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Assessment of the impact of urbanization-land subsidence, climate change and implementation of the Irrigation Plan 1547 on flooding in Ho Chi Minh City by the year of 2030

PHÙNG CHÍ SỸ¹, PHÙNG ANH ĐỨC¹, PHẠM THẾ VINH²

¹ Environmental Technology Centre

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Abstract: Flooding in Ho Chi Minh (HCM) City is caused by heavy rain, high tide, flood discharge from upstream, urbanization-land subsidence and climate change. Simulation programs used for flood control of downstream of the Dong Nai river system basin, including model of rainfall flow and hydraulic model (MIKE 11). Simulation scenarios include tidal flooding in consideration of urbanization-land subsidence and climate change in the area. The urbanization data by the year of 2030 is used in accordance with urban space development planning. The impacts of the urbanization-land subsidence, climate change and implementation of the Irrigation Plan 1547 by the year of 2030 is considered according to the scenario of 2030RCP4.5 as the baseline for comparison and the scenario of 2030RCP4.5_P1547. Predicted results show that water levels in the main river as well as in the urban area have increased significantly, resulting in increased flooded areas.

Keywords: Flooded area, climate change, urbanization-land subsidence, simulation scenarios.

JEL Classification: Q54; R00; R28.

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1. INTRODUCTION

HCM City is a coastal city, with an intricate network of rivers and canals (about 2,953 routes with total length of about 4,371km), low terrain (about 75% of the area has an elevation of less than 2 m), and rapid land subsidence over 1.0 cm/year over a large area of about 240 km², therefore, flooding often occurs, causing serious damage to property, disrupting production processes, limiting public transportation, increasing disease and negatively impacting environmental quality.

Flooding in HCM is caused by heavy rain, high tides, flood discharge from upstream, urbanization-land subsidence and climate change. According to statistics from the authorities, by the end of 2016, the City had 105 flooded points, including 47 points flooded due to rain, 7 points flooded due to tide and 51 points flooded due to rain combined with high tide.

Implementation of the Irrigation Plan to prevent flooding in HCM City area approved by the Prime Minister according to Decision No. 1547 (the Plan 1547) [2] will improve the flood situation in the city.

This paper will present an assessment of the impact of urbanization-land subsidence, climate change and implementation of the Irrigation Plan 1547 on flooding in HCM City by the year of 2030.

2. RESEACRH AND METHODOLOGY

2.1. Simulation inputs

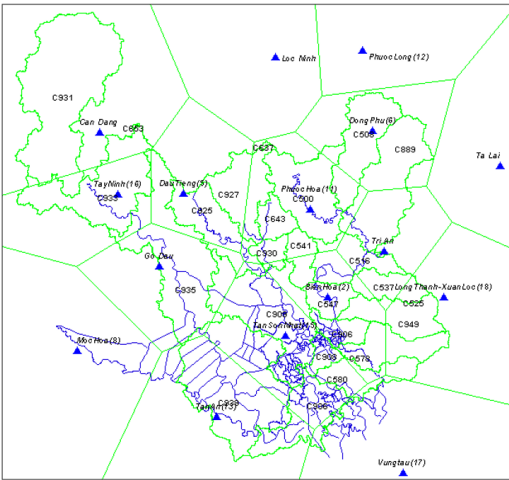
Simulation: Simulation programs used for flood control of downstream of the Dong Nai river system basin including model of rainfall flow (Figure 1) and hydraulic model (MIKE 11) (Figure 2).

Input Data

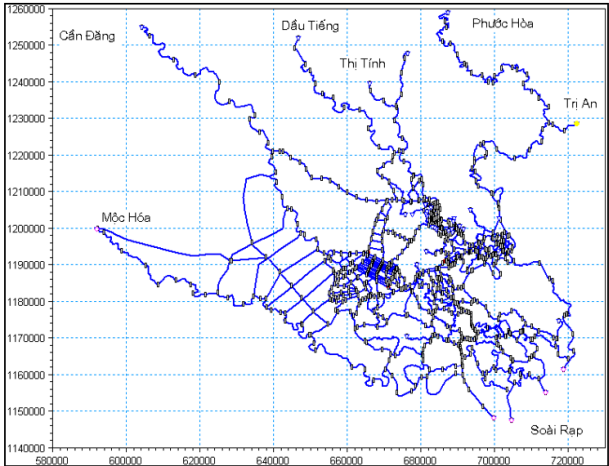
Rainfall data: Rain stations are monitored for the downstream areas of the Dong Nai river system basin using daily rainfall data. Tan Son Hoa station however is calculated using rainfall data for every 15 minutes. The frequency of rainfall is calculated according to the Gumble distribution. Under climate change conditions, rainfall during autumn is calculated corresponding to climate change scenarios (Table 1).

Water level data: The water level stations for the downstream area of the Dong Nai river system basin are monitored with the hourly data. The sea level rise scenarios only consider the change in average sea level (See Table 2) according to Vietnam's climate change scenario published in 2016.

Headwater flood data: According to the flood discharge process of the Southern Institute of Water Resources Planning during the flood control irrigation planning phase for the HCM City, future scenarios will also partially reduce flood peaks.



▲ Figure 1. Distribution of downstream rainfall stations



▲ Figure 2. Schematic diagram of downstream of the Dong Nai river system basin

Table 1. Changes in autumn rainfall (%) compared to the base period [1]

Scenario RCP4.5			Scenario RCP8.5		
2016 - 2035	2046 - 2065	2080 -2099	2016 - 2035	2046 - 2065	2080 -2099
11.4	22.6	19.7	14.0	18.4	22.0
(1.5 ÷ 21.6)	(8.7 ÷ 38.1)	(5.1 ÷ 34.4)	(4.5 ÷ 23.5)	(8.1 ÷ 29.2)	(6.6 ÷ 37.3)

Table 2. Raising sea level (cm) based on scenario RCP4.5 from Ke Ga Cape to Ca Mau Cape [1]

Timelines							
2030	2040	2050	2060	2070	2080	2090	2100
12	17	22	28	33	40	46	53
(7 ÷ 18)	(10 ÷ 25)	(13 ÷ 32)	(17 ÷ 40)	(20 ÷ 49)	(24 ÷ 58)	(28 ÷ 67)	(32 ÷ 77)

2.2. Model calibration

Model calibration: The model was calibrated with actual water level in 2013 at the main hydrological stations of the Dong Nai river system, then rechecked with data from 2007. Overall, the model is very good, the error of peak and bottom flood is negligible. The difference in water level between simulation and measurement is low (See Table 3).

Table 3. Parameters of October 2013 water level simulation calibration [3]

Station	River	Correlation coefficients	Max error (%)
Phu An	Saigon	0.987	0.050
Thu Dau Mot	Saigon	0.971	0.076
Nha Be	Dong Nai	0.987	-0.024
Bien Hoa	Dong Nai	0.980	0.243
Ben Luc	Vam Co Dong	0.987	-0.063

Model validation: Based on the set of parameters, the model correction for 2007 at the national hydrological station, including Nha Be, Phu An, Thu Dau Mot, Ben Luc was conducted. Hydraulic model validation was performed on the main river at the national hydrological stations, so the test results were relatively good. Correlation coefficients were also high from 0.971 to 0.987.

2.3. Simulation scenarios

Simulation scenarios include tidal flooding in consideration of urbanization - land subsidence and climate change in the area. The impacts of the climate change by the year of 2030 is considered according to the scenario of contribution of 10% high flood 10% tide, 10% rain under climate change and urbanization-land subsidence (2030RPC4.5) as the baseline for comparison and the scenario of contribution of 10% high flood, 10% tide, 10% rain under climate change and urbanization-land subsidence, built according to Irrigation Plan to prevent flooding in HCM City area [2] has been approved by the Prime Minister according to Decision No. 1547 (Plan 1547) (Phase 1) (2030RCP4.5_P1547). Specific scenarios are presented in Table 4.

Table 4. Simulated scenarios of the Plan 1547 [4]

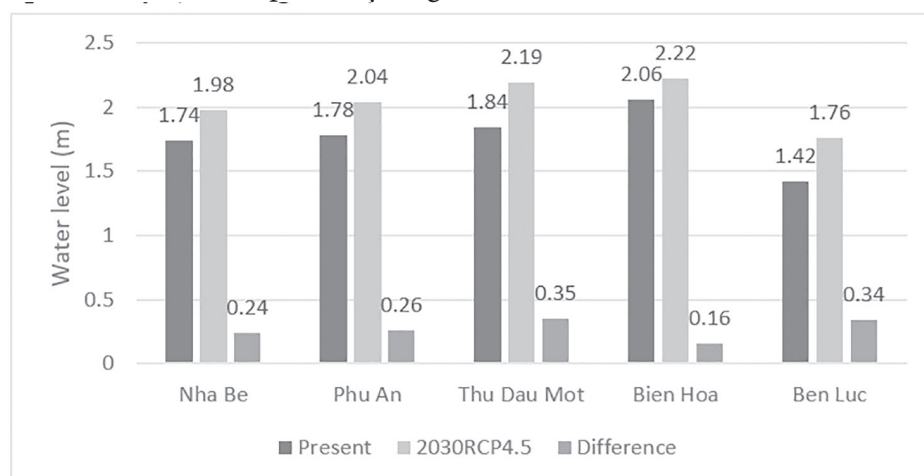
No	Scenario	Rainfall (%)	Tide (%)	Flood (%)	Topography	Climate Change	Land subsidence
1	Present	10	10	10	Not considered	Not considered	Not considered
2	2030RCP4.5	10	10	10	Plan 2030	2030RCP4.5	Subsidence 2030
3	2030RCP4.5_P1547	10	10	10	Plan 2030 + Plan 1547	2030RCP4.5	Subsidence 2030

3. RESULTS AND DISCUSSION

3.1. Present and forecasted flood situation at HCM City

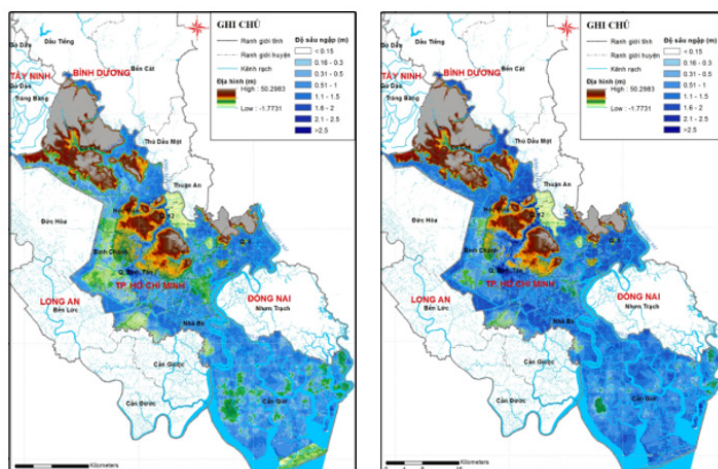
Present scenario

Water levels: Water levels in the major rivers and in urban areas are rising. Those at Nha Be, Phu An, Thu Dau Mot, Bien Hoa, Ben Luc stations are 1.74, 1.78, 1.84, 2.06, 1.42m, respectively (Figure 3).



▲ Figure 3. Water levels of the present scenario versus the scenario of 2030RCP4.5

Flooded area: Total flooded area in the whole HCM City is 120,118 hectares, accounting for 60.5% of the total natural area. Flood depth is of 0.2 to 1.5m depending on the area. The total flooded area in the protected area currently is 26,028 ha, accounting for 46.8% of the total calculation area (Figure 4).



Scenario of Urbanization-land Subsidence and Climate Change Impact (2030RCP4.5)

Water level: For the scenario of 2030RCP4.5, almost all water levels in the main rivers and in the region will be risen significantly. Those at Nha Be, Phu An, Thu Dau Mot, Bien Hoa, Ben Luc stations are 1.98, 2.04, 2.19, 2.22, 1.76m, respectively. The differences comparing to the present scenario at Nha Be, Phu An, Thu Dau Mot, Bien Hoa, Ben Luc stations are 0.24, 0.26, 0.35, 0.16, 0.34m, respectively (See Figure 3).

Flooded area: The total flooded area of HCM City for the scenario of 2030RCP4.5 is about 141,758 ha, accounting for 71.5% of the natural land area and 21.641 ha higher than that of the present scenario (Figure 4).

The total flooded area in the protected area for the scenario of 2030RCP4.5 is about 36,726 ha, accounting for about 55% of natural land area, and increase by 10,698 ha comparing with that of the present scenario. The flooded area with a depth of less than 1m, 1-2m, more than 2m are 20,264 ha, 14,737 ha, 1,725 ha, respectively (Figure 6).

Scenario of Urbanization-land Subsidence, Climate change impact and implementation of the Plan 1547 (2030RCP4.5_P1547)

Water levels: For the Scenario of 2030RCP4.5_P1547, almost all water levels in the main rivers will increase. Those at Nha Be, Phu An, Thu Dau Mot, Bien Hoa, Ben Luc are 1.98, 2.07,

▲ Figure 4. Flooded maps of the present scenario and the scenario of 2030RCP4.5

2.25, 2.23, 1.77m, respectively. The differences comparing to the scenario of 2030RCP4.5 at Nha Be, Phu An, Thu Dau Mot, Bien Hoa, Ben Luc are 0.00, 0.03, 0.06, 0.01, 0.01m, respectively. In the protected area by the flood control system in accordance with the scenario of 2030RCP4.5_P1547, the water level will be reduced by 0.87m comparing with the scenario of 2030RCP4.5 and reach the level of +1.22m (Figure 5).

With the scale of the first phase, instead of building 12 floodgates with protected area of about 1,800km², only 8 floodgates was built with protected area of about 1/3 comparing to the Plan 1547.

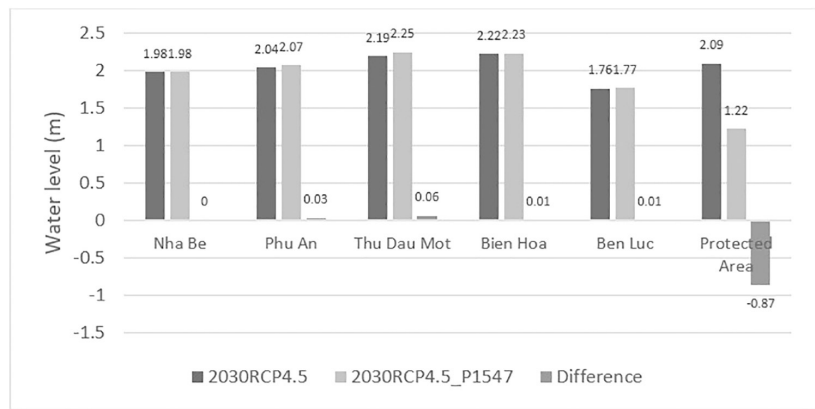
Flooded area: The total flooded area of HCM City, after the construction of flood control works is about 134,847 ha, accounting for about 68% of natural land area and decrease about 6,911 ha comparing to without those.

The total flooded area in the protected area for the Scenario of 2030RCP4.5_P1547 is about 30,584 ha, accounting for about 55% of natural land area, and reduce by 6,142 ha comparing with the scenario of 2030RCP4.5. The flooded area with a depth of less than 1m, 1 - 2m, more than 2 m are 20,418 ha, 8,685 ha, 1,482 ha, respectively. Corresponding to depths of 1 - 2m, the reduction of about 6,052 ha and the depth of over 2m, the reduction is about 243 ha comparing with the scenario of 2030RCP4.5 (Figure 6).

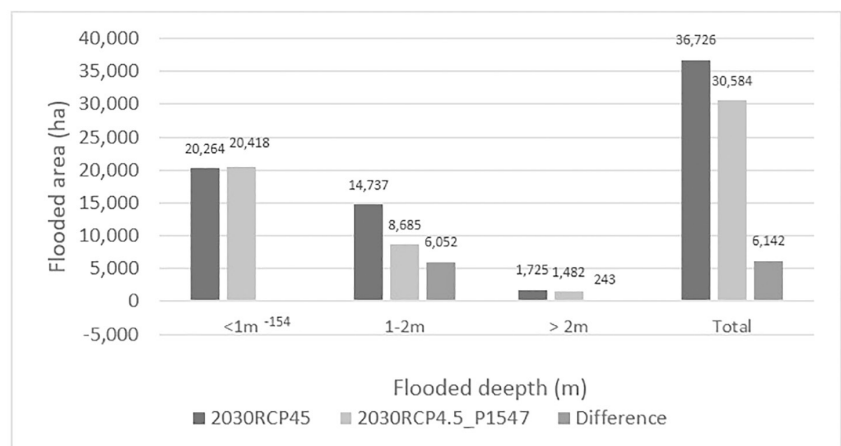
4. CONCLUSION AND RECOMMENDATION

Flooding in HCM City is caused by heavy rain, high tide, flood discharge from upstream, urbanization-land subsidence and climate change. Predicted results show that water levels in the main rivers as well as in the urban area has been increasing significantly, resulting in increased flooded area.

When construction of 8 large floodgates and connecting them with existing dyke system to pro-



▲ Figure 5. Projected water level according to the scenario of 2030RCP4.5_P1547 versus the scenario of 2030RCP4.5



▲ Figure 6. Simulated Flooded Area for scenarios of 2030RCP4.5 and 2030RCP4.5_P1547

tect the Central and Southern regions of the City, floods under tidal impacts in the inner City will be significantly reduced. On the other hand, the water level in the main rivers outside the protected area has slightly increased in Phu An, Ben Luc, Bien Hoa stations. The dredging of canals in the Central and Southern regions when the tidal protection barrier was built did not have much impact on lowering urban water levels.

It is recommended that the People's Committee of HCM City soon develop an integrated strategy to minimize the impact of urbanization-land subsidence climate change on flooding in the City ■

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Green transition, digitalisation in a circular economy to improve the total factor productivity in Quang Ninh

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Abstract:

Total factor productivity (TFP), also known as Solow's residual, is a measure of the share of production growth that cannot be explained by increases in inputs like capital and labor. It captures the impact of technical development, increases in production, and other unnoticed elements. To improve the productivity of total factors, Quang Ninh needs to innovate its growth model, fully exploit favorable natural conditions and natural resources, and implement green transformation and digital transformation to a circular economy, mobilizing maximum domestic and foreign capital, improving the quality of human resources, enhancing scientific applications and expanding international cooperation.

Keywords: Green transition, digitalisation, total factor productivity.

JEL Classifications: D24, E31, O40.

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1. Green transition and digitalisation in the global context

Productivity represents advances in better use of inputs of production (resources, capital and labor) to produce higher outputs with higher quality. In economics, productivity is the efficient use of economic resources. Productivity is also associated with the quality of growth. Productivity increases thanks to scientific and technological advances that constantly improve qualifications, management techniques, skills, and labor experience to ensure optimal and effective use of scarce input resources to produce the maximum amount of output with fair distribution to ensure social efficiency, along with environmental protection to ensure efficient sustainable use of natural capital. Nobel Prize-winning economist Paul Krugman said: "Productivity is not everything, but in the long run, it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise output per worker" (Krugman 1994). Therefore, improving labor productivity is the key to improve living standards over time.

TFP reflects the combined contribution of factors to the effective use of all input resources through the optimal choice of economic decisions in the use of capital and labor. TFP is not directly due to the partial productivity of each input factor of produc-

tion. TFP reflects progress in science, engineering and technology, education and training, through which increasing output depends not only on increasing the quantity of inputs but also on the quality of inputs. Input factors are capital and labor. Increasing TFP is associated with applying technical advances, technological innovation, improving management methods and improving skills and qualifications of workers... With the same amount of input, the amount of output can be larger thanks to improving the quality of labor and capital and using these resources more effectively (Solow, 1994).

The Chinese Communist Party's "ecological civilization" stance since 2007 was reinforced in the 2022 Political Report of the Communist Party of China, which affirmed that "nature is the basic condition for existence and development of human beings. Respecting nature, obeying nature and protecting nature are internal requirements to comprehensively build a modern socialist state. The cradle of all living things, humans and nature is a living community (Yong, R. 2007). Ecological and environmental security is an important part of national security, an important guarantee for sustainable and healthy economic and social development" (Kennedy and Johnson, 2015).

Global investment in the green transition will triple by 2030 from US\$ 1 trillion in 2022 (European Commission, 2020). The 2019 Labor Party Manifesto set out a plan to transform UK society and the economy to tackle climate change through a Green Industrial Revolution based on investment in the circular economy, energy renewables and low-carbon infrastructure to radically transform the way public transport services are owned

and operated, and to review agricultural subsidies to prioritize natural habitat conservation and ecosystem restoration. The European Commission has announced the focus of its strategy to lead the green industrial revolution through a circular economy to compete with the United States and China in creating clean technology products and access the raw materials needed for the green transition to ensure Europe is not only at the forefront of cutting carbon emissions but also ahead of the technology needed.

2. To implement the strategy and policy towards improving TFP in Quang Ninh

Vietnam's Communist Party's viewpoints and policies from the 6th Congress (1986) to the 13th Congress (2021) have determined that environmental protection and response to climate change are vital issues for the country and people, has an interactive impact on the country's sustainable socio-economic development. Responding to climate change and building a harmonious and friendly ecological environment requires the cooperation and contribution of the entire world community. Managing, exploiting, and using natural resources economically and effectively, protecting the environment and responding to climate change are both goals and basic contents towards sustainable development. The 13th Party Congress has determined the viewpoint on innovating the growth model and restructuring the economy: Rapid and sustainable development relies mainly on science and technology, innovation and digital transformation. Vietnam must innovate thinking and action, proactively grasp promptly and effectively take advantage of the opportunities of the Fourth Industrial Revolution associated with the process of international integration to restructure the economy and develop a digital economy, a digital society to improve productivity, quality, efficiency and competitiveness of the country. The market plays a key role in mobilizing, allocating and effectively using production resources, especially land. The legal system must promote innovation, digital transformation and the development of new products, services and economic models.

Resolution No. 230/NQ-HDND dated December 7th, 2020 of the 13th People's Council of Quang Ninh affirmed the goal of improving the quality of economic growth. Restructuring the economy is associated with innovating growth models, improving productivity, quality, efficiency and competitiveness, promoting administrative reform, improve an open and favorable investment and business environment, and unleash all resources. Quang Ninh Province promotes sustainable development of the tourism industry, focusing on in-depth development, effectively implementing Res-

olution No. 08-NQ/TW dated January 16th 2017, of the Politburo, Resolution No. 07-NQ/TU dated May 24th 2013, Resolution No. 02-NQ/TU dated February 5th 2016, of the Provincial Party Committee on service and tourism development. Quang Ninh needs to strengthen the application of science and technology in management and development of goods, services and tourism; ensuring a secure, safe, clean, beautiful, friendly and sustainable environment for long term growth.

In the economic and social development strategy to 2030, with vision 2045, the Province needs to focus on comprehensively implementing the goal of improving the quality of economic growth; restructuring the economy towards developing services and tourism associated with innovating growth models; Developing Quang Ninh culture and people and high-quality human resources, associated with promoting the application of science and technology and innovation; Strengthening resource management, protect the environment, preventing natural disasters, and proactively responding to climate change. Improving the TFP is the basis for Quang Ninh to successfully implement the Resolutions of the Party, People's Council on strategy and development planning of the Province until 2030.

3. Green transition and digitalisation in a circular economy are keys to improve TFP in Quang Ninh

Quang Ninh is the province with the highest investment efficiency compared to provinces/cities in the Northern key economic region and the whole country, based on the incremental capital-output ratio (ICOR). During the period 2011 - 2020, the ICOR of Quang Ninh decreased from 6.3 in 2011 to 5.414 in 2020, showing that the efficiency of investment capital has increased over time. Quang Ninh has the highest labor productivity (GRDP/worker) compared to other localities in the Northern key economic region and compared to the whole country in 2019, reaching 270.7 million VND/worker, and increased up to 325.7 million/employee in 2020, three times higher than in 2011. Labor productivity is due to the mining industry, specifically coal mining, which contributes a significant part to Quang Ninh's economy. In 2020, among economic sectors, the labor productivity of the agriculture-forestry-fishery industry reached 75.9 million VND/employee, much lower than the labor productivity of the service industry group estimated at 305,000 VND/worker. Quang Ninh's labor productivity growth rate in the entire period 2011-2020 reached 8.3%, ranking 8th/63 localities in the country and 4th/11 localities in the Red River Delta Region (after Hai Phong, Ha Nam and Bac Ninh). Similar to the GRDP growth rate, Quang Ninh's labor productivity growth rate in the period 2016 - 2020 (11.1%/year) is superior to the period 2011 - 2015 (5.6%/year).



At the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26), Vietnam committed to bringing net emissions to “zero” by 2050. In the Nationally Determined Contributions updated in 2022 submitted to the United Nations, Vietnam aims to reduce total greenhouse gas emissions by 43.5% by 2030 if there is international support, a remarkable increase compared to 27% of 2020 NDC. At the 15th Conference of Parties to the United Nations Convention on Biological Diversity (COP15), Vietnam and 190 countries approved the “Kunming - Montreal Global Biodiversity Framework”. After South Africa and Indonesia, Vietnam is the third country to reach an agreement to establish the Just Energy Transition Partnership (JETP).

Quang Ninh Province considers environmental protection a condition, foundation, and prerequisite to promote sustainable socio-economic development. Quang Ninh must combine pollution prevention with environmental improvement while preventing and repelling the trend of increasing pollution and environmental degradation, solving urgent environmental problems, and restoring environmental quality. Quang Ninh needs to prevent the loss of biodiversity, to improve capacity and awareness of environmental protection, gradually proactively respond to climate change; ensuring environmental security, building and developing a circular green low carbon economy towards the goal of sustainable development. Environmental protection is the responsibility of the entire political system and the entire society, in which local authorities, businesses, communities and people play important roles.

On average each year, the volume of waste dumped at coal mining sites in Quang Ninh is about 150 million m³. Current reserves of landfills are about over 1.3 billion m³ of soil and rock. To minimize the risk of landslides and affect the living environment of people around the area, Quang Ninh and the coal corporations have agreed to take advantage of this mine waste soil and rock source for leveling infrastructure projects. This is considered a new direction that brings high efficiency in circular economic development. Increase the use of mine waste soil and rock as filling material. Using soil and reused mine waste rock as backfilling materials for projects in Quang Ninh addresses the urgent need for backfilling materials while also reducing resource exploitation and waste treatment costs, minimizing environmental pollution and significantly reducing business costs. Quang Ninh needs to propose the Ministry of Natural Resources and Environment to develop mechanisms and policies and complete procedures for licensing mining waste dump areas.

Quang Ninh currently has 176 lakes and dams operating to provide water for irrigation and daily life for the people. The useful capacity of the reservoirs is over 315 million m³. Quang Ninh needs to take advantage of post-mining mines to renovate them into reservoirs.

Specifically, for the mining pit area, it is necessary to renovate the mining pit into a water reservoir; to build sewers to drain water into the sea. Renovating coal mines into freshwater reservoirs not only helps save recovery costs but also opens up new opportunities for many other coal mines to be converted into freshwater reservoirs after mining in consistent with the circular economy development trend that Quang Ninh is encouraging to replicate. Quang Ninh needs to update the environmental protection project to have effective solutions to protect water sources.

Quang Ninh needs to apply digital transformation and digital technology to reduce transaction costs, trace the origin and composition of products, materials, waste streams of plastic, metal, lubricants, rubber, glass, wood, paper and other biomass (National Science Agency of Australia, 2021). The quality of secondary materials, reusability and recycling of goods and materials in the value chain is important. Quang Ninh needs to expand and accelerate the application of scientific and technological achievements, especially information technology, promoting smart production, tourism, healthcare, education, information and communication, and political construction towards digital Government and building smart cities. The contribution of TFP to the Province's economic growth should reach over 50% ■

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An overview on the air pollution in Hanoi and suitable solutions proposed to address challenges based on adaptable sustainable development strategies

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Abstract: As urbanization accelerates globally, concerns about air pollution have grown, impacting metropolises' quality of life. Hanoi - the Capital of Vietnam - is among these cities, having faced deteriorating air quality due to industrialization, vehicular emissions, and the urban heat island (UHI) effect. While numerous papers address air pollution in Hanoi and strategies adopted globally, a gap exists in deliberating on the alignment of such strategies with Hanoi's context. This paper aims to bridge this gap by investigating Hanoi's air pollution, correlating it with strategies used elsewhere, and proposing tailored solutions. Focusing on urban greening, low-emission zones, and improved waste management practices, this study explores flexible approaches for mitigating air pollution. Considering these strategies within Hanoi's context is essential for evaluating their potential benefits in Vietnam's capital. By linking global strategies to Hanoi's specifics, this research aims to develop localized air pollution solutions, drive sustainable City development, and contribute to existing knowledge. Collaboration among stakeholders is essential for successful and comprehensive implementation, which will result in improved urban air quality for Hanoi residents.

Key words: Hanoi; Air pollution; Air quality; The urban heat island effect.

JEL Classification: Q53; Q56; R00.

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1. INTRODUCTION

Hanoi is the Capital, the political and cultural hub, and has long been of great importance to Vietnam. Hanoi has been growing to achieve the status of an international metropolis, including urban development, sustainable urban planning, luring investment, and opening the nation to globalization (Leducq and Scarwell, 2018). The City strives to manage its urban transition and competing development in its metropolitan area, which spans over 3.300km². Government bodies in Hanoi have passed three Master Plans in 1998, 2003, and 2008, but none have been implemented. Land use, transportation, housing, economic development, environmental protection, and public facilities are typical topics covered. Most significant and flagship projects have been conducted by private companies, and the Vietnamese Government has received assistance internationally. However, the results of these cooperative efforts between the Government and private companies are disputed (Leducq and Scarwell, 2018).

As a result of rapid urbanization and industrialization, Hanoi has been experiencing significant air quality issues (Lasko et al., 2018). The Comprehensive Urban

Development Program in Hanoi (HAID-EP) has identified traffic, industrial activities, and construction as Hanoi's primary sources of air pollution (Lasko et al., 2018). Furthermore, emissions from rice residue biomass burning in suburban areas of the City have also significantly contributed to air pollution in Hanoi (Lasko et al., 2018). The Capital's climate has also adversely impacted its air quality. In a 2017 study, the authors found that temperature inversions had a detrimental effect on the concentration of various air pollutants (Sakamoto et al., 2018). There have been proposed and implemented plans to address the issue of decreasing air quality, ranging from publicity campaigns to raise awareness, stricter regulations to curb the burning of rice straw, and even a proposal to ban motorcycles entirely within the City. The City's master plan for 2030 included policies aimed at various improvements, such as enhancing public transportation and establishing a



Green Corridor. However, most, if not all, of these plans only exist on paper or have not achieved any noticeable results, such as Government agencies and state media have admitted (Leducq and Scarwell, 2018).

Therefore, it is necessary for Hanoi to learn from other nations and cities, to look at what solutions have been implemented, in what way and to what extent they have had impacts, and whether they are suitable for the City. Previous studies have mainly focused on the cause and effect of air pollution and the current state of air pollution in Hanoi. There have also been many strategies implemented in major cities around the world, along with their impact and past, present, and plans for dealing with air quality issues. However, there is a lack of studies focusing on air pollution in Hanoi, examining measures imposed in other metropolises to deal with the same issue, and then suggesting those that can work for Hanoi. This study fills this gap by including the problem within the context of Hanoi, examining what has been done elsewhere to alleviate air pollution, and concluding with probable solutions Hanoi can implement.

2. METHODOLOGY

This research is carried out by reviewing previous papers on the state of Hanoi's development, problems Hanoi is facing with, air pollution issues, cause and effect of air pollution in Hanoi and current strategies implementing to mitigate air pollution to find out shortcomings, inadequacies and difficulties that Ha Noi is facing with. Also, lessons and experiences to deal with the same issue of other metropolises will be examined. Based on such reviews and discussions, suitable solutions and recommendations with focus on adaptation of sustainable development strategies from similar major cities will be proposed for Hanoi for further considerations. During the study process, interviews and discussions with experts and policy makers will be held to finalize the findings and solutions proposed for Ha Noi.

3. RESULTS AND DISCUSSION

3.1. State of Hanoi's urban development

Hanoi's urban planning has transitioned from a rigid Soviet-style Master Plan to a more adaptable Strategic Plan, primarily under the influence of a heightened neoliberal perspective driven by both international and domestic investments (Leducq and Scarwell, 2018). The urban development of the Hanoi Capital Region has been guided by the urban cluster model, which consists of a central core connected to satellite urban areas via road networks and aims to strike a balance between economic growth and environmental preservation (Leducq and Scarwell, 2018). Despite this, the expansion has caused difficulties in managing air pollution, which has been exacerbated by projects such as the Hoa Lac Hi-Tech Park, a science and technology development hub, and the construction of a metro system.

There are some effects that urbanization has caused in Hanoi. In a 2015 paper by Nam et al., it was discovered that the expansion plans in the Hanoi Master Plan 2030 would accelerate the UHI effect and significantly increase energy demand, primarily due to elevated energy consumption. The UHI effect, resulting from urbanization, industrialization, and transportation, causes urban areas to experience higher temperatures compared to their rural surroundings (Nam et al., 2015).

3.2. Problems Hanoi is facing, past and present

Hanoi is located in the center of the Red River Delta and covers an area of 3,358.6km², accounting for 1% of the natural area of the whole country. Hanoi's climate is a tropical monsoon, with humid, rainy summers and arid, cold winters (Hoang et al., 2022). Hanoi experiences a higher maximum temperature value than surrounding cities due to population, socio-economic activities, and the UHI effect. Due to the UHI effect, the temperature in the inner City is about 1 - 2°C higher than surrounding areas, while the relative humidity in the inner City area is higher and the wind speed is weaker in the suburban areas (Hoang et al., 2022). As a result of climate change, the frequency and intensity of heatwaves in the City could increase in the future, leading to heat stress and public health concerns (Hoang et al., 2022).

On the other hand, the population rise of Hanoi came an increase in personal transportation, most prominently motorcycles. In Hanoi, motorcycles account for more than 90% of all vehicles (Nguyen Thi Yen et al., 2022). In a paper by Sakamoto et al. (2018), observed results supported the claim that motorbikes were the primary source of air pollution within the City and traffic within Hanoi. The City also has a public bus system that runs on multiple lines with very affordable tickets. However, many buses, either city or privately-run, are often a few years old and have obsolete or inadequate exhaust systems that emit a significant amount of air pollutants (Leducq and Scarwell, 2018).

Hanoi has a highway network that connects it to other cities in Vietnam. However, many of them, including those recently opened, are already congested. This has resulted in significant traffic issues in and around the City (Leducq and Scarwell, 2018).

Regarding waste management, Hanoi's current technologies and strategies for municipal solid waste (MSW) management are obsolete, as the majority of unsorted MSW is incinerated or landfilled (Hoang and Fogarassy, 2020). This has resulted in severe congestion of existing landfills and has had negative effects on the air, soil, and water quality of the City (Hoang and Fogarassy, 2020).

The emissions are generated from the biodegradation of organic matter contained in the waste, the combustion of waste, the release of gases from decomposing waste, and the evaporation of liquids from the waste and the odors from landfills and improper waste sites can further degrade the air quality of surrounding areas. The incineration of MSWs has been found to significantly affect public health, such as evident in the rise of respiratory diseases resulting from airborne particulates generated from this action (Sonibare et al., 2019).

Also, the rapid growth of the City has led to an increase in industrial activities, transportation, and construction, which has contributed to the City's economic growth but also resulted in higher levels of air pollution.

3.3. Causes and effects of air pollution in Hanoi

According to Ministry of Natural Resources and Environment (MONRE) (2020), the recent worsening of air quality in Hanoi is a result of weather factors combined with inherent pollution emission sources. In the Northern parts of Vietnam, which include Hanoi, the winter season brings in dust from distant sources, combined with dry, cold weather and high pressure, leading to increased PM_{2.5} concentrations (MONRE, 2020). It should be noted that weather is a natural phenomenon that has always existed, and air quality deterioration is due to emissions.

Inversion also plays a role in elevated pollution levels and is particularly pronounced during early mornings, when calm winds are unable to disperse pollutants. When sunlight warms the lower atmosphere, the inversion effect subsides, causing PM_{2.5} particles to disperse, resulting in an improvement in air quality (MONRE, 2020).

Air pollution sources in Hanoi include emissions from traffic, household activities like honeycomb charcoal use, construction dust, and straw burning. Industrial production and coal-fired power plants in neighboring provinces also impact the City's air quality (MONRE, 2020). Besides, the main factors contributing to the severe air pollution episodes in 2019 in Hanoi were local emissions from industrial and urban sources, as well as regional sources of pollution such as biomass burning and the formation of secondary inorganic aerosols (Phung Ngoc et al., 2021). Meteorological conditions also had a significant impact, particularly the Northeast monsoon bringing continental cold air from Siberia, which exacerbated the pollution levels (Phung Ngoc et al., 2021).

3.4. Review of sustainable development strategies implemented in other major metropolises and their effects on air quality

3.4.1. Mitigation of the UHI effect in Kuala Lumpur, Malaysia

Kuala Lumpur (Malaysia) has a similar tropical climate to Hanoi, with distinct wet and dry seasons. The Capital of Malaysia has also undergone significant urbanization in recent years, leading to some environmental concerns that are comparable to those of its Vietnamese counterpart, and similarly, it has taken some measures to combat them (Leducq and Scarwell, 2018; Aflaki et al., 2017), especially urban vegetation. Urban vegetation can significantly mitigate the UHI intensity in Kuala Lumpur, both directly and indirectly, resulting in a decrease in air temperature and mean radiant temperature of up to 4 and 4.5 degrees Celsius, respectively (Aflaki et al., 2017). Green vegetation has also removed pollutants and reduced the concentration of atmospheric nitrogen oxides and sulfur dioxide (Aflaki et al., 2017). However, there are some limitations to the implementation of urban vegetation in the Malaysian Capital, such as limited implementation due to little awareness, lack of suitable spaces for planting, maintenance cost, requirement of highly skilled labor.

3.4.2. Management of MSW in China

China recently has implemented simultaneously several measures for better management of MSW, such as apply higher control standards for MSW incineration in China, use gasification and pyrolysis instead of incineration... Gasification and pyrolysis are advanced waste disposal technologies that can help reduce the environmental impact of waste management (Tian et al., 2013). In a paper by Tian et al., gasification and pyrolysis were found to reduce the volume of waste by up to 90% and 80%, respectively, and produce less air pollution and greenhouse gas emissions than traditional incineration. It was also highlighted within the same paper that gasification and pyrolysis can recover valuable materials from the waste stream, such as metals and glass from gasification and carbon black and metals from pyrolysis, which can be recycled.

However, both methods require significant investment and may not be suitable for all types of waste. The implementation of gasification and pyrolysis demands high



capital and operational costs, as well as high-quality waste feedstock, while still having the potential to emit toxic pollutants (Tian et al., 2013). Therefore, it is suggested that appropriate regulations be developed to ensure the safe and effective operation of these two methods.

3.4.3. Low emission zones in European cities

Low emission zone (LEZ) is a policy implemented in several European cities, including London, England, and Munich, Germany, to reduce air pollution and enhance air quality. The LEZ establishes emission standards for vehicles entering the zone (Ku, Bencekri, Kim, Lee and Lee, 2020). Vehicles that do not meet these standards are required to pay a fee or are prohibited from entering the zone (Ku, Bencekri, Kim, Lee and Lee, 2020).

In London, vehicles must either meet emission standards or pay a daily fee, which can reach up to 110 Euros (Ku, Bencekri, Kim, Lee and Lee, 2020). The analysis of air quality concentrations indicates that the Ultra Low Emission Zone (ULEZ) has significantly reduced NO₂ levels, with central London concentrations decreasing by 46% and inner London concentrations decreasing by 21% compared to a scenario without the ULEZ (Mayor of London, 2023). However, the ULEZ in London still has some limitations.

In Munich, Germany, the LEZ requires vehicles to meet certain emissions standards to enter (Fensterer et al., 2014). The Munich LEZ was implemented in multiple phases, with each phase enforcing increasingly stringent emission standards (Fensterer et al., 2014). The study by Fensterer et al. shows significant reductions in PM10 levels, notably near busy roads and to a lesser extent, in urban background areas. Similar to London, LEZ in Munich still has some limitations which must be overcome.

3.5. Discussion

The findings of this paper, which shows that Hanoi can borrow effective ideas from other cities, can be highly beneficial and serve as suggestions or proposals for policymakers to consider. The effects of these strategies on the air quality of their respective cities have been noteworthy, and with the necessary modifications, they can be implemented in Hanoi. These strategies can work in Hanoi, but modifications are required to accommodate the Capital's distinct personality. There is no solution that is universally applicable. When comparing the findings of this paper to existing research, there are numerous similarities. In other cities, strategies such as planting more vegetation to cool the urban environment and restricting the use of polluting vehicles have been effective. However, this study has limitations. It did not investigate the costs of these strategies or request opinions from residents. In future work, it is essential to examine the costs and public opinions. Also, investigating how different strategies can be combined can be beneficial to better address the research question. The key to making these

changes a reality is cooperation between the Government, businesses, and citizens. While this research helps to determine future steps, additional research and collaboration among concerned parties are needed to implement these changes.

4. RECOMMENDATIONS FOR HANOI

As Hanoi goes through its own urbanization process, the incorporation of successful strategies employed in other global cities becomes a potential avenue for sustainable development and effective urban planning. To successfully implement these strategies, Hanoi must adapt them to its unique sociocultural, geographical, and infrastructural characteristics.

4.1. Urban vegetation

Adapting the urban vegetation strategy from Kuala Lumpur to Hanoi requires adjustments that consider each City's unique characteristics. Even though both cities have a tropical climate with wet and dry seasons, Hanoi's layout, weather patterns, and particular challenges affect the efficacy of the strategy. Introducing elements such as green roofs, vertical gardens, and green pavements could assist in mitigating the UHI effect, improving air quality, and creating more comfortable outdoor spaces (Leducq and Scarwell, 2018; Aflaki et al., 2017). However, the selection of plant species should be tailored to Hanoi's climate, which includes both high temperatures and heavy precipitation (Leducq and Scarwell, 2018).

Also, adapting the strategy for Hanoi requires consideration of space constraints and the population density of the City. Hanoi, in contrast to Kuala Lumpur, has narrower streets and a distinct urban layout, requiring innovative means of incorporating green spaces (Leducq and Scarwell, 2018; Aflaki et al., 2017). It will be essential to collaborate with City planners, environmental experts, and local communities to find good locations and designs that complement Hanoi's urban landscape. Lessons from Kuala Lumpur demonstrate the importance of involving and educating local residents (Aflaki et al., 2017). By describing the numerous advantages of urban greenery, Hanoi can foster a sense of community involvement in its evolving urban landscape. Collaboration with those who have a stake in the City will be crucial to long-term success.



To keep Hanoi's urban vegetation flourishing, its people and policymakers must prioritize and develop regular maintenance and management strategies. Creating clear guidelines for maintenance and closely monitoring the condition of the green installations will ensure their longevity. In addition, keeping track of ongoing research will assist in making well-informed decisions, enhancing the strategy's effectiveness and adaptability. In short, adapting Kuala Lumpur's urban vegetation strategy for Hanoi necessitates combining global concepts with local factors.

4.2. Management of MSW

Adapting effective waste management strategies to Hanoi demands a strategic, adaptive approach. Effective implementation requires consideration of the City's distinct waste generation patterns, existing infrastructure, and socioeconomic factors. The patterns of waste generation in Hanoi must be thoroughly examined so strategies can be adapted accordingly. Appropriate waste management solutions can be determined by analyzing the types and amounts of waste produced as well as their seasonal variations. Equally important is evaluating the compatibility of Hanoi's current waste infrastructure with the proposed strategies.

Socioeconomic variables also play an important role. Adaptations will only be equitable if income disparities, local industries, and resident needs are considered. Garnering engagement from residents, businesses, and waste management authorities will be essential for gaining support and achieving success.

Increasing public awareness is essential. Informative campaigns can educate the citizens of Hanoi on the benefits of new strategies, encouraging their participation and compliance. Developing regulations that address Hanoi's unique waste management challenges will provide a solid foundation for transformation.

Partnerships with industries, academic institutions, and relevant stakeholders will facilitate the transfer of technology and the development of applicable solutions. These partnerships ensure that adaptations are compatible with Hanoi's context and contribute to an improvement in air quality and a greener urban environment.

4.3. Implementation of LEZ

For Hanoi to adapt LEZ strategies effectively, careful planning is necessary. It is essential to identify the unique characteristics of Hanoi's air pollution sources, traffic patterns, and urban layout. Hanoi's street and road system is different from that in European cities, with different types and amounts of vehicles and varying levels of emissions. By adapting emission standards and zone boundaries to Hanoi's unique challenges, the City can ensure the most influential impact. Campaigns and initiatives promoting public participation and awareness are equally important. Collaboration with local industries, transport providers, and regulatory bodies will facilitate the integration of LEZ policies into Hanoi's infrastructure.

Furthermore, Hanoi can learn from the limitations of existing LEZs. Although such zones have been effective, they are not a stand-alone solution (Fensterer et al., 2014; Mayor of London, 2023). Consequently, Hanoi must supplement a LEZ with broader strategies addressing industrial emissions, construction activities, and residential heating. By taking a comprehensive approach and fostering inclusivity, Hanoi can pave the way for cleaner air, improved public health, and a more sustainable urban future.

5. CONCLUSION

As Hanoi is facing ongoing air quality issues because of rapid urbanization, population growth, and industrialization, learning from sustainable development strategies implemented in major cities around the world can provide valuable insights for the City's own sustainable development. The complex interactions of factors contributing to Hanoi's air pollution emphasize the need for individualized, multifaceted solutions that consider the City's distinct features.

The urban vegetation initiatives of Kuala Lumpur provide Hanoi with a model for mitigating the UHI effect and improving air quality. By adapting this strategy to Hanoi's climate and urban layout, the City can strategically introduce green spaces to combat the UHI effect and subsequently improve the City's air quality.

China's advancements in regulating waste management and the development of advanced waste disposal techniques such as gasification and pyrolysis provide Hanoi with models for effective municipal waste management. Adapting these strategies to Hanoi's waste generation patterns and infrastructure can reduce waste volume and, as a result, air pollution.

Lessons learned from the implementation of LEZs in cities such as London and Munich highlight the need for targeted policies to reduce vehicle emissions and improve air quality. These cities' experiences can be used to design policies that encourage the use of public transportation, promote cleaner modes of transportation, and set up effective compliance mechanisms considering Hanoi's growing vehicle congestion and number, combined with rising air pollution.



To implement these measures, Government bodies, private sector stakeholders, and local communities must cooperate. Effective governance mechanisms, transparent regulations, and clear implementation strategies are essential for closing the gap between policy development and measurable outcomes.

Furthermore, by utilizing technology for real-time monitoring and data-driven decision-making, Hanoi could be able to track progress and make informed adjustments as needed. Furthermore, aligning economic incentives with sustainable practices can encourage citizens and businesses to adopt more environmentally friendly behaviors.

Overall, Hanoi's goal of enhanced air quality through the adaptation of successful strategies from other cities requires a systematic approach. The city can address air quality challenges with precision and informed choices by tailoring these strategies to Hanoi's unique urban landscape, legal framework, and social and economic context ■

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Strengthening management of the coastal soil and water environment

HOÀNG NHẤT THỐNG

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Ministry of Natural Resources and Environment

Coastal zone is the transition area between the mainland or island and the sea, including coastal sea and coastal land area. This place is under great environmental pressure due to socio-economic activities from the continent, activities at sea as well as natural movements. The coastal zone is a sensitive area, containing “hot spots” of marine environmental pollution, including soil and water pollution. Recently, soil and water resources in the coastal zone have tended to increase in pollution, while management of the marine environment is facing problems. Therefore, solutions to strengthen the management of the marine environment, including the soil and water environment in coastal zones.

Current status of soil and water environment in coastal zone

Vietnam's coastal zone has a coastline of over 3,260km (excluding island shores) spanning many regions having different geographical and geological characteristics with hundreds of estuaries, lagoons, bays, islands and archipelagos... creating a system of complex, diverse habitat types and the presence of diverse ecosystems: Tidal flats, mangrove forests, estuaries, lagoons, coves, coral reefs, deltas, sandbanks, tidal mudflats, upwellings, brackish water aquaculture lagoons, coastal wetlands... This place also converges 6/8 world heritage sites, 7/11 world biosphere reserves, 8 national parks, 15 marine protected areas, 44 bays and 125 beaches that can be exploited for tourism development.

Vietnam's coastal zone has 28/63 provinces and centrally governed cities, where up to 50% of the country's population is concentrated, with vibrant socio-economic activities taking place because of its advantage in natural resources and human resources. Vietnam's coastal zone has over 300 industrial production locations including marine economic zones, industrial parks, industrial clusters, and coastal export processing zones, along with scattered industrial establishments and many coastal craft villages. Vietnam's coastal provinces are also provinces with large agricultural production output. These industrial, handicraft, farming, animal husbandry and aquaculture activities have released huge amounts of waste into the coastal soil and water environment. The geographical location, natural conditions, and specific characteristics of Vietnam's seas and islands have created great pressure on the marine environment, especially the problem of cross-border marine pollution and marine environment of unknown origin as well as the existing impacts of climate change and sea level rise. These factors also put considerable pressure on the coastal soil and water environment of Vietnam.

Solid waste in the coastal zone: In recent years, solid waste in the coastal zone of Vietnam has increased from socio-economic activities such as industry, agriculture, infrastructure construction, tourism, daily life, healthcare... According to the Ministry of Natural Resources and Environment (MONRE), coastal territories have a higher level of solid waste generation than territories far from the sea: The Southeast (32%), Red River Delta (22%), North Central and Central Coast (18%), Mekong Delta (15%), Northern Midlands and Mountains (7%), Central Highlands (5%).

In 2014, the volume of urban domestic solid waste (including coastal cities) generated was about 32,000 tons/day. By 2019, the volume of urban domestic solid waste generated reached 35,624 tons/day. The country's industrial solid waste in 2011 was 22,400 tons/day, while coastal territories accounted for 20,670 tons/day (Southeast: 7,570 tons/day; Red River Delta: 7,250 tons/day; North Central and Central Coast: 3,680 tons/day; Mekong Delta: 2,170 tons/day). Statistics in some localities in 2014, except for Ha Noi City, show that some coastal provinces generated a higher volume of solid waste from medical activities than inland provinces (Nghe An: 3,904 tons/year; Ninh Binh: 3,548 tons/year; Thanh Hoa: 3,128 tons/year; Lang Son: 1,706 tons/year; Kon Tum: 3.22 tons/year; An Giang: 236 tons/year).

Besides, in rural areas (including coastal rural areas), solid waste generated is increasing, from 18,200 tons/day in 2011 to 28,394 tons/day in 2019. The development of craft villages (including coastal craft villages), especially metal recycling and copper casting craft villages, also puts great pressure on the environment by emitting large volumes of solid waste.

Coastal continental surface water environment: With a dense river system in 10 river basins distributed and spread across the country having a total area of over 1,167 million km², the total average annual surface water volume of Viet Nam is about 830 billion m³. Due to flow characteristics,



the seasonal distribution of water is uneven. Wastewater from industrial and handicraft establishments, agricultural activities, and domestic and other activities, following the river system to the coastal area, pollutes the continental surface water environment in the coastal zone when pollutants in water have concentrations that exceed allowable standards, ranging from 1.5 to 3 times.

Coastal seawater environment: According to the assessment of the MONRE, Viet Nam's coastal seawater quality is still quite good with most values of parameters typical for seawater quality within allowable limits of QCVN 10-MT:2015/BTNMT. However, the coastal seawater environment at some times in the rainy season due to the increase in the value of organic compounds, nitrogen-containing compounds (NH_4^+), TSS from land to sea, and the drift of pollutants from offshore to the coastal strip, so the marine environmental risk quotient (RQ) in some sea areas is high (Tra Co, Quang Ninh Province) and very high (Dinh An, Tra Vinh Province); NH_4^+ , TSS, Fe, Coliform, and P-PO_4^{3-} content values exceed QCVN 10-MT:2015/BTNMT in some Northern coastal areas; some parameters such as NH_4^+ , Coliform, DO, TSS and Fe have contents exceeding the allowable limit of QCVN 10-MT:2015/BTNMT in some Central coastal areas; main pollution parameters include NH_4^+ , Coliform, TSS and Fe in some Southern coastal areas.

Pollution in Vietnam's coastal zone affects the soil and water environment. Domestic solid waste is dumped directly on the ground such as in spontaneous landfills, organic components decompose in anaerobic conditions and under the action of microorganisms will create organic acids that acidify (sour) the soil. In addition, the accumulation of heavy metals and hazardous substances in the soil due to seepage from leachate into the soil also contributes to soil environmental pollution. Domestic solid waste discharged into water sources causes substances to float to the surface of the water, causing loss of landscape, blocking the transmission of light, and affecting the photosynthesis process of plants in the water. Domestic solid waste suspended in water, especially plastics, will get tangled in boat propellers, blocking traffic, and affecting aquatic species. Waste settles to the bottom, an increased volume of sediment must be dredged every year and the anaerobic digestion process produces toxic gases that poison aquatic species.

Waste from socio-economic activities affects the soil environment by affecting the physical and chemical properties of the soil. Physical impacts such as erosion, soil compaction, and destruction of soil structure due to construction and production activities. Solid, liquid, and gaseous wastes can accumulate in soil for long periods, causing chemical effects and potential risks to the soil environment.

Industrial waste includes toxic chemicals and heavy metals that are highly accumulative in soils rich in clay minerals and humus. Gas emissions pose many potential risks to the quality of the soil environment because they have the ability to agglomerate or form acid rain that falls to the ground, polluting the soil. Wastes that pollute the soil at high levels are from detergents, dyes, paints, the battery manufacturing industry, leather tanning, and the chemical manufacturing industry. Many types of organic matter coming from sewer water, city ditches, and industrial wastewater used as a source of irrigation water in agricultural production are also agents of soil pollution.

Wastewater from coastal production areas and residential areas is untreated and discharged directly into the environment through canals and seeps into the soil, causing soil pollution and changing the content of chemicals in the soil. Leachate from composting tanks and landfills has extremely high organic pollutant loads as well as heavy metals that are not treated according to regulations and will seep into the ground, polluting the soil and groundwater in the coastal zone.

It is the factors that cause increased environmental pollution in the coastal zone along with climate change that has caused the soil environment to face soil degradation (salination, humification, drought, erosion, desertification) in Quang Ninh, Da Nang, Ba Ria - Vung Tau, Ho Chi Minh City, Tien Giang, Bac Lieu, Ca Mau...; or soil pollution in Nghe An, Ha Tinh, Da Nang, Binh Dinh; marine environmental RQ by coastal seawater in some areas has high levels (Tra Co, Quang Ninh) and very high levels (Dinh An, Tra Vinh).

Issues raised in the management of soil and water environment in coastal zone

Recently, the State of Viet Nam has paid attention and focused on marine environmental management (including coastal soil and water environment) through promulgating and organizing the implementation of a system of policies and legislations, programs, plans and evaluation of the results of activities to control marine and coastal environmental pollution...

Although certain results have been achieved, marine environmental management (including coastal soil and water environment) in Viet Nam is also facing limited management problems:

Firstly, legislation on marine environmental management still leaves blank the issue of determining damage and liability for compensation due to marine environmental incidents; there are no specific regulations and



instructions on the management, collection, reduction, and treatment of ocean plastic waste in the context of increasingly serious ocean plastic waste pollution in our country today.

Legislation also does not have specific, unified, and synchronous regulations for sea reclamation activities, so it is very difficult to meet the requirements for protecting the coastal soil and water environment; lack of sanctions to handle violations by organizations and individuals when violating regulations on integrated management of natural resources and environmental protection of sea and islands.

Many documents on economic and technical norms related to the marine environment were issued a long time ago and are outdated, but are slowly amended and supplemented, so they are no longer suitable for practical requirements for marine environmental management.

Secondly, the organization of the state management agencies for the marine environment still has overlapping tasks among agencies, especially a unified mechanism for coordinating marine environmental management activities has not really been established.

Thirdly, the team of civil servants performing the task of state management of the marine environment is limited at both the Central and local levels, especially civil servants in organizations performing the function of state-integrated management of the seas and islands.

Fourthly, material resources for marine environmental management still have many problems and have not been invested commensurate with marine environmental management requirements.

Fifthly, the role of residential communities, organizations, individuals, and other stakeholders participating in marine environmental management has not been promoted.

Sixthly, activities of checking, controlling, inspecting and handling violations of the marine environment are irregular, incomplete and slow to detect violations. Supervision activities of the Provincial People's Council and local National Assembly Delegation on the environment (including the marine environment) in the areas have not yet been paid attention to, and sometimes they are formal, and effectiveness is still not high.

Some solutions for the management of soil and water environment in the coastal zone

To strengthen the management of the marine environment in Viet Nam (including coastal soil and water environment) in the coming time, the following solutions are needed:

Firstly, organize a review to amend, supplement, and develop new legal regulations on marine environmental management: First of all, organize the development and promulgation of regulations on determining damage and liability to compensate for damage caused by marine environmental incidents; develop and promulgate regulations related to controlling and minimizing ocean plastic waste; develop and promulgate regulations on sea reclamation to

control negative impacts on the marine environment from sea reclamation activities. At the same time, supplement and promulgate new specific regulations on handling violations of the contents of integrated resource management and environmental protection of seas and islands. In addition, it is necessary to promote the development and promulgation of economic and technical norms for marine environmental management.

Secondly, develop and promulgate mechanisms and policies to encourage the community and relevant parties to participate in marine environmental management: Based on economic and educational tools, develop mechanisms and policies to encourage the promotion of community regulations on marine environmental management appropriate to the new context. Complete the mechanism to ensure community participation in the formulation of strategies, master plans and programs for integrated management of coastal resources; establish coastal protection corridors; conduct environmental impact assessment for projects on seas, islands and coastal zones.

Thirdly, organize the development and implementation of strategies and master plans for resource exploitation and environmental protection of seas and islands: Focus on completing the development, submission to competent authorities for approval and implementation of the National Marine Spatial Master Plan, the Master Plan on Sustainable Exploitation and Use of Coastal Resources for the period of 2021 - 2030, with a vision to 2050. Organize the immediate implementation of solutions to protect the marine environment and coastal zone in the process of implementing the Strategy for the Sustainable Exploitation and Use of Natural Resources and Protection of the Marine and Island Environment to 2030, with a vision to 2050.

Fourthly, improve the coordination mechanism between agencies in developing and implementing policies and legislations on integrated management of natural resources and environmental protection of seas and islands: Carry out a review to complete regulations on the assignment of responsibilities of each agency on the basis of the legislations on marine and island resources and environment. In particular, clearly identify the agency that performs the function of coordinating activities of integrated resource management and environmental protection



of seas and islands; clearly define the contents of coordination between relevant agencies in integrated resource management and environmental protection of seas and islands.

Fifthly, improve the quality of civil servants and public employees: Strengthen the organization of training courses on expertise and integrated marine management as well as marine environmental management to improve the capacity of civil servants to perform their duties; promote public service ethics and increase the responsibility of civil servants and public employees in performing marine environmental management tasks. At the same time, it is necessary to ensure enough civil servants to carry out marine environmental management tasks based on determining specific job positions, especially in coastal localities.

Sixthly, increase investment and effective use of facilities, equipment, and public finance for marine environmental management: Invest in improving the capacity to monitor, supervise, and forecast marine resources and environment; establish a comprehensive and synchronous information system and database on marine and island resources and environment. At the same time, promote proactiveness in finding, establishing, and promoting international cooperation on the marine environment; proactively seek foreign funding sources using new financial mechanisms such as ODA loans, concessional loans, public-private partnerships, foreign investment... Develop programs and projects with medium to large scope and scale having an impact on policy, which solves many multi-sectoral, cross-field, inter-regional, and cross-border issues. In addition, it is necessary to focus on scientific research and technology applications, promoting innovation in marine environmental management.

Seventhly, raise awareness about the marine environment: Diversify the contents, methods, and forms of legal propaganda and education, raise awareness about the sea, sustainable exploitation and use of resources, and marine and island environment protection. Deploy synchronously and effectively all forms of propaganda and education on maritime legislation, sustainable exploitation and use of resources, and marine and island environment protection.

Eighthly, improve the quality of investigation, inspection, and supervision of the implementation of policies and legislations on marine environmental management: Strengthen control of marine environmental pollution; improve the effectiveness of coordination in pollution control, prevention and response to marine environmental incidents, climate change and sea level rise. Promote the activities of elected agencies, socio-political organizations and socio-professional organizations in supervising and inspecting the implementation of policies and legislations on marine environmental management ■

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In the context that climate change is becoming a major challenge for every country in the world, with a threat to the lives of ten million people and the property of many countries worth many trillion USD. Many policies aimed at combating climate change and restoring nature are receiving attention and priority in all policies of countries. Green growth and sustainable development are the trends and directions of many economies around the world to effectively respond to the negative impacts of climate change, especially for developing countries like Vietnam. To successfully implement the national strategy on green growth towards sustainable development, therefore, it is necessary to mobilize resources from the entire society, in which the banking system plays a key role. The Fourth Industrial Revolution (Industry 4.0), with digital technology and digital transformation, will promote this role.

1. Industry 4.0 with digital transformation in the banking system

In the history of development, the global industry has gone through three industrial revolutions and today is in the process of Industry 4.0. In previous industrial revolutions, mechanical power, oil, and electricity were the materials for economic development driving force, then in the 4.0 era, data became a new resource. In the 4.0 era, IoT and Blockchain technologies are acting as data "drilling rigs", poured into the reservoir of Big Data, refined by AI based on the cloud computing platform, and have become useful information before transferring to automation



Promoting the role of digital transformation in the banking system for green growth and sustainable development

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applications (Automation/IoT). Industry 4.0 has been having profound impacts on the economy in general and the financial market, especially the banking sector. From there, the concept of “digital transformation” or “digital banking” in the banking sector, was formed.

Digital banking is a banking model that operates based on technological processes to provide all services to customers through digital devices connected to the Internet, mobile telecommunications networks, or self-service branches. In fact, recently there have been views on the nature of digital banking and electronic banking services, however, these are two different concepts. Electronic banking includes Internet Banking, SMS Banking, and Mobile Banking services, which are service delivery channels for customers based on the bank’s existing business processes; Digital banking are banks that operate based on the digitization of banking activities: From digitizing traditional distribution channels and developing modern distribution channels to automating business processes, applying big data analysis serving the decision-making process and creating digital products, applying innovative products. Thus, digital banking is more comprehensive, and modern than electronic banking.

2. The role of banks in green growth, toward sustainable development

Along with economic development, natural disasters and epidemics are becoming increasingly serious (such as climate change and the recent Covid-19 pandemic). That is an inevitable consequence of the process of pursuing the goal of economic development at all costs, which has left imbalances and, moreover, the destruction of the natural environment, causing extremely serious global climate change that humans are suffering from. To sustainably develop the economy, many countries around the world, including Vietnam, have chosen to develop a green economy. This policy has been clearly expressed in the National Strategy on Green Growth; National Action Plan on Green Growth for the period of 2021 - 2030 and other documents.

In the context of increasingly depleted resources and serious environmental deterioration, the change to “green” production and consumption trends is not only an inevitable rule but also represents the progress of society and the Government’s determination to promote the green economic growth model, moving towards sustainable development. Green growth is an important content of sustainable development. The pillars of green growth include; (1) Modern science and technology; (2) The use

of environmentally friendly renewable energy; (3) The consumption of goods, products, and services that cause the least damage to the environment. In that context, the banking sector also had a shift in its development strategy, and the category of “green banking” appeared.

In a broad concept, “green banking is sustainable banking” (Imeson M., and Sim A., 2010), research shows that, for a bank to develop sustainably, investment decisions need to look at the big picture and act in a way that benefits consumers, the economy, society, and the environment. In a narrow concept, “green banking” refers to the bank’s professional activities that encourage environmental activities and reduce carbon emissions, such as: Encouraging customers to use green products and services; Applying environmental standards when approving loans, or granting concessional credit for CO₂ reduction, renewable energy projects... (UN ESCAP, 2012). Thus, a bank is called “green” when it provides services associated with environmental commitments or invests in lending for clean, green production. Therefore, banks play a key role in “greening” investment capital flows; actively contribute to promoting the process of green economic development and transition, to orient sustainable development. And digital transformation promotes this role of banks.

3. Digital transformation promoting the role of the banking system in green growth, toward sustainable development

Vietnam is one of the countries most vulnerable to climate change, in recent times, Vietnam has always proactively and actively implemented many activities to both respond to climate change and towards green and sustainable development. In this context, at the 26th UN Climate Change Conference of the Parties (COP26), the Prime Minister of Vietnam made strong commitments from Viet Nam as determined to bring net emissions to “zero” by 2050 which has been highly appreciated by the interna-

tional community, thereby opening up many opportunities for cooperation on low-emission growth, promoting circular economy development, adapting to climate change, creating favourable momentum for Vietnam to develop quickly and sustainably. To realize the above goal, immediately after the COP26 with the drastic direction of the Prime Minister, the National Steering Committee for implementing Vietnam's commitments at COP26 was established with the participation of many Ministries and sectors, including the State Bank of Vietnam along with specific programs, tasks and goals and affirmed Viet Nam's determination to the international community.

According to World Bank estimates in the Vietnam Country Climate and Development Report (CCDR), to implement the green growth, climate change adaptation, and net zero emissions roadmap, it is expected that Vietnam will need to mobilize additional financial resources of about 6.8% of annual GDP, equivalent to about 368 billion USD from now to 2040, of which about 50% needs to be mobilized from the private sector. The banking sector has developed and issued the "Green Banking Development Project" in Vietnam, closely following the Government's policy on "National Action Plan on Green Growth for the period of 2021 - 2030, vision to 2050". As a financial intermediary, the banking sector needs to participate more deeply in the process of economic transformation towards green growth, sustainable development, and digital transformation to help promote this role.

When banks apply digital technology transaction space Digital Lab, will help customers enjoy, experience, and feel self-service banking through the application of modern technology and equipment; Mobile Banking, Internet Banking services with a modern, friendly, easy-to-use interface design. Updated May 2022, non-cash payment transactions increased by 69.7% in quantity, and 27.5% in value, and Internet transactions also increased by 48.39% in quantity and 32.76% in value, payments via mobile phone channels increased by 97.65% and 86.68% respectively; payment via QR Code has also increased by 56.52% and 111.62% respectively over the same period in 2021, the total number of activated e-wallets increased by 10.37% compared to the end of 2021. This result shows that banks have successfully applied the achievements of Industry 4.0.



▲ Digital transformation helps banks reduce direct transactions, contributing to protect natural resources and the environment

But even more meaningfully, in terms of environmental protection, applying digital transformation helps banks save a lot of paper and ink, contributing to reducing CO₂ emissions and protecting the environment - towards green growth and sustainable development.

Digital transformation helps banks reduce direct transactions, moving towards "no customers at the transaction office", contributing to protect natural resources and the environment, towards sustainable development. If green credit activities are just the beginning, green internal activities have been focused on developing by banks in recent times. Therefore, digital transformation helps banks reduce carbon emissions in banking by performing online activities, using ATM systems, mobile banking, cards, and exchanging via email... In addition, when banks apply digital transformation, customers do not need to travel to transaction offices, contributing to minimizing the use of gasoline and oil that depleting resources. Besides, limiting traffic will also reduce CO₂ emissions into the environment, helping to keep the environment clean. Therefore, digital transformation helped banks fulfil their role in promoting green and sustainable development.

On the basis of Industry 4.0, along with taking advantage of scale and sharing economies, the deployment of high-tech digital technology applications related to Internet connection, cloud computing, sensor tech-



nology, virtual reality... will help reduce transaction, transportation, and management costs, contributing to financial savings for Vietnamese banks and improving profits, ensuring high availability for the system in meeting customers' needs for using electronic banking services...

The role of digital transformation in banking for green economic development and sustainable development is important. However, there are currently a number of issues that need to be resolved for this role to be more effective, such as the national database systems are not complete on economic and financial information, standardization of the format and content of collected information; the mechanism for collecting, linking, and sharing information effectively between entities participating in the financial market in general and the green financial market, in particular, has not yet been completed...

4. Solutions for digital transformation to promote the role of the banking system in green growth, toward sustainable development

Firstly, the Government and relevant Ministries, agencies, and sectors need to build a database system as well as mechanisms and methods to access and share information effectively, transparently, and publicly among management agencies from central to local levels and to market participants.

Information is an important input factor in developing digital transformation of the banking system to promote green economy and sustainable development. Information about businesses or projects that need to mobilize green financial capital will help banks more easily make decisions to finance those projects. From the perspective of control and management of lenders, investors, or state management agencies throughout the investment, funding, and use of green financial resources, information about businesses and projects also plays a particularly key role. Therefore, one of the top priorities in digital transformation for banks to mobilize and use green financial resources is to ensure the ability to provide, store, and access quality, transparent, and public information sources to provide data to evaluate the greenness of a business, a project... In the coming time, Vietnam needs to soon complete and put into use a complete national database system of economic-financial information, and standardize the format, as well as the content, of collected information. Next, it is necessary to build an effective mechanism for collecting, linking, and sharing information between entities participating in the financial market in general and the green financial market in particular. This will create a foundation for banks to exploit information and apply digital transformation to help the economy develop green and sustainably.

Secondly, about internal transactions of banks. Banks should encourage, advocate, and propagate to employees to limit the use of printing in reports or pol-

icy approval submissions. At the same time, banks should also use alternative and energy-saving products, the one hand, to save costs and on the other hand to help protect the environment. In addition, banks can also switch to using renewable energy such as solar, and wind energy... to manage their offices and ATMs.

Additionally, banks need to expand and bring more complex products and services to the online transaction system, such as the transfer of money abroad, foreign exchange transactions, the opening of letters of credit, requests for issuance of guarantees, or requests for automatic disbursement or automatic payment from the customer's accounting system.

Thirdly, banks need to establish a specialized department that understands digital transformation and has in-depth knowledge and experience in green banking, sustainable growth, and has expertise and experience in appraising issues related to the environment... to make the bank a leading enterprise in commitment to the environment, society, and sustainable finance.

The specialized department is also the focal point in encouraging the entire bank to implement internal initiatives to minimize the bank's own impact on the environment, by managing and reducing its carbon emissions. Once established, the specialized department will conduct training and develop unified policies so that all member units of the bank can jointly research and develop initiatives to increase positive impacts of banking operations on the environment and society. Training on environmental and social risk management for bank officials and employees needs to be regularly focused on so that this specialized department can operate effectively. A further step is to link with universities and include these contents as one of the mandatory trainings content at universities ■

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Access to land for small and medium-sized enterprises - Issues raised in improving land policy

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Resolution No. 18-NQ/TW dated 16th June 2022 on “Continuing to renew and improve institutions and policies to strengthen the effectiveness, and efficiency of land management and land use, creating motivation for Vietnam to become a developed country and high-income” has commented, “administrative reform in land management is still slow and does not meet practical requirements; access to land for enterprises, especially small and medium-sized enterprises (SMEs), is still difficult...”

1. INTRODUCTION

In the world, SMEs play a very important role in implementing socio-economic development goals. In recent decades, this business system has been a central target of policies to support the economic development of countries. Research on “Land Tenure and Rights for Improved Land Management and Sustainable Development” by Emmanuel Kasimbazi (2017) stated that “Access to land, security of land use and land management rights are all important for livelihoods, development, reducing land degradation and investing in sustainable land management...” In Vietnam, in order to concretize the provisions of the Constitution 2013 to ensure that all entities in different economic sectors are equal and shall cooperate and compete with one another in accordance with Law (Article 51), the Party and State have developed and issued Resolution No. 35/NQ-CP dated 16th May 2016 on supporting and developing enterprises until 2020, Resolution No. 19-2016/NQ-CP dated 28th April 2016 of the Government issued with the main tasks and solutions to improve the business environment, enhance national competitiveness in 2016 - 2017 with an orientation to 2020 and especially, the Law on Support for SMEs issued on 12th June 2017.

In Resolution No. 35/NQ-CP, the Ministry of Natural Resources and Environment (MONRE) shall assume the prime responsibility for, and coordinate with relevant Ministries and agencies to carry out the task: “Research and propose policy mechanisms to support enterprises to access production land in industrial parks and industrial clusters and allow flexible land rental payment terms to suit the needs of SMEs” to create a favorable environment to support start-up and innovative enterprises.

In Resolution No. 19-2016/NQ-CP, the Government assigned the responsibility to the MONRE: “Complete amendments to regulations on administrative procedures in registration... Propose solutions to publicize funds for unused land, unleased land, and subleased land in industrial parks, industrial clusters, export processing

zones, economic zones, and land allocated and leased by the State but slowly put land into use. Create favorable conditions for enterprises, especially SMEs to access land”.

The Law on Support for SMEs stipulates: “Exemption and reduction of land use fees for a limited period according to the provisions of land legislation” (Clause 2, Article 16). Article 15 of the Law on Investment 2020 stipulates the form of investment incentives, including incentives for “exemption and reduction of land use fees, land rent, and land use tax” for those eligible for investment incentives including: “Investment in the business of product distribution chains of SMEs; investment in the business of technical facilities to support SMEs and incubate SMEs; investment in the business of a common working area to support innovative start-up SMEs in accordance with the legislation on supporting SMEs” (Clause 2, Article 15). Thus, the viewpoints and policy orientations of the Party and State have paid attention to the issue of access to land for SMEs. The right to access land for SMEs requires ensuring the right to fairness and equality in land exploitation and use compared to entities of all economic sectors.

2. ACCESS TO LAND FOR SMES IN VIETNAM CURRENTLY

“Access to land” is not a completely new term, however, there is no complete concept or definition of “access to land”. The terms “access to land” or “access to land use rights” are not currently recorded in land legal documents. However, “access to land and stability in land use” is one of 10 indexes for VCCI to evaluate the competitiveness of localities in attracting investment through the Provincial Competitiveness Index (PCI). The PCI uses the index “access to land and stability in land use” to measure two aspects of the land problem that enterprises face: Whether it is easy to access land and whether enterprises feel secure and assured of stability when they have business premises.



Article 3 of the Civil Code states the basic principle that “all individuals and legal entities are equal, must not use any reason to discriminate, and are equally protected by Law in terms of personal and financial rights”. Thus, all land users need to be guaranteed the same rights. Article 27 of the Land Law 2013 defines: “Enterprise is one of the objects belonging to the group of economic organizations”. However, the current land policy does not clearly demonstrate and delineate land use regulations for land users who are SMEs.

According to statistics from the Ministry of Planning and Investment in the “Vietnam SME White Paper 2014”, the proportion of SMEs with land is relatively high compared to large enterprises, the proportion of SMEs with land and ownership of certificate of land use rights is relatively low compared to large enterprises. On average, 87% of SMEs have land, specifically 93% of micro-enterprises, 83% of small enterprises and 63% of medium-sized enterprises have land, production, and business premises (possibly originating from assets of individuals, families, or the State allocates land with land use fees, enterprises receive transfer of land use rights, lease land from the State or sublease from individuals...). However, for enterprises with land of the above origin, only 54% of micro-enterprises, 56% of small enterprises, and 71% of medium-sized enterprises have certificates of land use rights; as for large-scale enterprises, up to 87% have certificates of land use rights. These figures partly explain that SMEs’ access to bank capital is significantly lower than that of large-scale enterprises. On average, 40% of micro-enterprises, 62% of small enterprises, and 74% of medium-sized enterprises have loans from banks; this figure for large-scale enterprises is up to 81%. About 90% of SMEs said they must have mortgaged assets when borrowing money from banks, significantly higher than the rate of large enterprises (82%).

On the other hand, the stability of the business premises of enterprises is relatively low compared to large-scale enterprises. Only 22% of the micro-enterprises, 24% of small enterprises, and 29% of medium-sized enterprises said that the level of stability of their business premises (measured by the assessment that the risk of land acquisition is low) is high or very high; this rate of large-scale enterprises is 31%. Assessing the ability to receive adequate compensation for business premises if it is recovered, 29% of the micro-enterprises, 31% of small enterprises, and 32% of medium-sized enterprises said they are likely to or always receive adequate compensation, this figure for large-scale enterprises is 37%.

Another assessment also shows that SMEs have difficulty accessing land in localities compared to large-scale enterprises. 27% of SMEs said they did not encounter difficulty in accessing or expanding production and business premises. However, for large-scale enterprises, this rate is 35%. For some localities, there is a policy of relocating production and processing facilities out of

urban areas to avoid pollution, and ensure fire and explosion safety... also making it difficult for SMEs to find a place to relocate when they cannot enter industrial parks and clusters because of high land rents.

Currently, the number of SMEs with land located in industrial parks/clusters is very low, less than 3% of the micro-enterprises and 8% of small enterprises have land located in industrial parks and clusters. For medium-sized enterprises, this figure is nearly 19%, this rate is lower than the figure of 35% for large-scale enterprises. While the demand for land rental in industrial parks and clusters of SMEs is very large, the State needs to have uniform policies on rental prices, as well as planning, labor, and infrastructure to create more favorable conditions for SMEs in accessing land in industrial parks/clusters.

3. ISSUES IN COMPLETING LAND POLICY TO IMPROVE ACCESS TO LAND FOR SMEs

Access to and registration of land for enterprises in Vietnam have gone through many stages of amending and improving policies. However, there are still many difficulties and inadequacies, especially for SMEs in production, business, trade, and services. Some reasons can be stated as follows:

Firstly, provinces/cities have almost no separate policies for SMEs, and have mainly devoted resources to large projects and FDI enterprises.

Secondly, production premises for SMEs are very difficult, and the proportion of SMEs accessing land in industrial clusters is very low (medium - sized enterprises account for 19%, small enterprises account for 8%, and micro-enterprises account for 3%). Most SMEs are still taking advantage of land in residential areas, renting houses as production and business premises. In fact, subleasing in industrial parks and clusters by SMEs is still limited because the scale of leased land according to detailed construction planning of industrial parks and clusters is often not consistent with the ability of SMEs to pay. This leads to a situation where some investment projects subject to land acquisition have to wait for the State to spend large costs to carry out land acquisition, site clearance, and create a clean land fund to allocate and lease land to investors; while small investors are not economically qualified to receive free land use rights on

the market. According to Clause 8, Article 168 of the Draft Land Law (amended) has also researched and supplemented provisions on land for industrial parks, export processing zones, and industrial clusters, stipulating: “Investors of industrial park infrastructure are responsible for setting aside industrial land funds with invested infrastructure for the Provincial People’s Committee to lease land to SMEs...”, however, there should be guiding provisions for the Law to come into practice.

Thirdly, land use planning does not meet the development needs of enterprises, many plots of land are far from infrastructure, next to polluted areas, or too close to residential areas. Overlapping between types of planning, adjusting planning, and not fully disclosing information about planning options has made it difficult for enterprises to access land. It is very difficult for SMEs to access land when access to planning information is still difficult, enterprises are likely to face risks when land is recovered, especially SMEs are not able to keep up with the State’s land planning adjustments.

Access to land information is also not transparent, making it difficult for SMEs to find land to locate their headquarters, most of them have to sublease. Besides, issues of site clearance and land prices... also always make enterprises worried. Every year, a large number of new SMEs are established, increasing the demand for land for industrial and commercial purposes to build factories, and offices... Access to information to obtain land and register land to ensure full land rights of SMEs always needs the attention of the Government to promote the development of the country’s economy.

Fourthly, administrative procedures for SMEs are still troublesome and complicated. Many SMEs have assets but do not have enough valid documents to carry out mortgage procedures, such as: Enterprises are allocated land for use but have not been issued documents proving land ownership or enterprises have land lease contracts with annual payments but are not allowed to mortgage the land to borrow capital from banks... Easy access to land and land registration will create opportunities for SMEs to access credit more easily through mortgaged assets such as land. Holding a certificate of land use rights helps ensure property rights and creates peace of mind for enterprises and investors about long-term investment prospects. Not having land use rights means that enterprises lack mortgaged assets to access credit and borrow capital from banks.

4. SOME SOLUTIONS TO IMPROVE ACCESS TO LAND FOR SMES

Firstly, Propaganda and encourage localities to develop mechanisms and policies to support SMEs in accessing land; strengthen the application of information technology so that the business community can easily access information channels that ensure openness, transparency, and continuous updates.

Secondly, continue to implement solutions to simplify and reduce the time for handling administrative procedures in the land sector, creating favorable conditions for SMEs to access land.

Thirdly, promptly publicize land use planning and plans; land price, and provisional land price (with adjustment coefficient). Regularly review investment projects, and projects that have been granted Investment Registration Certificates, and carry out procedures for receiving and handing over land and paying land rent to ensure convenience, speed, and compliance with regulations.

Fourthly, promptly remove difficulties and obstacles for localities in site clearance, land allocation, land lease, and change of land use purpose for enterprises, ensuring legal rights and interests of people whose land and assets are recovered.

Fifthly, strengthen discipline and improve public service ethics. Inspect and supervise the handling of administrative procedures by civil servants and public employees to reduce harassment and inconvenience for enterprises.

5. CONCLUSION

Land legislation has a great influence on socio-economic life, regulating complex social relationships, directly related to the important national resources, which are also valuable assets for individuals and enterprises. To promote land resources in socio-economic development, there should be breakthrough changes in land policy to create favorable conditions for SMEs to easily access land, contributing to economic growth ■

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Effective approaches for the successful integration of the circular economy concept into Vietnam's energy industry



▲ Prof. Nguyễn Xuân Huy, Faculty of Geology and Petroleum Engineering, HCM University of Technology, National University of HCM City

The development of a circular economy (CE) in Vietnam's energy industry is crucial for achieving sustainable socio-economic growth and reducing emissions. The Ministry of Natural Resources and Environment (MONRE) has assigned Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE) to collaborate with relevant organizations to create a "National Action Plan for the Implementation of CE". This Plan aims to promote the application of CE principles and strategies in various sectors, with a particular emphasis on the mining and energy sector.

The CE framework revolves around minimizing resource consumption, maximizing resource efficiency and reducing waste generation. By transitioning to a CE, Vietnam's energy industry can reduce its environmental impacts, enhance resource efficiency, and contribute to the goal of achieving net-zero emissions by 2050. The specific details of the Draft Plan for the mining and energy sector may vary, but it is likely to include certain fundamental measures and initiatives.

Valuable insights on the efficient execution and utilization of the CE model in Vietnam's energy sector can be gained by consulting experts, notably such as Professor Nguyễn Xuân Huy, Faculty of Geology and Petroleum Engineering, Ho Chi Minh (HCM) University of Technology, Viet Nam National University of HCM City. These consultations can also suggest context-specific implication on the distinct challenges and opportunities within the country's energy industry.

• At present, Vietnam is recognized for having the highest greenhouse gas (GHG) emissions in its energy industry, and it is projected that this emission rate will continue to rise in the future. What is your evaluation of this situation? Furthermore, how do you regard the Vietnam Government's initiative to promote the development of renewable energy as a means to mitigate these emissions?

Prof. Nguyễn Xuân Huy: Based on a GHG inventory report from the Ministry of Natural Resources and Environment, Vietnam observed a significant surge in total GHG emissions between 1994 and 2016. Specifically, these emissions soared from 103.8 million tons to an alarming level of 316.7 million tons of CO₂ equivalent during this period (Nishioka, 2016). Notably, it was the energy sector that experienced the highest growth as its emissions skyrocketed from 25.6 million tons to a staggering 206 million tons of CO₂ equivalent, constituting close to 65% of Vietnam's overall GHG emissions. The primary contributor to GHG emissions is the utilization of fossil fuels, particularly coal or oil for producing electricity. This practice serves as the major factor behind carbon emissions. Furthermore, in Vietnam, industries dependent on fossil fuel consumption and the transportation sector also play a substantial role in contributing to emissions.

In response to the aforementioned threats, Vietnam has implemented various policies aiming to decrease emissions in the energy industry by those promoting the development of renewable energy sources. Notably, measures such as implementing feed-in tariffs (FIT) for electricity and providing tax benefits have been incorporated within the revised Power Plan VII issued by the Government in 2017 to encourage the establishment of renewable energy ventures. Consequently, solar and wind power have experienced substantial growth and now play a more prominent part in the nation's energy composition, representing 27% of the overall installed power capacity (Figure 1). Nonetheless, re-



newable energy sources only contribute around 15% to the commercial electricity output, while traditional methods like coal thermal power still prevailing at over 40%, followed by hydropower at approximately 35%.

The proportion of coal-fired power in Vietnam's energy structure has decreased in recent years, from more than 60% before 2020 to about 50% today. This is a positive development that signals Vietnam's commitment in reducing its dependence on coal while increasing the share of renewable energy in its energy mix. However, renewable energy sources such as solar power and wind power are unstable due to their dependence on weather conditions, which can cause challenges to the stability of the national grid system and power transmission.

In order to promote the use of renewable energy, the Government has announced ambitious targets for its expansion in Vietnam. By 2030, they aim to raise the percentage of electricity generated from renewable sources to 30%, and by 2050, this is expected to reach 50%. Despite these aspirations, there are numerous obstacles that need to be overcome for Vietnam to successfully transition into a low-carbon economy. These challenges include financial limitations, lacking of proper institutional capabilities, as well as insufficient awareness and participation from the public.

Furthermore, according to Decision No. 687/QĐ-TTg issued by the Government to endorse the CE Development Project in Vietnam, a specific aim has been declared whereby CE initiatives will be implemented and enhanced with regard to their impacts on the economy, society, technology and environment by 2025 (Tran and Nguyen, 2023). This objective encompasses activities such as resource retrieval, decreased energy usage, and an augmented share of renewable energy within the overall primary energy supply. Consequently, it becomes imperative to implement CE models within Vietnam's energy industry in order to accomplish the aforementioned target.

**** To achieve “zero” net emissions by 2050 and maximize energy utilization, it will be essential for Vietnam's energy sector to adopt CE frameworks in the near future. Could you please provide information on successful research models that have been implemented globally and specifically in Vietnam to achieve this target?***

Prof. Nguyễn Xuân Huy: The term “CE” emerged in the 1980s within the field of industrial ecology, which focuses on understanding industrial systems and their relationship with the environment. However, it was British economist David Pearce who introduced the concept in a 1990 report titled “Blueprint for a Green Economy”, commissioned by the European Commission (Barbier, 2013).

In the early 2010s, the CE gained wider recognition, largely due to the efforts of the Ellen MacArthur Foundation (EMAF, 2013). This UK-based charity, found-

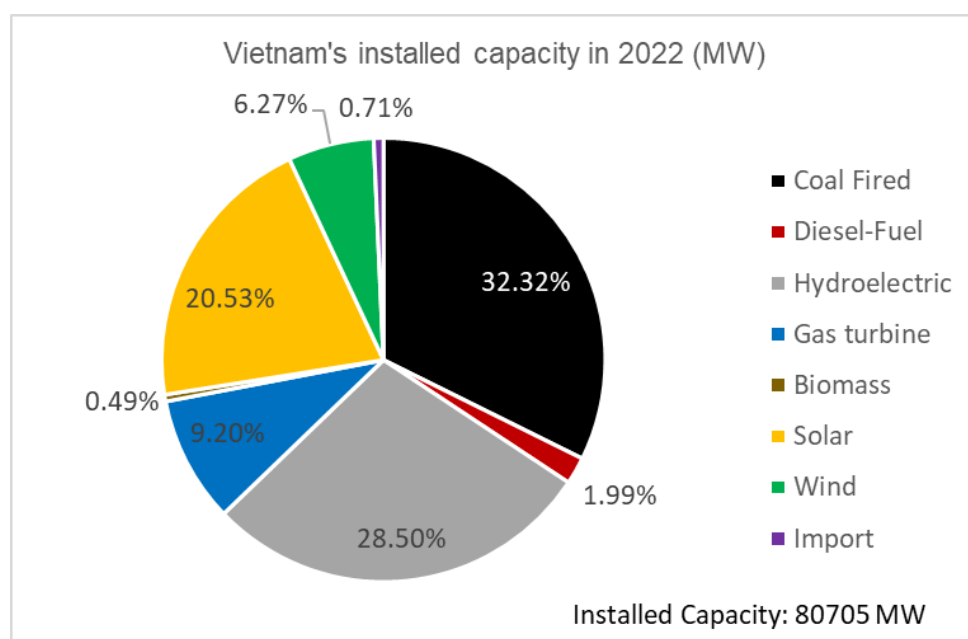
ed by sailor and environmentalist Ellen MacArthur, has been instrumental in promoting the CE as a means to create a more prosperous and sustainable future.

The Ellen MacArthur Foundation's 2013 report “Towards a CE: Economic and business rationale for an accelerated transition”, played a significant role in popularizing the concept and providing a practical roadmap for its implementation across various sectors. The report highlighted the economic and environmental benefits of transitioning from a linear “take-make-dispose” model to a circular model that focuses on minimizing waste, maximizing resource efficiency, and promoting closed-loop systems.

Since then, the CE has gained increasing attention in sustainability discussions and policymaking globally. Governments, businesses, and organizations recognize the potential of the CE to address resource scarcity, reduce environmental impacts, and foster economic growth. Efforts are being made to integrate CE principles into national policies, business strategies, and academic research to drive the transition towards a more sustainable and regenerative economic model.

The CE offers a comprehensive framework for rethinking production, consumption, and waste management, aiming to create a closed-loop system where resources are used and reused in a sustainable manner. By promoting the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems, the CE presents a compelling vision for building a more resilient and sustainable future.

While the term “CE” may be relatively new, the concept of integrated agricultural systems and resource optimization has long been practiced in Vietnam, particularly in the agricultural sector. The VAC (Garden - Pond - Barn) integrated production model in Vietnam is an excellent example of a CE approach in agriculture (Trinh Thu, 2023). This model emphasizes the interconnectivity and synergy between different components of farming, such as crops, livestock, and aquaculture. By integrating these elements, farmers can maximize resource efficiency and economic returns while minimizing waste and environmental impacts.



▲ Figure 1: Vietnam's power capacity installed in 2022

disposed of end up in landfills. Additionally, they create inventive business strategies like the “Loop” platform which facilitates the delivery of products using reusable containers that can be collected, cleaned and refilled. This CE model is gaining significant traction among Vietnamese companies.

Renault, the automobile company from France, has implemented the concepts of CE in its production procedures (Lopes, 2007). They have established

In the VAC model, the garden represents the cultivation of crops, the pond refers to fish farming or aquaculture, and the barn represents livestock rearing. These components are interdependent and they create a closed-loop system where the waste outputs from one component become inputs for another. For example, crop residues can be used as animal feed or organic fertilizer, while animal waste can be utilized as fertilizer for crops or as feed for fish.

By adopting the VAC model, farmers can optimize land, water and solar energy resources usage, reducing the need for external investments and enhancing overall productivity. This integrated approach aligns with the principles of the CE by emphasizing resource efficiency, waste reduction and the regeneration of natural systems.

The rising advancements in data information connection systems, including IoT (internet of things), big data, cloud storage..., have led to the widespread adoption of information technology. This has resulted in the emergence of popular practices such as resource sharing among individuals. Instead of owning possessions like cars, houses, equipment and tools outrightly, people can now share them with others. Companies like Airbnb, Uber and Grab have played a pivotal role in popularizing this model by enabling individuals to rent out their homes or vehicles for a specified fee (Esposito et al., 2017).

TerraCycle, an enterprise focusing on waste management, specializes in recycling materials that are typically challenging to recycle and developing circular solutions across different sectors (Wallace, 2015). They collaborate with manufacturers of consumer goods, retailers, and local authorities to gather and recycle items and packaging that would otherwise be

a facility dedicated to restoring and repairing used components like engines and transmissions for resale at reduced prices. By adopting this strategy, Renault effectively minimizes waste generation, preserves valuable resources, and lessens the environmental repercussions associated with manufacturing brand new parts.

The application of CE principles in sugarcane factories in Vietnam is a commendable example of resource optimization and waste reduction (Nguyen et al., 2022). The utilization of sugarcane bagasse, the residue left over from sugarcane processing, as a source of energy through combustion is an efficient way to extract value from what would otherwise be considered waste. By carefully transporting bagasse to power-generating boilers, factories can generate heat and steam, which can be used for various purposes within the factory, such as electricity generation and process heat. The combustion of bagasse not only provides a renewable source of energy but also helps to reduce the reliance on fossil fuels and decrease GHG emissions. It is a sustainable alternative to traditional energy sources.

Furthermore, the conversion of bagasse ash into biochar highlights the commitment to closing the loop and extracting value from waste streams. Biochar, a stable form of carbon, can be used as a soil amendment, contributing to improved soil health, carbon sequestration, and



nutrient retention. By transforming the ash into biochar, factories are effectively repurposing the waste into a valuable resource with beneficial uses, such as agricultural applications.

The implementation of strict quality control measures throughout the entire process chain ensures the efficiency, sustainability, and environmental friendliness of the production process. This commitment to quality control helps to maintain the integrity of the CE model and ensures that the generated energy and byproducts meet the required standards.

By applying CE principles in sugar cane factories, such as utilizing bagasse for energy generation and converting ash into biochar, the industry can reduce waste, optimize resource use, and contribute to a more sustainable and environmentally friendly production process. This approach aligns with the broader goals of the CE by minimizing waste, maximizing resource efficiency, and promoting a closed-loop system.

• *ISPONRE has been tasked by the MONRE to collaborate with relevant group of experts in order to develop and propose the “National Action Plan for implementing the CE” to the Prime Minister for approval. Do you have any opinions or evaluations regarding this objective? The Draft Plan outlines specific objectives, principles, roadmap and priority industries such as mining and energy that will be focused on during the implementation of CE practices?*

Prof. Nguyễn Xuân Huy: The concept of a CE is crucial in attaining sustainable development and the mining and energy industries have a vital role in achieving these objectives. They contribute by keeping resources in use for as long as possible, extracting maximum value from them, while minimizing waste and pollution. In order to grasp the significance of the CE in relation to mining and energy sectors, it is crucial to acknowledge their significant role in global GHG emissions and resource utilization. Notably, these industries play a major part in extracting minerals and metals that are vital components across various products such as electronics, vehicles, and infrastructure. However, the extraction and processing procedures associated with these materials often require substantial amounts of energy while also producing considerable waste and pollution.

The energy industry plays a crucial role in harnessing different forms of energy to support socio-economic progress. However, the majority of electricity production relies on non-renewable resources like coal and oil, which not only contribute to climate change but also lead to other environmental issues. To address this, shifting towards renewable energy sources and enhancing energy efficiency can help alleviate these problems. Nevertheless, implementing such measures would necessitate substantial investment and alterations in both production and consumption practices that consume energy.

Promoting sustainable resource use and waste reduction, the CE presents a solution to these challenges. One such approach involves creating long-lasting and recyclable products, minimizing the demand for new resources and maximizing the lifespan of materials already in existence. Similarly, closed-loop supply chains can be implemented to minimize waste and pollution while also generating fresh economic prospects.

The Draft National Action Plan for CE implementation specifies priority sectors and industries. From my perspective, a crucial area to focus on is the advancement of electric vehicles, which heavily rely on mining mineral resources like lithium, cobalt, and rare earths. By prioritizing responsible sourcing, recycling, and reutilization of these materials, we can effectively reduce the environmental consequences associated with electric vehicle manufacturing and usage.

The construction industry is another significant domain, wherein the construction and functioning of buildings contribute greatly to worldwide energy usage and GHG emissions. By prioritizing energy-efficient building designs, utilizing eco-friendly materials, and adopting circular approaches like recycling and reusing construction elements, we have the potential to decrease these effects and foster the development of more sustainable urban areas and communities.

In the mining and energy sectors, generally it is important for groups and industries embracing the concept of a CE to establish clear objectives and detailed action plans in order to attain optimal results. Accomplishing this objective will necessitate collaboration among industry players, Government bodies and other relevant parties. Although realizing this vision may be challenging, the potential rewards are substantial. However, reaching this objective will demand considerable investments in research, innovation, infrastructure, as well as policy adjustments and shifts in consumer attitudes.



• *In the forthcoming years, what suggestions do you offer for Vietnam to successfully adopt and put into practice CE principles within the energy sector?*

Prof. Nguyễn Xuân Huy: The key strategies for driving the implementation of a CE in the energy sector comprise: *Firstly*, policy and regulatory assistance: The Government has the ability to establish a conducive policy environment by enacting regulations and providing incentives that encourage the adoption of CE practices within the energy sector. These measures may include tax reliefs, subsidies and financial aid specifically aimed at supporting clean technologies, renewable energy ventures and initiatives related to CE principles.

Secondly, promoting sustainable finance options, such as the issuance of green bonds, stocks, and credits, can incentivize private investment in energy sector CE initiatives. By highlighting the proven positive impacts on the environment, society, and finances that come with CE projects, it becomes feasible to establish an appealing investment climate and gather essential resources for facilitating this transition.

Thirdly, Vietnam possesses considerable prospects for generating electricity through renewable energy sources like solar, wind, and biomass. These alternatives offer opportunities for the nation to shift away from fossil fuel reliance, lower GHG emissions, and foster job creation. By promoting the expansion of distributed energy systems such as autonomous rooftop solar setups and residential-based wind power projects, Vietnam can enhance energy accessibility, lessen dependency on traditional grids, and stimulate localized economic progress. Embracing this decentralized approach also enhances the overall resilience and flexibility of Vietnam's energy infrastructure.

Fourthly, enhancing energy efficiency across diverse sectors, such as industrial, commercial, and residential areas, can contribute to a decrease in overall energy usage. This can be achieved through the adoption of energy-saving technologies, implementation of building energy codes, and encouraging consumers to adopt energy-saving practices.

Fifthly, the waste-to-energy program offers Vietnam a chance to tackle issues pertaining to waste management and energy generation. It is crucial to promote investments in waste-to-energy initiatives, including the production of biogas from agricultural waste or the recovery of gas from landfills. These projects not only generate clean energy, but also help minimize both waste and pollution.

Sixthly, the development of smart grids involves the investment in technology that can enhance energy efficiency and management, minimize transmission losses, and seamlessly integrate a greater amount of renewable energy into the power grid. By implementing smart grids, there is an opportunity to improve demand response capabilities, as well as achieve real-time monitoring and control of energy usage. This enables the optimization of energy consumption and reduces unnecessary wastage.

Seventhly, to encourage recycling and the recovery of materials: The establishment of infrastructure and systems for material recycling and recovery can contribute to waste reduction, reclaiming valuable resources, and fostering new business opportunities. Some initiatives embraced by the newly-formed alliance are e-waste recycling, battery recycling, and construction material recycling.

Eighthly, encouraging the use of sustainable transportation options, like electric vehicles, can aid Vietnam in decreasing its reliance on fossil fuels and lowering GHG emissions. By backing the expansion of charging infrastructure for electric vehicles and offering incentives to promote their adoption, there is potential to foster widespread usage of electric vehicles throughout Vietnam.

Ninthly, enhancing the circumstances for industrial symbiosis by setting up hubs or platforms where companies can swap by-products, waste, or resources can contribute to the development of closed-loop systems and decreased resource usage. As an illustration, surplus heat from industrial operations could be harnessed to generate power or supply warmth to neighboring structures, while waste material can serve as a valuable input for other sectors.

Tenthly, the establishment of research and development and innovation centers specifically dedicated to CE solutions can expedite the advancement and implementation of new technologies and practices in the energy industry. These centers serve as a hub for collaboration between Government, universities, academia and industry, facilitating knowledge exchange and the generation of novel business prospects.

• *Thank you very much!*

CHÂU LOAN

The environmental impact of e-commerce

Online shopping has become a popular way for consumers to purchase goods without leaving the comfort of their own homes. However, this convenience comes at a cost to the environment, particularly in the form of packaging waste.

E-commerce has revolutionized the way we shop, making it easy to buy anything from the comfort of our homes. With the increase in online shopping, the amount of packaging waste generated has also increased significantly. Every online purchase is shipped in some form of packaging, whether it's a cardboard box, plastic envelope, or padded envelope.

According to a report by the World Economic Forum, e-commerce packaging accounts for 165 billion packages annually, and this number is expected to continue to grow.

Online shopping generates various kinds of waste, including:

Packaging waste: This is one of the most significant forms of waste generated by online shopping. Items are often packaged in layers of plastic, bubble wrap, and cardboard boxes, which can be difficult to recycle.

Electronic waste: The rise of e-commerce has also led to an increase in electronic waste. As more people purchase electronics online, the disposal of old electronic devices becomes a growing problem.

Carbon emissions: The transportation of goods from warehouses to consumers generates significant carbon emissions. This can contribute to air pollution and climate change.

Single-use products: Online shopping can also contribute to the use of single-use products, such as packaging materials and shopping bags, which can end up in landfills or oceans.

Returns and disposal waste: The ease of online shopping has also led to an increase in returns, which can result in additional waste generated from packaging, transportation, and disposal of unwanted items.

Online shopping has become increasingly popular in recent years due to its convenience and ease. However, the packaging used to ship these products often goes unnoticed and can have a significant impact on the environment. Many different types of packaging materials are used in online shopping, including cardboard boxes, plastic bags, bubble wrap, and air pillows.



▲ Online shopping has become a popular way for consumers to purchase goods without leaving their homes



According to a report by Oceana, a marine conservation organization, Amazon alone generated 465 million pounds of plastic packaging waste in 2019. This waste includes air pillows, bubble wrap, and other plastic packaging items added to the approximately 7 billion Amazon packages delivered in 2019.

The packaging waste generated by online shopping has a significant impact on the environment. Plastic packaging waste, in particular, is a major problem, as it takes hundreds of years to break down and often ends up polluting the oceans and harming marine life. Another issue with online shopping packaging waste is that it is often not recycled or reused.

According to a report by the Ellen MacArthur Foundation, only 14% of the plastic packaging used globally is collected for recycling, and even less is actually recycled. The rest ends up in landfills or the environment, where it can take hundreds of years to break down and release harmful chemicals. The amount of waste generated from e-commerce packaging is staggering. The equivalent of one garbage truck full of textiles is landfilled or burned every second, and this number is expected to increase. This waste not only takes up valuable space in landfills but also pollutes the environment and contributes to greenhouse gas emissions.

In addition to plastic, other packaging materials like cardboard, paper, and styrofoam are also commonly used in e-commerce packaging. While these materials are biodegradable and recyclable, they still contribute to the amount of waste generated.

The increase in online shopping has also led to an increase in transportation, which further contributes to pollution and harm to the environment. Delivery trucks and planes emit greenhouse gases that contribute to climate change. To combat this issue, some companies are taking steps towards more sustainable packaging. For example, Amazon has introduced "Frustration-Free Packaging", which is designed to reduce waste and be easier to open.

Additionally, the shipping process requires energy and resources, such as fuel and packaging materials, which further contribute to pollution and environmental harm. To combat the negative impact of e-commerce on the environment, companies are exploring more sustainable pack-

aging options. Some companies are using biodegradable or compostable materials in their packaging, while others are implementing a circular economy approach to reduce waste and reuse materials.

Consumers can also play a role in reducing the environmental impact of e-commerce. They can choose to shop from companies that prioritize sustainable packaging and shipping methods. They can also reduce their carbon footprint by consolidating orders to reduce the number of shipments and opting for eco-friendly shipping options.

As consumers, we can take steps to reduce the environmental impact of our online shopping habits. One way is to choose products with minimal packaging, or to purchase from companies that use eco-friendly packaging materials, such as recycled paper or biodegradable materials. Another option is to reuse or recycle packaging materials whenever possible. Many companies now offer recycling programs for their packaging materials, such as TerraCycle's Zero Waste Box Program.

In conclusion, while online shopping may be convenient, it is important to be aware of the environmental impact of e-commerce packaging. By taking steps towards more sustainable packaging and making conscious choices as consumers, we can work towards a more sustainable future for our planet. The convenience of online shopping should not come at the cost of our environment. It is important for both consumers and companies to take responsibility and take steps towards reducing this waste and finding sustainable packaging solutions.

By doing so, we can help protect our planet and ensure a better future for generations to come. The use of plastic in packaging is a significant environmental concern ■

VŨ HỒNG
(Source: *Earth5R*)



Five drivers of the nature crisis

Humans have introduced more than 37,000 invasive species, many harmful, into biomes around the world, threatening a range of plants and animals, finds a new study from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Invasive alien species (IAS) are one of the five major drivers of biodiversity loss and the framework aims to “eliminate (or) reduce” their impact on the environment. Here’s a closer look at IAS as well as the other top causes of nature loss identified by IPBES, an independent body that aims to help states sustainably manage biodiversity.

1. INVASIVE SPECIES

IAS are animals, plants, fungi and microorganisms that have entered and established themselves in the environment outside their natural habitat. IAS have devastating impacts on native plant and animal life, causing the decline or even extinction of native species and negatively affecting ecosystems.

The IAS Report, produced by experts from 49 countries, says these intruders have been a major factor in 60 percent of all extinctions and that they cost the global economy more than US\$ 423 billion annually. The Report called invasive alien species a threat to sustainable development and human well-being. It comes with more than 1 million plants, animals and other living things facing the threat of extinction. The publication arrives as countries are working to speed up the implementation of the Kunming - Montreal Global Biodiversity Framework, a landmark agreement to halt and reverse nature loss by 2030.

The global economy, with increased transport of goods and travel, has facilitated the introduction of alien species over long distances and beyond natural boundaries. The negative effects of these species on biodiversity can be intensified by climate change, habitat destruction and pollution.

IAS have contributed to nearly 40 percent of all animal extinctions since the 17th Century, where the cause is known. Meanwhile, environmental losses from introduced pests in Australia, Brazil, India, South Africa, United Kingdom and the United States are estimated to reach over US\$ 100 billion per year.

IAS is a global issue that requires international cooperation and action. Preventing the international movement of these species and rapid detection at borders is less costly than control and eradication.

2. CHANGES IN LAND AND SEA USE

The biggest driver of biodiversity loss is how people use the land and sea. This includes the conversion of land covers such as forests, wetlands and other natural habitats for agricultural and urban uses.

Since 1990, around 420 million hectares of forest have been lost through conversion to other land uses. Agricultural expansion continues to be the main driver of deforestation, forest degradation and forest biodiversity loss. The global food system is the primary driver of biodiversity loss, with agriculture alone being the identified threat of more than 85 percent of the 28,000 species at risk of extinction.

Harvesting materials such as minerals from the ocean floor and the building of towns and cities also impact the natural environment and biodiversity. Reconsidering the way people grow and consume food is one way of reducing the pressure on ecosystems. Degraded and disused farmland can be ideal for restoration, which can support protecting and restoring critical ecosystems such as forests, peatlands and wetlands.

3. CLIMATE CHANGE

Since 1980, greenhouse gas emissions have doubled, raising average global temperatures by at least 0.7 degrees Celsius. Global warming is already affecting species and ecosystems around the world, particularly the most vulnerable ecosystems such as coral reefs, mountains and polar ecosystems. There are indications that climate change-induced temperature increases may threaten as many as one in six species at the global level.

Ecosystems such as forests, peatlands and wetlands represent globally significant carbon stores. Their conservation, restoration and sustainability are critical to achieving the targets of the Paris Agreement. By working with nature, emissions can be reduced by up to 11.7 gigatons of carbon dioxide equivalent per year by 2030, over 40 percent of what is needed to limit global warming.



▲ *Forests are cut down and converted to other uses, mainly agricultural*

4. POLLUTION

Pollution, including from chemicals and waste, is a major driver of biodiversity and ecosystem change with especially devastating direct effects on freshwater and marine habitats. Plant and insect populations are dwindling as a result of the persistent usage of highly dangerous, non-selective insecticides.

Marine plastic pollution has increased tenfold since 1980, affecting at least 267 animal species, including 86 percent of marine turtles, 44 percent of seabirds and 43 percent of marine mammals. Air and soil pollution are also on the rise.

Globally, nitrogen deposition in the atmosphere is one of the most serious threats to the integrity of global biodiversity. When nitrogen is deposited on terrestrial ecosystems, a cascade of effects can occur, often resulting in overall biodiversity declines.

Reducing air and water pollution and safely managing chemicals and waste is crucial to address the nature crisis.

5. DIRECT EXPLOITATION OF NATURAL RESOURCES

The recent IPBES report on the sustainable use of wild species reveals that the unsustainable use of plants and animals is not just threatening the survival of one million species around the world but the livelihoods of billions of people who rely on wild species for food, fuel and income.

According to scientists, halting and reversing the degradation of lands and oceans can prevent the loss of one million endangered species. In addition, restoring only 15 percent of ecosystems in priority areas will improve habitats, thus cutting extinctions by 60 per cent by improving habitats.

Negotiations at COP15 are expected to focus on protecting plants, animals and microbes whose genetic material is the foundation for life-saving medicines and other products. This issue is known as access and benefits sharing governed by an international accord - the Nagoya Protocol.

Delegates at COP15 will be looking at how marginalized communities, including Indigenous Peoples, can benefit from a subsistence economy - a system based on provisioning and regulating services of ecosystems for basic needs. Through their spiritual connection to the land, Indigenous Peoples play a vital protection role as guardians of biodiversity ■

AN BÌNH

(Source: UNEP.org)



How does the Chinese e-waste disposal fund scheme work?

China is a large producer of electronic and electrical equipment (EEE). According to the Chinese National Bureau of Statistics, in 2010, the total production of televisions, refrigerators, air conditioners and personal computers exceeded 546 million units. As a result, China is a large generator of EEE waste. The All-China Federation of Supply and Marketing Cooperation estimated that China generated about 50 million units of e-waste in 2010 - a number expected to increase rapidly. By 2020, it is estimated that e-waste in China will grow to 137 million units. This is worrying because e-waste contains several precious metals, and other recyclable and hazardous materials, it can cause serious environmental contamination and health problems if disposed or recycled incorrectly.

Accordingly, the former State Administration of Environmental Protection of China promulgated the Administrative Measures on Prevention and Control of E-waste Pollution in September 2007 to regulate the development of e-waste recyclers - especially informal recyclers with sub-standard recycling and disposal techniques and less environmental awareness. Formal e-waste recycling plants were established, however, they face collection problems, low or negative profit, competition from informal recyclers.

1. The “Old-for-new” Scheme for domestic EEE and the e-waste recycling fund

In 2009, the National Development and Reform Commission (NDRC) of China announced the National Old-for-new Home Appliance Replacement Scheme (HARS) - part of a stimulus package to target the 2008 global financial crisis. The Scheme would give consumers a subsidy for purchasing new electronic appliances (including televisions, air conditioners, refrigerators, washing machines, and personal computers) worth 10% of the price, if they sold their old electric goods to certified recycling companies. This dramatically changed domestic EEE recycling. The Scheme was first implemented in nine pilot areas from 1st June 2009 to 31st May 2010, which was then extended to 31st December 2011 and expanded to 28 cities and provinces. The HARS provided a great incentive for consumers to bring their old appliances to certified recyclers, ultimately promoting the development of the formal e-waste recycling industry.

As the Chinese economy recovered, the Government stimulus ended, including HARS on 31st December 2011. This left the formal e-waste recycling industry with the same problems they had faced before the scheme was implemented. As a result, the Central Government pushed for the issue to be put on the table. It is widely agreed that internalizing the environmental externality is a basic solution, which can be done by introducing extended producer responsibility (EPR) policies and establishing an e-waste disposal fund in the form of an advance disposal fee. This approach is defined in the Ordinance for Administration

of Collection and Disposal of Waste Electronic and Electrical Products promulgated by the State Council of China on 25th February 2009. Article 7 states that the State should establish an e-waste disposal fund to subsidize the collection and disposal of e-waste. After a series of consultations with e-waste recycling companies, EEE producers and importers, the Ministry of Finance (MoF), the Ministry of Environmental Protection (MEP), the NDRC, the Ministry of Industry and Information Technology (MIIT), the General Administration of Customs (GAC) and the State Administration of Taxation (SAT) of China jointly elaborated and publicized the Measures for the Collection and Administration of the Funds for the Recovery and Disposal of Waste Electronic and Electrical Products, entering into force on 1st July 2012.

2. Responsibilities of key players in the Chinese E-waste Disposal Fund Scheme

The key players include the producers and importers of EEE, the recyclers of e-waste and the related authorities.

The Scheme's objective is to promote the collection and disposal of e-waste, push forward the comprehensive utilization of resources, protect the environment and safeguard human health (stated in the 1st Article of the Ordinance for Administration of Collection and Disposal of Waste Electronic and Electrical Products and in the 2nd Article of the Measures for the Collection and Administration of the Funds for the Recovery and Disposal of Waste Electronic and Electrical Products). Also an important component of the national strategy is to build a resource-saving and environment-friendly society.

The responsibilities of producers, importers, recyclers and the relevant authorities

Producers and importers of electronic and electrical products must pay for each unit they produce or import, except for those products which are exported. The producers declare and pay into the Fund quarterly via the tax authority, and the importers pay when declaring their import products to the customs via the custom authority. Those who fail to fulfill their obligations will face legal action. The certified recyclers who can provide the necessary proof of the e-waste they have recycled or disposed of will be eligible to apply for a subsidy.

As the Fund is controlled by the Central Government, the MoF is the general administrator (responsible for coordinating collection, utilization and administration of the Fund); SAT



and GAC are the Fund's collectors (responsible for collecting payment from the producers and importers of EEE respectively with the help of their branch agencies across the country); MEP is the recyclers' administrator (responsible for developing and implementing criteria for certification of e-waste recyclers, monitoring their environmental compliance, and monitoring and checking the recyclers' production data with the help of local 4 environmental protection agencies); NDRC, MIIT and the National Audit Office provide supervision to ensure the Scheme's operation runs smoothly.

Product coverage and product levies

In the previous "Old-for-new" Scheme as well as in the new fund, five common household electronic and electrical appliances were/are covered, including televisions, refrigerators, washing machines, air conditioners and personal computers. Based on a series of consultations with experts, producers, importers and recyclers related to e-waste generation and treatment, the fee and subsidy rates were set. The rates are adjusted according to the change in cost for collection and disposal of e-waste when needed, but should be based on consultations with the relevant enterprises and associations. Both the rate charged and the subsidy are unit based (Table 1). The rate is much lower than the subsidy, rendering the total collection received for the products low. This ensures that the authorities distribute and utilize the funds without surplus. The value of the subsidy is based on the basic cost of the recycling and disposal of the five kinds of e-waste, not including the cost of collection.

3. The Scheme's Governance

The technical aspects of the Fund are managed by MEP, who is responsible for developing and implementing the criteria to certify e-waste recyclers, for checking data received from the recyclers for application of the subsidy... Only those recyclers who have the ability to recycle and dispose the e-waste correctly and have been certified accordingly, are qualified to apply and obtain the subsidy.

The criteria that qualify certified recyclers include four aspects, differentiated between those located in the East and Central part of China (comparatively more developed), and those located in the West part of China (comparatively less developed).

a. Sufficient capacity and infrastructure for recycling and disposing of e-waste, including qualified treatment and recycling facilities, workshops, storage sites... (Table 2).

b. Central monitoring systems and facilities to deal with emergencies and provide first aid. The plant should be recorded 24 hours a day by the Central monitoring system.

c. Compliance with environmental management regulations. Waste water discharges, waste gas and noise emissions must comply

Table 1. Charged rates and the subsidy values for the e-waste covered in the Chinese E-waste Disposal Fund Scheme

Products or e-waste/rate	Rate of Charge (CNY/unit)	Rate of subsidy (CNY/unit)
Television	13	85
Refrigerator	12	80
Washing machine	7	35
Air conditioner	7	35
Personal computer	10	85

with the standards of pollution emissions, and solid waste must be sent to competent companies or landfill sites to be disposed of appropriately.

d. A sufficient number of technicians with qualifications in occupational safety and health, quality control and environmental protection. The recycler must have at least 3 technicians with engineering degrees and of which no less than one has expertise in the field of occupational safety and health (OSHA), quality supervision and environmental protection.

The prefecture level environmental protection agency is responsible for the certification of recyclers. Beforehand, it must consult the public by publishing the applicants' information at least 10 working days before receiving the final approval. MoF, MEP, NDRC and MIIT finally approve and publish the list of the certified recycling companies.

Approval requirements

The beneficiaries of the Fund should count and record the types and quantity of e-waste they recycle and dispose of on a quarterly basis and report to the relevant province-level environmental protection authorities. They should provide four kinds of additional supporting materials: (1) Inbound and outbound records of their e-waste; (2) Recycling and disposing work records of their e-waste (dismantling process must be recorded 24 hours a day and the record must be kept as archives for at least one year); (3) Inbound and outbound records of recycled products that can be reused as raw materials and residues; (4) Sale Vouchers of recycled products or that of residue disposed of.

Table 2. Capacity and infrastructure requirements for certification of e-waste recyclers

Location/requirement	Total capacity of recycling and disposal (tons/year)	Total building area (m ²)	Total workshop area (m ²)
East and Central part of China	≥ 10,000	≥ 20,000	≥ 10,000
West part of China	≥ 5,000	≥ 10,000	≥ 5,000



The province-level environmental protection authorities are responsible to collect and verify the information, endorse and send it to MEP. MEP will re-check the data and provide it to MoF for final verification and the subsidy disbursement.

China Government encourages the producers of EEE to establish their own recycling operations. Local governments provide a fast track procedure for the establishment and certification of e-waste recycling facilities operated by producers. MoF organizes other relevant authorities to elaborate regulations that encourage producers to take measures to improve their products' designs - such as using more environment-friendly materials. These two points are defined separately in Article 19 and 11 in the Measures for the Collection and Administration of the Funds for the Recovery and Disposal of Waste Electronic and Electrical Products.

To ensure high-quality collection, proper utilization of the Fund and to avoid cheating, the following measures are foreseen:

(1) MoF is responsible for establishing an on-line administrative information system to monitor the production and sale of EEE, and the recycling and disposal of e-waste with the help of MEP, NDRC and MIIT. The producers and importers should input their respective production or import data into the information system and the recyclers should build and connect their monitoring systems to the Government's monitoring system.

(2) The tax and custom authorities are responsible for taking measures of monitoring and inspection to ensure the Fund is effectively collected from producers and importers.

(3) The province-level environmental protection authorities should check the data provided by the recyclers, compare the data with that coming from the information system, check the data on site... to verify the accuracy of the information from recyclers. MEP and the provincial environmental protection authorities should publish the statistics, to ensure transparency.

(4) The National Audit Office also takes part in the supervision of the collection and utilization of the Fund. Public supervision is welcomed. Any infringement will be dealt with in accordance with the Law.

4. Current state of policy implementation

The large potential of the e-waste recycling industry in China

Since the implementation of the E-waste Disposal Fund Scheme two batches - 64 e-waste recycling companies in total - have been certified and published by MoF, MEP, NDRC and MIIT jointly. Among the 31 main cities, provinces and autonomous regions (not including Taiwan, Hong Kong and Macau), 22 of them have certified recycling companies, and only 9 cities have not yet received any certifications. Among the 64 certified companies, 32 are from the areas in the Eastern part of China, accounting for 50%; 20 are from the 8 areas in the Central part of China, accounting for 31.25% and only 12 are from the areas in the

Western part of China, accounting for 18.75%. In total 81.25% of the certified recycling companies are from the comparatively more developed areas.

According to the requirements of certification, in the Eastern and Central parts of China the minimum capacity that the relevant company must reach is 10,000 tons per year and in the Western part of China the minimum capacity is 5,000 tons per year. There are currently 52 certified companies in the Eastern and Central parts of China and 12 in the Western part, which means that the minimum capacity of all the certified companies must be more than $10,000 \text{ tons/y} \times 52 + 5,000 \text{ tons/y} \times 12 = 58,000 \text{ tons/y}$. Hence, the theoretical e-waste recycling capacity is about 0.038kg/capita/a. This compares to annual per capita e-waste collection in the EU of 4 to 16kg, which is roughly 200 times more. For comparison, GDP per capita in China is USD 6,000, compared with USD 40,000 in France (a factor of only 6.5). It is therefore obvious that, if successful, the E-waste Fund will require the recycling industry to expand significantly in the future.

Recycled e-waste data published online by recyclers

Some of the certified recycling companies have established very formal and open websites where they have begun to publish their recycling data regularly. For example, the Beijing Hua Xin Green Spring Environmental Co. Ltd (referred to as Beijing Hua Xin) publishes its recycling data monthly for public monitoring and supervision since the beginning of 2013 and the Shanghai Xin Jinqiao Environmental Protection Co. Ltd (Shanghai Xin Jinqiao) has published its recycling data daily since 17th April 2013. From 1st April to 30th June 2013, Beijing Hua Xin collected 265,828 units of e-waste and recycled 258,439 units (254,763 units were television sets, accounting for 95.8% of the total). From 17th April to 30th June 2013, Shanghai Xin Jinqiao collected 122,086 and recycled 123,223 units (117,764 units were television sets, accounting for 96.5% of the total).

From the data we find that the majority of E-waste collected and recycled is television sets. There are a number of reasons that help to explain this fact: (1) China's households are replacing their CRT television sets by LCD ones in large quantities (Table 3,4); (2) Television sets are more easily collected by the certified recyclers than the other four kinds of products that form part of the E-waste Scheme; (3) Collecting and recycling of television sets them is more profitable than that of other e-waste products, because the subsidy rate for television sets is higher than for any other subsidized e-waste product.



Table 3. Certified recycling companies in the main cities, provinces and autonomous regions (not including Taiwan, Hong Kong and Macau)

No.	Area	Enterprises
1	Beijing	1
2	Tianjin	2
3	Hebei	0
4	Shanxi	3
5	Neimenggu	0
6	Liaoning	1
7	Jilin	2
8	Heilongjiang	1
9	Shanghai	4
10	Jiangsu	8
11	Zhejiang	4
12	Anhui	0
13	Fujian	2
14	Jiangxi	4
15	Shandong	4
16	Henan	1
17	Hubei	5
18	Hunan	4
19	Guangdong	4
20	Guangxi	1
21	Hainan	0
22	Chongqing	2
23	Sichuan	5
24	Guizhou	2
25	Yunnan	0
26	Xizang	0
27	Shan'xi	0
28	Gansu	1
29	Qinghai	0
30	Ningxia	0
31	Xinjiang	1
	Total	64

(Source: MoF et al, 2012 and 2013)

At the same time, this indicates that uncertified/informal recyclers are still capturing most other e-waste, despite the fact that they cannot benefit from the subsidies under the E-waste Fund.

Collection and use of resources under the E-Waste Fund

As the levy is collected by the tax and customs authorities, collection is relatively straightforward. According to the budget report of MoF, the Fund raised CNY 854 million in the second half of 2012 since the Scheme began and that sum is expected to rise to CNY 2.8 billion in 2013. However, the funds raised in 2012 have not yet been distributed and have instead been transferred to the following year's budget, thus, CNY 3.654 billion will be added to the 2013 budget. MEP is actively pursuing the implementation of the scheme and conducted extensive on-site verifications in order to facilitate disbursements from the fund. In June and July of 2013, MEP organized expert teams to go to different provinces to check the declarations of certified recyclers. In total, 9,020,491 units of e-waste were declared, after strict paper and on-site checks, 7,678,989 units were verified (accounting for 85.1% of the total declared) and among the approved recycled e-waste, 7,214,083 units were television sets (accounting for 93.9% of total collected units), showing approximately the same percentages posted on Beijing Huaxin's and Shanghai Xin Jinqiao's websites. MEP has sent the verified applications to MoF and the subsidy for the e-waste recycled in the third and fourth quarter of 2012 is due to be disbursed to the applicant companies soon.

5. An initial assessment

Table 4. The five kinds of e-waste collected and recycled by Beijing Hua Xin from 1st April to 30th June 2013

Kind/number	Collected		Recycled	
	Units	Percentage	Units	Percentage
Television	254,763	95.8%	248,050	96.0%
Refrigerator	11,065	4.2%	10,389	4.0%
Air Conditioner	0	0	0	0
Washing Machine	0	0	0	0
Personal Computer	0	0	0	0
Total	265,828	100%	258,439	100%

Table 5. The five kinds of e-waste collected and recycled by Shanghai Xin Jinqiao from 17th April to 30th June

Kind/number	Collected		Recycled	
	Units	Percentage	Units	Percentage
Television (CRT)	117,764	96.5%	117,767	95.6%
Refrigerator	21	0.02%	0	0%
Air Conditioner	422	0.3%	1,025	0.8%
Washing Machine	3	0.002%	0	0%
Personal Computer	3,876	3.2%	4,431	3.6%
Total	122,086	100%	123,223	100%

The Chinese E-waste Disposal Fund Scheme was established just over a year ago, making it too early to do any in-depth analysis. Thus, find below some initial observations.

Key achievements

Firstly, charges are comparatively easy to be levied, because of the participation of tax and custom authorities - the Fund has been efficiently collected since the beginning of 2013.



Secondly, the Fund is clearly helping to develop the e-waste recycling industry. However, there are currently only 64 recycling companies certified, with 9 provinces still without any certified recycling companies at all. Thus, there is still a large potential for the industry's development.

Thirdly, there is a minimum capacity requirement for all recycling companies to be certified. Ultimately, each province should at least have two certified recycling companies to promote quality and efficiency through appropriate levels of competition.

Fourthly, issues of free riders and orphan products should be limited because the subsidies from the e-waste Fund apply to all products entering the waste stream, independent of their type or production date.

Fifthly, transparency requirements under the Scheme are strict and demanding, which should help to limit opportunities for cheating and ensure the sound operation of the Scheme.

Key challenges

Firstly, the current quantities of e-waste collected are still not sufficient as informal e-waste recycling is still profitable and with the exception of television sets, captures the majority of discarded products covered by the Scheme. The Government will need to modify the incentive structure under the Scheme in a way that allows increasing collections by 14 certified recyclers, while at the same time taking account of the impact that this will have on people working in the informal sector.

Secondly, cheating within the Scheme needs to be minimized - all measures listed in the Scheme should be fully implemented, updated and adjusted regularly.

Thirdly, the administration of the Scheme as it currently stands is complicated and costly, resulting in increased pressure on the Chinese administrations in charge of implementing the Scheme. As the Scheme increases scale, its governance may need to be revised. One option might be to hand more responsibility to producers, and to encourage the creation of one or several a producer responsibility organizations (PRO).

Fourthly, the development of incentives to encourage producers to improve product design (product designs that are easier and less costly to recycle) have been considered in the framework of the Scheme. The MoF is planning to elaborate measures to encourage producers to improve designs and to use more environment-friendly materials. This should be done as quickly as possible.

Fifthly, the scope of products covered under the Scheme is still limited. According to MIIT statistics, by the end of March 2013, the number of mobile phone users in China reached 1.146 billion; according to the Ministry of Public Security of China statistics, the total number of automobile vehicles reached 233 million by the end of July 2012. This means that mobile phones and vehicle waste will significantly increase in the near future. Other products such as rechargeable batteries, fluorescent light bulbs, microwave ovens, printers, photocopiers... should also be considered for inclusion into the Scheme.

The main product that is currently collected and recycled is television sets, but the Fund is sourced from fees on four other product groups. The Fund will need to find a better balance between the costs and the revenues that different product groups generate in order to be acceptable to EEE producers and importers, as well as implementing the polluter pays principle.

Sixthly, EPR policy has two principal features: One is the shifting of responsibility (physically and/or economically; fully or partially) upstream to the producer and away from 15 municipalities and the other is to provide incentives for producers to incorporate environmental considerations in the design of their products. The Chinese E-waste Disposal Fund has been successful in beginning to shift the cost of e-waste recycling and disposal from municipalities to producers, but further incentives need to be observed to encourage more environmentally friendly product designs. To achieve optimal environmental effectiveness as well as greater cost-effectiveness China's E-waste Scheme will need to evolve, and experience with the use of different types of EPR in other countries could be helpful in identifying what the options are as well as providing useful guidance.

Seventhly, the establishment of the Chinese E-waste Fund is an important achievement in dealing more effectively with this fast growing waste stream. Over the coming years, the e-waste Scheme will be improved by deepening its implementation. Cooperation and collaboration of different Government departments have played an important role in the establishment and functioning of the e-waste disposal Scheme. Currently, MoF, MEP, NDRC, MIIT, SAT, GAC, the Ministry of Commerce (MoC) and China CO-OP are contributing to the administration of the Scheme. On 21st March 2013, MoC published the Measures on the Administration of Circulation of Old Electronic and Electrical Products to encourage and regulate the circulation of second-hand EEE. China CO-OP is a federation for the supply and marketing affairs of agriculture-related products with branches covering the whole country and a large network of waste and old products collection and recycling - consisting of more than 150,000 depots and 1 million employees. It has set itself high targets for e-waste collection and recycling, which should help to improve China's E-waste management ■

BÍCH HỒNG
(Source: OECD.org)



EU to introduce new laws around battery recycling

The EU has announced new legislation surrounding the collection, recycling and reuse of batteries following a provisional political agreement between the European Parliament and the Council. The legislation - known as “Batteries Regulation” - were adopted by the European Council, establish waste collection and material recovery targets that will increase at set points over the next decade. Additionally, they restrict the use of hazardous materials in battery production and require the due diligence of suppliers - who will have to demonstrate that their materials were sourced in a socially and environmentally responsible manner.

The Council hopes these regulations will help to promote a circular economy and push towards decarbonization while also reducing the impacts of battery production by regulating the entire life cycle of the batteries used within the EU. The Regulation follows the proposal of The Critical Raw Materials Act and The Net Zero Industry Act by the European Commission earlier this year, which seek to reduce the dependency of EU member states on global supply chains by reinforcing more renewable and circular domestic production capabilities.

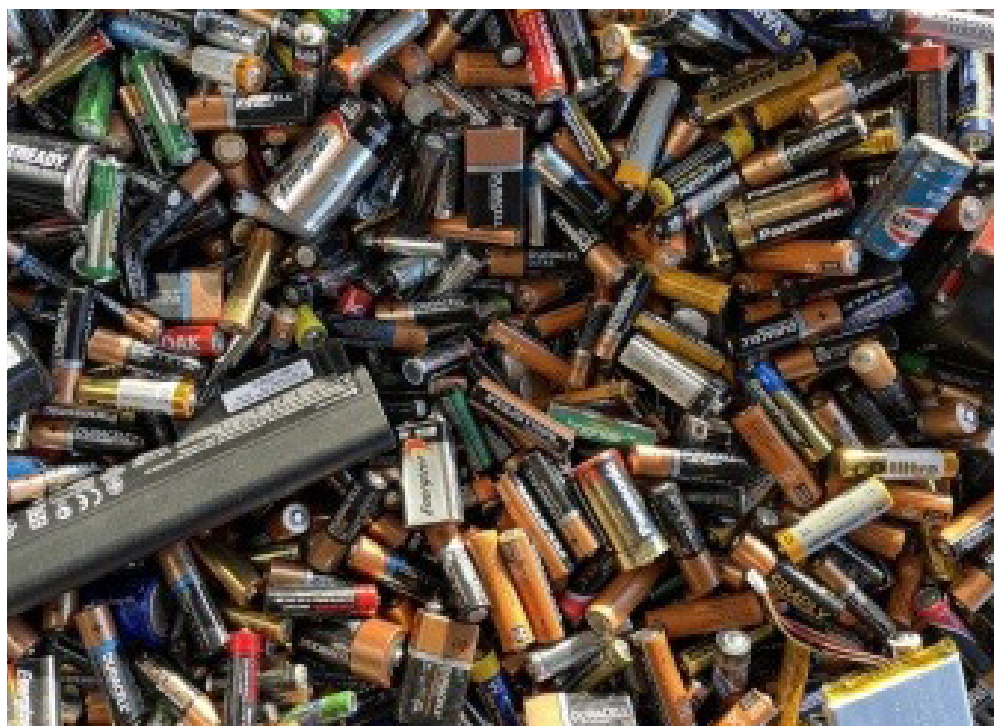
The Critical Raw Materials Act looks towards securing a robust, affordable and sustainable supply of raw materials for European member states. It identifies a list of “strategic” materials that are crucial to Europe’s green and technological ambitions, but which may be subject to supply risks in the future.

The Act will reduce the administrative burden on new critical materials projects in the EU, in an attempt to make them easier to establish, but will also require that member

states adopt national measures to improve the collection and recycling of waste that is rich in critical materials, including the copper, cobalt, lithium, nickel and lead now set to be recovered as part of the Batteries Regulations.

The framework will start to come into effect from 2024 onwards, with new rules around carbon footprint, recycled content, and durability being introduced gradually. In mid-2025 a “more comprehensive” regulatory framework on extended producer responsibility (EPR) will come into force. The 2025 guidelines will include the gradual introduction of higher collection targets. For portable batteries, this includes a collection target of 63 percent in 2027, which will be increased to 73 percent in 2030. The current collection target is 45 percent. Batteries from light means of transport will have a target of 52 percent in 2028, increasing to 61 percent in 2031. Batteries from light means of transport were excluded from the original collection targets set in 2006.

All collected batteries will be recycled to recover materials such as copper, cobalt, lithium, nickel and lead. Material recovery targets for lithium will be 50 percent by 2027, increasing to 80 percent by 2031. If the legislation is formally



▲ “Batteries collected for recycling” by Josh Cameron (Unsplash License)



adopted, secondary legislation with detailed laws to support the transition will need to be formally adopted from 2024 to 2028. The formal adoption of EU Law usually takes several weeks and is to be completed by a yet-to-be-agreed-upon date. Following this, the legislation is published in the Official Journal and brought into effect 20 days later.

Both pieces of legislation expand on the 2006 Batteries Directive - the first piece of EU legislation to set out rules and targets for the recycling of batteries. In December 2020, the EU agreed to revise the Directive. These revisions take into account the rapidly increasing demand for batteries, which is set to increase a further 14-fold by 2030. It is predicted that the EU will account for 17 percent of that demand, mostly through electric transport. Companies operating within the EU internal market will be mandated to demonstrate both socially and environmentally responsible sourcing of materials.

Vice-President for Inter-institutional Relations and Foresight Maroš Šefčovič said: "All industrial players in Europe will now have a clear, predictable legal environment that supports them in innovating and preparing for the expected surge in e-mobility in coming years. This is yet another milestone, as our battery industry is of strategic importance to Europe's global competitiveness".

Commissioner for Internal Market Thierry Breton added, electric mobility is a new and coveted market. Global competition is fierce and demand for batteries has increased sharply. "We are mobilizing substantial public and private investments in the battery value chain, and with the new regulation agreed we will ensure that batteries placed in the EU market - even if produced in a third country - are sustainable and safe throughout their entire life cycle. Because batteries are at the heart of Europe's competitiveness and resilience", he said.

Responding to the new batteries regulation, the Director for Public Affairs and Communications at RECHARGE Kinga Timaru-Kast, the European Industry Association for Rechargeable and Lithium batteries said: "Carbon intensity and due diligence provisions have the potential to not only prevent underperforming batteries from entering the EU market, but to truly work towards the climate-neutrality and sustainability objectives of the EU. The new EU batteries regulation, together with the Critical Raw Materials Act and the Net Zero Industry Act, have the potential to shape the future for a competitive and sustainable battery value chain" ■

TRẦN TÂN

(Source: RESOURCE)

Indore, a fast-growing city in India, has emerged as a model for sustainable waste management practices. Over the past few years, Indore has consistently ranked as the cleanest City in India, thanks to the efficient waste management system put in place by the municipal corporation. This case study explores the background, challenges faced, and solutions implemented and key learnings from Indore's successful waste management system.

Indore, with a population of over 3.2 million people, generates around 1,100 metric tons of waste daily. Prior to 2016, the City struggled with waste management, leading to unhygienic conditions, increased pollution, and negative impacts on public health. However, the launch of the Swachh Bharat (Clean India) campaign in 2014 led the Indore Municipal Corporation (IMC) to undertake a comprehensive transformation of its waste management system. This involved an overhaul of existing infrastructure, policies, and community engagement initiatives to create a more efficient and environmentally friendly waste management system.

Challenges faced

Lack of waste segregation at the source

Indore faced issues with mixed waste, which hindered the recycling and disposal process. Unsegregated waste resulted in inefficient waste collection and processing, causing further strain on the waste management system.

Inefficient waste collection and transportation system

With limited resources and vehicles, the City's waste collection and transportation system could not keep up with the growing population and waste generation. In addition, the absence of adequate waste processing facilities led to the practice of open dumping and burning of waste, which contributed to air and land pollution.

Inadequate public awareness and participation

Citizens were not fully aware of the importance of waste segregation, recycling, and proper disposal, resulting in low participation rates and disregard for waste management rules.

Limited infrastructure for waste processing and disposal

The City's waste processing and disposal infrastructure was unable to cope with the increasing waste generation, leading to unmanaged landfills and environmental degradation.



Sustainable waste management in Indore City, India

Solutions implemented

Segregation at the source

The IMC implemented a mandatory waste segregation policy, requiring households to separate waste into wet (biodegradable) and dry (recyclable) categories. This allowed for more efficient waste collection and processing, as well as increased recycling rates.

Door-to-door waste collection

A fleet of over 600 GPS-enabled vehicles were deployed to collect segregated waste daily from all households and commercial establishments. This ensured timely and efficient waste collection, preventing littering and illegal dumping.

Waste processing and disposal

The City established a state-of-the-art waste processing facility capable of handling 1,000 metric tons of waste daily, including a 15 MW waste-to-energy plant and a 200 TPD (tons per day) composting plant. These facilities enabled Indore to process and dispose of waste more effectively, reducing the environmental impact of waste disposal.

Public awareness and participation

The IMC launched numerous awareness campaigns, involving local celebrities, schools, and religious institutions, to educate the public on the importance of waste segregation and cleanliness. This resulted in increased community involvement and support for the waste management program.

Strict monitoring and enforcement

Regular inspections, fines, and incentives were introduced to ensure compliance with waste management rules. This helped maintain the cleanliness of the City and encouraged citizens to adhere to waste segregation and disposal guidelines.

Results achieved

Waste segregation

Over 90% of households in Indore now segregate their waste, significantly improving the efficiency of waste collection and processing, and reducing the burden on landfills.

Waste processing

The City's waste processing facility successfully manages 1,000 metric tons of waste daily, with a 95% waste recovery rate. This has led to a substantial reduction in landfill usage and has minimized the environmental impact of waste disposal.

Cleanliness

Indore has consistently ranked as the cleanest city in India in the annual Swachh Survekshan survey since 2017. This highlights the success of the City's waste management system and the active participation of its residents in maintaining cleanliness.



▲ IMC is planning to upgrade its existing waste segregation into 35 different categories



Health and environment

Cases of vector-borne diseases have dropped by 60% since the implementation of the waste management system, and air quality has improved due to reduced open burning of waste. This has led to a healthier environment and improved overall quality of life for Indore's residents.

Key learnings

Political will and administrative commitment are crucial for the successful implementation of waste management systems. Indore's transformation was made possible by strong leadership and a dedicated municipal corporation committed to addressing the City's waste management challenges.

Public awareness and participation play a significant role in ensuring the success of waste management initiatives. By actively involving the community and raising awareness about the importance of waste segregation and proper disposal, Indore was able to achieve a high level of public participation and support.

Strict monitoring and enforcement mechanisms help ensure compliance with waste management rules and regulations. Indore's approach to enforcing waste segregation and disposal guidelines, combined with regular inspections and penalties, proved to be effective in maintaining the City's cleanliness.

Investing in modern waste processing infrastructure can significantly improve the efficiency of waste management systems and reduce environmental impact. Indore's investment in a state-of-the-art waste processing facility allowed the City to process and dispose of waste more effectively, leading to a substantial reduction in land-fill usage and associated environmental issues.

Beside, Indore's transformation into a clean, sustainable city serves as an inspiring example for other urban centers in India and around the world. By adopting a comprehensive, integrated approach to waste management, Indore has successfully addressed its waste management challenges and set a benchmark for sustainable urban living.

Indore is making strides in its waste management services, with the goal of running on zero waste. The City has implemented a number of initiatives to reduce, reuse, and recycle its waste, and the results are already evident. With the help of its residents, Indore is well on its way to becoming a model city for waste management. The City's experience provides valuable insights and lessons for other municipalities looking to improve their waste management systems and promote environmental sustainability ■

HÔNG CẨM
(Source: *Earth5R*)

The UK Government has recently reaffirmed its commitment as a leader on international nature conservation, with a package of measures to address pressing challenges such as biodiversity loss, marine protection, climate change and illegal fishing.

The announcements made at the UN General Assembly in New York by Environment Secretary Thérèse Coffey and Foreign Office Minister Lord Ahmad will build on the work that the UK has already done on the international stage to put nature and the environment at the top of the international agenda.

This includes playing a leading role in negotiating and securing the new Global Biodiversity Framework (GBF) at the UN Biodiversity Summit in Montreal, which contains targets and goals to halt and reverse biodiversity loss by 2030.

To help protect marine life in the high seas, the UK will be one of the first signatories of the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement, which will help establish large-scale marine protected areas in the two-thirds of the global ocean that lie beyond national jurisdiction. The UK will also sign the Ocean Conservation Pledge, building on our existing commitments to protect at least 30% of our own marine area by 2030, and has endorsed the High-Level Panel Leader's Communiqué, urging ocean-based action across climate, fisheries, pollution, management and mobilizing finance.

Environment Secretary Thérèse Coffey said: "It is vital that we maintain the momentum of the UN Biodiversity Conference last year and focus on implementation. Today's announcements will help to tackle biodiversity loss at sea and on land, and I urge more nations to join us as we drive forward progress on this global mission ensuring a sustainable future for generations to come".

Mr. Lord (Tarid) Ahmad of Wimbledon - Minister of State for the United Nations at the Foreign, Commonwealth and Development Office said: "I look forward to signing the BBNJ Agreement at the United Nations General Assembly and making the UK one of the first signatories. This Agreement is a major victory for ocean protection and multilateral diplomacy and underpins the UN Convention on the Law of the Sea as the cornerstone of ocean governance".

The UK played an important role in the negotiations and will continue to be proactive in preparing for implementation and entry into force and supporting other, particularly developing, countries, to do so.



UK pushes protections for international marine biodiversity

In addition, the UK Government has pledged funding to support marine protection, ocean research and activities to combat illegal fishing. These investments will bolster initiatives aimed at conserving our oceans and ensuring their long-term sustainability by allocating resources to these critical areas.

As part of the full package of measures to drive forward international progress on tackling biodiversity loss in the ocean and on land, the UK Government has also announced:

£2.5 million to support the Joint Analytical Cell (JAC), which is a crucial initiative aimed at combatting illegal, unreported and unregulated (IUU) fishing. This substantial financial backing underscores the UK's commitment to safeguarding marine ecosystems and promoting sustainable fishing practices.

£120,000 in funding to Plymouth Marine Laboratory as the secretariat for the Ocean Acidification Research for Sustainability (OARS) Program. Ocean acidification poses a significant threat to marine ecosystems, and this funding will contribute to efforts aimed at monitoring, mitigating, and adapting to this critical issue.

A commitment to fund a project focused on the development of potential area-based management tools (ABMTs), such as Marine Protected Areas, in areas beyond national jurisdiction. This initiative aligns with efforts, such as the BBNJ Agreement, to enhance the conservation and sustainable management of marine areas of the global ocean, addressing a critical aspect of marine protection and sustainability. This project will draw on the important work that existing organizations have already carried out and recognize the need to collaborate closely with countries in regions where such proposals are to be developed.

That it has welcomed Costa Rica, Panama, and Peru joining the Global Plastic Action Partnership (GPAP), a program funded by the UK's Blue Planet Fund that supports countries in their ambitions to reduce plastic pollution.

In addition, the UK is resolutely focused on delivering the target to halt and reverse biodiversity loss by 2030 through a number of different actions such as welcoming the

final Taskforce on Nature-related Financial Disclosures (TNFD) risk assessment framework, contributing £10 million towards the GBF Fund and actively establishing both Marine Protected Areas and Highly Protected Marine Areas within UK waters.

More information on how the UK is focused on achieving the target to halt and reverse biodiversity loss by 2030:

The UK has welcomed the TNFD risk assessment framework, which was launched on 18th September in New York, and encourages all UK businesses and financial institutions across sectors to engage with the TNFD's framework and consider getting involved in the work of the UK's TNFD National Consultation Group. The TNFD is an invaluable tool for redirecting financial flows towards nature positive outcomes.

The UK is contributing £10 million towards the GBF Fund. This contribution serves as a testament to the UK's recognition of the interconnectedness of global ecosystems and the importance of collective action.

On the domestic front, the UK has been actively establishing Marine Protected Areas and Highly Protected Marine Areas within its own waters. This effort is a vital component of the UK's broader strategy to safeguard marine biodiversity and promote sustainable fisheries. These designated areas serve as havens for marine life, allowing ecosystems to thrive and regenerate while also contributing to broader conservation objectives.

Furthermore, the UK is actively engaged in international efforts to protect critical ecosystems, such as mangroves. The commitment to the High-Level Climate Champions Mangrove Breakthrough target to mobilize US\$ 4 billion in funding to revitalize mangroves highlights the UK's recognition of the vital role these coastal ecosystems play in carbon sequestration, biodiversity conservation, and climate resilience.

The UK has also committed to spending at least £3 billion on climate solutions which will focus specifically on the intrinsic connection between climate change and biodiversity loss. By investing in climate solutions that priorities nature, the UK aims to address both environmental crises simultaneously, ensuring a sustainable and resilient future for both our ecosystems and our communities ■

NHẬT MINH
(Source: GOV.UK)



Wildlife returns to one of US' most famous rivers

The splash was so loud that environmental advocate Mr. Lewis Pugh, the British-South African, who is a United Nations Environment Programme (UNEP) Patron of the Ocean, thought someone had jumped off the bridge that he was swimming under. But then Mr. Lewis Pugh, in the midst of a month-long swim down the United States' Hudson River, saw what had joined him in the water: a bald eagle. "This majestic creature spread its wings and lifted up right in front of us. I will never forget the sight of it", says Mr. Lewis Pugh.

Mr. Lewis Pugh, has completed a 507km swim down the Hudson. The journey cast a spotlight on the River's resurgence - and the need to protect the world's waterways from pollution, climate change and a range of other threats.

The appearance of a bald eagle on the Hudson would have seemed nearly impossible a few decades ago. America's national bird, they were on the verge of extinction in the Northeastern United States, decimated by the widespread use of the pesticide DDT. But since a ban on the pesticide in 1972, the bald eagles have returned.

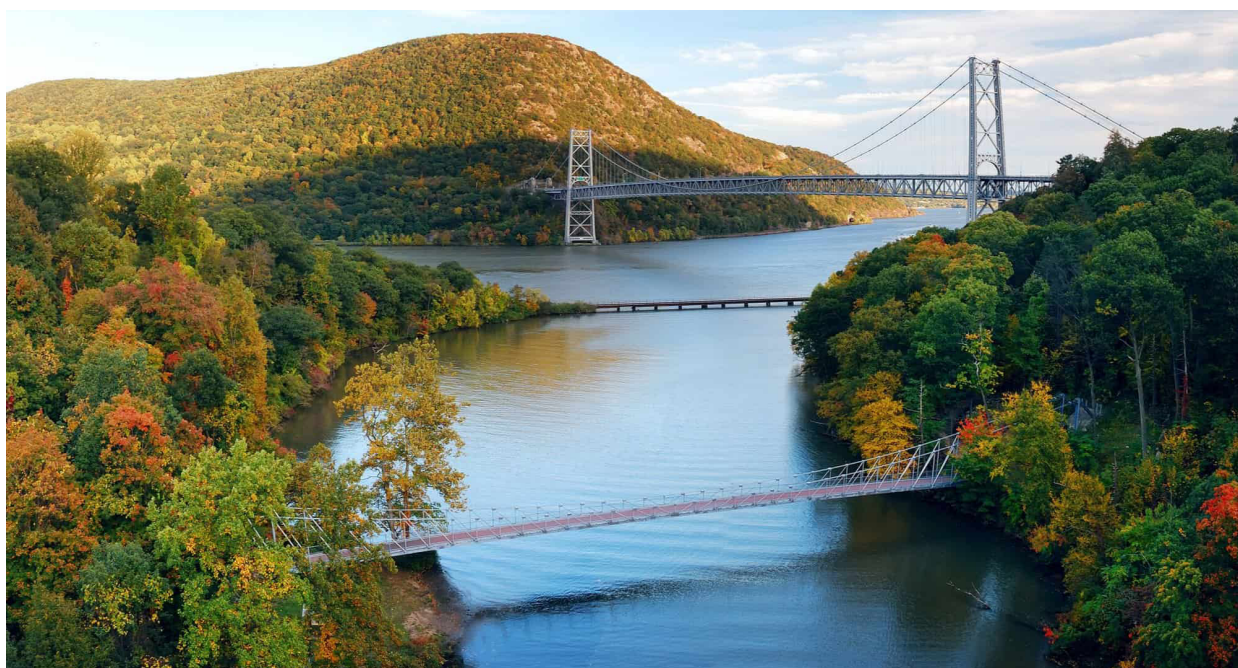
"This year, the locals say they have seen record numbers of these birds. What a wonderful success story", says Mr. Lewis Pugh. During his swim, he also saw turkey vultures, beavers, ospreys, snakes a black bear and some snapping turtles, which can reach 30kg. "They are terrifying. I would rather face a great white shark than a snapping turtle", Mr. Lewis Pugh jests.

The return of wildlife to the Hudson, once one of the country's most-polluted rivers, is seen in many quarters as a conservation success story. It comes after a decades-long effort to clean up the waterway and for many, it is a promising sign for the future.

"Rivers are the lifeblood of human civilization, but in too many places they - and the animals and plants that call them home - are in peril", said Mrs. Leticia Carvalho, the Head of the Marine and Freshwater Branch at UNEP. "The improvement in the health of the Hudson River shows us that it is possible to revive inland waterways - and make them teem with life once again. What is good for the health of our water bodies is also good for human health!"

Back from the brink

Just 150 years ago, the Hudson River was one of the most productive ecosystems in the world. Schools of migratory shad, sturgeon, river herring, blue crab, menhaden and striped bass used the River as an unimpeded corridor from the Atlantic to their spawning grounds. That abundance supported a range of other species and a thriving fishing industry.



▲ *The Hudson River in New York City, US*



In the 20th Century, population growth and industrialization led to pollution, damming, excessive logging and habitat fragmentation, hammering fish stocks. Efforts over the past 50 years to clean up the River and its many tributaries, however, have begun to bear fruit.

In 1972, the United States passed the Clean Water Act, which stopped companies from routinely dumping toxins into the River. Bans on commercial fishing were introduced in 1976 and extended in 1985. Today only two of the 228 fish species in the river are caught commercially - the blue crab and river herring. In 2002, officials began dredging silt laden with polychlorinated biphenyls, better known as PCBs, which had contaminated a 320km stretch of the River.

New York State passed a law that established the Hudson River Park Trust to operate and maintain a new public park and estuarine sanctuary along the Manhattan shoreline, one of many efforts to rewild the Hudson's banks.

Apart from Government initiatives, citizen scientists, schools and campaign groups, like Riverkeeper, are tracking aquatic species to help inform policy decisions. Challenges remain, though. Old dams in some tributaries are still preventing fish from reaching their spawning grounds. As well, riverine planning is uncoordinated, as over 80 percent of the watershed is privately owned, according to Cornell University.

Climate change is another challenge. Warmer ocean temperatures, causing sea-level rise, as well as more intense heatwaves, flooding and droughts, are affecting the River's ecology. In an assessment in 2011, 70 of 119 wildlife species in New York state were found to be vulnerable to climate change, with mollusks and amphibians near the top of the list, according to the New York Natural Heritage Program. Invasive species are an additional challenge.

A global problem

Freshwater ecosystems are particularly biodiverse, supporting about 10 percent of all described species. Some 55 percent of fish species depend on freshwater for their survival. These species are going extinct more rapidly than terrestrial or marine species, with around one-third of all freshwater biodiversity facing extinction due to invasive species, pollution, habitat loss and over-harvesting. In 2018, the World Wildlife Fund estimated that populations of animals living in fresh water experienced a far more drastic decline than elsewhere on the planet - 83 percent between 1970 and 2014.

Pollution is a major driver of aquatic wildlife decline. Globally, water pollution has continued to worsen over the last two decades, increasing the threats to freshwater ecosystems and human health, says UNEP's 2021 flagship report, *Making Peace With Nature*.

Another important driver of riverine wildlife decline is infrastructure development that breaks up the connectivity of freshwater ecosystems. "The diversity of wildlife in and around a river is an indicator of its resilience and health as an ecosystem", says Mrs. Leticia Carvalho. "We must redouble our efforts to monitor river biodiversity, prevent pollutants from entering rivers and the ocean, allow nature to return and in the longer term create more circular economies".

On the rebound

There are signs internationally of a willingness to turn around the fates of some rivers. In 2022, the UN Environment Assembly, the world's highest decision-making body on the environment, passed a resolution calling for the protection of lakes and connected ecosystems, like rivers.

In March 2023, a collection of six developing nations launched the Freshwater Challenge, the largest ever initiative to restore degraded rivers, lakes and wetlands. It is expected to be a cornerstone of efforts to safeguard freshwater ecosystems at the upcoming UN Climate Change Conference in Dubai.

Across the world, efforts are being made to clean up and restore rivers, such as the Thames and Ganga. Officials are even aiming to clean up what is said to be the most polluted river in the world, Rio Motagua in Guatemala. France is ambitiously aiming to make the Seine swimmable in time for the 2024 Summer Olympics.

In the Netherlands, a 30-year project to restore a 45km stretch of the River Meuse has reduced flood risk, made nature more diverse, and boosted the local economy through tourism. In February 2023, the Government of Kenya set up the Nairobi Rivers Commission to coordinate the rehabilitation, protection and restoration of the heavily polluted Nairobi River.

The Kunming-Montreal Global Biodiversity Framework, a landmark pact to protect and restore nature adopted in December 2022, seeks to, among other things, ensure that by 2030 at least 30 percent of areas of degraded inland water are under effective restoration. This is seen as crucial to enhancing biodiversity and reviving the interconnectedness of ecosystems ■

PHẠM VĂN NGỌC
(Source: UNEP.org)



AEON Vietnam: Join hands in creating a sustainable society

The project on strengthening plastic waste management in Vietnam (Decision No. 1316/QĐ -TTg) has determined the goal of striving to use 100% eco-friendly plastic bags and packaging at commercial centers and supermarkets for domestic or household purposes to replace non-biodegradable plastic bags by 2025. To achieve that goal, in recent years, Vietnam has received the companionship of various retailers in the journey to reduce plastic bags and plastic waste pollution, including AEON Vietnam.

Sharing experiences in the implementation process, Mrs. Nguyễn Thị Ngọc Huệ - General Manager of Communications and External Affairs of AEON Vietnam had a discussion with Environment Magazine about this topic.

• **Could you share some information about AEON Vietnam?**

Mrs. Nguyễn Thị Ngọc Huệ: AEON Vietnam Co., Ltd, a subsidiary of AEON Japan's leading retail group, was officially established on October 7th, 2011. The Company has diversified its investments across various segments in the retail industry: Shopping Centers (SC); General Merchandise Stores (GMS); Specialty Stores (SS); E-commerce (EC); Small and Medium-sized Supermarkets (SM). With a vision to become an "Indispensable Retailer in Vietnam", AEON Vietnam is dedicated to creating shared values. The Company tirelessly pursues the mission of "contributing to Vietnam's economic and social growth" for sustainable development.

AEON Group has identified Vietnam as second key market (behind Japan) to expand investment in long-term strategy. AEON's ultimate goal is to become a familiar brand to the Vietnamese people, serving them and contributing to the nation's development. As AEON expands its business operations, it not only contributes to the development of Vietnam's commercial infrastructure, but also stimulates the consumption of Vietnamese products within AEON's system. AEON aims to provide quality products at reasonable prices to customers, contributing to the development of the local workforce in the Vietnamese retail industry.

In the next 3 - 5 years, AEON plans to focus on opening large-scale shopping centers. However, to adapt to changes in customer behaviour, especially the prioritization of convenience after the pandemic, AEON will develop diverse and flexible

business models tailored to the needs and realities of each locality. These formats may include Shopping Mall, General Merchandise Stores, Specialty Stores, Convenience Stores, Super Supermarkets. This approach will accelerate the opening of new stores and bring quality products and services to local residents. AEON will continue its expansion in Hanoi, Ho Chi Minh City, and extend its presence to the Central region and nearby provinces/cities.

As a retailer, AEON places a strong emphasis on sustainable production and consumption as one of main objectives. AEON Vietnam has implemented various initiatives to raise awareness and facilitate customers and employees in making sustainable consumption decisions. AEON has collaborated with domestic manufacturers to develop private brand products which are high quality and eco-friendly according to AEON's standards. Furthermore, in an effort to provide quality products at reasonable prices to local customers and contribute to the stability of the supply chain, AEON has collaborated with suppliers to research and develop Private Brand products produced in Vietnam according to AEON's standards.



▲ Customers can borrow eco-bags from the checkout counter to pack their goods when shopping at AEON Vietnam



• Could you please share results that AEON Vietnam has achieved in the journey to reduce plastic bags in particular and plastic waste in general?

Mrs. Nguyễn Thị Ngọc Huệ: At AEON Vietnam, sustainable development is not just an individual volunteer activities; it is associated with our operational activities and business philosophy. In addition to our primary mission as a retailer providing products and services to meet customer needs, AEON Vietnam aims to collaborate with the community to create sustainable social development. We focus on three crucial pillars: Society (People) - Economy (Profit) - Environment (Planet). Within the Environment (Planet) pillar, projects to reduce plastic waste are AEON Vietnam's relentless efforts to minimize the environmental impact of our business operations, preserve the local landscape and biodiversity; and contribute to the sustainable development of Vietnam's environment.

By the end of 2022, there have been 2 million plastic bags refusal transactions (equivalent to reducing 5.8 million plastic bags); 6% of plastic bag refusal transactions at our nationwide business locations; 100% of shopping bags provided to customers in General Merchandise Stores are eco-friendly (excluding AEON Delica and AEON Bakery). However, during implementation, we faced some challenges. For instance, plastic bags are convenient and ingrained in customer habits, so urging them to change takes time. In addition, concepts related to sustainable development and biodiversity conservation are still unfamiliar to consumers. For businesses like AEON, the production costs of eco-friendly and sustainable products/materials are usually higher than that of regular products. This often translates to higher prices for customers, while they tend to prioritize competitively priced products. Therefore, raising awareness and changing customer behavior is a long-term process that requires collaboration from various parties. Hence, businesses like AEON need to monitor customer behavior and adjust programs to ensure sustainable results for the Company, customers, and society.

• How did AEON Vietnam calculate and assess the reduction of plastic bags and plastic waste at business locations?

Mrs. Nguyễn Thị Ngọc Huệ: AEON Vietnam has been implementing various activities to support customers in making environmentally-friendly decisions more easily and conveniently. In addition to these efforts, we have organized activities such as environmental bag design competitions, provided various eco-friendly bag designs and choices, offered bag rental services to assist customers, set up priority checkout counters for customers who refuse plastic bags, provided free cartons boxes for packing, and show appreciation to customers who refuse to use bio-plastic bags.

To optimize the efficient use of local natural resources, invest in and seek sustainable alternatives solutions, AEON Vietnam has managed the number of biodegradable bags used for packaging; replaced single-use plastic and foam packaging materials with eco-friendly materials such as paper and bagasse; converted physical membership cards and paper coupons into the mobile app; and limited the display and supply of single-use plastic products. The success of AEON Vietnam's initiatives and activities is evaluated based on the ratio of plastic bag refusal transactions to total customer transactions during shopping; The reduction in the number of plastic bags used in our operations; The amount of plastic waste sorted at source and handed over to waste collection units.

Over the past 30 years, AEON in Japan has implemented long-term strategies and efforts to achieve a result of 80% of customers refuse to use plastic bags when shopping. As AEON entering Vietnam, our goal is to contribute to reducing plastic bags and plastic waste, with a long-term target of reaching 70% of customers refuse to use plastic bags within 10 years. All initiatives and activities contribute to the long-term goals of the Company and the authorities. With the expectation that when legal corridors regarding plastic bag fees will be issued, consumers have already formed the habit of not using plastic bags when shopping.

• Based on your experience in implementing these initiatives at AEON Vietnam's stores, could you please share some insights and recommendations for Government authorities and other retailers in Vietnam?

Mrs. Nguyễn Thị Ngọc Huệ: Based on our experience, initiatives or changes must ensure customer needs and convenience without disrupting the customer experience. Importantly, change should start internally within the Company as a model for customers and the community. In addition, we aligned with Government policies and work closely with relevant agencies to create systemic changes. Sustainable development initiatives in general and plastic waste reduction activities in particular, should not only target consumers, but should also be applied throughout the supply chain of retailers and relevant entities. Joint efforts from businesses and regulatory authorities will help to protect the environment, reduce plastic waste, and create a significant impact on society.

• Thank you very much!

NGUYỄN HẰNG



The role of data in circular economy development

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In the digital age, optimizing the value of data is a key factor to help businesses achieve outstanding success. The right use of data can promote progress and contribute to the sustainable development of society and environment. Within the scope of this article will analyze several aspects of the importance of data in the national economy. Through analytical research and synthetic methods, the article evaluates its role in developing a circular economy (CE). The article provides some basic information about the role of data in Vietnam's continuous efforts to improve data infrastructure and support the development of a CE.

1. INTRODUCTION

Data is a form of information, a rich document on the economics of information (Swallow and Haksar, 2019). In terms of hierarchy, data collected directly from the source through observation, survey, interview... which is called primary data. In contrast, available data, publicly disclosed without having to be directly collected, is called secondary data.

In relation to information and knowledge, data is uninterpreted information that plays an important role in many fields. Information is data that has been interpreted, carries meaning and provides the necessary insights for human decisions and activities. Knowledge is formed by giving meaning to information and connecting it with existing knowledge, helping to build new knowledge and deepen understanding of specific issues. Therefore, data can be seen as the precursor of information and knowledge.

The European Union's Convention "The General Data Protection Regulation" (GDPR) provides an indirect definition of data. According to Clause 1, Article 4 of GDPR, data is divided into two main categories: personal data (identifying data) and non-personal data (anonymous data). Personal data is information that can identify a particular person, while non-personal data cannot identify that individual.

In Vietnam, the recently issued Clause 1, Article 2, Decree No. 13/2023/NĐ-CP dated April 17th, 2023, of the Government on the protection of personal data provides the definition: Personal data is information in the form of symbols, letters, numbers, images, sounds or analogous form on the electronic medium that is associated with a particular person or helps to identify a particular person. Personal data includes basic personal data and sensitive personal data.

In general, the concept of data is a diverse concept and has many different categories in different fields. Data plays an important role in performing computation, generating information and knowledge, while ensuring the protection of each individual's privacy and intellectual property rights. However, the issue of data definition and classification is still being studied and discussed to ensure understanding and compliance with relevant legal regulations.

2. IMPORTANCE OF DATA IN THE NATIONAL ECONOMY

The rapid development of contemporary technologies such as the Internet and cloud computing has released a new resource in the form of data. According to statistics in 2021, every day, we generate 2.5 quintillion bytes of data, 70% of global GDP will be digitized by 2022. Intriguing videos on Instagram make 91% of users engage. Cloud data is expected to surpass 200 zettabytes by 2025. With hundreds of millions of tweets and emails sent daily, the data is constantly being produced and hoarded to a massive extent. Not only increasing in quantity, the value of data is also increasingly concerned. Data is likened to the new oil of the digital economy and is increasingly asserting its position. Businesses that are "rich" in data also become rich in fact. In 2020, Apple, Alphabet, Microsoft, Amazon and Facebook hold up to 26% of the Standard and Poor's 500 Stock Index (a stock index based on the capitalization of the 500 largest public companies in the US).

Today, data is viewed as a valuable commodity in the modern economy. According to the report "Financial Statement Impact of Intellectual Property and Cyber Assets: 2020 Aon - Ponemon Global Report conducted independently", intangible assets of companies (including customer records, employee records, financial statements, analytics data, source code, and other intellectual property) has an average value of US\$ 1,274 million. Meanwhile, physical assets, including all fixed assets and industrial automation systems have an average value of only US\$ 1,223 million.



For the same reason, in 2020, Microsoft spent more than US\$ 26 billion to acquire LinkedIn, an influential company and considered a social network for job seekers. This agreement allows Microsoft to integrate LinkedIn with their enterprise products and services, creating a connected environment for businesses. LinkedIn has 433 million users and collects a lot of valuable data about users’ profiles, skills, and relationships. A company’s value is largely based on the content and data it accumulates. Microsoft is willing to spend huge sums of money to indirectly buy data in the name of acquiring an app. Currently, the purposes and ways companies use data are very diverse. Every company has its own way of collecting and using data to get the most out of it.

Data research has appeared in many different fields, including Application of product quality monitoring in production; application in the service environment; application in supply chain management; applications in information gathering and analysis activities. For manufacturing, developing an integrated text analytics framework to use social media data to detect product defects (Abrahams et al., 2014). Along with the diversity of data in the market, data research can help to deepen understanding of consumer behavior and improve marketing activities. To ensure security, most of the customer service data collected is personalized.

Data is not only massive but is also produced with many variations in geographical areas, in media and in diverse fields of activity (Gupta et al., 2019). The large and complex data set called big data includes huge volume, diversity and increasingly fast circulation. However, sometimes it is the volume, variety, speed, and authenticity of the data that can become the cause of decision-making difficulties (Almanza et al., 2023).

Big data is mainly driven by the development of new technologies and methods. On the other hand, big data in supply chain management helps to improve supply chain visibility and product quality, improve operational efficiency, personalize services and enhance service quality. At the same time, operate new and better predictive business models (Wang and Alexander, 2015). Data enables managers to act on structured and unstructured data to aggregate and analyze business information systems such as financial position and personnel structure. Overall, data is an integral part of creating innovative value through product and service innovation in the national economy. Data contributes to business profitability through behavioral assessment and big data analytics (Del et al., 2021). By using data in descriptive statistics, individuals and businesses can actively analyze, make predictions and make appropriate business plans.

Besides, big data brings benefits in extracting useful production information, supporting decision making process, improving productivity as well as competitiveness of manufacturing enterprises. The popularity of big data and the development of machine learning algorithms have enabled data analytics to solve increasingly complex problems (Swallow and Haksar, 2019). In the report of the International Monetary Fund 2019, data plays an important role in the development of the digital economy with two main roles: (1) Data is an input to the production of goods and services, contributing to innovation and efficiency; (2) Data generates and shifts information between economic actors, influencing strategic interactions and information conflicts.

Table1: Analysing the role of data in CE development

Data action	Role in CE
Data analysis	Data analysis facilitates the adoption of the CE model. The data derived from analytics will enable individuals and organizations to simplify complex processes in manufacturing and services, thereby improving the sustainability of their business in the long term.
Data management and mining	Effective data management and mining brings many benefits to individuals and businesses, driving demand and supporting the development of a better CE.
Data forecast	Forecasting the possibility of daily production and maintenance changes; human performance; health, safety and environment; especially the status of raw materials for recycling or reuse.
Data report	Secondary data provides statistics, impact indicators and effectiveness assessment tools, help make decisions about the cycle plan of products and services that apply to different sectors and sizes of companies.
Data technology	Data technology supports the digitization of business processes to achieve the CE. In addition, data technology plays a role in regulating the relationship between human resource management and business performance in the supply chain of the CE.



3. THE ROLE OF DATA IN CE DEVELOPMENT

The CE is an important form of economy, based on the reuse and recycling of goods and materials. A company that manufactures and ships traditional products directly to the customer or to the customer's distribution location, everything ends at the time of delivery and payment. However, in a CE, the company will have to create a closed loop system to regenerate natural materials after use and ensure a new feed to the supply chain.

Because data itself is an intangible asset with inherent recycling property (the output of one processing can be the input of another) and it has no impact on the creation of waste. So, the goal of data in a CE is to manipulate the data so it gets to where it needs to be, focus on the ability to effectively exploit data to ensure optimal benefits that data brings.

Development must go hand in hand with sustainability. National data policies also require a balanced integration between individual competitive objectives and socioeconomic interests. According to the World Bank, data development is fundamental for national policy making, efficient resource allocation and optimal public service delivery to: (1) Driving growth and competition through access to data; (2) Ensure incentives for data collection and processing; (3) Promote stability by investing adequately in cybersecurity; Ensure that individual privacy preferences are respected. For that reason, many countries around the world have established legal frameworks for data protection. In May 2018, the GDPR issued by the European Union established standards for a data policy framework by defining and clarifying the rights and obligations of residents residing, living and working in the European Union with respect to personal data.

However, in the perspective of transitioning to a CE, in addition to ensuring the privacy of individuals with respect to data, an important aspect that needs attention is ensuring access to data to promote faster economic development. Currently, data collection and access are still facing many difficulties. Businesses and individuals are afraid to share data because of concerns about security and competition. This creates limitations for governments, development organizations and private businesses when implementing data solutions in the CE.

To solve this problem, anonymous methods can be used or just shared non-specific information. It is important to create a supportive environment to promote secure data sharing and collaboration between businesses and organizations. Another approach is to use blockchain technology to create an anonymous and trusted marketplace for the trading of recycled and reused resources. This technology can help build trust and transparency in transactions, thereby encouraging cooperation between business partners.

4. CONCLUSIONS

Data is an important component in building and operating a CE model. Assessing the role of data, many countries have issued policies related to rights and obligations in data collection and exploitation associated with the circular production process.

Big data technology is seen as a possible solution to accelerate the implementation of the new CE initiative, which involves reducing the intensity of raw materials, reusing products and increasing efficiency. Analysis, management, mining, forecasting and decision-making from data-related activity will become essential tools, which brings many benefits in developing data for the CE. At the same time, there is a need for extensive cooperation and transparency across businesses and sectors throughout the circular supply chain ■

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Enabling the informal recycling sector to prevent plastic pollution and deliver an inclusive circular economy

Recycling by the informal sector provides a rapid, inexpensive solution to plastic pollution, whilst supporting the livelihoods via their inclusion and empowerment. This solution will have the greatest benefit to the environment if supporting interventions are targeted at types of plastic pollution that are the most damaging from an ecological and wider risk perspective. Interventions should target three aspects of the pollution: reducing barriers to collection, improving the revenue from the materials and wider informal recycler remuneration, and increasing the quality of the materials. Done well, these interventions will increase the collection rate, reduce pollution from plastics, and help millions of people escape poverty. They present a scalable international solution to a global challenge; and are likely the only viable solution to the widespread lack of solid waste services and infrastructure across low- and middle-income countries.

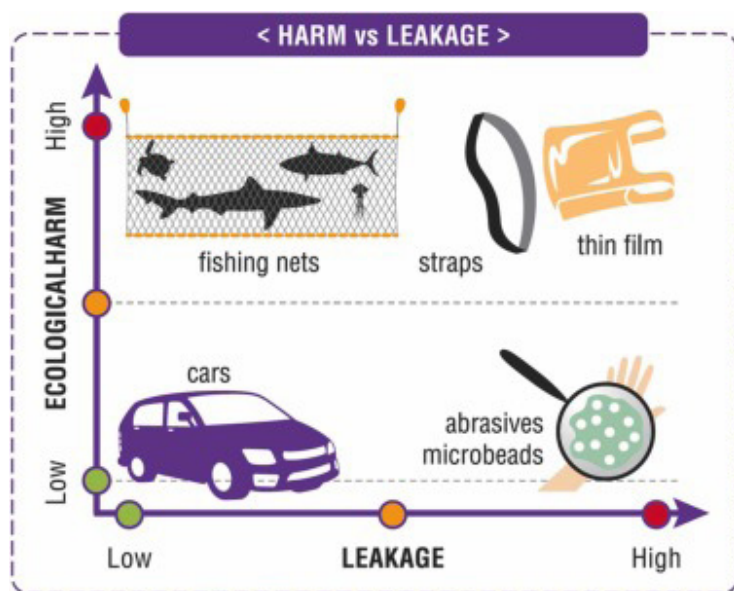
1. INTRODUCTION

Plastic is everywhere. Despite the many improvements plastic has made to our modern lives, its global mismanagement has led to its widespread release into the environment (plastic pollution), with disastrous environmental consequences. Fortunately, a pool of 11 million plus waste pickers, who are in fact plastics recycling experts, may be our best hope for preventing this global failure. The article proposes using the environmental and wider risk posed by this pollution to target interventions to support these recyclers and benefit the environment.

Plastic pollution has ubiquitous impacts on human and natural systems. For instance, more than 700 marine species have been demonstrably affected by this pollution, with the number growing rapidly as more species are studied. Additionally, there is much discussion about the potential impacts to human health, via toxicological effects through the food system. Its economic costs are also significant, with marine plastic alone estimated to cost between 6 and 19 billion US dollars globally in 2018, accounting for its impact on tourism, fisheries, aquaculture and clean-up activities. However, the negative effect of plastic pollution differs across items, species and contexts, with disproportionate impacts resulting from particular items (plastic straps, plastic bags and fishing gear) due to their propensity to entangle animals or obstruct the gut if ingested. The damage from this pollution is thus a product of the impact of a particular item and its rate of loss into the environment (Figure 1).

How we target interventions can take into account the relationship between leakage and harm. Some items such as thin film and packing straps have disproportionately high harmful impacts on ecosystems and are frequently lost to the environment. Other items (microbeads) are lost to the environment readily, but their resultant ecological harm, whilst still uncertain, is thought to be low (and bans have been implemented). Identifying where items fall on leakage and harm spectrum can maximize environmental benefits and support the informal sector. Although this figure expresses harm in terms of ecological harm, there are many other forms harm can take such as harm to human health, infrastructure (blocking of storm drains leading to flooding), or economic harm (damage to tourism or clean-up costs).

World leaders are now taking full notice of the “plastic pollution crisis”, as reflected in the UNEA-5.2 Resolution to work towards a global legally binding treaty to ending plastic pollution (UNEP/EA.5/L.23/Rev.1), putting waste management failures in the spotlight. In the meantime, China stopped accepting imports of certain recyclable waste in 2018, disrupting global plastic recycling markets and making the world acutely aware of the potential mismanagement of globally traded secondary resources; a sustainability crisis we could have anticipated. With the present focus by the United Nations on Sustainable Development Goals (SDGs) to reduce land-sourced pollution in oceans (SDG Target 14.1), improve livelihoods for the World’s poor (SDG 1), and improve life in cities by sound waste collection and disposal (SDG Indicator 11.6.1), there is an immediate, imperative opportunity for synergistic strategies that achieve multiple goals simultaneously.



▲ Figure 1. The relationship between leakage and harm of plastic waste into the environment and ecosystems

2. INFORMAL RECYCLING - A RAPID SOLUTION TO PLASTIC POLLUTION

The key to stopping plastics pollution is to target the primary source; that of uncollected waste. Around 3 billion people worldwide lack access to regular municipal solid waste (MSW) collection and/or controlled disposal services. Therefore, without implementing waste collection services for recycling, or at least collection for controlled disposal (engineered landfill), the tap on plastics pollution cannot be turned off. In a recent study, a business-as-usual scenario projected more than 1.36 billion metric tons of plastic will accumulate on land or in aquatic environments from 2016 to 2040 if we do not act.

The global size of the informal waste and recycling sector has been recently conservatively estimated at 11.4 million waste pickers and previously at between 12.5 and 56 million. These individuals are already delivering efficient, viable plastics recovery. This is particularly relevant in the lowest income countries, where most of the solid waste is at risk of "leaking" into the environment due to insufficient formal solid waste management services and infrastructure. When using the estimate of 11.4 million waste pickers, calculations reveal as much as 27.4 million tons of plastic is currently being collected globally by waste pickers, plastic which otherwise may have entered the environment. Waste pickers and their wider supply chains are therefore already an important part of the solution to plastic pollution.

Despite this contribution the informal recycling sector (IRS) currently make, global plastic recycling is still modest in comparison to other recyclables such as paper, estimated by weight at just 9%. Intergovernmental bodies, such as the G20 countries, are working to coordinate responses to plastic pollution and build the groundwork for both effective waste management and the development of a circular economy. A G20 statement on marine litter contains seven sections, two

of which focus exclusively on infrastructure development, operational establishment, and funding of the formal waste management sector. However, the role of the informal sector in addressing waste received scant attention. For instance, the only mention of the informal sector in the G20 Action Plan on Marine Litter is "where needed, integrate informal waste workers into modernized waste management systems in order to improve their working conditions and livelihoods". This does not suggest including and integrating the IRS broadly as part of the system, and in direct contrast to the statements about the formal sector, it does not support targeting funding on capacity and infrastructure development to enable their efforts. The mentioning of the informal actors in the UNEP/EA.5/L.23/Rev.1 Resolution (recognizing the significant contribution made by workers under informal and cooperative settings to collecting, sorting and recycling plastics in many countries) could serve as a basis for a more just transition to ending plastic pollution.

We acknowledge the critical role that innovation in materials, durability, and consumption patterns will play in reaching a sustainable circular economy. However, if waste is not collected, the inherent value of its constituent materials cannot be delivered back into the economy. Definitions of circular economy propose that after first-use, materials are best maintained at their highest point of "value" for multiple cycles. Generally, plastics currently follow a linear approach (make, use, dispose) rather than a circular economy approach (design for use, recover, redesign). For instance, a PET bottle increases in value as it moves from the raw material through to its final point of sale and use (Figure 2).

However, after use the bottle's value is frequently degraded through secondary uses, mixing with other waste and finally being lost into the environment (Figure



2). These processes reduce the economic value of the item, by reducing its quality or increasing the effort required to recover it.

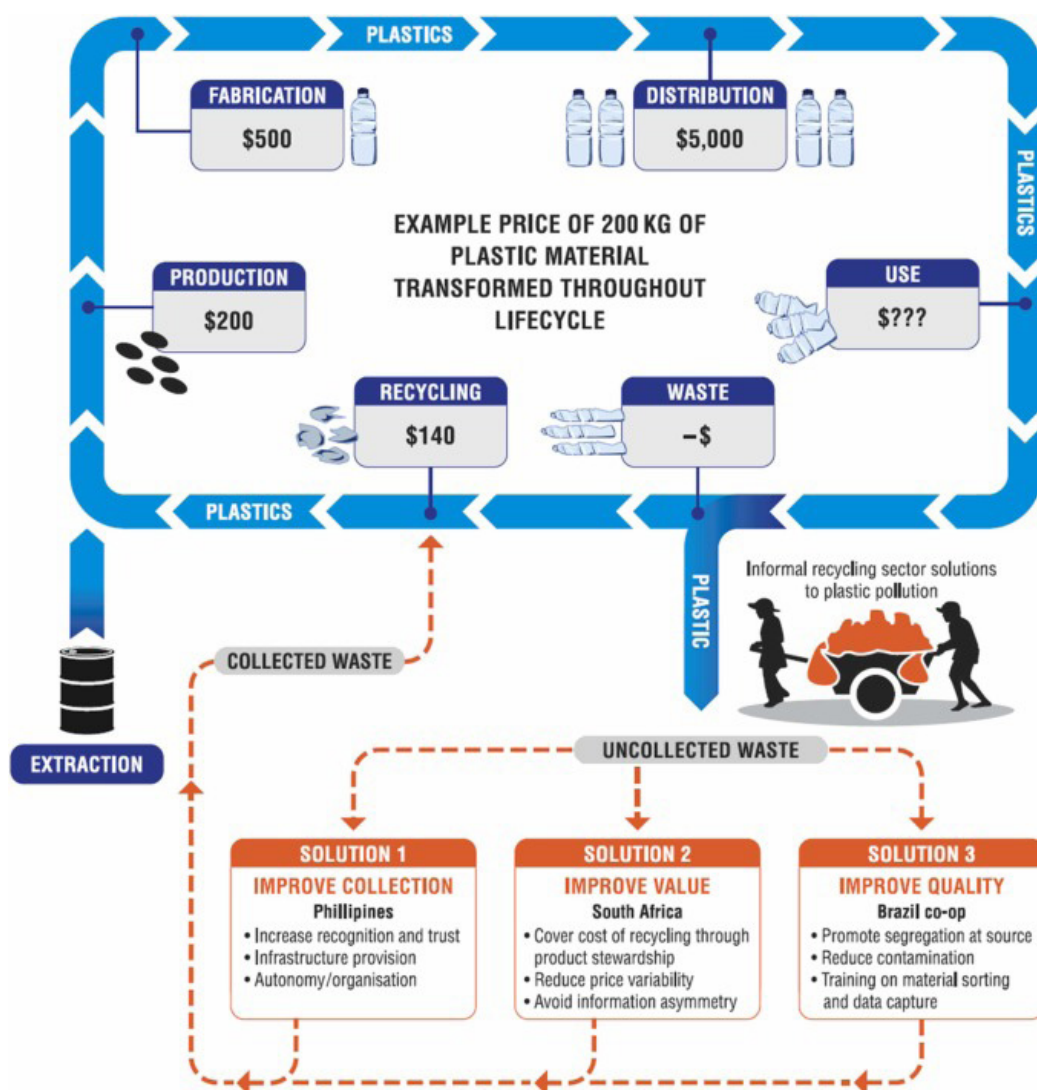
Plastic materials and products have different value at each stage of its life within a circular economy. Sufficient value should be available to be appropriated by those who collect, sort, and clean the materials, and the waste pickers need support in delivering this service at scale (Solution 1). The massive drop in value when plastic items become waste, and its direct competition with virgin material on price, does not help its collection for recycling at scale. This needs fixing, for example by product stewardship schemes such as (extended-producer responsibility (EPR) whilst prices should also reflect the environmental harm of particular items (Solution 2). By better understanding the necessary quality of recyclables, higher quantities of more suitable recycled materials can be targeted (Solution 3). All three solutions combined can serve as levers to prevent plastics pollution in a cost-effective, rapid, and socially responsible way.

While circular economy and its supporting recycling system is a laudable long-term goal, it will require significant investment and multi-year to decadal development times. For instance, extending formal waste management across India via public private partnerships (PPP) would require US\$ 5 billion every year, if it is even possible to implement on the ground. In contrast, the informal sector requires relatively little infra-

structure, is highly responsive to economic signals, and is very flexible in its operations. By targeting our interventions around enabling the informal sector to collect and recycle after-use plastics, we can immediately begin to tackle plastic pollution.

3. HOW SHOULD WE TARGET INTERVENTIONS?

Waste pickers customarily separate materials, components, and products of sufficient value to support their livelihood. However, not all waste items leak into the environment in the same quantities, nor do all items cause similar harm once they become pollutants. Therefore, focusing interventions and providing additional incentives on items such as plastic films, bags and packing straps that are frequently lost into the environment and result in high harm (Figure 1) is key to maximizing the environmental benefits of investments and supporting the informal sector.



▲ Figure 2. Plastic materials and products have different value at each stage of its life within a circular economy and solutions to reduce plastic pollution

The informal sector faces three key issues that affect the value of waste items: search times, material price, and material quality. These issues are prominent for the currently uncollected items, which are often widely dispersed and mixed with other waste. If we can develop strategies to shift these factors for the informal sector, they will respond rapidly, delivering reduced environmental damage, while increasing economic returns and potentially better human health outcomes.

We contend that organizing, legitimizing, and expanding waste picking activities, as part of a “just transition” focused on door-to-door collection rather than from dumpsites, is a fast, affordable and implementable strategy for preventing plastics pollution in the short to medium term. To do this, three critical solutions/levers are suggested (Figure 2): Expand and improve informal recycling sector (IRS) collection; Improve revenue from recycled materials; Improve materials quality.

If these efforts are targeted at the particularly damaging types of plastics, we can substantially reduce the impacts of plastic pollution in the near term, whilst implementing other long-term improvements such as packaging innovations or formal waste collection infrastructure. Below, we address this three-pronged approach to linking the informal sector and plastic pollution and provide a successful example for each.

3.1. Expanding and improving IRS collection

Virtually all recycling in low-income countries is accomplished by the informal sector, of which many diverse roles exist. Simplifying, most waste picking occurs at dumpsites, where material is concentrated and collection is performed by unorganized individuals and marginalized communities (Figure 3A). However, the most valuable items are often recovered from the streets or doorsteps of householders. One key transformative action therefore needed is enabling waste pickers to move away from dumpsites and street picking, becoming collection service providers, itinerant waste buyers and sorters in organized environments and entrepreneurial structures they own and run (Figure 3B). This is the case in Metro Manila in the Philippines where the IRS cooperative known as Linis Ganda organized waste pickers to collect recyclables directly from households whilst simultaneously strengthening the links with waste dealers and encouraging waste segregation at source. Likewise, the SWaCH Cooperative in Pune, India formed a pro-poor PPP with the municipal administration to provide door-to-door collection services to around half of all households, including many informal settlements where waste collection is typically more challenging. The Cooperative earns income from charging households’ collection fees, whilst further supporting their income from the sale of recyclable materials.

Figure 3A: Mismanaged solid waste is the major source for plastics pollution. Unorganized waste pickers are targeting plastics material for recycling, but often under problematic and sub-optimal conditions, as in this case in Dandora informal settlement in Nairobi, Kenya.

Figure 3B: Collecting plastics for recycling before entering the environment by an organized IRS is a much more effective and affordable solution, whilst also improving working conditions. An IRS door-to-door collector has elaborately decorated their cart to make a statement in the streets of Sao Paulo, Brazil.

Figure 3C: Fate of after-use municipal solid waste plastics worldwide (waste quantities represented by areas not in scale). Environmentally sound disposal is unavailable to around 3 billion people, whose solid waste becomes (plastics pollution (purple shows where IRS is currently involved in waste management). The IRS already recycles substantial quantities in the absence of formal mixed collection or recycling services. With revenue incentives, organization and support, the IRS could collect massive quantities (dotted line depicts expanded IRS opportunity) of after-use plastics in a timely, effective and affordable way for recycling, preventing it from becoming plastic pollution.

Supporting the informal sectors efforts and encouraging the provision of door-to-door collection has the potential to benefit the working conditions and livelihoods of the informal sector, whilst simultaneously reducing plastic pollution from uncollected waste by promoting improved collection services (Figure 3C). Furthermore, organizing the IRS into cooperatives/associations or other micro-business structures increases market material knowledge and hence incomes in the sector. Simple innovations such as smartphone applications like Cataki (2019) in Sao Paulo, Brazil, have assisted people in locating material for collection. By supporting network organization among the waste pickers and creating a trust market with households, these systems make provision of collection services by the informal sector economically viable. The systems also assist pickers in achieving fair market value for materials, as price information can be shared across the network. Issues with digital access may limit this solution but use of smartphones is already extensive amongst the world’s poor (for electronic wallet and microfinancing purposes in Africa).

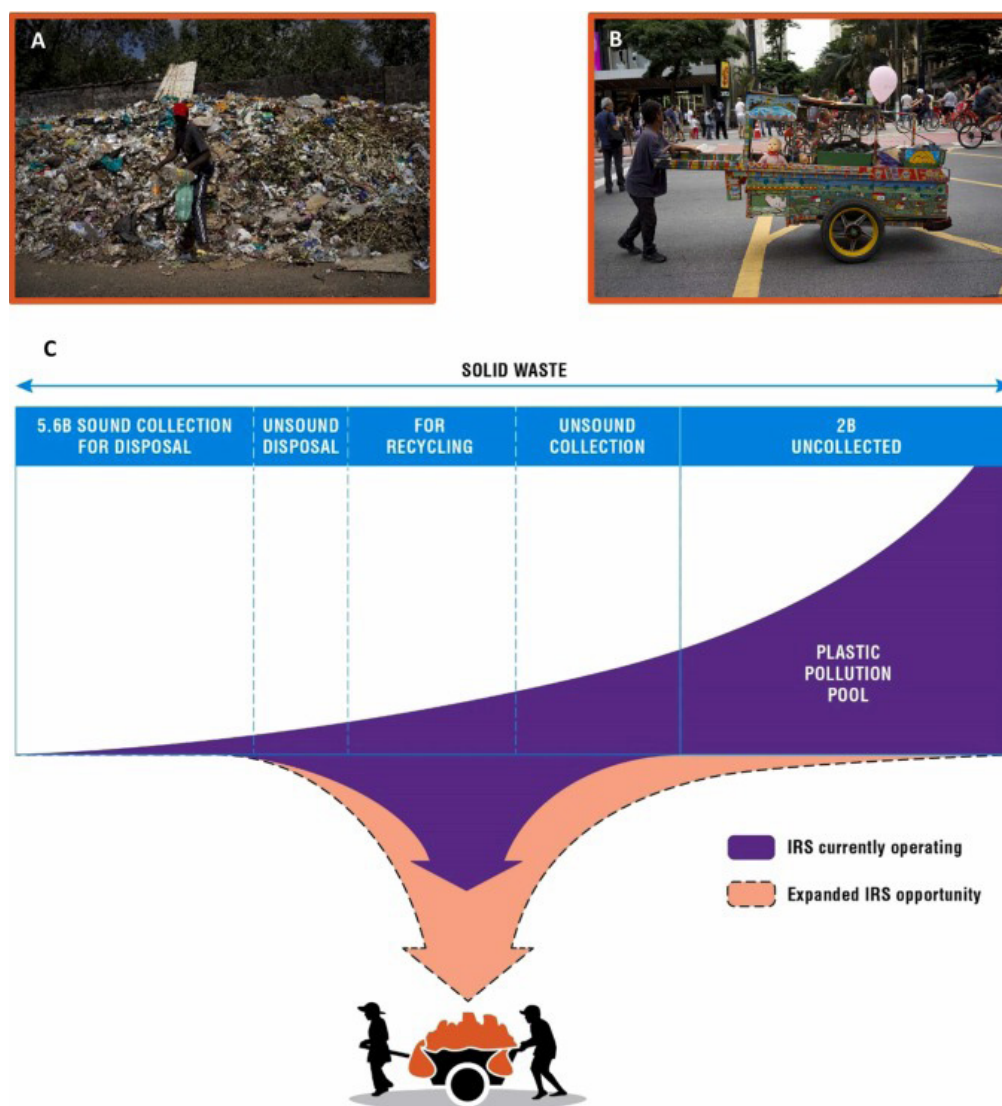


3.2. Improving revenue from recycled materials

Interventions to recover the full cost of collecting and returning after-use plastics into the production cycle are fundamental prerequisite for reducing plastic pollution. The price of reclaimed (secondary) material is typically substantially lower than the price of primary plastics. If this material is to not to be dispersed in the environment and it is to be reclaimed in a circular economy, it must be valued in a way that makes it financially comparable to primary plastic. Simply put, if the positive (saving in primary resources) and negative (damage from environmental leakage) costs are not incorporated into the price of secondary goods placed on the market, the economics of recycling do not stack up. Incorporating averted harm or damage into the "value" placed on plastics can incentivize collection of such items prior to them being lost into the environment.

Incentives could be provided to expand recovery activities, targeting high environmentally damaging items, including those that are currently considered unrecyclable. In this way, regulation of the materials market could help to correct for the inability of the free market to incorporate the cost of collection, treatment, or environmental harm from plastics at the end of life.

This inclusion of environmental harm costs in product/services pricing has already proven to be a success in reducing



▲ Figure 3. Collecting plastics for recycling before entering the environment by IRS in Metro Manila in the Philippines

plastic pollution, such as the deposit refund/return scheme implemented in Estonia that targets heavily littered items such as plastic bottles. Additionally, in South Africa, the plastics industry has implemented a voluntary EPR scheme to promote PET recycling by the IRS. In doing so, the informal sector is protected from price fluctuations, allowing the development of a reliable supply chain. In the absence of such protection, during periods of low prices, workers shift to other activities, causing disruption in the supply of recycled materials, thus preventing the establishment of an economically viable supply chain. This system has resulted in collection rates of 65% for the targeted material (PET) and provides livelihoods for thousands of people.

New systems and sustainability analysis methodologies have recently been developed to quantify the "value" of plastic waste and its removal more broadly (to include social, environmental and economic aspects)

and in a circular economy context. Such approaches can help us understand how value in relation to plastic items is generated, appropriated and destroyed, enabling us to intervene to retain this value, incentivizing collection and thus reducing environmental and economic damage.

3.3. *Improving material quality*

Plastics recovered from dumpsites rather than collected at source (door to door) are more likely fouled by organic or other waste, which poses major challenges in conventional recycling systems. By transitioning to door-to-door collection and encouraging segregation at source, physical contamination (non-targeted materials/items) can be reduced and therefore the quality and value of the item increased. For example, improvement of material quality through segregation at source is the most influential area for intervention, as demonstrated through value chain analysis of the Zabaleen IRS in Cairo, Egypt.

Waste pickers are world experts in recognizing after-use plastic types and instantly assessing on the spot their recyclability. For example, in a collection and sorting cooperative in Brazil, pickers can quickly sort plastics into 17 grades, reflecting secondary plastic market needs and end-use outlets. This is partly feasible as financial support is provided by the regional Government to operatives in the form of salaries for delivering environmental services (see Solution 2). Enabling standardized descriptions and quantification of secondary plastics quality, and training waste pickers in these skills will increase the chance for materials to be recovered rather than lost to the environment.

4. SYNERGIES BETWEEN SOLUTIONS - ADDRESSING SYSTEMIC COMPLEXITY

We recognize that the three-pronged solutions proposed are inevitably a simplification of a highly complex system, featuring also considerable variability across the world. Despite such complexities, we maintain that these three areas of intervention could be the core elements in addressing plastic pollution by means of the IRS, enabling functional and sustainable solutions. Similarly, although presented here as separate solutions, in reality significant overlap and synergies exist between each of them. For example, by pricing plastics at a level that reflects the appropriate value of plastic pollution prevention, the economics would shift in favor of increasing collection services to recover this valuable material. Likewise, by focusing on improving material quality through segregation at source, improvements to the value of after-use plastics are realized and therefore the price is also increased. Enabling door-to-door collection by informal collection services or itinerant buyers would also provide benefits to material quality by encouraging direct interaction and education of households by the IRS.

5. LEGITIMIZING THE INFORMAL SECTOR REDUCES POVERTY

There is considerable evidence that the IRS can be empowered to provide affordable, high-quality collection and sorting services. We also acknowledge the considerable challenges around marginalization, exploitation, abuse, child labor, and reduced community health due to picking from dumpsites and working without any personal protective equipment. However, with appropriate economics in place, organized services (such as cooperatives, associations or community-based organizations) can be deployed at scale to capture a sizable proportion of plastics that are mechanically recyclable. Legitimization and wider inclusion of the IRS has been applied extensively across Latin America, with tools currently available to assist with such processes. This approach has resulted in reduced poverty and enhanced societal inclusion for organized IRS, where employed.

6. A RAPID, INEXPENSIVE, JUST AND SCALABLE SOLUTION

Addressing underlying systemic failures is key to reducing plastic pollution. Legitimizing and integrating waste pickers mobilizes an incredibly valuable source of human capital. Our three-pronged framework provides a roadmap for tapping the unrealized potential of the informal waste sector to contribute an effective, rapid, inclusive, and inexpensive solution to prevent plastics pollution. This needs to be combined with long-term efforts to innovate plastic materials and product design to enable sustainable circularity and to support material recovery.

Simple interventions in the framework provided can dramatically reduce plastic pollution and benefit the livelihoods of millions of waste pickers by improving collection, price/revenues and material quality. Examples of how to achieve these changes include moving from collection at dumpsites to door-to-door collection, choosing incentives that economically address the misfit between the value in recovered plastics and current pricing, and improving material identification. This shift may have significant benefits for the workers, while at the same time addressing the key source of plastic pollution: Unmanaged waste dumped along streets or in the environment. By targeting these interventions at the waste items with the highest leakage rates and environmental and wider damages, it is feasible to address the global plastic pollution problem ■

NAM VIỆT

(Source: Sciencedirect.com)



Women's participation vital for environmental protection

The image of a woman carrying a reusable bag and some plastic containers has become familiar at a traditional market in Linh Nam Ward in Ha Noi's Hoang Mai District.

On average, each Vietnamese household uses around 1kg of nylon bags per month. More than 80 percent of these bags are discarded after single use, with a minimal proportion being properly processed. "I bring these plastic containers to hold various types of food when buying meat or fish instead of using single-use plastic bags given by the sellers", said Mrs. Nguyen Thi Hien, a 35-year-old woman from Nam Du Street.

"I've been in the habit of using reusable bags for shopping for the past three years. The purpose of using them is primarily to protect my family's health from low-quality single-use plastic bags and also to contribute a small part to environmental protection, as plastic pollution is becoming increasingly alarming not only in our country but also in countries around the world", she said.

Mrs. Nguyễn Thị Hiền said that initially using reusable plastic containers for shopping surprised many people at the market, but most of them understand her intention of using them for environmental pro-

tection. The image shoppers using plastic containers while shopping hasn't been widely seen, especially at traditional markets, but she hopes it can spread to more people, contributing to raising awareness among citizens about reducing plastic waste in the environment.

Plastic pollution has become a biggest challenge for Viet Nam and many countries worldwide today. The overuse of plastic products, especially non-degradable nylon bags and single-use plastic products, has been having serious consequences on the environment, placing Viet Nam among the top 20 countries with the largest amount of waste globally and ranking fourth in the world for plastic waste discharged into the ocean, according to the Ministry of Natural Resources and Environment.

In Vietnam, an average of about 1.8 million tonnes of plastic waste is generated annually, including over 30 billion nylon bags. On average, each Vietnamese household uses around 1kg of nylon bags



▲ Women carry booth displaying eco-friendly products during an event to respond to the month of action for the environment



per month. More than 80 percent of these bags are discarded after single use, with a minimal proportion being properly processed.

According to statistics from the Việt Nam Plastics Association, plastic waste and nylon bags in Việt Nam account for approximately 8 percent to 12 percent of solid household waste, but only around 11 to 12 percent of plastic waste and bags are actually recycled or reused. The majority are disposed of through landfilling, incineration, and improper waste management practices, causing harm to the environment. With the goal of reducing plastic waste in the environment, numerous projects, programs and environmental protection campaigns have been initiated across most regions in Vietnam.

A model of waste classification at source has been implemented in Ha Noi since late 2021, starting with pilot projects in rural districts of Dong Anh and Soc Son, according to Head of the Publicity and Education Department of the Hanoi Women's Union Hoàng Thu Hồng. "The pilot implementation in the two districts on the outskirts of Hanoi has yielded significant results. As of now, waste classification at source has been rolled out in all districts of Hanoi City", said Mrs. Hoang Thu Hong.

"We have organised training sessions and introduced waste classification models at the source to all levels of women's unions. These members are the ones directly applying, guiding and mobilising local residents to participate in the program".

According to a report from Dong Anh District, at the beginning of the project, the number of households participating was only 14 percent. By 2023, the project had expanded to 24 communes and township, with over 54,000 households participating in waste classification at the source, reaching 57 percent of total households in the locality.

"The awareness of residents regarding waste classification and treatment at the source has been raised, gradually forming a sense of responsibility in environmental protection. This has led to the application and use of organic fertilisers in farming", Mrs. Hoàng Thu Hồng said. "Some women have had the opportunity to start businesses from plastic waste. They produce and sell products made from collected plastic waste. They are also trained in making organic fertilisers from organic waste. We are striving to expand this waste classification model to 100 percent of the communes in Ha Noi", she added.

These are practical actions by women that demonstrate their significant role in natural resource management at both the household and community levels. Many studies and practical evidence have shown that women often bear the primary responsibility for

daily household tasks, which significantly influences consumption, classification, and disposal of plastic waste within the family.

Women play a vital role in household management, nurturing children, and imparting consumption habits such as not wasting water, reducing electricity consumption, limiting the use of single-use plastic products and using plastic containers. They simultaneously raise awareness about energy conservation practices, sustainable product usage, minimising use of disposable goods, and managing waste from factories, agricultural fields, and households.

According to the findings of the Vietnam National Plastic Action Partnership (NPAP) in its report "Gender equality and social inclusion (GESI) in the plastic value chain in Viet Nam", women also form the majority of informal waste collection roles, often receiving low wages and working in hazardous conditions with limited social protection and healthcare benefits. They face numerous challenges related to safe housing, sanitation, labour safety, and social protection. During their work, many informal labourers also experience issues of harassment and sexual abuse.

Both male and female workers in the waste sector encounter social prejudice, and their job value remains unrecognised by authorities and the community alike. Overall, there is a gender imbalance within waste management units, particularly with more men than women in leadership and staff positions. Women often undertake less significant tasks, receiving lower wages due to gender biases, according to the NPAP report. They lack full participation and a heard voice in policy development and implementation processes. Women's involvement and contribution in decision-making processes regarding plastic policies are not fully recognised.

On the morning of August 29th, the Vietnam Women's Union, in collaboration with the Embassy of Canada to Viet Nam and UNDP Viet Nam, organized a workshop on "GESI in Plastic Waste Management".



▲ *Households in Dong Thap Province have been classifying waste at source by women since 2020*

The participants discussed the roles of women and strategies to enhance gender equality and comprehensive development in plastic waste management at the household and community levels, emphasising the need to include gender and social inclusion issues in the joint action plan to integrate fragmented solutions into an inclusive and sustainable plastic circular economy by leveraging resources from policymakers, experts, enterprises, and development partners.

“Women are disproportionately affected by negative environmental impacts, especially impoverished women who often have limited access to land rights, education, and essential support services related to agriculture, finance, and more. This vulnerability places them at a higher risk”, said Vice President of the Vietnam Women’s Union Nguyễn Thị Minh Hương.

However, from another perspective, women also play a positive and pivotal role in environmental conservation. They can act as agents of change, raising awareness among other family members about consumption and waste management. “From the perspective of producers, consumers, or managers, they all play an important role in preserving and protecting the environment, protecting public health”, Mrs. Nguyễn Thị Minh Hương emphasised.

According to UNDP Deputy Resident Representative Patrick Haverman, women play a crucial role in the formal and informal sectors of the collection, sorting,

and recycling of plastic within households and communities. Authorities and communities should take women’s roles into account during policy formulation. “Policymakers need more research, data, or evidence on plastic, gender, and social inclusion issues to avoid any adverse impacts on women, migrants, and other vulnerable groups when implementing the Extended Producer Responsibility policies and other relevant policies”, he said.

Ambassador of Canada to Việt Nam Shawn Steil said the Government of Canada is working with its partners around the world to reduce plastic waste and pollution. Canada’s program focuses on supporting women’s rights and livelihoods that complement efforts to transition to a more sustainable and circular plastics economy. A circular economy approach is needed to tackle how we produce, use, and dispose of plastics, and coming to grips with the growing challenges related to human health, gender equality and social inclusion”, the Ambassador said ■

ĐỨC ANH

(Source: Vietnamnews.vn)

Tackle climate change impacts through ecological protection and green development measures in China

Overview

An Asian Development Bank-funded project is helping the Huangshan Municipality in the People's Republic of China (PRC) tackle climate change impacts through ecological protection and green development measures, such as monitoring forest health, constructing wetlands, improving wastewater treatments, and promoting green agricultural practices. It's Anhui Huangshan Xin'an River Ecological Protection and Green Development Project (from 11th December 2019 to 30th December 2026).

The Project uses climate risk modeling techniques to assess local conditions, thoroughly evaluates climate-related risks, and incorporates them into the Project's engineering design and technical road map. This localization of approaches is expected to activate appropriate and impactful measures that will engage stakeholders and make the project more effective and productive.

Context

The PRC, a key emitter of greenhouse gas (GHG), is a signatory to the 2015 Paris Agreement on climate change, under the United Nations Framework Convention on Climate Change. In 2010, the PRC set to reduce carbon dioxide (CO₂) emissions by 40% - 45% by 2020 compared to 2005 levels. This was achieved but GHG emissions are projected to increase until at least 2030 under current policies. In 2020, the country announced it would become carbon neutral by 2060. To attain this

goal, it needs to tackle the threat of climate change and create low-carbon cities with sustainable and competitive economies.

Low-carbon development has become a key component of the China's approach to sustainable development. In 2017, Huangshan was designated as a pilot city for low carbon policy by the PRC Government to actively address climate risks and explore low-carbon and green development paths tailored to the local situation.

The Huangshan Municipal Government sought to integrate climate change risk control measures in its tourism industry - a pillar of the local economy - in line with the aim to peak carbon emissions by 2030 and then decrease them.

Challenges

Huangshan has a subtropical, humid monsoonal climate with a rising annual mean temperature and increased rainfall that is becoming less evenly distributed in a year. The highest-level climate-related risks identified were in the areas of urban flooding and extreme heat. The municipality faces the risk of water scarcity, wildfires, cyclones, and landslides.

More consideration needs to be given to water conservation for Huangshan to become resilient to increased drought hazards and prevent long-term water scarcity. Extreme weather phenomena, such as flooding, drought, or high temperatures, can also reduce labor productivity and damage production chains, slowing local economic growth. Other impacts include a reduction in both agricultural yields



▲ The Huangshan Municipality in the PRC implements measures to mitigate the risks of climate change



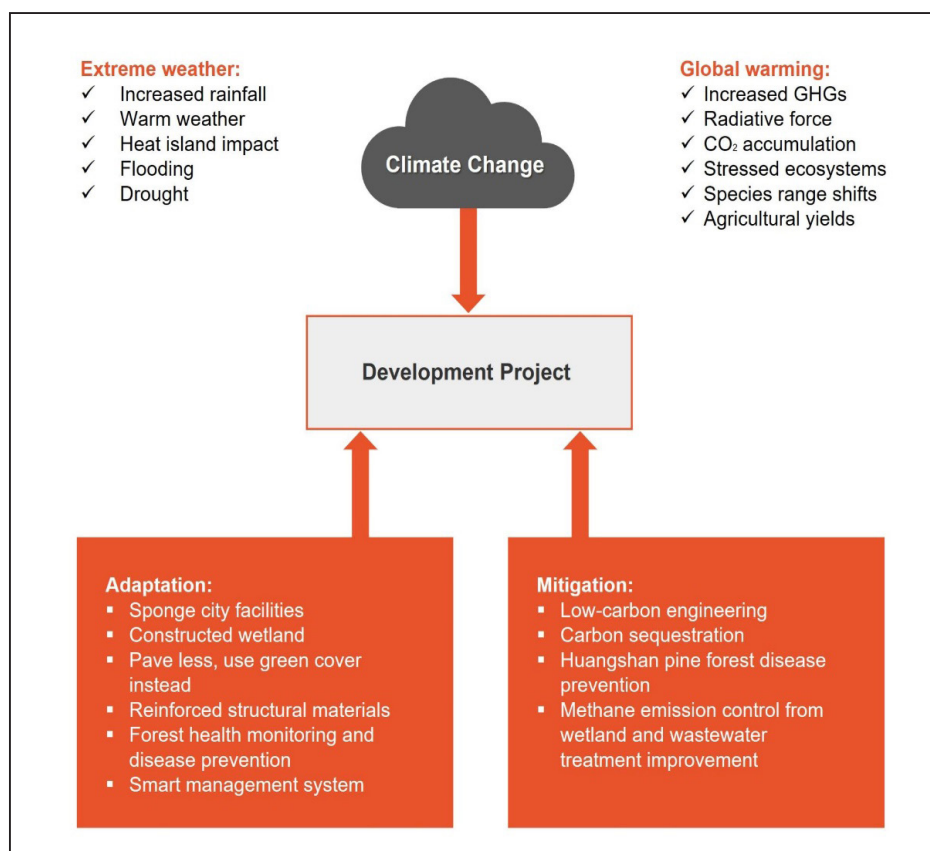
and availability of fresh-water, associated public health consequences for the local population, and damage to species like the Huangshan pine tree. Climate change could also play a part in changes to the geographical distribution of species. For example, there are signs that warmer weather might lead to nematodes moving northwards (these worms naturally occur in soil and control soil insect pests). This would cause the spread of the pine wilt disease, resulting in death of more of Huangshan's pine forests.

Solutions

The Anhui Huangshan Xin'an River Ecological Protection and Green Development Project is implementing an ecological protection and green development model designed for

small and medium-sized cities or development areas. Through climate risk modeling, the Project design considered Huangshan's historical climate data, climate change trends and risks, and projected impacts. Risks were integrated into the engineering process, and a technical road map for the Project was developed to mainstream the strategy and recommendations for tackling climate change impacts. Suitable mitigation and adaptation activities were identified by evaluating climate vulnerability and the costs of each option. These measures are elaborated on in the ongoing detailed design and construction stages of the Project (Figure 1).

Mitigation activities are at the forefront of project design and promote efforts to reduce, avoid, or sequester GHG emissions. These are aimed at decoupling development from fossil fuel-based consumption and creating a city with high green coverage, large water surface, and a comfortable living environment.



▲ Figure 1: Climate Change Adaptation and Mitigation Measures under the Project

(Source: Cities Development Initiative for Asia, 2020. *Climate Change Adaptation and Mitigation: Risk Management through Integrated Project Design*. Manila)

Some key climate mitigation measures included in the Huangshan Project are:

Monitoring of forest health

In January 2019, Huangshan was declared an epidemic region for *Bursaphelenchus xylophilus*, the parasite that causes the deadly pine wilt disease, which is fatal for trees within 40 days of infection. The local practice is to burn infected dead pine trees to control the spread of pests and disease, which consequently increases CO₂ into the atmosphere. The Huangshan Project includes strengthened monitoring and disease prevention measures, which should effectively control the disease.

Constructing wetlands with green features

According to the Intergovernmental Panel on Climate Change 2007 report on methane emission from wetlands, natural wetlands contribute between 20% and 39% of the global emissions of methane. So instead, wetlands will be created with greener features. Two plots of land along the Xin'an River in She County - one with an area of 6,000m² and another with 4,000m² - will be developed as constructed wetlands under the Huangshan Project.

Reducing GHG emission through wastewater treatment improvements

The Project includes the use of both aerobic and anaerobic wastewater treatment systems. Aerobic wastewater treatment systems generate CO₂ as a by-product while anaerobic systems produce a mixture of methane and CO₂. Under the sewerage improvement component of the project, 27,662 cubic meters per day of urban wastewater will be collected and transported to treatment plants, while 2,339 cubic meters per day of rural wastewater will be collected and treated in rural wastewater treatment stations.

Improving green tea farming for carbon sequestration

Nitrogen fertilizer is currently applied in tea farms at a rate of 277 kilogram of nitrogen per hectare (ha) per year, with only 20% efficiency, and a substantial proportion of the fertilizers is eventually emitted into the ambient air in the form of nitrous oxide. To address this, the Project promoted green agricultural practices that use a recommended formula of fertilizers according to soil testing and soil amelioration that will lessen emissions.

Expected results

When the Project is completed in 2026, its climate mitigation and other green initiatives will improve environmental conditions upstream and reduce, avoid, or sequester GHG emissions.

Better forest health

Strengthened forest monitoring and disease prevention measures would reduce pine tree infection in the Huangshan area by 80%, which will then reduce the release of CO₂ into the atmosphere. This could save an estimated 18,428 pine trees annually. In 2018, 80% of the trees that died. The carbon sequestered would amount to 18,557 tons of CO₂. The pine forest disease prevention program is expected to provide carbon sequestration of close to 0.5 million tons of CO₂ over 25 years.

Improved wetlands with green features

The variation in the quantity of the GHG release is largely due to differences in the nature of the emitting vegetation, including soil microbiota, which interfere with the production and consumption of methane. Thus, the wetlands to be constructed under the Huangshan Project along the Xin'an River in She County will have greener features that are set to improve anaerobic conditions and reduce the release of methane.

Improved wastewater quality and agricultural practices and productivity

Through improved water systems, total daily GHG emissions are predicted to fall by 5,026.5 tons of CO₂ equivalent.

Environment-friendly practices in green tea farming are expected to improve the productivity of croplands, reduce nonpoint source pollution, and increase biodiversity and carbon sequestration. In addition, the 10% reduction in chemical fertilizer usage in around 4,500 ha of tea farms would reduce GHG emissions by 23,333 tons CO₂ equivalent per year ■

NGUYỆT MINH

(Source: Asian Development Bank)

Mangroves are often misunderstood and undervalued ecosystems. These coastal forests are sometimes perceived as “dirty” or “dead areas”, a wasteland that could be cleared in favour of sandy beaches, swanky resorts or other developments. These myths about mangroves could not be farther from the truth. They are the only trees that thrive in salty waters and improve water quality by filtering out nutrients and sediments.

They are also teeming with life: more than 1,500 plant and animal species depend on mangroves. This includes fish and birds who use the shallow waters beneath mangrove trees as nurseries. Research now indicates that mangroves are also critical for larger mammals, such as monkeys, sloths, tigers, hyenas and African wild dogs. Protecting mangroves and restoring damaged ones also helps combat climate change through carbon sequestration as they are some of the most carbon-rich ecosystems on the planet, storing on average 1,000 tons of carbon per hectare in their biomass and underlying soils.

But mangroves are threatened. Worldwide, a fifth of them have already disappeared. The main driver of mangrove loss is coastal development, when mangrove forests are cleared to make way for buildings and fish or shrimp farms. “Mangroves are a remarkably diverse and important ecosystem that works in tandem with other marine ecosystems including seagrass beds and coral reefs all of which are essential not only for the health of our ocean, coasts and the biodiversity that they support, but for the wellbeing of humans”, said Head of Marine and Freshwater at the United Nations Environment Programme (UNEP) Leticia Carvalho. “We also need to protect and restore our mangroves as they are an important habitat and source of food supplies for many indigenous peoples and local communities around the globe”, she added.

To celebrate World Mangrove Day, we have compiled five key benefits of mangrove ecosystems paired with winning photos from the Mangrove Photography Awards, an annual competition partnering with the United Nations Decade on Ecosystem Restoration and the UN Decade on Ocean Science.



An inside look at the beauty and benefits of mangroves

1. Mangroves are climate heroes

To meet the global climate targets, the world urgently needs to reduce emissions and remove carbon from the atmosphere. Mangroves are critical in this second task. They extract up to five times more carbon than forests on land, incorporating it in their leaves, branches, roots and the sediments beneath them. The salty and oxygen-poor conditions beneath mangrove forests mean that decomposition of organic material happens very slowly. In the right environmental conditions, mangroves can store the carbon they took from the atmosphere for decades, centuries, or even millennia.

2. Mangroves protect against extreme weather and disasters

Not only do mangroves help prevent the progression of climate change, they also play an important role in limiting its impact. As global temperatures rise, extreme weather events like storms and flood surges are becoming more frequent and severe. The trunks of mangroves absorb the impact of waves, making them an excellent front line of defense that helps to protect higher ground. Restoring and protecting mangroves and valuing their role as a nature based-solution improves resilience of coastal communities and national economies.



▲ A corner of Dam Bay Mangrove Forest in Vinh Nguyen Ward, Nha Trang City in Khanh Hoa Province

Along with other measures, investments in mangroves are expected to generate benefits around four times greater than the costs. Mangroves have also been found to be an effective defense against tsunamis, reducing wave heights between five and 35 per cent.

3. Mangroves are a haven for threatened animals

Of the over 1,500 species that depend on mangroves for their survival, 15 per cent are threatened with extinction. This number is increasing when looking at mammals: Nearly half of mammals living or feeding in mangrove forests could go extinct in coming years, with trends worsening for most of them. Protecting and restoring mangrove forests thus means bringing back critical habitat for vulnerable animal species like tigers and jaguars. The good news is that restoration works! Initiatives in Indonesia and the United Arab Emirates have been recognized as UN World Restoration Flagships for bringing

back nature in coastal ecosystems.

4. Mangroves boost food security

As biodiversity havens, mangroves support a huge variety of plants and animals, many of them important for food production. They act as nurseries for young fish and home to honey bees. For 1.5 billion people, fish is the most critical source of protein and in low-income food-deficit countries, nearly 20 percent of the average animal protein intake comes from fish. The disappearance of mangroves would have dramatic consequences for fisheries in developing countries.



Conversely, restoring mangroves could add 60 trillion young, edible and commercially valuable fish and invertebrates to coastal waters every year, providing a significant boost to food security as our human population continues to grow.

5. Mangroves can bounce back naturally

Bringing lost ecosystems back to life is a daunting task. However, one of the most effective ways to protect and restore damaged mangroves is through enhanced recognition and implementation of Indig-



▲ The Mangrove Photography Awards



▲ The Mangrove Photography Awards

enous Peoples' collective rights and actions across the broader spectrum of environmental governance and rule of law as envisaged in the Kunming-Montreal Global Biodiversity Framework.

This is particularly important given that “globally, Indigenous Peoples are custodians of 80 percent of the planet’s biodiversity with 5000 unique traditional cultures and ancestral lands covering 32 percent of all global land and inland waters across 90 countries”. When communities along the coast of Java, Indonesia, started replanting mangroves to conquer rising sea levels, the results were sobering: only 15 - 20 percent of planted saplings survived. The rest was simply washed away with the tides.

With the help of researchers and partners - such as Wetlands International - the villagers tried out a new solution: trapping the mud with seawalls made of natural materials, giving young mangroves space to recover naturally. The results were astounding. Mangrove

Mangrove Action Project is running its ninth annual Mangrove Photography Awards. The competition invites photographers of all levels around the world to contribute their images to celebrate the beauty and diversity of mangrove forests and inspire action to conserve them. Today, less than half the world’s original mangrove forests remain, and it has never been more important to promote the conservation of these fragile ecosystems through inspiring photography. These powerful images are a compelling reminder of the vital role mangroves play and inspire us to protect them for future generations. In celebration of World Mangrove Day, discover stunning mangrove images from across the globe.

survival rates shot up from 20 to over 70 per cent. The Building with Nature Initiative has since been recognized as UN World Restoration Flagship for its success.

Natural regeneration is now recognized and tried out in other parts of the world, together with other restoration approaches suited to local conditions. Understanding and addressing the drivers of mangrove loss is the first step towards ecosystem restoration ■

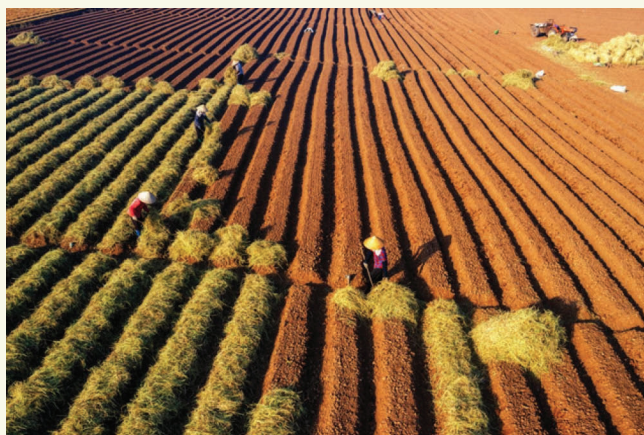
BẢO BÌNH

(Source: UNEP.org)

WINNING WORKS AT THE CIRCULAR ECONOMY PHOTO CONTEST 2023



Work "Making eco-bricks from plastic bottles";
Author: Vũ Sơn Lâm (Đông Nai) - Second prize



Work "Applying the circular economy model in agriculture in carrot fields"; Author: Đinh Hải Ngọc (Hà Nội) - Second prize



Work "Using solar energy at DK1/12 Rig";
Author: Nguyễn Đăng Khoa (Hà Nội) - Third prize



Work "Green tourism"; Author: Phan Vũ Trọng (Quang Nam) - Third prize



Work "Recycled drowning lifebuoy"; Author: Huỳnh Thanh Hùng (An Giang) - Consolation prize



Work "Golden land"; Author: Cao Thị Thanh Hà (Ho Chi Minh City) - Consolation prize



Work "New vitality"; Author: Huỳnh Thanh Liêm (Tây Ninh) - Consolation prize



Work "High-tech shrimp farming process using circulating water"; Author: Phan Thanh Cường (Bạc Liêu) - Consolation prize

Closing and Awarding Ceremony of Circular Economy Photo Contest 2023

On 21st September 2023 in Hà Nội, the Environment Magazine and C asean held the Awarding Ceremony of Circular Economy Photo Contest 2023. After nearly 2 months of launching, the Organizing Committee has received 919 works of 148 authors from 37 provinces/cities nationwide, in which, Ho Chi Minh City is the locality having the largest number of authors participating in the Contest with 17 authors. Through photography lens, the photographic works have conveyed clear messages, bringing new and unique perspectives, showing the importance of circular economy in the use of natural resources, environmental pollution and degradation minimization, climate change response... thereby contributing to propaganda to raise the awareness of producers and the public about the responsibility for the product life cycle. The Contest also creates a useful and interesting playground for professional and amateur photographic artists in the country in creating and publishing beautiful works about the circular economy.

After a period of serious and conscientious work, the Jury including experts in the fields of natural resources and environment; culture, sports and tourism; photographic artists; Environment Magazine and C asean, agreed to select 9 winning works, including 1 First prize, 2 Second prizes, 2 Third prizes, and 4 Consolation prizes. The winning works are displayed at C asean Vietnam Headquarters (Melia Hotel Lobby, 44B Ly Thuong Kiet, Hoan Kiem, Ha Noi), and are used in propaganda work to build a circular economy model in the coming time.

Speaking at the Awarding Ceremony, Dr. Nguyễn Trung Thắng, Deputy Director General of the Institute of Strategy, Policy on Natural Resources and Environment, Editorial Director of the Environment Magazine - Head of the Jury confirmed that the Jury evaluated, most of the works in this



▲ Organizing Committee and Jury took photos with the winning authors

Contest having good quality, sticking to the circular economy with many rich, diverse topics, many new perspectives, rich in creativity and art; as the basis for forming a photo data system for propaganda to build a circular economy model in the coming time.

On this occasion, the Organizing Committee of the Contest would like to thank the Leaders of the Institute of Strategy, Policy on Natural Resources and Environment, Ministry of Natural Resources and Environment; Department of Fine Arts, Photography and Exhibition, Ministry of Culture, Sports and Tourism; Vietnam Association of Photography Artists; Thai Beverage Public Company Limited (ThaiBev Group) ... who have always cared, supported, stood side by side with the Contest; the press and media agencies at the Central and local levels have accompanied and reported propaganda about the Contest. Especially the enthusiastic support and participation of 148 authors from 37 provinces/cities nationwide, have made an important contribution to the successful Contest•



Work "Clean energy source"; Author: Phan Thanh Cường (Bac Lieu) - First prize