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OPINION PAPER

Implementing a Pilot Scale-Eco-county Concept Towards Circular Economy and Sustainability

Yong-Nam Kim[1] · **Nam-Chol O**[2]

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Abstract
In the past decades, the eco-industrial concept, based on the ecological material flow and industrial symbiosis, has been introduced to many industrial parks, aiming to promote economic development and minimize environmental burdens in many countries. However, the eco-industrial park development programs could not completely solve the environmental problems, particularly in the case of a whole town or a county. An eco-county concept could be introduced into counties, which can be defined as a county towards circular economy and sustainability, which features low consumption of energy, low emission of pollutants, highly efficient use and recycling of resources, healthy living conditions, accessible transportation, and affordable residence. From that, the DPR Korean government launched a pilot project of eco-county in Kangryong. This article describes the eco-county development program, including background, geographical and climatological conditions, natural resources, general development programs, indigenous characteristics, challenges, and perspectives.

Keywords Circular economy · Eco-county concept · Industrial park · Sustainability · Zero-waste

Background and Objective

In the past decades, industrial park development has become one of crucial strategies to promote economic development in many countries [1]. The projects of the industrial park development, however, have resulted in the environmental problems internationally: resource depletion, regional environmental contamination, and climate change. Responding to these issues, the eco-industrial concept, based on the ecological material flow and industrial symbiosis [2], has been introduced to many industrial parks [3, 4], aiming to minimize environmental burdens and improve resource efficiency and

✉ Yong-Nam Kim
yn.kim0224@ryongnamsan.edu.kp

[1] Department of Land Planning, Faculty of Global Environmental Science, KIM IL SUNG University, Pyongyang, the Democratic People's Republic of Korea

[2] Department of Environmental Conservation, Faculty of Global Environmental Science, KIM IL SUNG University, Pyongyang, the Democratic People's Republic of Korea

environmental benefits [5] in the parks by implementing circular economy via reuse/recycling of waste fractions from one process as raw materials for another process. However, the evidence is questionable whether the eco-industrial park (EIP) development programs could completely solve the environmental problems, particularly in the case of a whole town/a county. Stating the conclusion first is hasty, but it is not possible to solve the problems due to some limitations of EIP [6]. In regard to the environmental performance and economic benefits of a county, an eco-county (EC) concept could be introduced into counties, which can be defined as a county towards circular economy and sustainability [2], which features low consumption of energy, low emission of pollutants [7, 8], highly efficient use and recycling of resources [9], healthy living conditions, accessible transportation, and affordable residence. From that, the DPR Korean government launched a pilot project of EC: The Pilot Scale-EC Development Program in Kangryong [10]. The project was approved for construction, which aimed to perform a physical exchange of materials, energy, water, and by-products to promote the efficiency of resource use and improve the environmental management within ECs towards circular economy and sustainability.

Geographical and Climatic Conditions

Kangryong County, having a population of 93,100, situated in the southern part of the South Hwanghae Province in DPR Korea, straddles over 521.86 km^2 of the Kangryong peninsula, which stretches from northeast to southwest, including tens of islands in the sea off the county (Fig. 1). Kangryong County is located at latitude 37° 40′ ~ 38° 00′ north and at longitude 125° 10′ ~ 125° 47′ east. The center of the EC, the seat of Kangryong, is approximately 170 km away from Pyongyang, the capital of DPR Korea, and 33 km from Haeju, the port city. Kangryong County has favorable transportation conditions as it is near to Haeju port and connected to Pyongyang, while it has oceanic climate, presenting a range of 10 ~ 11℃ of the annual average temperature and at the same time making it one of the warm regions in DPR Korea.

Natural Resources

In the county which has a harmonious combination of hillocks, vast fields, sea, and islands, there are abundant natural resources, including renewable energy resources (i.e., solar, wind, biomass, and ocean waves), tideland resources, underground resources (e.g., ferrous and nonferrous metals, nonmetallic minerals, and fossil fuels), marine resources, and tourist resources. Especially, there are plenty of marine resources (inclusive of seaweed, clam, abalones, oyster, tangle, jellyfish, mullet, etc.), since it has got favorable marine conditions for the cultivation of these resources. Furthermore, the county with a long and winding coastline has thousands of hectares of tideland for farming, while it has tremendous tidal energy potential to develop, accounting for approximately 1 million kW. In addition to that, the county is richly cultivated with sweet potato, as one of the leading counties in the production, and it has geographically suitable conditions for livestock breeding and Unjong tea planting.

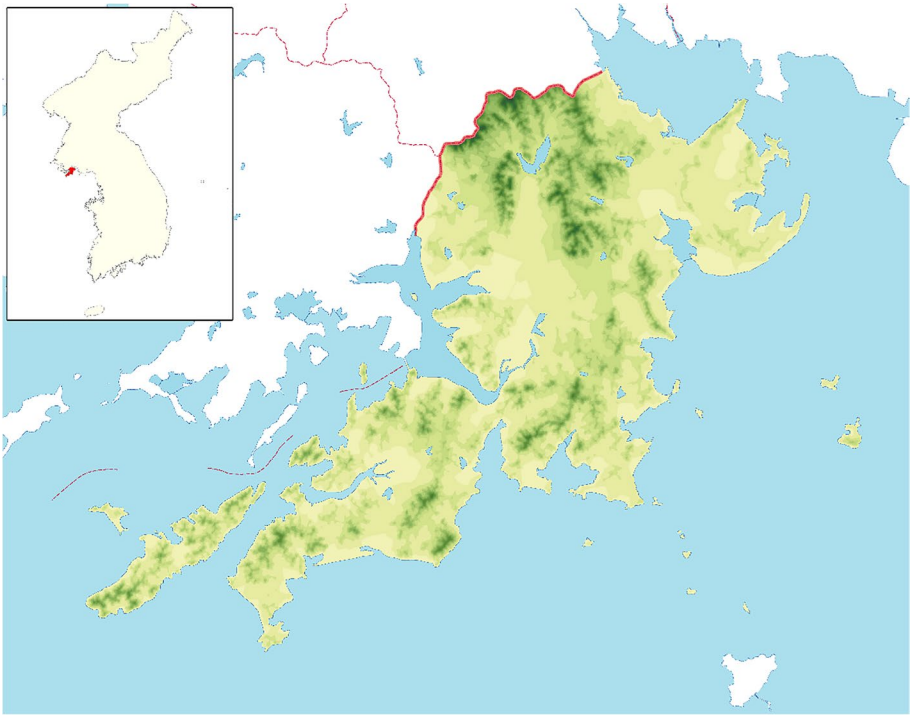

Fig. 1 A case study county, Kangryong, DPR Korea, to be applied a Pilot Scale-Eco-county Concept

General Development Program

The general development program for Kangryong EC is categorized into residential sectors ensuring access to affordable, reliable, and renewable energy, EIPs based on industrial symbiosis, and sustainable infrastructure (Fig. 2). Residential sectors' development program ensuring access to affordable, reliable, and renewable energy [11] is divided into hotels and tourist accommodations, service, science and technology exchange, recreation, and sports. EIP development program is subcategorized into Pilot Scale-EIPs in combination with "agriculture-livestock-processing-agriculture" and "fishery-processing-livestock-agriculture," respectively, ensuring the concept of circular economy. The former "agriculture-livestock-processing-agriculture" ends by using by-products as fertilizers for farming via livestock husbandry and meat processing starting from agricultural products, while the latter "fishery-processing-livestock-agriculture" starts with fishery products, followed by fishery processing, livestock husbandry, and use of by-products in agriculture, respectively. The infrastructure development program includes ring road networks, electricity mix from renewable energy resources, communication service, waste management, and water utilization for sustainable socio-economic development. In addition, planners are willing to create a special economic development district for foreign investors, belonging to the general development program [10].

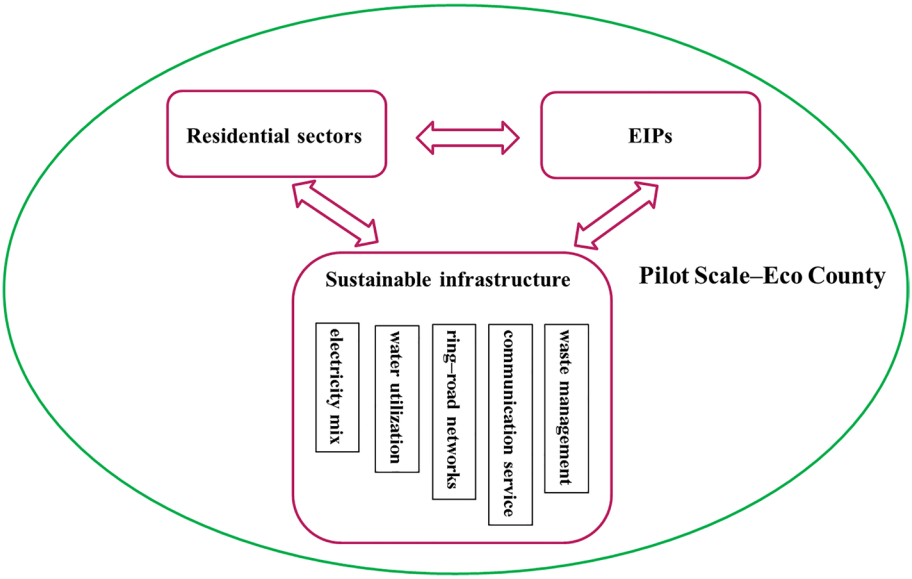

Fig. 2 The general development program for implementing a Pilot Scale-Eco-county Concept

Indigenous Characteristics

The development program of EC being conducted for the first time in the whole county has indigenous characteristics in terms of the geographical coverage and industry composition. Generally, in DPR Korea, a program for land development is carried out by a county unit, the lowest unit of administrative guidance. From the indigenous characteristics in the development program, the EC development program would be an integrated project, covering the whole county, as well as including many sectors (e.g., industry, forest and agriculture, fishery, tourist, commerce, and energy). Furthermore, according to the construction plan of EC, the government is planning to create a special economic development district of over 3.5 km^2 in the seat of the county. In accordance with the law of foreign direct investment, DPR Korea, individual foreign businessmen, economic groups, and overseas compatriots who want to invest could create enterprises, branches, and offices, etc. in the economic development district. They could also conduct free economic activities and are provided with the privileged economic conditions in many aspects: land use, employment, and tariffs.

Perspectives and Challenges

Once the Pilot Scale-EC Development Program will be implemented, practical/valuable experiences of implementing circular economy and sustainability gained from the development program could provide lessons to guide the on-going EC development in DPR Korea, while the experiences would definitely contribute to the implementation of eco-city/zone development program in many countries. However, the implementation of EC development

program in Kangryong results in a few challenges, including specific planning and design (industry composition suitable for circular economy), technical barriers (development of recycling technologies available for the industry composition), and economic barriers (active investment activities). Although implementing the development program could face a few challenges, the Pilot Scale-EC in Kangryong would be one of the greener and sustainable zones by the concerted effort of domestic and foreign investors, while providing economic benefits to all participating in the development program and promoting circular economy and sustainability.

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Code Availability Not applicable.

Declarations

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Consent to Participate Not applicable.

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Conflict of Interest The authors declare no competing interests.

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