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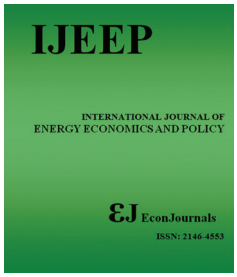

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Low Carbon Energy Symbiosis for Sustainability: Review of Shared Value-based Policy Metabolism to Enhance the Implementability of the Sustainable Development Goals in Asia

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ABSTRACT

The low energy symbiosis for development metabolism is reviewed for its potential to enhance the implementability of the Sustainable Development Goals. Metabolism is the carrying capacity limit of rural-urban or rurban eco-systems, that is self-replenishable through endurability drawn from metabolic processes. This research paper probes the symbiotic common-ground for sustainability for the shared value-based policy metabolism, deployed on emerging Asia. The unified motivation would be to co-implement quantum innovations and adaptations on governance mechanisms to usher pathways on symbiosis for sustainability. Intended outcomes are budgeting social metabolism, symbiotic scale-up that would attain efficiency and practicality. An important destination is trust renaissance developed on common-ground challenges facing the aspirational low carbon Energy-Asia. This conceptual paper posits a dual aimed methodology. (i) Where low carbon Energy-Asia would like to be for symbiotic common-ground for sustainability through trust renaissance and, (ii) what shared value policy trajectory should be plugged-in for healthy metabolism into their symbiotic development strategy. The unified motivation would be to co-implement quantum innovations and adaptations on governance mechanisms to usher pathways on symbiosis for sustainability.

Keywords: Symbiosis for Sustainability, Low Carbon Energy-Asia, Shared Value-based Policy Metabolism, Trust Renaissance, Water – Waste – Energy Metabolism
JEL Classifications: Q01, O35, R580

1. THE LOW CARBON ENERGY SYMBIOSIS FOR SUSTAINABILITY RATIONALE

The low carbon energy symbiosis for sustainability metabolism has potential to be positioned as energy policy integrator in Asia. This paper endeavours to review this proposition. Metabolism is the carrying capacity limit of rural-urban or rurban eco-systems, that is self-replenishable through endurability drawn from prospective eco-processes (Dakhia and Berezowska-Azzag, 2010). When metabolism links symbiosis and sustainability, the combination serves as a determiner of continuous environmental performance (Lyakurwa, 2014). Catastrophes, natural disasters and extreme climate occurrences in the Asia heartland and both in China - India along with others are impacted. This necessitated conceptual shifts for re-evaluation. Metabolism in the certain context draw on social change to consider doing good for people by co-habiting technology and nature and were the guiding tenets for home-for-all project (Tamari, 2014). This research paper probes the symbiotic common-ground for sustainability for the shared value based policy metabolism (Leonard, 2007). The unified motivation say between India – China, along with others in Asia, would be to co-implement quantum innovations and adaptations on governance mechanisms to usher pathways on symbiosis for sustainability (Martinez-Alier, 2007). Metabolism

is the entropy for socio-economic sustenance in processes, transit and infrastructure services (Pauliuk and Hertwich, 2015). Social metabolism is the quantum of societal material and energy for robust continuity (Ayres and Kneese, 1969). Extrapolating environmental metabolism to span pan-Asian social fabric can create direct and indirect energy and emissions reduction in key sectors, transportation, buildings, and industry (Kovacic and Giampietro, 2017). Budgeting social metabolism can decouple energy dependence and moderate lifestyle (Pauliuk and Müller, 2014). Low-Carbon energy sustainability need is challenging their respective agrarian and urban demand for resources (Ayres and Simonis, 1994). The common ground for sustainability symbiosis depends on technology-adapted, entrepreneurial innovation-driven and proactive behavioural change approaches (Dentchev et al., 2018). Evidences indicate renewable options from wind power in China and India reaching utility-scale (Lewis, 2007).

It is without question that shared value-based developmental outcomes outweigh any intricacies between the two aspirants for global future. Both the countries have competence in indigenous innovation, skilled manpower, and are both impacted by climate change, and disaster vulnerability (Renner, 2007). The competing exemplars are worthy to of symbiotic paradigms given the value creation in the sustainable term with finite sharing of natural resources (Ozturk and Acaravci, 2010). Growing security concerns eat-up valuable resources for defence-spend. Instead, shared value-based sustainable development on the symbiotic architecture would be a win-win for sovereign nations in Asia (Zhang et al., 2017; Ramaswamy and Gouillart, 2010). Scale-up at country level compared to symbiotic scale-up for sustainability, would attain efficiency and practicality (Tiwari, 2012). Low-carbon smart cities and robust rural initiatives have multiple commonality that foster willingness to work in consensus (Reed et al., 2016). The visionary leadership of the two countries has all the momentum for industriousness (Cabrera and Unruh, 2012). Defence and strategic trust could germinate on confidence building initiatives on ecology, economy and empathy based symbiotic sensitivity (Flint, 2012). Based on this rationale the paper embarks on literature review based on the future symbiotic trajectory and what path should be followed to incorporate a self-replenishing metabolism into the symbiotic development strategy for smart – cities, robust - rural shared value based on circular economy concept.

2. LITERATURE REVIEW

Where Energy-parched Asia, such as, China – India would like to be? Symbiotic common-ground for sustainability through trust renaissance.

Trust renaissance brings together the motivation to assess the symbiotic common-ground for sustainability (Diekhöner, 2017; Rauf et al., 2018). Trust at the community-level emanates from self-regulation and leads to reinterpretation of the mutual strengths between China – India (Schepel, 2005). Given the heritage and potential of the two most populous entities, energy good-governance architecture is to be deployed with wisdom (Mathur et al., 2001). That resolves and pre-empts issues on partnered energy sector related greenhouse gas emission reduction (Kroeze et al., 2004) and contentions (Emmott, 2009; Srinivasan, 2006). Sustained benefits from symbiosis and metabolism accrue from beyond-compliance policy interventions (Cohen-Rosenthal and Musnikow, 2017; Singh et al., 2017; Emmott, 2009; Vandenbergh, 2017).

There are issues to integrate the inherent multiple ethnicity leading to a phenomenon of super diversity (Vertovec, 2007). The gender inequity issue needs balancing the social capital distribution in the process of development. Gender issues have pertinent voices for energy-resurgent Asia's market-reliant view for the expansion of human freedom and capabilities (Sen, 1997). The vast low-carbon energy market can serve as the basic enabler to promote symbiosis for sustainability (Nolan, 2005). Entrepreneurial ecosystems evolve as connective networks to bridge the boundary-zone differences (Neumeyer et al., 2018). Bootstrap panel co-integration share positivity on the international landscape issues (Arouri and Rault, 2012). This takes us to the issue of how healthy metabolism could be plugged-into the symbiotic development strategy.

What trajectory would Low Carbon Energy Asia likely to follow? Plugging-in healthy metabolism into symbiotic development strategy.

Healthy metabolism reverses migration, augments symbiosis through the self-sufficiency and proximity principle with community guarantee for the maximal safeguard of environment and health (Mamì and Mormino, 2014). Metabolism with sense of proactive participation for low carbon energy can be configured as a combination of urban-led rural-resurgence (UN-Habitat, 2016). It is customary to observe the foregrounding of the city as the epicenter of investment driving development (Hutton, 2004). This affects rural prospects as they tend to be relegated (Fan, 2003). The expanse of the geography has provincial inequity interspersed with poverty-traps (Jalan and Ravallion, 2002). Certain pockets receive urban investment support are better placed than rural centers. This results in detrimental effects with respect to poverty (Onyebueke and Hope, 2011). Healthy metabolism has the elemental ability to co-grow through rural - urban symbiosis (Gandy, 2004).

The metabolism spurs public-private-community financing in the entrepreneurial mode through bio-bank governance (Gottweis and Lauss, 2012). This symbiotic developmental strategy could convince low-carbon energy policy planners to divest investments from urban-only to rurban-only formats. A direct benefit that would accrue due to this symbiotic sustainability is check on cross-border migration (Li and Wei, 2011) that has fall-outs on respective country's assimilation for culture and adaptation for locale specific security (Nee and Alba, 2012). The issue of transforming migration to symbiotic participation is evocative creator of opportunity for sustained shared-value creation (Autio and Thomas, 2014). The contentious issue here is that mere migration can be without consideration for the environmental well-being of the host country, as is evidenced by the over-crowded, unhygienic urban slums in developing countries. This paper posits that symbiotic participation can reverse migration (Ford and Hill, 1971) and create a healthy metabolism for both countries such as, China – India. In the sustainable time-term, it makes sense to usher symbiotic growth as that creates sense of shared value (Burnley, 2007). The

shared value can manifest as green services in a public-private coupled domain (Morse, 2010). This can enhance eco-efficiency (Akinwale, 2018). The value of green services and technologies and innovative applications of green technologies provide good rationale for financing mainly on recycling and development of brownfield regeneration (Piacentini, 2012).

The two-pronged literature review led to two methodological propositions, the destination and the path. The former is addressed as low carbon Energy Asia as a combined eco-habitat. This is viewed as a geographically meshed common-ground to seek feasible options to address imbalance of skills, resources and processes. The next pathway need is to identify metabolic priorities or steps for shared value based policy metabolism development archetypes.

3. METHODOLOGY FOR ATTAINING METABOLISM TO NOURISH THE LOW CARBON ENERGY ASIA SYMBIOTIC SUSTAINABILITY CONSTRUCT

Geographically open cascades link segments across countries thereby sharing resource consumption (Geng et al., 2013). The methodology adopted for this conceptual analysis is developing four steady state archetypes (described below), that are based on local aggregation with externalities (Bocken et al., 2014). As a cross-check to the viability of the methodology, issues such as, reversing migration for sustainable symbiosis is assessed with literature support. The goal is to attain the right kind of metabolism that would be self-replenishable, that would sustain the carrying capacity for urban-rural aligned symbiotic format. This section focuses on the methodology to do that. The literature review serves the following steady state archetypes for determinative action with respect to symbiotic sustainability with metabolism for continuity:

(a) Continuous sustainability pursuit through harnessing water along with energy and waste.
(b) Common ground for future-proofing low carbon Energy Asia's eco-efficiency, rural – urban or rurban equity.
(c) Metabolism assists assimilation of the sustainability attained through symbiosis of shared approach on water – waste – energy inter-dependence to re-invigorate smart urban with robust rural.
(d) Reversal of migration in favor of entrepreneurial eco-systems based on water, energy, waste inter-relatedness for carbon-optimality, climate-benign future with reconfigured iron & steel, cement, eco-agriculture (Fan, 2003).

Each of the perspectives are elaborated in the following sections to configure the road-map for shared value sustainability initiative that would be ascertained as. (i) Where they are now represented as symbiotic needm, (ii) where they would like to be charted by the metabolism that would nourish the sustainability.

3.1. Assessing Potential Pathways for Continuous Sustainability Pursuit through Harnessing Water along with Energy and Waste

The low-carbon Energy Asia's symbiosis on the management of waste can create newer avenues of recruitment while creating opportunities for re-deployment for displaced or migrant population. The eco symbiosis can cover eco-industrial development as well as robust rural financing (Sertyesilisik and Sertyesilisik, 2016). Financiers would also be interested in investing in education and training relevant to the transition towards greener production and waste recycling modes. This situation would significantly enhance the financing appetite for investors who address Asia's economic shared value holistically. The vast and quality aspiring consumer bases of emerging Asia's benefit from shared value arising from the rising demand for low-carbon services. Blending the urban with rural can consolidate the domain and widen the reach by comprehensively covering a spectrum of sectors (Hassan and Islam 2016). There is growing evidence of results-based financiers and insurers investing across Asia, rather than in individual countries, for better risk spread (Nanto, 2011; Gray, 2008; and Moody-Stuart, 2006). Literature indicates that destination of foreign direct investment is correlated to high levels of gross domestic product, high domestic savings, large foreign reserves and export orientation (Bano and Tabbada, 2015). Quantum of inflows may vary with the level of development. Given the sheer developmental aspiration of Asia's shared value, a transform from inwardly directed to symbiotic shared value-oriented, will alter the investment effectiveness. This assessment would serve as a significant methodological step needed for policy makers, private financiers, processors and peoples to develop symbiotic combination to metabolize their joint quest water – waste – energy integration as the basis for a low-carbon and circular economy. The essential feature here is the continuous pursuit that would ensure future-proofing, as discussed in the next section.

3.2. Gauging the Common Ground for Future-proofing Low-carbon Eco-efficiency, Rural – Urban or Rurban Equity

Measures to address the metabolic shortfall with respect to sustainability would make the pitch for the low carbon Asia-common ground search. The world acknowledges that rapid growth leveraged by economic development has precipitated severe issues with respect to disaster vulnerability, carbon-effusion and waste proliferation (Dakhia and Berezowska-Azzag, 2010). It is well endorsed that to create shared value across Asia, there needs to be spectacular transformation in terms of rapid urbanization. However, eco-efficiency and rural – urban or rurban equity is necessary to check the large movement of people migration due to the structural shift towards industrialization. In the past, majority of the Asia's population chose rural habitats with primary vocation as agriculture. Agriculture used to account for about a third of their respective gross domestic product. The scenario tilted drastically with Asia's urbanization rate exceeding 50% while agriculture contracting, mainly due to lack of skilled farmers. For instance, both China – India are voracious export seekers. To fuel this export as well as spur domestic goods appetite, emphasis tilted to industry, process innovation, supply chain and productivity.

The environmentally and societally unwelcome fallout is the metabolic shortfall arising out of economic emphasis. In quantitative terms, China – India is jointly responsible for a quarter of world's energy consumption, half of global cement consumption and forty percent of iron ore consumption. The rapid industrialization has exerted increasing stress on natural

resources including water and energy (Lyakurwa, 2014). Trust renaissance is a good avenue to harness the metabolic shortfall (Diekhöner, 2017). The common ground emanates from trust. Trust at the community-level emanates from self-regulation and leads to reinterpretation of the mutual strengths between China – India. For instance, there is growing realization in China – India financiers that energy and resource intensive growth strategy need to be re-oriented to be sustainable. Symbiotic instance of China – India jointly dealing with issues on water pollution and energy availability, makes the case for common ground for water, waste and energy resources. However, the key is ethical apportioning with a view to common shared well-being. Such trust-led common positions catalyze the metabolic intent, as is discussed next.

3.3. Metabolism Assists Assimilation of the Sustainability Attained through Symbiosis of Shared Approach on Water – Waste – Energy Inter-dependence to Re-invigorate Smart Urban with Robust Rural

Shared value Asia has ambitious aspirations on smart ecology-aligned cities. This needs enormous quantities of water and energy and would generate colossal waste. According to International Energy Agency, majority of Asia account for nearly 50% of energy worldwide within the next 5 years. This fact has implications on water – energy availability and the simultaneous treatment of waste. Metabolism enhances the carrying capacity and improves the self-replenishment ability. Metabolism assists the process of assimilation of the mutual trust that enables water – waste – energy shared value. This situation fosters symbiosis for the pursuit of shared value. This is expected to enhance the shared bargain-ability of the two joint entities in energy – water – waste negotiations. The leverage can be favorably deployed to hedge against rising energy and other resource prices. Though competition may continue to exist, as is natural in business, symbiosis and metabolism would immune and strengthen shared value sustainability position as it needs low-carbon and circular economy. Low-carbon and circular economy is pivoted on waste management. To maintain the consistent economic growth balanced with environmental and societal value added, the resources of energy and water need to be enhance. This is possible with waste utilization, as both water free of contamination or waste and energy devoid of carbon, also considered as waste, need proper alignment. There is strong interdependence between water and energy as most of the energy production processes require a significant amount of water and the treatment and transfer of water requires energy usually in the form electricity. The energy production technologies adopted determines the amount of water required to produce a given quantum of energy. Similarly, the availability and allocation of fresh water resources determine the amount of water that can be used for energy production. Waste is a common determiner of clean water and clean energy.

3.4. Reversal of Migration in Favor of Entrepreneurial Eco-systems Based on Water, Energy, Waste Inter-relatedness for Carbon-optimality, Climate-benign Future with Reconfigured iron and Steel, Cement, Eco-agriculture

Asia's migration transition has been enabled by entrepreneurial initiatives at borders. Symbiosis can spawn social control and opens avenues for reversal of migration, due to opportunities on carbon-optimization, climate-friendly innovations, recasting of iron and steel, cement and eco-agriculture. Reverse migration enhances their formalized status in a robust rural and smart urban symbiotic format. These perspectives could also be applied to gender inequity situations. The shared value policy metabolism assimilates respective alignable socio cultural norms. This enables gender mobility (Fan, 2003). This instance confirms the water, energy and waste inter-relatedness determine the smart-city and robust – rural alignment. For low carbon Asia self-renewal, concepts such as, symbiosis and metabolism, become inseparable. Water and energy usage could be resource-efficient, locale-specific, and innovatively parsimonious. Innovation, balance and proactive stakeholder participation on a circular economy model is at the core. Metabolism renders an assimilationist notion and symbiosis instils a sense of togetherness to share. Shared value Asia aim to carve-out an optimal consensus for positive momentum for the continuance of bilaterally beneficial cooperation.

Establishing mutually symbiotic linkages would ameliorate differences, to portray to the world how symbiosis could lead to sustainability between to power centers. Confluence and assimilation of the heritage and diversity evolved through the ages, have embellished Asia's socio-cultural fabric. There is floating population of migrant personnel, traders who infiltrate urban centers, thereby turning them to be villages in the city. Emerging Asia face this situation of rural to urban influx, that deteriorate the proper environmental living-space inhabitants so direly need. Additionally, Asia suffer from deterioration of habitat attributable to unsustainable processes and negative environmental footprint. Migrants have diverse cultural, social traits have seen a changing direction of the flow (Castles et al., 2013). With respect to water usage, there is locational or spatial variance, given the vastness of Asia, the distribution of water is not in sync with the distribution of smart urban and robust rural locales. We now proceed to discuss how the steady state archetypes can make the pitch for shared value-based energy policy symbiosis for sustainability through metabolism.

4. DISCUSSION: SYMBIOTIC SUSTAINABILITY CAN AUGMENT THE WATER – WASTE – ENERGY METABOLISM

Inter-relatedness of energy linked with metabolic growth essentially enhance factors, such as, water – waste – energy. Water – waste – energy stress is exacerbating across developing Asia with hike in non-agricultural water – energy demand and proliferation of non-agricultural waste, creating stress on societal equity (Cai, 2008). This exacerbates water – waste – energy quality due to improper metabolic time to match the demand for urban-led growth, impeding rural robustness. Symbiosis is a natural process that curb environmental damage, and improve quality of livelihood. The process to symbiotic sustainability with metabolism is evinced from the steady state archetypes, pathways, common ground, assimilation and reversal. Asia's low carbon pathways with respect to water – waste – energy are redistribution, rural – urban symbiotic reforms, so that the robust

rural stakeholders' can save water, reallocate waste recycling, and propel low-carbon renewable energy at appropriate scale for all groups. stress (Cai, 2008). Common ground-level challenges for majority of Asia are unpredictable rainfall, climate swings, over- or under-precipitation among others.

4.1. Quest for Symbiotic Sustainable Development: Where low Carbon Energy Asia would Like to be? What Pathway?

Rural heritage when blended with eco-urban innovations (Suphahitanukool et al., 2018) can germinate the metabolism for symbiosis. Table 1 summarizes the finding of this conceptual research with two intents, namely, where low carbon energy Asia would like to be and what pathway?

Beyond sustainability, design for abundance (McDonough and Braungart, 2013) proposition inject the continuous forward momentum for the shared value energy policy metabolism. Symbiotic scale-up among Asia's leadership would lead to budgeting social metabolism.

5. CONCLUSION AND MAINSTREAMING IMPLEMENTATION OF THE SUSTAINABLE DEVELOPMENT GOALS

5.1. Economic Review: Enhancing the Implementability of the Sustainable Development Goals in Asia

Symbiotic scale-up on water – waste – energy inter-relatedness would begin at design, receive momentum from budgeting for social metabolism in terms of consumption linked with production and disseminate to robust rural and smart urban communities to improve habits on water – waste – energy for self-replenishment for shared value creation. The efficiency and practicality measures would draw away water - energy intensive agriculture. This would impact robust-rural contribution to overall GDP. Enhancing efficiency on water – waste – energy usage/generation in the rural sector is not at all easy given the inequity issues. However, the dual-purpose co-financing innovations from environmentally and societally benign investors would see the benefits in the sustainable term. Simultaneously, co-shared measurement and assurance systems would check the exuberant and ascending water – energy demand from the urban and industrial sector, with conscious control on waste. This outcome is in consonance with policy articulation and policy implementation (Rauf et al., 2018) match for local-global needs to maintain a proper balance between growth and symbiosis through sustainability metabolism. There are pitfalls to attain this steady state archetype, as focus on water conservation, waste with-hold, and energy efficiency tend to take a hind seat when prices of carbon-heavy energy are lower. To tag-in energy efficiency with water – waste – energy symbiosis for sustainability, the enterprise approach is envisaged. The enterprise approach is based on attainment of steady-state metabolism through a holistic and unifying common ground seeking mechanisms. Derived from the findings of the four steady-state archetypes, sustainability destination and pathway for implementability of the sustainable development goals, need trust renaissance (Table 1).

Table 1: Asia's symbiosis for sustainability with self-replenishing metabolism

Low carbon energy symbiosis for sustainability	Policy metabolism for self-replenishment for shared value
Symbiotic scale-up	Budgeting social metabolism
Efficiency and practicality	Dual-purpose co-financing innovations
Measurement and assurance systems	Enterprise program
Water – waste – energy inter-relatedness metric	Trust renaissance

It is well known that developing Asia share rich heritage from ages. There are aberrations on issues. However, given the true benefits accrued for both the global entities through share, symbiosis, metabolism, would out-weigh the differences. The trust rejuvenation is quite natural on mutual water security, continuous value creation from waste and renewables-focus energy. Trust quotient will prosper when emphasis is on delivering functionality, positive stewardship and re-purposing development (Bocken et al., 2014). The success of the symbiotic destination and the metabolic pathway emanates from organized approach, governance driven leadership and results-based financing. It is noteworthy that sustainable development goals need to acquire a sharing-outlook for generic, heritage-tested and practical results. The common ground needs to be transitioning to market needs. Water – waste – energy are generic resources for both entities. Hence, policy-alignment to share the economic, societal and environmental benefits at a rural – urban combined space is a worthy goal to pursue. It may be concluded that the low carbon Asia combined development metabolism promises to be a game changer, in their common pursuit for low carbon circular economy. Instead of standalone approach, shared-value Asia need to integrate. This would enhance the reach of the symbiotic and metabolic circle periphery, eventually leading to the implementation of the Sustainable Development Goals.

5.2. Shared Value Policy Symbiosis and Metabolism for Low Carbon Circular Economy

An important outcome of this research is designing resilience with respect to intensifying disasters (Jones et al., 2010), that developing Asia is piloting and scaling-up. Emphasis on symbiosis binds the developmental path to low carbon circular economy that inter-relates water – waste – energy usage, regulation and administration. The camaraderie among disaster-vulnerable Asia is mandatory. Post-disaster build back better, could be deployed in virtuous cycles through appropriate incentives for entrepreneurs, agriculturalists, service providers and communities. Community awareness and sensitivity with respect to water – waste – energy is a function of perseverant metabolic initiatives. The two countries need to progress on bringing to the community conversation the issue and benefits of partnership and symbiosis. Mere regulation is inadequate, public appreciation would sustain the symbiosis and metabolism. Though, a dexterous policy regime accompanied by efforts to spur market-based mechanisms are needed to deliver results. An elaborate evaluation framework for seamless performance linkages between provincial and central institutional

frameworks would enable proper design of the symbiosis linked metabolism budget:

(i) Budget on locale-specific water – waste – energy productivity levels.
(ii) Participatory metrics on budgeted attainments.
(iii) Entrepreneurial empowering at community levels recognizing locale typicality.
(iv) Service sector value chain with water – waste – energy infrastructure projects.
(v) Flow of financing for a cause.

Co-implementation of quantum innovations with respect to urban industrial and services-based water – waste – energy optimization by focusing on demand side management would be an enabler for metabolic linkage with symbiosis. Adaptations on governance mechanisms for process retrofit, efficiency improvement, waste heat and pressure utilization and heat and power cogeneration, need to be reviewed. Such initiatives are expected to usher pathways on symbiosis for sustainability on the core plank of trust renaissance.

REFERENCES

Akinwale, Y.O. (2018), An empirical analysis of short run and long run relationships between energy consumption, technology innovation and economic growth in Saudi Arabia. International Journal of Energy Economics and Policy, 8(4), 139-146.

Autio, E., Thomas, L. (2014), Innovation ecosystems. The Oxford Handbook of innovation management, 2014, 204-288.

Ayres, R.U., Kneese, A.V. (1969), Production, consumption, and externalities. The American Economic Review, 59(3), 282-297.

Ayres, R.U., Simonis, U.E. (1994), Industrial Metabolism: Restructuring for Sustainable Development. Tokyo, New York, Paris: United Nations University Press.

Bano, S., Tabbada, J. (2015), Foreign direct investment outflows: Asian developing countries. Journal of Economic Integration, 23, 359-398.

Bocken, N.M., Short, S.W., Rana, P., Evans, S. (2014), A literature and practice review to develop sustainable business model archetypes. Journal of Cleaner Production, 65, 42-56.

Burnley, S.J. (2007), He use of chemical composition in waste management planning – A case study. Waste Management, 27(3), 327-326.

Cabrera, A., Unruh, G. (2012), Being Global: How to Think, Act, and Lead in a Transformed World. Boston, MA: Harvard Business Press.

Cai, X. (2008), Water stress, water transfer and social equity in Northern China - Implications for policy reforms. Journal of Environmental Management, 87(1), 14-25.

Castles, S., De Haas, H., Miller, M.J. (2013), The Age of Migration: International Population Movements in the Modern World. United States: Palgrave Macmillan.

Cohen-Rosenthal, E., Musnikow, J. (2017), The role of government in eco-industrial development. Routledge: Eco-industrial Strategies. p68-88.

Dentchev, N., Rauter, R., Jóhannsdóttir, L., Snihur, Y., Rosano, M., Baumgartner, R., Jonker, J. (2018), Embracing the variety of sustainable business models: A prolific field of research and a future research agenda. Journal of Cleaner Production, 194, 695-703.

Dakhia, K., Berezowska-Azzag, E. (2010), Urban institutional and ecological footprint: A new urban metabolism assessment tool for planning sustainable urban ecosystems. Management of Environmental Quality: An International Journal, 21(1), 78-89.

Diekhöner, P.K. (2017). The Trust Economy: Building Strong Networks and Realising Exponential Value in the Digital Age. Singapore. Marshall Cavendish International Asia Pvt Ltd.

Emmott, B. (2009), Rivals: How the Power Struggle between CHINA, India and Japan will Shape Our Next Decade. Boston, MA: Houghton Mifflin Harcourt.

Fan, C.C. (2003), Rural-urban migration and gender division of labor in transitional China. International Journal of Urban and Regional Research, 27(1), 24-47.

Flint, R.W. (2012), Practice of Sustainable Community Development: A Participatory Framework for Change. New York: Springer Science and Business Media.

Ford, W.F., Hill, L.E. (1971), Reverse migration and population dispersion: A partial solution for urban problems. Nebraska Journal of Economics and Business, 10, 45-60.

Gandy, M. (2004), Rethinking urban metabolism: Water, space and the modern city. City, 8(3), 363-379.

Geng, Y., Sarkis, J., Ulgiati, S., Zhang, P. (2013), Measuring China's circular economy. Science, 339(6127), 1526-1527.

Gottweis, H., Lauss, G. (2012), Biobank governance: Heterogeneous modes of ordering and democratization. Journal of Community Genetics, 3(2), 61-72.

Gray, R. (2008), Review essay: Envisioning sustainability and re-envisioning the large corporation: A short review essay on business and sustainable development. Social and Environmental Accountability Journal, 28(1), 45-48.

Hasan, M.K., Ismail, A.F., Abdalla, A.H., Ramli, H.A., Hashim, W., Islam, S. (2016), Throughput maximization for the cross-tier interference in heterogeneous network. Advanced Science Letters, 22(10), 2785-2789.

Hutton, T.A. (2004), The new economy of the inner city. Cities, 21(2), 89-108.

Jalan, J., Ravallion, M. (2002), Geographic poverty traps? A micro model of consumption growth in rural China. Journal of Applied Econometrics, 17(4), 329-346.

Jones, A., Pimbert, M., Jiggins, J. (2010), Virtuous Circles: Values, Systems and Sustainability. London: International Institute for Environment and Development (IIED).

Kovacic, Z., Giampietro, M. (2017), Between theory and quantification: An integrated analysis of metabolic patterns of informal urban settlements. Energy Policy, 100, 377-386.

Kroeze, C., Vlasblom, J., Gupta, J., Boudri, C., Blok, K. (2004), The power sector in China and India: Greenhouse gas emissions reduction potential and scenarios for 1990–2020. Energy Policy, 32(1), 55-76.

Leonard, A. (2007), Symbiosis and the viable system model. Kybernetes, 36(5/6), 571-582.

Lewis, J.I. (2007), Technology acquisition and innovation in the developing world: Wind turbine development in China and India. Studies in comparative international development, 42(3-4), 208-232.

Li, Q., Wei, W. (2011), The research review of the study on the application of symbiosis theory in city groups. Journal of Yulin University, 1, 16.

Lyakurwa, F.S. (2014), Industrial ecology a new path to sustainability: A review. Independent Journal of Management and Production, 5(3), 623-635.

Mamì, A., Mormino, L. (2014), Sustainable urban requalification: Circularity of processes for a new metabolism. Journal of Engineering and Architecture, 2(2), 2014.

Martinez-Alier, J. (2007), Social metabolism and environmental conflicts. Socialist Register, 43, 273-293.

Mathur, A., Zhang, Y., Neelankavil, J.P. (2001), Critical managerial motivational factors: A cross cultural analysis of four culturally divergent countries. International Journal of Cross Cultural Management, 1(3), 251-267.

McDonough, W., Braungart, M. (2013), The Upcycle: Beyond Sustainability-Designing for Abundance. Boston, MA: Macmillan.

Moody-Stuart, M. (2006), Discussion of does sustainabililty reporting improve corporate behavior? Wrong question? Right time? Accounting and Business Research, 36(sup1), 89-94.

Morse, R.S. (2010), Integrative public leadership: Catalyzing collaboration to create public value. The Leadership Quarterly, 21(2), 231-245.

Nanto, D.K. (2011), Japan's 2011 Earthquake and Tsunami: Economic Effects and Implications for the United States. United States: DIANE Publishing.

Nee, V., Alba, R. (2012), Rethinking Assimilation Theory for a New Era of Immigration. Routledge: The New Immigration. p49-80.

Neumeyer, X., Santos, S.C., Caetano, A., Kalbfleisch, P. (2018), Entrepreneurship ecosystems and women entrepreneurs: A social capital and network approach. Small Business Economics, 2018, 1-15.

Nolan, P.H. (2005), China at the Crossroads. Journal of Chinese Economic and Business Studies, 3(1), 1-22.

Onyebueke, V., Hope, N. (2011), Rural–urban 'symbiosis', community self-help, and the new planning mandate: Evidence from Southeast Nigeria. Habitat International, 35(2), 167-418.

Ozturk, I., Acaravci, A. (2010), Testing the export-led growth hypothesis: Empirical evidence from Turkey. The Journal of Developing Areas, 23, 245-254.

Pauliuk, S., Hertwich, E.G. (2015), Socioeconomic metabolism as paradigm for studying the biophysical basis of human societies. Ecological Economics, 119, 83-93.

Pauliuk, S., Müller, D.B. (2014), The role of in-use stocks in the social metabolism and in climate change mitigation. Global Environmental Change, 24, 132-142.

Piacentini, M. (2012), Rationale and policies for the green growth of cities and regional economies. International Economics and Economic Policy, 9(2), 129-146.

Ramaswamy, V., Gouillart, F.J. (2010), The Power of Co-creation: Build it with Them to Boost Growth, Productivity, and Profits. New York: Simon and Schuster.

Rauf, A., Liu, X., Amin, W., Ozturk, I., Rehman, O., Sarwar, S. (2018), Energy and ecological sustainability: Challenges and panoramas in belt and road initiative countries. Sustainability, 10(8), 2743.

Rauf, A., Liu, X., Amin, W., Ozturk, I., Rehman, O.U., Hafeez, M. (2018), Testing EKC hypothesis with energy and sustainable development challenges: A fresh evidence from Belt and Road initiative economies. Environmental Science and Pollution Research, 25, 1-15.

Reed, J., Van Vianen, J., Deakin, E.L., Barlow, J., Sunderland, T. (2016), Integrated landscape approaches to managing social and environmental issues in the tropics: Learning from the past to guide the future. Global Change Biology, 22(7), 2540-2554.

Renner, M. (2007), Beyond Disasters: Creating Opportunities for Peace. Vol. 173). Washington D.C.: World Watch Institute.

Schepel, H. (2005), The Constitution of Private Governance: Product Standards in the Regulation of Integrating Markets. Oxford: Bloomsbury Publishing.

Sen, A. (1997), Development and Thinking at the Beginning of the 21st Century. IDEAS Working Paper Series from RePEc.

Sertyesilisik, B., Sertyesilisik, E. (2016), Eco industrial development: As a way of enhancing sustainable development. Journal of Economic Development, Environment and People, 5(1), 6-27.

Singh, H., Padmanabhan, A., Emanuel, E.J. (2017), India as a Pioneer of Innovation. Oxford: Oxford University Press.

Srinivasan, T.N. (2006), China, India and the world economy. Economic and Political Weekly, 54, 3716-3727.

Suphahitanukool, C., Hunsacharoonroj, I., Usapein, P., Khedari, J., Waewsak, J., Hirunalbh, J. (2018), An evaluation of economic potential solar photovoltaic farm in Thailand: Case study of polycrystalline silicon and amorphous silicon thin film. International Journal of Energy Economics and Policy, 8(4), 33-41.

Tamari, T. (2014), Metabolism: Utopian urbanism and the Japanese modern architecture movement. Theory, Culture and Society, 31(7-8), 201-225.

Tiwari, A.K. (2012), On the dynamics of energy consumption, CO_2emissions and economic growth: Evidence from India. Indian Economic Review, 37, 57-87.

UN-Habitat. (2016), Planning Sustainable Cities: Global Report on Human Settlements 2009. Routledge.

Vandenbergh, M.P. (2017). The Future of Environmental Enforcement. Petition Dismissed in Southern California Alliance Of Publicly Owned Treatment Works v. US EPA.

Vertovec, S. (2007), Super-diversity and its implications. Ethnic and Racial Studies, 30(6), 1024-1054.

Zhang, Y., Wu, Q., Wang, X., Fath, B.D., Liu, G., Hao, Y., Li, Y. (2017), Analysis of the ecological relationships within the CO_2 transfer network created by global trade and its changes from 2001 to 2010. Journal of Cleaner Production, 168, 1425-1435.