



Bicycle industry as a post-pandemic green recovery driver in an emerging economy: a SWOT analysis

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Abstract

The COVID-19 pandemic has exposed socioeconomic vulnerabilities around the world. After fighting the coronavirus for more than 1 and a half years now, the countries are recovering from the epidemic with the help of cutting-edge medical research. The policymakers are implementing stimulus packages for post-pandemic economic recovery. However, sustainable “green recovery” plans are yet to get adequate attention. Sustainable investment in green industries can create green jobs, promote a low-carbon economy, and foster long-lasting economic growth in the post-pandemic world. COVID-19 affected countries with emerging economies call for even more focus on such investments. In Bangladesh, the bicycle industry — a growing low-carbon industry — has been showing promising potential for growth since the beginning of the pandemic. Both the local and global markets of Bangladeshi bicycles have seen substantial growth during the epidemic. In this paper, we analyze the potential of the Bangladeshi bicycle industry as an effective green recovery driver. We conduct semi-structured interviews with relevant experts and professionals, analyze their opinions, and perform a “strengths, weaknesses, opportunities, and threats (SWOT)” analysis. The analysis reveals valuable insights regarding post-pandemic sustainable economic and environmental recovery which will be beneficial to the policymakers of Bangladesh and similar developing countries.

Keywords Post-pandemic · Green recovery · Bicycle industry · Sustainability · Carbon emission · SWOT analysis · Sustainable transport

Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has shaken the world economy with its unprecedented and dreadful impacts. Around the world, there is barely any sector that has not suffered from the detrimental consequences of the epidemic. Due to prolonged and repetitive lockdowns

worldwide and the majority of the economic activities shut down, the world economy is struggling to thrive. Fortunately, the development in medical science has gifted us with multiple vaccines such as Moderna, Pfizer-BioNTech, Oxford-AstraZeneca, Sinopharm, and Johnson & Johnson vaccines (WHO 2021). With the production and supplies of vaccines on the rise, we can expect that the world is slowly going to win against this invisible enemy. Many countries are already recovering gradually through the proper implementation of economic, technological, and public health strategies (World Economic Forum 2021).

The economic impacts of the COVID-19 pandemic are colossal. The consequences are even worse in the developing and least developed countries (WTO 2020). The world leaders and policymakers acknowledge that the economy needs significant investment as the first pillar of the post-pandemic recovery strategy. However, the question to be asked before the financial decision-making is “How sustainable is the investment?” For the investment to be sustainable, the policymakers need to ensure that expected economic growth

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comes with desired environmental benefits. Green investment can achieve both economic and environmental sustainability (Zahan and Chuanmin 2021; Zhou et al. 2020). In the context of 27 Asian economies, several research findings (Abbas et al. 2021a, b; Abbas et al. 2021a, b) indicate that foreign direct investment significantly promotes environmental sustainability and regional collaboration. We believe that green investment could facilitate “green recovery” in the post-pandemic world. Green recovery policies should take into account climate change due to human interference with the environment. According to the Asian Development Bank (ADB), “A green recovery is the key to ensuring a sustainable and resilient return to growth and development after COVID-19” (ADB 2020).

The coronavirus pandemic, although a curse to the global economy, has been a blessing for the global environment (Khan 2021; Wang and Su 2020; Muhammad et al. 2020; Verma and Prakash 2020). Since the crisis has forced the frequent shutdowns of industrial, transportation, and day-to-day activities, there have been significant changes in terms of improved air quality, improved water quality, and reduced carbon emission. However, the optimistic recovery from the pandemic has already reopened the industries, traffic, and other sources of environmental pollution. Therefore, we can no longer expect that the temporary improvements will sustain unless we take proactive measures. When we think of protecting our environment, reducing carbon emission is the first thing that comes to our concern.

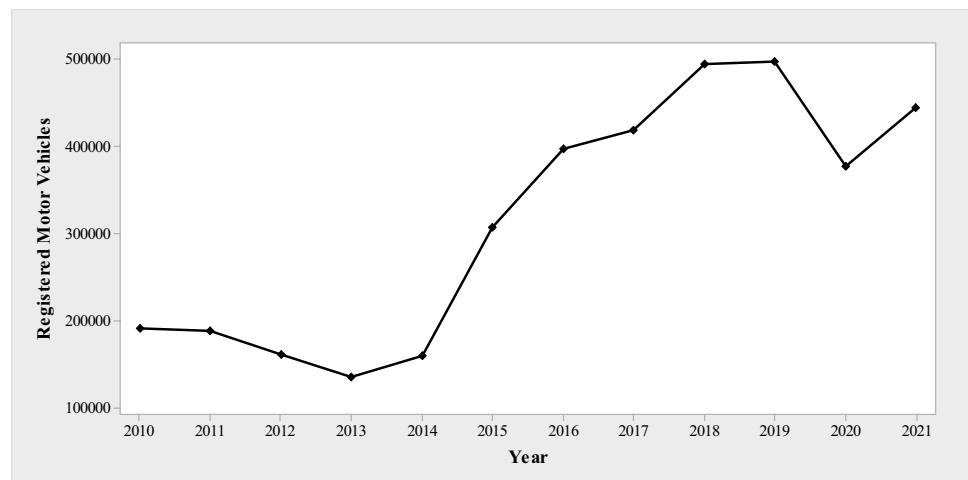
The two major sources of global greenhouse gas (GHG) emission are electricity (31%) and transportation (15%) (World Resources Institute 2017). The primary contributor to GHG is carbon dioxide. To reduce carbon emissions, one significant area of improvement could be the reduction of transportation-related emissions. One of the most consequential actions related to post-pandemic green recovery suggested by the United Nations (UN) aims to call an end

to fossil fuel subsidies (UN 2020). The adoption of electric vehicles has a great potential for reducing fossil fuel consumption and thus reducing carbon emissions (Kumar and Alok 2020). However, are the countries with emerging economies yet ready to adopt electric vehicles over traditional fossil fuel-based vehicles? To find that out, Ahmed and Karmaker (2019) conducted a study in Bangladesh, a South Asian country with an emerging economy. They identified some key challenges in the adoption of electric vehicles. Some of which include shortage of power supply, lack of charging stations, high charging cost, high battery price, high life-cycle costs, etc. Under the circumstances, what should Bangladesh or the countries with similar developing economies consider as the potential alternative of a low-carbon transportation mode? In this study, we explore the strength and opportunities of the bicycle industry as a green recovery option in Bangladesh. Based on the current market scenario, evidence from previous research works, opinions from focus group discussion, and expert interviews, we perform a strengths, weaknesses, opportunities, and threats (SWOT) analysis. Through in-depth analysis of the external and internal factors, we analyze the potential of the Bangladeshi bicycle industry for green recovery through sustainable economic and environmental growth.

Current status of motorization in Bangladesh

Bangladesh has seen rapid motorization in the last decade with an average motorization rate of 5.6% (BRTA 2022). Figure 1 shows the trend for the number of registered motorized vehicles in Bangladesh. Starting from 2013, a steep positive slope can be observed until 2019. However, we notice a decline in the average number in the year 2020. This can be attributed to the economic crisis brought about

Fig. 1 Motorized vehicle trend in Bangladesh (Source: Bangladesh Road Transport Authority, 2022)



by the COVID-19 pandemic. According to the ADB (2021), Bangladesh's GDP fell drastically in the wake of the pandemic resulting in a loss of 5 million full-time jobs in the fiscal year 2020–2021. The epidemic has critically affected the country's long-standing macroeconomic stability, disrupted people's livelihood, and raised poverty to 40.9% in 2020 (UNDP 2021). This resulted in fewer yearly purchases of motorized vehicles such as cars, buses, trucks, and bikes.

Dhaka, the country's capital and the 6th most densely populated megacity in the world, is faced with difficult challenges in achieving sustainability in urban transportation because of rapid motorization and a decline in public transport use. The city alone contributes to releasing 1000 MT GHG gas into the environment, 70% of which is attributed to fossil fuel-powered motorized vehicles (UNESCAP 2018). Unplanned and non-green investment in the transport sector has helped the growth of motorized vehicles. This has not only worsened the air pollution and GHG emission in the city but also increased road accidents and fatalities in the metropolitan area.

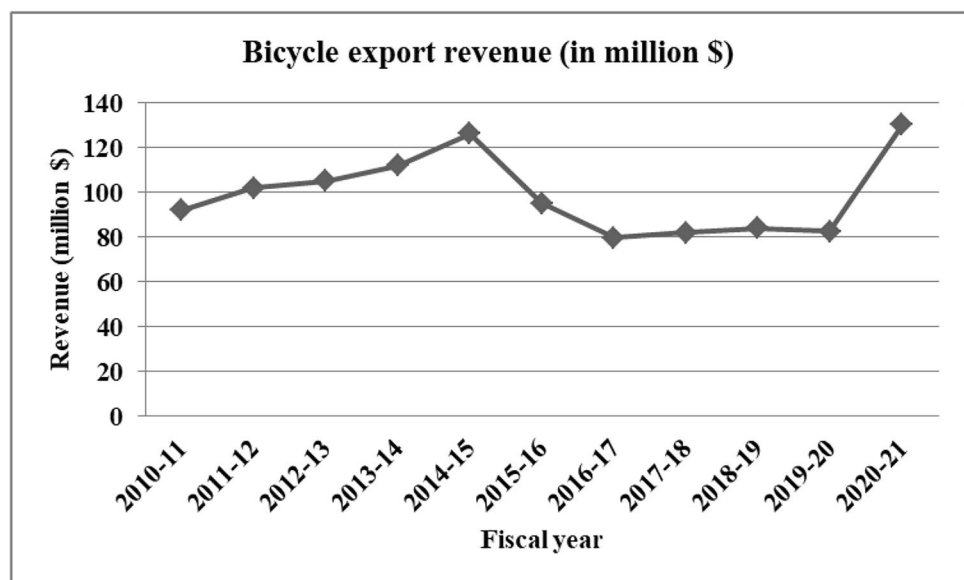
In its Nationally Determined Contributions (NDC), Bangladesh pledged to reduce GHG emissions from the power, transport, and industry sectors by 2030 by 5% in comparison to BAU scenario (MOEF 2018). Bangladesh can also aim for 15% emission reduction if it receives appropriate support from the developed countries. Decarbonizing the country's transport sector can help Bangladesh achieve the goal of emission reduction. "Decarbonizing the transport sector is imperative to achieve the Paris Climate Agreement goal and avoid dangerous climate change" (UNCRD 2021). Low-carbon transport policies such as electric vehicle adoption, pedestrian-friendly design, and bicycle-oriented development are the most significant contributors to emissions reduction (Zhang et al. 2018). The major sources of

external financing for the transport sector in Bangladesh are the Asian Development Bank and the World Bank. They call for an environmentally sustainable and low-carbon transport solution for resilient recovery from the COVID-19 pandemic. Being the low-carbon non-motorized transport (NMT) option, investment in the bicycle industry and bicycle transportation can play a pivotal role in reducing carbon emission, creating green jobs, and reducing socioeconomic disparities.

Current status of bicycle industry in Bangladesh

Bicycles are the largest contributors to the engineering products export sector (DATABD.CO 2020). Since 1999, Bangladesh has been exporting bicycles to European countries. In 2020, Bangladesh became the 3rd largest non-European exporter of bicycles only behind Taiwan and Cambodia (The Financial Express 2020). Also, Bangladesh is the 8th largest exporter of the global market. The revenue generated from exporting bicycles over different fiscal years is shown in Fig. 2. In 200–21 FY, Bangladesh earned an estimated \$130 million surpassing all previous records (The Daily Star 2021). The big three companies that contribute to the exports are Meghna Group, Alita Bangladesh, and Pran-RFL Group (DATABD.CO 2020). The local market size for bicycles is approximately 1.5 million per year with an annual growth rate of 30% (Dhaka Tribune 2021). The local manufacturers are fighting to satisfy this huge local demand that is ever-increasing. By 2031, the estimated worth of the global bicycle market will be \$111 billion (Persistence Market Research 2020).

Fig. 2 Bangladesh bicycle export revenue trend over time (Source: Export Promotion Bureau, Bangladesh)



With this on the horizon, the Bangladeshi bicycle industry has great potential to be a key contributor to this market.

In Bangladesh, people use bicycles predominantly for personal commute. The country's majority of bicycle users are in the capital city of Dhaka. Dhaka ranks first as the most densely populated city in the world (Statista, 2021). Due to the day-to-day city life congested traffic, people are always looking for a faster mode of transport to reduce the time wasted in the traffic jam. The bicycles can easily escape traffic jams by finding alternative routes since they can travel through compact space on the road. The growing popularity of bicycles results in an increasing demand for bicycles every year. Bicycles are not only the most affordable mode of transportation, but also their maintenance cost is very low. Moreover, people are becoming health-conscious more than ever. This sensible concern is driving mostly young people to choose bicycling as an exercise option.

Another significant aspect that is contributing to the growing market demand for bicycles is the e-commerce boom in Bangladesh. These online-based businesses for food delivery (Foodpanda, HungryNaki, Uber Eats, Pathao Foods, etc.), grocery items (Chaldal, Shwapno, Meenacllick, etc.), and courier service (RedX, Delivery Tiger, eCourier, etc.), along with various other e-commerce such as Daraz, Rokomari, and Pickaboo, are adopting bicycles extensively for last-mile delivery. This trend is creating jobs for many young people. Through an affordable investment of buying a bicycle, they are now making money easily by joining the last-mile delivery job. Moreover, recently, many families in Bangladesh who have been economically affected by COVID-19 are joining these delivery jobs (Xames et al. 2022). Bicycles indeed are helping them recover financially. Thus, bicycles are becoming popular in Bangladesh as an economical and a sustainable mode of transportation for business and personal use.

Some recent studies (Buehler and Pucher 2021; Double-day et al. 2021; Kraus and Koch 2021) show that bicycle use has increased rapidly during the pandemic in Europe, the USA, and Australia. The trend is also similar for the countries with developing economy. Bangladesh has experienced remarkable increase in bicycle sales during the pandemic (Al Jazeera 2020). The risk perception of COVID-19-driven social distancing among common people has been the major player for this demand surge. Not only the local market demand has escalated, but also the bicycle export has hit a new high during this time (The Daily Star 2021). Therefore, there was never a better time to invest in the bicycle industry in Bangladesh. We believe the industry has a great potential for resilient economic recovery after the pandemic by earning through export, by creating jobs, and by flourishing business in the country. We also believe this low-carbon mode of transport will ensure sustainable green recovery for

the global climate. In this study, we analytically explore the prospects of the bicycle industry.

Methodology of research

In this research work, we attempt to identify the potential strengths and opportunities of the growing bicycle industry of Bangladesh. We choose SWOT analysis as the methodological tool for this purpose. The SWOT is the acronym for strengths, weaknesses, opportunities, and threats. According to Helms and Nixon (2010), "SWOT analysis provides the foundation for realization of the desired alignment of organizational variables or issues." It is used to identify and analyze the internal factors (strengths and weaknesses) and external factors (opportunities and threats) that determine the success or failure potential of a business organization. Researchers and practitioners have been using the SWOT analysis tool to make strategic suggestions since the advent of the methodology. By analyzing the favorable and unfavorable factors, professionals can understand how the opportunities can be leveraged by the strengths and how the weaknesses can potentially amplify the threats unless proper actions taken.

To perform the SWOT analysis, we gather data from the published research works and the opinions from an expert body consisting five industry experts, two government experts, and three university professors. The experts and their credentials are listed in Table 1.

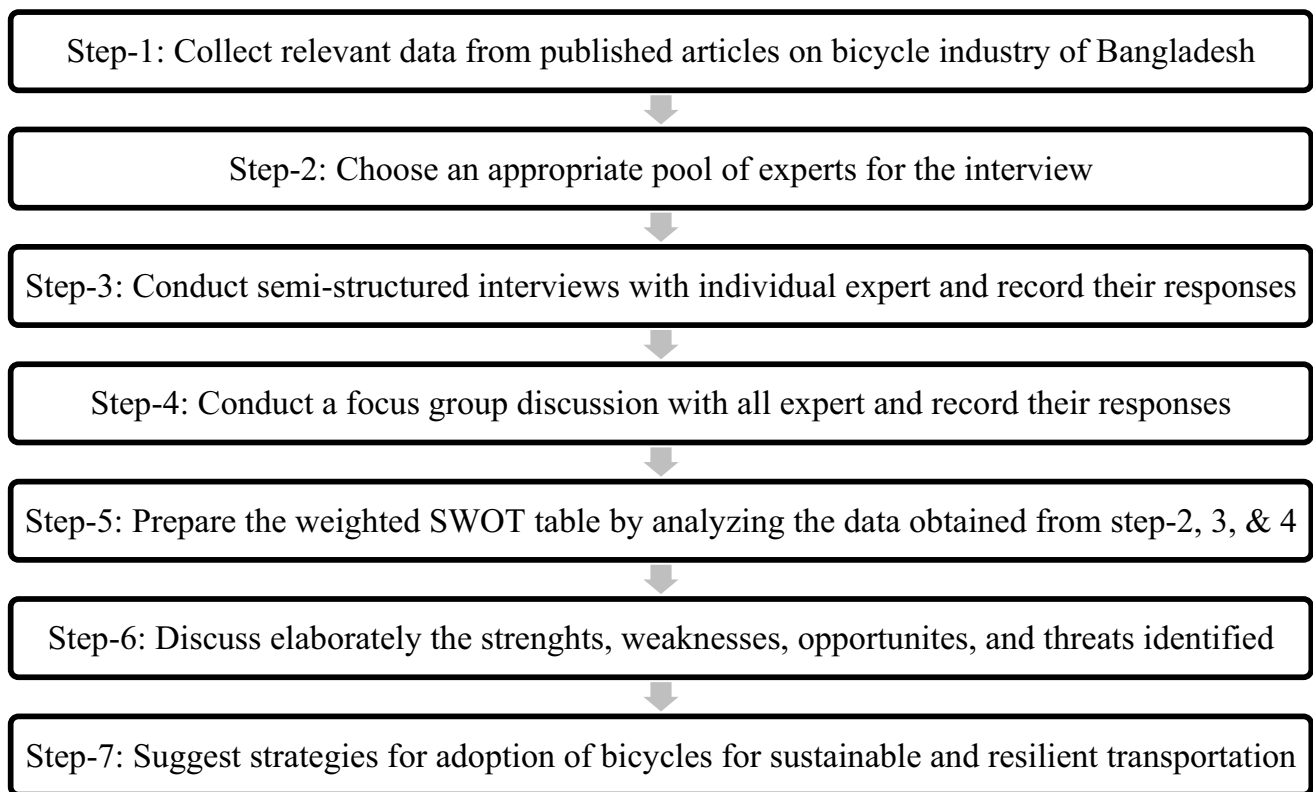
First, we obtained the Bangladeshi bicycle industry data from various local and international e-papers and the research articles published in refereed journals. Afterward, we conducted semi-structured interviews with every individual expert following a SWOT-based format during July and August of 2021. The participants were interviewed with open-ended questions aimed at gaining insights regarding the bicycle industry. Later, we arranged a focus group discussion where all ten experts participated and contributed to the active discussion. Next, we systematically organized all the collected qualitative data from all three sources — interviews, focus group discussions, and published articles. We observed and conducted in-depth analysis to construct the internal factor evaluation matrix (IFEM) and the external factor evaluation matrix (EFEM). Based on this, we developed the finalized SWOT table. We discuss the findings in the next section of this paper. The methodological framework of our research is illustrated in Fig. 3.

SWOT analysis

According to Harrison (2010), "SWOT analysis is a systematic assessment of an organization's internal strengths and weaknesses, its opportunities for growth and improvement,

Table 1 List of experts and their credentials

Sl	Designation of expert	Years of experience	Affiliated organization	Contributing role
1	Chairman	18 years	Bicycle manufacturing industry	Makes investment decisions
2	Marketing director	13 years	Bicycle import industry	Makes investment decisions
3	Head of manufacturing	8 years	Bicycle manufacturing group	Makes production planning decisions
4	Head of supply chain	10 years	Bicycle import industry	Makes outsourcing decisions
5	Head of supply chain	7 years	Bicycle export industry	Makes distribution decisions
6	Director (policy and planning)	14 years	Government agency	Contributes to government policy making
7	Deputy secretary (export)	8 years	Government sub-division	Contributes to government policy making
8	Professor, Department of Economics	20 years	Public university	Researcher of economics
9	Professor, Department of Environmental Science	16 years	Public university	Researcher of environmental science
10	Associate professor, industrial and production engineering	10 years	Public university	Researcher of manufacturing engineering

**Fig. 3** The research framework for this study

and the threats the external environment presents to its survival.” We construct the SWOT table following the SWOT approach in combination with IFEM and EFEM analysis. This helps us evaluate the strategic factors for better decision-making. Using the data extracted from the expert opinions and from the published articles, we conduct several brainstorming sessions to list the strengths, weaknesses, opportunities, and threats. Next, we construct the IFEM and

EFEM matrices (shown in Tables 2 and 3), and then by sorting the factors based on their weighted rating, we develop the finalized SWOT table (shown in Table 4).

The following rules were used to construct the internal factor evaluation matrix (adopted from Mondal 2017):

- (i) Each factor was assigned a weight in the range of 0 to 1 (least important to most important. The weights were

Table 2 Internal factor evaluation matrix (IFEM)

Strengths	Weight	Rating	Weighted rating
Strong relationship with European buyers	0.162879	4	0.651515
Cheaper labor cost compared to the competitors	0.155303	4	0.621212
Strong product diversification capability	0.132576	3	0.397727
Most affordable personal vehicle in the country	0.155303	4	0.621212
Weaknesses			
Infrastructure barriers of local market growth	0.140152	1	0.140152
Technological barriers of production	0.128788	2	0.257576
Lack of foreign investment	0.125	1	0.125
	1.00		2.814394

Table 3 External factor evaluation matrix (EFEM)

Opportunities	Weight	Rating	Weighted rating
Increasing awareness of climate change	0.162362	4	0.649446
Booming e-commerce related last-mile delivery	0.132841	3	0.398524
Increasing health concerns among youths	0.136531	4	0.546125
Potential of bicycle sharing services in the country	0.125461	3	0.376384
Growing demand due to COVID-19 awareness	0.162362	4	0.649446
Threats			
Foreign competitors' dominance in local market	0.136531	2	0.273063
High import duties on imported raw materials, and high VAT on production and trading	0.143911	1	0.143911
	1.00		3.0369

calculated using MS Excel based on the data obtained from the three input sources.

- (ii) Each factor was assigned a rating in the range of 1 to 4, where ratings 1, 2, 3, and 4 represent major weakness, minor weakness, minor strength, and major strength, respectively.
- (iii) The weighted rating for each factor was obtained by multiplying the weight and the rating. The total weighted rating was found by summing up the weighted rating for all internal factors.
- (iv) The decision rule used is if the total weighted rating exceeds 2.5, it implies that the strengths outweigh the weaknesses and vice versa.

The same steps were repeated to develop the external factor evaluation matrix where ratings 1, 2, 3, and 4 represent major threat, minor threat, minor opportunity, and major opportunity, respectively. The decision rule used was if the total weighted rating exceeds 2.5, it implies that the opportunities outweigh the threats and vice versa. The weighted rating of internal factors was found to be 2.814394, which is greater than 2.5, meaning the strengths outweigh the existing weaknesses. Similarly, the weighted rating of external

factors (3.0369) indicates the opportunities outweigh the threats. The overall findings suggest the bicycle industry has tremendous potential as a green recovery driver in developing countries.

Strengths analysis

Strong relationship with European buyers The experts mentioned that the Bangladeshi bicycle manufacturer companies maintain tight relationship with the European buyers. This close relationship provides the manufacturers' flexibility concerning lead time and some duty exemptions. However, the industry experts stated that the buyers generally do not compromise with product quality. This always drives the Bangladeshi manufacturers to focus on improving quality with time.

Cheaper labor cost compared to the competitors In Bangladesh, the labor price is relatively cheaper than most of its Asian competitors in the global market — India, Sri Lanka, China, Thailand, and the Philippines. Besides, the experts believe that Bangladesh can offer skilled labor and work force in manufacturing bicycles. They also agree

Table 4 SWOT analysis of the bicycle industry of Bangladesh

Internal factors	
Strengths	Weaknesses
<ul style="list-style-type: none"> • Strong relationship with European buyers • Cheaper labor cost compared to the competitors • Most affordable personal vehicle in the country • Strong product diversification capability 	<ul style="list-style-type: none"> • Technological barriers of production • Infrastructure barriers of local market growth • Lack of foreign investment
External factors	
Opportunities	Threats
<ul style="list-style-type: none"> • Increasing awareness of climate change • Growing demand due to COVID-19 awareness • Increasing health concerns among youths • Booming e-commerce-related last-mile delivery • Potential of bicycle-sharing services in the country 	<ul style="list-style-type: none"> • Foreign competitors' dominance in local market • High import duties on imported raw materials and high VAT on production and trading

undisputedly to the point that the country's education system is producing better engineers and technicians now. This is helping the country to stay competitive in the global market providing superior cost-quality trade-off.

Most affordable personal vehicle in the country According to the experts, the market demographic shows that the majority of the customers are young people aged between 16 and 28 years. This is because bicycle is the most affordable personal vehicle for them. The customers are mostly school, college, and university going students as well as young people trying to earn their bread by joining home delivery-based online business. Motorbike is the second most affordable personal vehicle, and that too is more than ten times costly than a bicycle. This indicates that there is no close competitor of other vehicles in the market. The experts claimed that even the low-income parents can now afford a bicycle for their children.

Strong product diversification capability Most of the experts believe that the bicycle industry is capable of product diversification both in the local market and global. To gain

majority market share of the local market, the companies have already started producing low-price bicycles. These are easily affordable to the country's low-income people. Duranta Bikes, a venture by Pran-RFL group, has gained popularity among local customers as a cost-efficient choice over foreign products. In terms of global market, Bangladesh is eyeing on the opportunity to win foreign markets besides Europe such as the USA and Australia. Some of the experts urged that this would be challenging and ambitious. However, if the companies can achieve manufacturing flexibility, the goal is not unachievable.

Weaknesses analysis

Technological barriers of production Over the world, the developed countries are leveraging automation and artificial intelligence in production. This results in reduced human labor, higher production volume, low unit product cost, and most importantly higher product quality. However, in developing countries like Bangladesh, the production facilities do not have proper access to smart manufacturing. The experts believe that if Bangladeshi bicycle manufacturers use state-of-the-art technology in their production facilities, their products will be more competitive in the foreign market. The experts are, however, optimistic about this progress soon.

Infrastructure barriers of local market growth The experts point out two infrastructure-related barriers that impede the local market growth. Those are lack of dedicated lanes for bicycles on the roads and lack of parking facilities. If these weaknesses could be eliminated, more people would consider using bicycles during their daily life. It is no secret that the country's capital city of Dhaka and some other big cities such as Rajshahi and Chattogram are suffering from their poorly planned traffic. The megacity of Dhaka is where the country's majority of the bicycle users and potential customers live. However, there are no dedicated lanes for bicycle riding on the roads. The experts expressed their concerns noting that riding bicycles on the same lanes with motorized vehicles such as bike, car, leguna, bus, and truck has substantial risk of accidents. The experts doubt that implementing dedicated bicycle lanes in Dhaka could be highly unfavorable. However, this should not be challenging to implement in other major cities of the country (Zafri et al. 2021). The parking facilities for bicycle in the major cities are inadequate. Often the users would not take their bicycles to places where they need to park the vehicle of hours. While the motorized vehicles can avail parking facilities, the bicycles do not. According to the experts, bicycle parking facilities can be easily developed since hundreds of bicycles can be parked in a compact space.

Lack of foreign investment Capital investment from foreign investors is a vital prerequisite in developing new production facilities in a developing country like Bangladesh. In 2018, Cube Bikes, one of the biggest manufacturers of bicycles in Europe, invested approximately \$12 million to Meghna Group to make high-quality bicycles (The Daily Star 2018a, b). Investment as such is what Bangladesh needs to look for. Bangladesh needs to attract the investors from countries with green investors. The government body needs to facilitate the investment process by removing bureaucratic complexities and by reducing tax on the investors. The same should be done for the local investors as well. The local investment can create new start-up companies capable of meeting local market demand.

Opportunities analysis

Increasing awareness of climate change Bicycles are the greenest mode of transportation which do not emit carbon when in use. Adopting bicycles over motorized transports can significantly reduce total carbon emission. A study conducted in Bangladesh by Roy et al. (2019) reveals that “53% of carbon dioxide emission can be reduced if only 40% of people use bicycles instead of using private transport for short distance.” The authors also found that bicycle production in Bangladesh is more environment-friendly in Bangladesh than in Europe. The increase in climate awareness demands for clean production and sustainable use of energy and resources. With this prospect, bicycle industries are getting attention over the last decade. Climate activists and the government are inspiring people to replace personal motorized vehicles with bicycles. The number of bicycle users in Bangladesh and also almost everywhere in the world is increasing. This implies a bright future scope for expansion of the bicycle industry in Bangladesh. The climate awareness is even more profound among the target customers, i.e., young people. The experts believe that this is the biggest opportunity for the bicycle industry to thrive.

Growing demand due to COVID-19 awareness The COVID-19 pandemic has led people to adopt bicycles for transportation for some definite reasons. First, to fight the disease boosting one's immunity is a vital prevention approach. Since cycling everyday boosts immunity, people are considering riding bicycles for personal commute. Second, during the COVID-19 epidemic, there has been a significant shift in travel mode choice (from public transport to personal vehicle) due to the risk perception among people (Bhaduri et al. 2020; De Vos 2020). Due to social distancing and other coronavirus-related safety protocols, public transports have seen decline in the number of passengers to travel. The cars and the motorcycles are among the widespread personal vehicle options. However, people in developing countries

are struggling to get either of them. Therefore, they are considering bicycle as an affordable personal transport mode. This trend is prevalent in Bangladesh and similar developing countries. According to experts, this growing practice will most likely result in increased bicycle demand for the years to come.

Increasing health concerns among youths In Bangladesh, people are becoming health-conscious now. The youth are adopting healthy lifestyle that includes doing regular physical exercise. Bicycling being an affordable exercise option is thus getting popularity among youths. According to Harvard Health Publishing (2016), cycling is good for health and muscles, and it improves how a person walks and balance and climb stairs. Besides its health benefits, it comes with economic benefits in terms reduced healthcare costs and fewer sick days of the employees (Handy et al. 2014). The experts believe that the growing health awareness among the youth is a big opportunity for the growth of bicycle industries in Bangladesh.

Booming e-commerce-related last-mile delivery The widespread adoption of the Internet has facilitated the rapid development and growth of Internet-based businesses, colloquially called e-commerce. These businesses focused on good customer experience and thus provide home delivery for their products. The best way for making such last-mile delivery is using bicycles in the big cities like Dhaka and Chattogram. Also, bicycles being the cheapest mode of transport significantly increase the profit of the business. The experts reckon that the booming e-commerce will expand even more in the upcoming years and this will accelerate the need for bicycle production in high volume.

Potential of bicycle-sharing services in the country Public bicycle-sharing scheme is getting popularity since the introduction of this in Bangladesh in 2018. JoBike, the country's first bicycle rental service, was launched in June 18, 2018 (The Daily Star 2018a, b). Since then, the system is serving the cities of Dhaka, Chattogram, and Cox's Bazar. Inside Dhaka, they are available in Gulshan, Banani, and Mirpur DOHS area. The use and popularity are growing in various university campuses as well. The investors of JoBike are optimistic about the venture's future despite the pandemic hit (The Business Standard 2020). A study conducted by Rahman (2020) revealed that the bicycle-sharing scheme has a good potential to increase bicycle use in Dhaka and other big cities of Bangladesh. Also, the users' environmental concern is positively affecting their intentions to adopt bicycle-sharing (Zhu et al. 2020). The experts believe that in the next 5 years, a number of bicycle-sharing services will be launched by entrepreneurs. Moreover, the experts claim that foreign bicycle-sharing companies such as Mobike and

Ofo will shortly be interested in starting their business in Bangladesh.

Threats analysis

Foreign competitors' dominance in the local market The major threat for the growth of bicycle industry in Bangladesh is the fierce market competition with the foreign companies in the local market. Two biggest competitors are India and China, who supply the vast majority (nearly 70%) of the local market demand (Dhaka Tribune 2020). One big reason for their dominance in the local market is the lower unit price than that of locally produced bicycles. Since the customers' bargaining power is growing, they tend to choose relatively cheaper foreign bicycles of comparable quality. Reducing the unit product cost that will be more affordable to the local customers remains a big challenge to overcome. Since most of the raw materials are imported at high price, reducing the unit cost to the competitors' level is difficult for the local manufacturers. The experts suggest that if the government can impose anti-dumping duty or other protective tariffs on the foreign companies, the local industry will see rapid growth in this business.

High import duties on imported raw materials and high VAT on production and trading The local companies import most of the raw materials and spare parts for bicycle from various countries. Recently, the import duty has been increased from 10 to 25% on raw materials (DATABD.CO 2020). Moreover, an average duty of 55% on the bicycle spare parts is a big barrier to overcome. Not only the high import duties are affecting the growth of the industry, poorly structured administrative issues at the ports often cause high lead time of the imported items. This eventually hampers the productivity and makes the local companies vulnerable to their competitors at both home and abroad. The experts believe that for the bicycle industry, the government should rethink the "VAT Act 2012" that imposes 15% VAT on production and 5% VAT on trading. A sizeable reduction in VAT can make the Bangladeshi bicycle companies highly competitive in both local and international market.

Policy implications

Rapid economic growth and increasing population are contributing to environmental degradation in Bangladesh, and the ongoing COVID-19 pandemic has exacerbated the situation even further. The Government of Bangladesh (GOB) has implemented containment measures and announced incentive and stimulus packages totaling \$22.1 billion in wake of the pandemic (ADB 2021). Recently, the World Bank has provided \$1.05 billion to help Bangladesh create quality jobs and accelerate economic

recovery from the coronavirus pandemic (World Bank 2020). However, for economic recovery in the post-pandemic setting, the investment should be focused on environmental sustainability. Prioritizing a green recovery from the pandemic is the right step towards sustainability (Nature4Climate 2020). Green recovery focuses on reducing carbon emissions, and decarbonizing the transport sector is the first step towards it (Brozynski and Leibowicz, 2018).

Government plans for transport decarbonization

In order to decarbonize the transport sectors, the GOB has taken several policy measures that include:

- (i) At least 15% of all registered vehicles will be run by "environment-friendly electricity" by 2030 (The Business Standard 2021). This will be achieved by investing in electric two-wheelers, three-wheelers, electric cars, electric buses, and electric trains.
- (ii) To popularize the non-motorized transportation system, the National Integrated Multimodal Transport Policy includes two policies (policy 70 and 71) regarding bicycle infrastructure development (DTCA 2015)::

Policy 70: Bicycles will be recognized as a mode of transport and separate lanes and crossings will be provided within the city in order to make bicycle journeys safe and pleasant.

Policy 71: The Government will support local industries in the manufacture of bicycles so that new designs can make bicycle purchase affordable to the poorer sections of society. And the Government will implement the actual condition survey and prepare the database. And also the government will submit the specification for facility and design standards.

- (iii) To achieve the mitigation target in NDC by 2030, the Ministry of Environment, Forest, and Climate Change will work on the "Avoid-Shift-Improve" framework (MOEF 2018) with a focus on the development of mass rapid transit (MRT), bus rapid transit (BRT), and energy-efficient rail locomotives.

Strategies to sustainable transportation by promoting bicycling

COVID-19 has called attention to the need for integrating health and the environment into urban and transport planning (Regmi, 2021). Several studies have been conducted by the researchers to find out the COVID-19-induced modal shift in Dhaka city. The findings suggest that non-motorized transport options (bicycling and walking) became popular (19.93%) during the pandemic (Paul et al. 2021). According to Zafri et al. (2022), one major positive outcome of the modal shift is the increased bicycle trips and walking

trips. This could have significantly contributed to the sudden reduction of air pollution in the city (Rahman et al. 2021). Zhang and Zhang (2021) demonstrated through scenario simulations that a bicycle-friendly infrastructure can significantly contribute to a reduction in energy consumption as well as CO₂ emissions. Therefore, a developing country like Bangladesh should look for green investment in bicycling as a non-motorized transport (NMT) option to reduce GHG emissions in the post-pandemic setting.

Based on the SWOT analysis in the fifth section, we have formulated some potential strategies for Bangladesh as well as other developing countries to facilitate the adoption of bicycles as a sustainable and resilient transport option. These are as follows:

- i. *Developing local manufacturing capability:* the country should build its own manufacturing facilities to ensure an adequate and affordable supply of bicycles to the local market. With the help of state-of-the-art technology, those manufacturing facilities need to be utilized effectively and efficiently to get maximum production.
- ii. *Developing dedicated lanes and crossings for bicycles:* bicycle-friendly infrastructure needs to be developed in the major cities. Separate lanes and crossings should be established to facilitate safe transportation via bicycles.
- iii. *Developing parking and shower facilities for the bicycles:* inadequate parking and shower facilities discourage bicyclists from choosing bicycles over motorized bikes. Therefore, it is very crucial to establish proper parking and shower facilities at appropriate strategic locations.
- iv. *Carbon pricing on motorized bikes:* carbon taxes should be imposed on motorized vehicle purchase, registration, and use, especially on motorized bikes since bikes are the closest competitor to bicycles among the commuters. Carbon pricing should also be implemented on fossil fuels to discourage its use. However, redistribution of carbon tax revenue should be done in such a way that it promotes the acceptance of carbon taxes.
- v. *Reducing import duties on raw materials outsourcing:* high import duties on imported raw materials and high VAT on production and trading make it difficult for the bicycle industry business to grow and compete. Therefore, a significant reduction in such import duties and VAT will make the bicycle industries more competitive in both local and international markets.
- vi. *Encouraging local investors for small-scale funding:* the government needs to encourage local investors in developing small-scale infrastructure to create green jobs. They should also be convinced to launch bicycle start-up companies and adequate support from the policymakers should be ensured.
- vii. *Attracting foreign investors for large-scale funding:* the government of a developing country like Bangladesh cannot survive on local investment in this sustainable transportation mode. Therefore, they need to attract foreign investors with green investment mindsets to invest in building large-scale facilities for bicycle production in Bangladesh.
- viii. *Launching government-owned bicycle-sharing service:* bicycle-sharing service will be popular in the coming future due to the ease of access to the Internet in the urban areas. Although private-owned bicycle-sharing services are available in the country, they are inadequate and not affordable to many. So, the government can aim at developing a state-owned venture to promote bicycling.
- ix. *Eliminating gender differences in bicycling:* gender differences in cycling exist because of the cultural norms in Bangladesh with negative societal views towards female bicyclists (Jamal et al. 2022; Koehl 2020). This scenario needs to be improved for the bicycles to be popularized among female riders. The government should introduce and popularize policies to ensure gender balance in cycling culture.
- x. *Promoting and shifting to active mobility:* the government should promote active mobility through proper campaigning and marketing channels. They need to create awareness among common people about the health and environmental benefits of cycling. It will accelerate bicycle adoption as a regular commute mode. This will also promote environmental awareness among the less-educated and uneducated population.

Conclusion

Sustainable investment ensures clean production and green usage of resources and thus could be an effective strategy for green recovery after the COVID-19 pandemic. Since bicycles are the greenest mode of transport, investing in the bicycle industry can bring about economic and environmental sustainability. In this paper, we perform a SWOT analysis to find out the potential of the bicycle industry as a post-pandemic green recovery driver in an emerging economy context of Bangladesh. We investigate the strengths, weaknesses, opportunities, and threats for the growth of the industry. We observe that the huge opportunities can easily be leveraged by the strengths of the industry. The weaknesses can be recovered through proper strategic planning by the government. The potential threats can be eliminated by designing and implementing a better tax policy. Moreover, proper implementation of the strategies (highlighted in the Strategies to sustainable transportation by promoting bicycling section) to facilitate and promote cycling as a transport

mode can help build a sustainable and resilient transportation system. Altogether investment in bicycle industry in Bangladesh as well as other developing countries has a tremendous potential to positively change the economic and environmental status quo of the country. We believe that the bicycle industry can surely be a significant driver for green recovery in the post-pandemic world.

Author contribution All authors conducted the interviews of the participants and gathered and analyzed responses. DX and JS wrote the manuscript. DX and JS revised the manuscript as per reviewers' comments. FS supervised the overall work. All authors read and approved the final manuscript.

Data availability The data used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

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