Expand to the regional scale and the regime level

MORE transformations build on FEW nexus transformations and expand their scope and ambition to enhance sustainable regional mobility and economic systems, and to preserve and responsibly benefit from regional natural systems and their ecological services. These interrelated economical-ecological ("eco-eco") systems should be planned and prioritized as the backbone of a well-functioning sustainable region: where people, materials, and products move with ease, speed, and minimal emissions; where jobs and services are nearby and accessible; where regional education systems and labor markets create knowledge and equal opportunities; and were all these systems help protect and benefit from thriving natural ecosystems. MORE transformations will often require developing and governing transboundary interconnections, especially in regions where existing administrative and even national borders do not align with the extent of economic interactions, geographical settings, and ecological

systems. These transboundary interconnections could be strategically developed to overcome political obstacles and create new incentives for cooperation and regional stability. MORE systems include:

- **Food**: expand and connect local food initiatives to regional agricultural hinterlands (rural communities beyond the urban core) and sustainable food import and export systems, minimizing "food miles"; foster a distinct regional food culture and "brand" (e.g. protected designation of origin).
- **Energy**: expand and connect local energy initiatives to regional renewable energy systems such as solar fields combined with agriculture or green hydrogen projects (connected to energy generation and storage); connect region to existing natural gas and electricity grids as a temporary bridge to full transition to renewables.
- **Water**: expand and connect local water initiatives to regional water systems such as larger scale "green" desalination plants (connected to renewable energy generation and storage); align water and wastewater systems with sustainable river basin and aquifer management; plan for regional water resilience, flood and sea level rise preparedness.
- **Materials**: expand and connect local material initiatives (including construction debris and waste) into a regional circular economy for different material flows and stocks; convert global supply chains and waste flows into sustainable regional loops that minimize carbon, material, and ecological footprints.
- **Mobility**: expand and connect local urban planning initiatives to a regional mobility plan, including regional-scale TOD; develop an electric bus rapid transit system (BRT) as a priority and affordable option; promote cross-border connectivity and movement (contingent on political and security considerations).
- **Regional Economy**: plan for a circular and decarbonized economy; promote "smart specialization" and distinct regional value chains; support regional R&D clusters, universities, and technological

ecosystems; develop data and management systems for “smart regions”; support regional cooperatives and “solidarity economy”; create cross-border free trade zones and integrated labor markets.

- **Regional Ecology**: promote land and marine conservation and sustainable river basin management; protect the integrity of regional ecosystems (e.g. through ecological corridors), biodiversity hotspots, and nature reserves; recognize and sustainably draw on ecological services; eliminate regional and cross-border pollution; enable abundant access to nature to all communities in the region.
- **Regional health**: develop an extended network of hospitals and health facilities that are fairly distributed across the region (avoiding “medical deserts”) and embedded in the regional economy (e.g. supporting health-tech and biotech R&D); connect healthy living environments and healthy ecosystems to enhance overall wellbeing.

The transformation of MORE regional systems is centered on the socio-technical **regime level** of the MLP framework. This entails developing strategies to transform existing institutions, industries, and infrastructure providers, both public utilities and private corporations. It also requires that regional strategies pay close attention to issues of regulation, industrial standards, social values, and cultural norms. Government should ensure the democratic functioning and fair play of regional transformation forums, bringing all the relevant stakeholders (including local communities) to the table to jointly determine transformation pathways. The **time scale** of MORE transformations should prioritize **mid-to-long-term initiatives**, based on strategic planning and an implementation horizon of ten to twenty-five years.

PLENTY Transformations: Connect to the global scale and the landscape level

The PLENTY nexus (Planet-Peace-Prosperity) posits that the health of our planet's ecosystems is intrinsically linked to the stability and peace of human societies – and that both are the foundations of human and natural prosperity. PLENTY Transformations offer policymakers an aspirational outlook for the future of the region in its interrelations with the world at large – from international development agendas (notably the SDGs), thorough global economic and societal trends, to the planet itself and its different systems. They draw new links between environmental nexus thinking and political nexuses and apply them in tandem to situations of conflict and to processes of peacebuilding. PLENTY Transformations concern:

- **International roadmaps**: align and purposely connect the FEW+MORE transformations with the SDGs, with relevant international agreements (e.g. the Paris Agreement on climate change, **The Kunming-Montreal Global Biodiversity Framework, The UN Convention to Combat Desertification), and with the post-2030 agenda.**
- **Planetary Boundaries**: align and purposely connect the FEW+MORE transformations to the PB framework; examine potential impacts on different earth systems under stress in line with the region's specific impacts on different PBs; ensure in a scientifically verifiable way that local and regional transformations do not add to the transgression of PBs and even contribute to retreating from dangerous thresholds and tipping points.
- **Ecologies of Peace**: consider ways to transform the climate and ecological crisis from a security risk enhancer to an opportunity for regional and international cooperation and peacebuilding; promote regional climate (mitigation, adaptation, resilience) and biodiversity initiatives as way to connect national plans (e.g. NDCs) and international agreements; work towards regional peace agreements that integrate climate and ecological initiatives.

- **Prosperity**: align the FEW+MORE transformations with economic thinking that recognizes the physical finiteness and ecological limits of the planet; shift from economic models obsessed with growth (GDP) to new economic frameworks (e.g. post-growth, degrowth, sufficiency), societal arrangements, and indices that emphasize non-material prosperity, wellbeing, and happiness (e.g. Sustainable Development Index, Happy Planet Index, World Happiness Report); create long term conditions for humans and nature to flourish together.
- **Planetary health**: align transformations with the One Health and Planetary Health frameworks as unifying approaches that aim to balance and optimize the health of people, animals, plants, ecosystems, and the planet.

The transformation of PLENTY global-planetary systems engages with the socio-technical **landscape level** of the MLP framework. While landscape dynamics cannot be willfully transformed or even wholly predicted, they are critical for framing any transformational process. Technological revolutions, geopolitical tensions, wars and conflicts, global economic fluctuations, trade agreements and tariffs, international conventions, climate change and planetary ecological stressors – should be considered for their potential impact on local and regional level transformations. Equally, the regional and local levels could be considered as specific "filters" or "lenses" of landscape dynamics, reflecting and refracting their impacts in ways that can be more or less advantageous to sustainable transformations. The **time scale** of PLENTY transformations aligns with **long-term initiatives** based on a strong visioning (or "futuring") element and with a strategic planning horizon of twenty to forty years and beyond. It should set up principles that are fundamental for human-planet prosperity yet enable flexibility to the inevitably changing circumstances.

Key stages and considerations in applying Nexus Transformations

1. **Identify specific socio-technical systems** that require urgent intervention or have potential for substantial transformation.
2. **Identify nexus connections between systems** that would produce synergies and minimize tradeoffs, considering both horizontal interactions between systems at the same scale and vertical interactions across scales.
3. **Analyze the niche**, regime, and landscape dynamics that impact the interrelated systems and nexuses in view of the sustainability transitions framework and the multi-level perspective.
4. **Map the** key institutions and actors that manage and impact the different systems across scales and levels, distinguishing between those that create "lock-in" and those that could contribute to sustainable transformation.
5. **Identify entry points or impact** points that have the most potential to support sustainable nexus transformations, including specific socio-technical systems, innovations, institutions and actors, communities and localities.
6. **Set up a temporal vision of sustainable** transformation and accumulative, flexible goals, from short-range collaborative local plans for FEW transformations, through mid-range regional outline plans for MORE transformations, to long-range scenarios and strategic plans for PLENTY transformations.

Future Directions for Applying Nexus Transformations for Sustainability and Peace

The Nexus Transformations framework can help policymakers draw critical connections between FEW (Food, Energy, and Water) systems at local scale, MORE (Mobility, Regional Economic and Ecological) systems at regional scale, and PLENTY systems for living within planetary boundaries in prosperity and peace. It is presented as a systematic way to think through entrenched and disadvantageous socio-technical systems and transform them into much more sustainable and potentially peaceful constellations. It calls on policymakers to address sustainable development challenges and regional conflicts, including post-conflict reconstruction, as opportunities for multi-level and multi-scale transformation.

The framework is open-ended enough to be potentially applied in different parts of the world, in both Global North and Global South contexts, and in different geographical and geopolitical settings. However, it is important to note that the paper was originally conceived with a specific region and context in mind. Namely, **the cross-border Gaza region**, encompassing both the Palestinian Gaza Strip and the Israeli Gaza "Envelope", following the shocking October 7th attack by Hamas, the devastating Gaza War that ensued, and currently, the fragile ceasefire, which could hopefully lead to a wider regional process. The framework offers a roadmap for transitioning away from the decades-long **unsustainable border and control regime** between Israel and Gaza, that has led to so many causalities and losses on both sides, in addition to immense economic costs and environmental damages. It can help identify different lock-ins and obstacles to transformation that might not be seen through conventional conflict management frameworks. More importantly, it can point at potential leverages and effective interventions – between niche innovations, regime destabilization, landscape pressures, and across local to planetary scales – towards a more stable, sustainable, and peaceful region.

The hope of this paper is to introduce Nexus Transformations as a useful framework that could be applied to the Gaza region; the wider region encompassing Israel, the Palestinian territories, and neighboring states such as Egypt and Jordan as direct partners in the envisaged transformations; and the wider Middle East region and the international community. The overall trajectory proposed here – moving from FEW systems through MORE synergies to PLENTY opportunities – would match the scale of the regional and global challenges at hand. How can we transform the immense and fraught task of rebuilding a war-devastated Gaza into a launchpad for a regional process of peacemaking? And how do we integrate this with multi-scale sustainability and resilience projects to address the climate and ecological crisis? The Nexus Transformations framework provides a method to explore ways of aligning the Gaza region, Israel, Palestine, and the Middle East with necessary socio-technical, political, and ecological transitions in the years and decades ahead.

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