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Living Lab” for Sustainability: Embedding the Spirit of Ownership and Proactivity with Disaster Resilient Supply Chain for Water-Waste-Energy Interrelatedness

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Abstract: The paper posits the innovative and dynamic proposition on "Living Labs" to repurpose disaster aligned supply chains' co-creation of water – waste – energy (W-W-E) interrelatedness for disaster resilience. This paper aims to repurpose the co-creation of disaster aligned supply chains through the "Living Labs" approach and achieve maneuverability through geospatially-enabled visual dashboards. Implementation of W-W-E aligned disaster-resilient supply chain faces formidable challenges due to exacerbation of waste, disaster debris, industrial contamination, energy-emitted carbon, and agricultural leftovers. Integrative W-W-E embeds a spirit of ownership. New dominant logic on shared value embeds the spirit of ownership to technology, innovation, and disaster resilience of W-W-E infrastructure. The triangulation method is used based on desk-top research: (i) from different evaluators, such as classical literature, (ii) different perspectives of theory from contemporary literature, (iii) from different results, such as current issues researched from secondary sources. The analysis is based on directionality and interrelatedness. Waste, as such, is shunned, ignored, and treated with apathy. The economics and business metrics often relegate waste to low priority levels. The paper promises a favorable outcome in the disaster-resilient supply chain as it deploys geospatial possibilities as visual dashboards to assess the supply chain trajectory to water, waste, and energy performance. Some takeaways are variation and dynamic intermittency, climate sensitivity, and disaster vulnerability. The linkage of W-W-E_Own equals "We Own" unfurls innovation, novelty and embeds the spirit of ownership and proactivity. Transfiguration is evidenced in habitat-centric innovation, climate-proof financing, and public-private-people partnership with good governance for sustainability. The visual dashboard approach on W-W-E_Own would enhance implementability regarding the W-W-E infrastructure's recyclability, reusability, and re-designability.

Keywords: Living Labs, water – waste – energy ownership, sustainability, geospatial statistics, disaster.

可持續發展的“生活實驗室”：將主人翁精神和積極進取精神嵌入抗災供應鏈中，實現水-廢物-能源相互關聯

摘要：該論文提出了“生活實驗室”的創新和動態命題，以重新利用與災害相關的供應鏈共同創造的水 - 廢物 - 能源相互關聯性，以實現抗災能力。本文旨在通過“生活實驗室”方法重新調整災難協調供應鏈的共同創建，並通過支持地理空間的可視化儀表板實現可操作性。由於廢物、災難碎片、工業污染、能源排放的碳和農業剩餘物的加劇，水 - 廢物 - 能源協調的抗災供應鏈的實施面臨著巨大的挑戰。綜合水 - 廢物 - 能源嵌入了主人翁精神。共享價值的新主導邏輯將所有權精神嵌入到水 - 廢物 - 能源基礎設施的技術、創新和災難恢復中。三角測量法是基於桌面研究使用的：(i) 來自不同的評估者，例如古典文學，(ii) 來自當代文學的不同理論視角，(iii) 來自不同的結果，例如從二手資料研究的當前問題。該分析基於方向性和相互關聯性。因此，浪費被迴避、忽視和冷漠對待。經濟和商業指標通常將浪費歸為低優先級。該論文承諾在抗災供應鏈中取得有利的結果，因為它將地理空間可能性部署為可視化

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儀表板，以評估供應鏈對水、廢物和能源績效的軌跡。一些要點是變化和動態間歇性、氣候敏感性和災害脆弱性。水 - 廢物 - 能源_自己的的聯繫等於“我們擁有”，展現了創新、新穎，並嵌入了主人翁精神和積極進取的精神。轉變體現在以棲息地為中心的創新、適應氣候變化的融資以及公私伙伴關係以及良好的可持續發展治理。水 - 廢物 - 能源_自己的上的可視化儀表板方法將增強水 - 廢物 - 能源基礎設施的可回收性、可重用性和可重新設計性的可實施性。

关键词：生活實驗室、水 - 廢物 - 能源所有權、可持續性、地理空間統計、災難。

1. Introduction

W-W-E_Own personifies Waste – Water – Energy Ownership. W-W-E_Own also portrays "We Own." The antecedent punctuates the credo of freedom with responsibility. The value proposition here is the proactive spirit of ownership. This paper brings the sustainability of core basics, such as W-W-E, into implementing sustainable development goals. In order to implement the climate-financed, disaster-resilient, community-centric energy architecture, one needs ownership. A 'grass-roots' proactive spirit is hugely interdependent on water and waste. For a sustained results-based dynamic performance monitoring of W-W-E_Own, a mesh of economic – societal – environmental sustainability conscience is necessary. The mere fear of punishment, the rule of law, is highly unsustainable in a fiercely competitive, economically driven habitat. Instead, good, ethical leadership creates the ambiance of 'feel good ownership.'

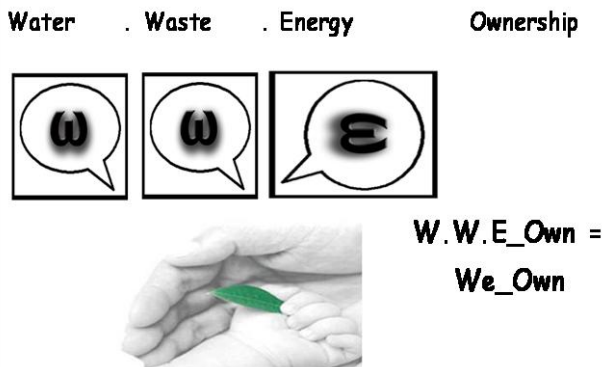


Fig. 1 Supply chain & dashboard of W-W-E_Own

W-W-E_Own for Sustainability signifies W-W-E_ownership (Fig. 1). This paper emphasizes three tenets, the inter-relatedness through visual dashboards that can embed "ownership." Inter-relatedness among W-W-E_Own = "We Own" configures technology, innovation, and adaptivity of infrastructure. W-W-E_Own also is "We Own," wherein the spirit of ownership proactively drives implementability and sustainability of any defined locale or habitat. "We Own," and W-W-E_Own created shared value among policymakers, processors, micro/small/medium

entrepreneurs (MSMEs), financiers, insurers, and most significantly, community ownership. The key intent of this paper is to verify to what extent W-W-E_Own is equal to "We Own" based on visual dashboards deploying Geo-spatial statistics. Exacerbating W-W-E crises across global – regional – local habitats pose the research gap this paper addresses. Issues such as variation and dynamic intermittency, climate sensitivity, disaster vulnerability visualize as a habitat fabric. The methodology adopted here is the creation of the habitat boundary and incorporating layers of color-coded, geo-pugged variants of W-W-E resources.

2. Literature Review

Resilient supply chains need to be proactive and better manage W-W-E disequilibrium as inland network issues. Supply chains configured as "living labs" are known to be doing good to generate value for society. Monitoring the disaster resilience is done with geospatial technologies such as geospatial statistics visually scrutinizing habitats through Landscape Information Models [1].

This paper draws inspiration from this simple definition of Sustainability, which led to the initiation of this research project on inter-relatedness of (a) Water (b) Waste (c) Energy cross-tabulated with (i) Policy (ii) Process (iii) Communications assessed concerning (a) Societal Cost of Capital (b) Environmental Cost of Capital (c) Economic Value Added [4, 23, 25]. W-W-E shared value is a key to societal, environmental, economic well-being [11]. Geospatial Statistics portrays Sustainable habitats.

Implementation of W-W-E aligned sustainable infrastructure face formidable challenges due to exacerbation of waste, disaster debris, industrial contamination, energy-emitted carbon, and agricultural leftovers [9]. Climate change, global warming, waste proliferation, and air, water quality deterioration impact [17]. The situation is hugely inter-dependent on water and waste. W-W-E_Own endeavors to embed the spirit of ownership to technology, innovation, and disaster resilience of W-W-E infrastructure. W-W-E_Own = W-W-E] and "We Own." Geospatial analysis can portray

layer by layer, color-coded temporal and spatial variation of for a defined habitat and superimpose policy - processors - community issues [21, 26]. For results-based dynamic performance monitoring of W-W-E_Own, a clear demarcation of the contours of the habitat is necessary. W-W-E_Own aims implementability of the urbanized W-W-E inter-linked conduits as valuable sustainability lessons inferred from the analysis of the evolution of how W-W-E systems evolved in the past deploying Exploratory Spatial Data Analysis. The isolated data sets conveniently interpolate with the W-W-E_Own = "We Own" model (enumerated in the next section).

3. Materials and Methods

3.1. Data Triangulation

Analysis and synthesis of the extant literature on pandemic and disaster perspectives provide materiality to this paper. Supply chain resilience is manifested as spatial scales, and scalable to the overall logistics network provides organic dynamism [16]. Secondary data triangulation sources devise the methods. Triangulation assures validity given the multiple sources and assessment of the effectiveness of green practices in managing two supply chains [18]. The triangulation approach offers robust research based on secondary sources. Triangulation is based on desk-top research: (i) from different evaluators, such as classical literature, (ii) different perspectives of theory from contemporary literature, (iii) from different results, such as current issues (relevant to the topic) researched from secondary sources. Three nodes of triangulation, namely, (a) focused literature review outcome evolving from the conceptual model, (b) case lets on geospatial applications (c) symposium outcomes from multilateral developmental institutions, (a) focused literature review outcome evolving from the conceptual model. The methodology emanates from the conceptual model elements.

3.2. Conceptual Model

The conceptual model posited is an interpolation of (i) W-W-E_Own and "We Own" stakeholders. W-W-E_Own aligns W-W-E to foster (i) innovation that is habitat-centric, (ii) financing that is climate-proof, and (iii) public-private-people partnership that has good governance for sustainability (Fig. 2). The outcome is Sustainable Business Value creation, represented by W-W-E_Ownership cross-tabulated with "We Own" stakeholders, policymakers, processors, community (Fig. 2) depicts a convincing case for Exploratory

Spatial Data Analysis, interpolation methods with regression kriging.

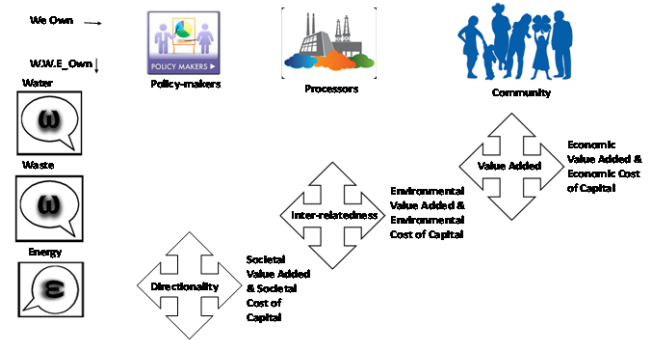


Fig. 2 The equilibrium of policy – processors – community vis-à-vis contaminants in W-W-E systems to supply chain

The integrated impact modeling framework (IIMF) tracks and quantifies climate consequences and socio-economic transformations concerning habitat usage and water characteristics onto policy-economy-climate-agriculture-water interfaces [26]. Geo-spatial Statistics can portray layer by layer, color-coded temporal and spatial variation of W-W-E for a defined habitat and superimpose policy - processors - community issues.

Conceptual model element (i): fostering habitat-centric innovation; geospatial application with triangulation case studies on green facility management and creating shared value [13]; constrained triangulation for guaranteed-quality triangular meshes [8]; maximal Poisson-disk sampling for variable resolution conforming Delaunay mesh generation: applications for three-dimensional discrete fracture networks and the surrounding volume [8].

Conceptual model element (ii): climate-proof financing: public-private-people partnership case lets good governance for sustainability. Instances are good governance performance outcomes for terrestrial protection.

Conceptual model element (iii): Sustainable Business Value creation represented by (a) societal value added, (b) environmental value added, (c) economic value added for high-income, knowledge-based, and sustainable economies.

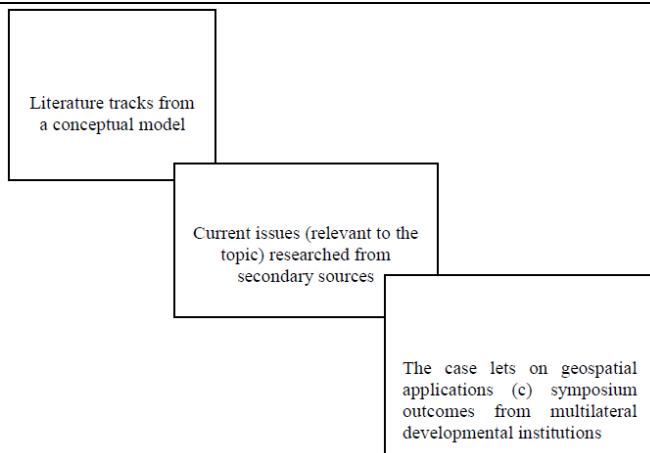


Fig. 3 Flow diagram on the triangulation methodology

3.3. Southern California: Identify and Prioritize Neighborhood-Level Environmental Justice Drivers

Southern California is characterized by increased number of natural disasters, fires, floods, and earthquakes, compared to any other state, with than any other state in the US. Texas ranks second, Oklahoma ranks third at 173. California Counties with the highest number of disasters appear along the western coast and south. Fire total 73% of the total disasters. Floods total nearly 12%, earthquakes, and severe storms total 4% each, and the remaining declarations, levee break, freezing, coastal storms, drought, fishing losses, hurricanes all total nearly 5% collectively in Kyoto, Manila, Singapore, Beijing, Delhi and currently at Khon Kaen, Thailand.

3.4. Symposium Outcomes from Multilateral Developmental Institutions

Southeast Asia Development Solutions Knowledge and Innovation Platform (SEADS) are seeds of growth for member countries of the Asian Development Bank, UNESCAP. In tandem with our partner program, Southeast Asia Development Symposium, we aim to crystallize thinking on critical development issues

This paper reviews the habitat-specific inter-relatedness of water-waste energy in some diverse yet related habitats at the conceptual level. These locations were selected to align with the author's hands-on intermittent project work during 2004-2021, supplemented by desk-top cases analyzed using Community Analyst Online, Business Analyst Online, and introductory Geospatial Statistics. Published data from multilateral developmental institutions, respective national governments, are sampled for the Spatio-temporal variance of W-W-E correlated with policy – processors – community. This approach corroborates with geospatial-statistical analysis for data-sets sourced from diverse habitats [2], top kriging interpolation [15], integrated modeling framework for climate ramifications on socio-environmental-economic issues

concerning land use and water quality [26].

The visual dashboard emanating from the number of 'W-W-E_Own' clusters gets accomplished with the statistical average distribution norms [5, 6]. The diverse yet inter-related parameters, from technology innovations, process adaptations, waste recyclability to emotive issues, such as ownership, entrepreneurial spirit, co-creation of societal, environmental, and economic value, and comprehensible, are color-coded clusters of layers of subgroups. In order to kindle the "We Own" potential, the Vietnam W-W-E_Own habitats are color-coded for predictive interpolation using regression kriging.

4. Results and Discussion

4.1. Directionality

Waste, as such, is shunned, ignored, and treated with apathy. The economics and business metrics often relegate waste to low priority levels. Footprint impacts ecology, the incessant proliferation of bottom-line focused growth and consumption splurge has exponentially increased waste generation. The critical issue is to strike a balance of waste optimized growth and a benign ecology lifestyle. W-W-E_Own-aligned habitat infrastructure comprises water-led parameters, such as quality, water quantity, contaminants, and water salinity. In the generic sense, waste is a by-product of water and energy processes, "ownership" among policymakers – processors – communities. Transforming processes, services, behaviors to (i) energy minus carbon way of life, (ii) water quality and security for rurbanization that blends rural and urban habitats, (iii) results-based governance with the proactive spirit of ownership, (iv) climate-proof financing for air quality, land rejuvenation, (v) disaster-resilient quality of growth will increase the Ecology-friendly lifestyle in 1.5 timed.

The Geospatial Statistics for W-W-E_Own for Sustainability One key learning from the results of this research is directionality. The inter-relatedness of W-W-E has a directional element, and the inter-relatedness leads to value creation. The food-water-energy nexus model utilizes positive-aspirational, unidirectional vectors. However, this research posits that there must be sets of bi-directional vectors for any cycle to be sustainable. Water, energy, and food are all positive-aspirational; while water and energy are buoyant, waste is harmful, creating a sustainable cycle. Directionality is a significant attribute here as it adds sustainability dynamics that propel the diffusion of innovation.

4.2. Interrelatedness

The author concedes lack of depth as a limitation

for this paper, as finding the based on secondary data and reliance on the innovative intent of W-W-E_Own = "We Own." However, the immense maneuverability of the visual dashboard powered by geospatial statistics underscores the inter-relatedness of the three sustainability parameters – W-W-E. The research intent of this paper is to assess the potential of geospatial statistics to bring out the inter-relatedness of W-W-E for a defined habitat. Regression kriging could be possible to deploy to identify locales with a higher degree of "We Own" in terms of (i) innovation that is habitat-centric, (ii) financing that is climate-proof, and (iii) public-private-people partnership that has good governance for sustainability.

4.3. Main Findings

Table 1 enumerates relevant and extant comparisons with other studies. The major findings are: (i) The impactful takeaways are directionality & inter-relatedness that configure disaster-resilient supply chains. The directional inter-relation necessary for the W-W-E sustainability triad adds innovative and dynamic characteristics; (ii) "Living Labs" approach helps to repurpose the co-creation of disaster aligned supply chains; (iii) A key outcome is maneuverability through visual dashboards enabled geospatially; (iv) The paper promises a favorable outcome in the disaster-resilient supply chain as it deploys geospatial possibilities as visual dashboards to assess the supply chain trajectory to water, waste, and energy performance; (v) Issues such as variation and dynamic intermittency, climate sensitivity, disaster vulnerability are some of the take-aways [26].

Table 1 Comparison with other studies

Inter-relatedness	Directionality	Sustainability triad
Creating shared value on water & energy [14]	Value capital by appropriate shared values, gather-integrate-communicate [13]	Triad of social responsibility [19]
Supply chain configuration of sustainable aviation fuel [11]	Minimum constraints conform to the triangulation method [8]	Green practices in supply chains [18]

4.4. Implication and Explanation of Findings

The implication of this research resonates with sustainable supply chain value creation. The cases in Khon Kaen, Thailand, that act as the hub for Cambodia – Laos – Myanmar – Vietnam are attributable largely to W-W-E_Own habitat that is assessed with the directionality and inter-relatedness outcomes.

5. Conclusion

This visual dashboard approach on W-W-E_Own would enhance implementability regarding recyclability, reusability, and re-designability of the W-W-E infrastructure. The explosive growth in debris and waste reutilized to reorient our "We Own" attitude. W-W-E shared value is key to societal, environmental, economic well-being [11]. Variograms with kriging regression tools can overlay the water, waste, energy map in the defined habitat. Superimposed on this is Sustainable Business Value creation represented by (a) Societal Value Added, (b) Environmental Value Added, (c) Economic Value Added. Implementation of W-W-E-aligned sustainable infrastructure faces formidable challenges due to exacerbation of waste, disaster debris, industrial contamination, energy-emitted carbon, and agricultural leftovers [9]. Benefits would accrue to public health [10], leading to the transition to clean energy [7]. The findings would encourage recommendations on stand-alone self-sustainable W-W-E inter-linked infrastructure [12]. Predictive crop choice [22], efficient farming practices [3], reliable irrigation powered by low-carbon energy systems [20] could configure the spirit of "ownership" [24], among policymakers, processors, and community.

6. Strengths and Limitations

Water-led parameters augment by energy-security issue-drivers, namely, disaster preparedness of energy infrastructure, carbon-intensity of energy facilities, and quantum of water needed for energy generation. However, waste to energy, waste or contamination-controlled water, and waste recyclability add the unsustainable element of the W-W-E aligned system. Khon Kaen as a 'rurban' hub for Cambodia – Laos – Myanmar – Vietnam to create buy-in among policymakers – processors – community.

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