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Assessment of Informal Used Lead Acid Battery Recycling and Associated Impacts in Bangladesh

Produced for: United Nations Environment Programme
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Date: April 2020

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Executive Summary

Bangladesh's economy has evolved rapidly from one based primarily on agriculture to a more diversified service and manufacturing economy. While this evolution has helped Bangladesh move up the income scale, it has also created new pollution control and environmental health challenges that may be outpacing the government's capacity to regulate industries and mitigate environmental health risks. This challenge is particularly acute with respect to the used lead acid battery (ULAB) recycling industry and the exposures to toxic lead pollution that result from informal and substandard recycling.

Bangladesh is believed to have more than 1,100 informal and illegal ULAB recycling operations across the country. To date, 270 of these locations have been identified and assessed by environmental health professionals from the non-profit organization Pure Earth and the Department of Geology of the University of Dhaka (see site list in Annex A). These assessments reveal high concentrations of lead surrounding informal ULAB recycling operations and severe public health risks to nearby residents. The environmental and demographic data captured through these assessments is publicly available in an online database at www.contaminatedsites.org. Based on these findings, informal and unsound ULAB recycling is believed to be a significant contributor to lead exposures across the country and the primary contributor to lead pollution hotspots.

The average concentration of lead in children's blood in Bangladesh is estimated to be among the highest in the world at approximately 8 micrograms per deciliter (µg/dL). This concentration is significantly above the "reference level" of 5 µg/dL that triggers government intervention and case management for a child in the United States. A recent meta-analysis suggests that nearly 28.5 million children in Bangladesh have blood lead levels above 5 µg/dL, and that more than 21 million have BLLs above 10 µg/dL (Ericson, 2020). At these levels, it would be reasonable to expect significant IQ reductions among the tens of millions of chronically exposed children. In 2017, exposures to lead were responsible for 4.3% of deaths in the country.

A study on economic impacts from lead exposures estimates that each year Bangladesh loses US $15.9 billion in GDP from reduced lifetime earning potential among the exposed population. This figure includes only lost earning potential due to IQ decrements, and does not include healthcare costs, lost earnings from premature death, or lost taxes from illegal ULAB recycling operations.

Based on the extraordinary public health and economic toll, investments in lead exposure reduction programs in Bangladesh would likely yield significant returns on investment, resulting in a more productive, healthier and resilient population.

Introduction and National Context

The generation of used lead acid batteries (ULABs) in Bangladesh has grown considerably in the last decade, as demand for lead acid batteries (LABs) increased in several sectors. LABs are in high demand in the transportation sector as well as for power storage in solar energy collection systems or in backup systems where there is unreliable grid electricity service. Figure 1 shows the type of LABs used by major consumers in Bangladesh.

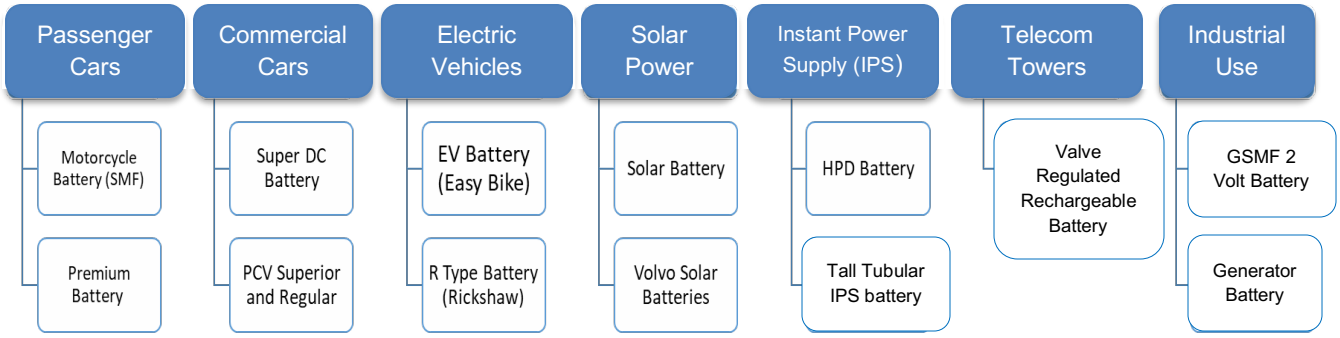

Figure 1: Sectors using Lead Acid Batteries in Bangladesh

In the transportation sector, the number of registered vehicles in December 2019 stood at 504,130, along with 2 million motorcycles (ILA, 2020). While it is expected that conventional 'vehicle starting battery' consumption will rise as the number of motor vehicles increases, there have also been a phenomenal growth of battery-run rickshaws and battery operated autorickshaw (locally known as 'easy-bikes') in the last decade (see box 1). These vehicles use a set of five batteries with a capacity of 60V, which consume 1kW of electricity daily and take 4-5 hours to be fully charged (Rasel, 2017).

Pooled ride-shares in these vehicles have generated employment opportunities for urban dwellers in towns outside Dhaka. While there are no estimates on the number of these type of rickshaws operating in the country, the market forces driving their adoption are similar to those in the context of neighboring India (Goel & Singh, 2019). These vehicles operate in the narrow roads off the highways serving the last miles for passengers. While it is difficult to estimate the total number of easy-bikes and battery-run rickshaws in the country, as registration for these vehicles with Bangladesh Road Transport Authority (BRTA) is not mandatory, it is reasonable to assume that these vehicles account for more than two-third of the demand for LABs.

Battery-run rickshaw

- Similar to electric bikes with pedal assist motors.
- Motor drive mechanism is directly controlled by a hand throttle
- Uses four 12V 20Ah lead acid batteries, placed under passenger seat
- Seating capacity = 2 passengers

Battery-run auto-rickshaw (easy-bike)

- Similar to tuk-tuks. Costs 150000 taka.
- Brushless DC motors with automatic gearbox
- Uses 5-6 12V lead acid batteries, placed under driver & passenger seats
- Seating Capacity = 5-7 passengers

Box 1: Distinguishing between battery-run rickshaws and easy-bikes

In the absence of a comprehensive regulatory framework for the environmentally sounds management and recycling of ULABs, this waste stream is becoming an increasing environmental and health concern for Bangladesh. Based on a LAB inventory analysis and the various life cycles for each category of LAB and their respective applications, it is estimated that the annual generation of ULAB is 118,000 metric tons (mt) (ILA, 2020). Figure 2 show the major sectors generating ULABs in Bangladesh, distinguishing between easy-bikes and battery-run rickshaws.

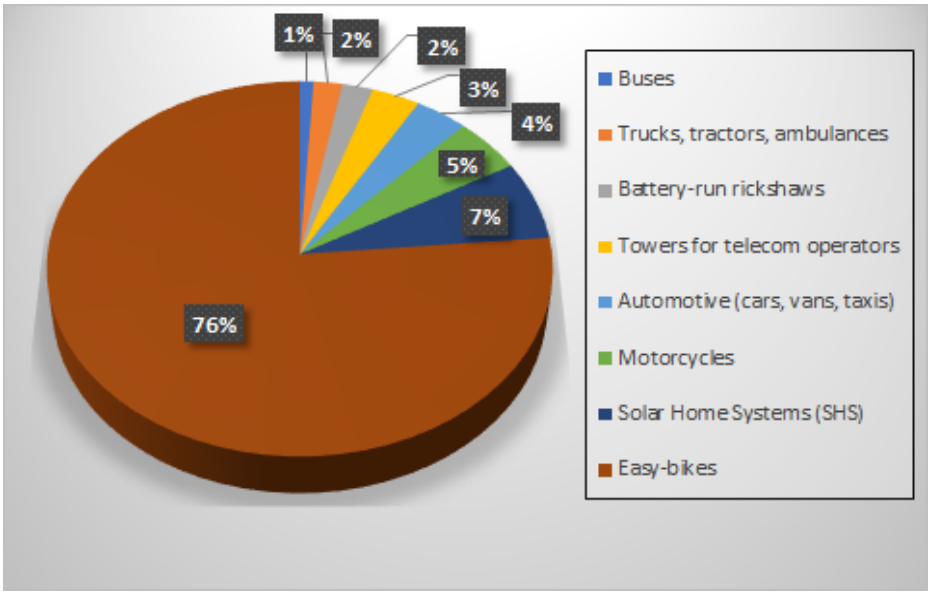

Figure 2: Estimated annual generation share of ULABs (ILA, 2020)

Estimates of the relative volume of LABs used across different sectors should be considered as indicative, rather than precise, as data is incomplete and the context for LAB usage is always evolving. For example, Batteiger (2015b) estimated that ULABs from Solar Home Systems (SHS) have crossed 10,000 mt in 2016, whereas ILA (2020) estimates 8,000 mt. Recent trends also suggest that ULABs generated from SHS may be entering the waste stream earlier than previously expected. Bangladesh has seen impressive growth in rural grid electrification since 2015, with monthly new connections in the range of 300,000–500,000 per month (Muzammil & Ahmed, 2019). As more households get connected to the grid (a cheaper alternative to SHS), the market for SHS is already slowing (Parvez, 2020), and it can cause existing SHS households to discard ULABs and other components prematurely.

The formal sector ULAB recycling capacity has not grown to cater to the volume of ULABs generated, although it was expected in earlier studies (Marro & Bertsch, 2015). Only four battery manufacturers have their own recycling facility, and there are another two authorized recyclers operating in the country as part of the formal industry. The known formal sector ULAB recyclers are:

- Rahimafrooz Batteries Ltd. - Zirani Bazar, Zirani Kashimpur Road, Panisail, Dhaka
- Panna Battery Ltd. – West Rasulpur, Ramrangirchar, Dhaka
- Khorshed Metal Industries (HAMKO Group) - Bangladesh Small and Cottage Industries Corporation (BSCIC) Industrial Area, Khulna
- RIMSO Battery - Masabo, Borpa, Narayanganj
- Kishan Accumulators Ltd. – Kashiyara, Uzirpur, Bokultala, Narail
- BengalXpo Ltd - Pabna

The locations of these recyclers near major towns and cities also poses a challenge, as they are located far away from many end-users. This and other factors have enabled the growth of hundreds of unauthorized recyclers as part of an informal economy, posing risks to the environment as well as occupational safety for the workers involved. Hotspot areas of illegal smelting have emerged in Tangail, Jessore, Bogura, Dhaka, Dinajpur and Pabna.

The terms “informal sector” and “informal economy” describe the unregulated, unlicensed, and often illegal economic activity within an economy. The informal sector includes undocumented laborers, street hawkers, sellers of banned products, and other small to medium-scale industries operating outside of the law. In the case of informal ULAB recycling in Bangladesh, such operations employ more than 100,000 people

throughout the country. In the village of Raksha, in Bera Upazila of Pabna District, the informal battery recycling sector is the major employer.

Market Forces Influencing the ULAB Trade

The diffusion of Solar Home System (SHS) units has had a significant influence on the battery industry and ULAB recycling in Bangladesh. There are about 5.8 million SHS units installed in the country (SREDA, 2020) out of which 4.1 million SHS have been installed in off-grid households through Partner Organizations (POs) of the Infrastructure Development Company Limited (IDCOL, 2018). IDCOL is the implementing agency receiving financial support from the World Bank, KfW Development Bank, Asian Development Bank and other development agencies through the highly successful Rural Electrification and Renewable Energy Development (RERED) project, which is in its second phase, and is scheduled to end in 2021 after two decades (Batteiger, 2015a).

Although the RERED program's main objective was CO_2 mitigation, as attention increased on other environmental impacts such as spent batteries, IDCOL released a policy guideline in 2005 on the disposal of warranty expired batteries (ULABs). The regulations of the Department of Environment (DoE) on expired batteries came out in 2006, and the final report of the World Bank stated that the RERED project helped to improve standards in battery recycling and influenced the subsequent DoE regulations (Batteiger, 2015a). IDCOL ensured that batteries supplied under their SHS program came from ISO 14001 and OHSAS 18001 compliant facilities. Out of the 17 battery suppliers to IDCOL, only four have recycling plants (IDCOL, 2019), while the rest have entered into arrangements with the existing recycling plants to use their facilities (Marro & Bertsch, 2015).

IDCOL's policy guidelines stipulate that consumers have to sell their expired batteries exclusively to Partner Organizations, which are responsible for collecting batteries and transporting them safely to the regional offices of battery manufacturers. Manufacturers are then responsible for collecting the units from these offices and transporting them to sites where the batteries will be recycled in an environmentally friendly manner. Recyclers collect the batteries without the acids in order to reduce weight during transit (Batteiger, 2015a). IDCOL pays up to US $10 for each returned warranty-expired battery as an incentive to the battery recyclers and the Partner Organizations. To incentivize consumers for returning expired batteries to Partner Organizations and not to backyard smelters, a 24% rebate of the new battery price is offered when they return old batteries (Marro & Bertsch, 2015). However, not all expired batteries end up with the Partner Organizations, especially in the rural areas where they are recycled by the

informal sector (Batteiger, 2015a). The actual share of users returning their warranty-expired battery to the Partner Organizations is low. The market share of the informal battery shops is around 50% (Batteiger & Rotter, 2018). Brossmann (2013) identified three main reasons for this behavior based on focus group discussion of end-users. Firstly, local battery shops offer more diversified services at lower prices compared to the Partner Organizations. These services include repair of broken batteries by replacing lead plates and substituting the acid, which is cheaper than purchasing a new battery recommended by most Partner Organizations. Secondly, consumers trust the local battery shop owners more as they are locally embedded as opposed to field agents of Partner Organizations who might change employers or local branches. Finally, the interest level is low among Partner Organizations to communicate with users about expired battery disposal (Brossmann, 2013). Although the estimated generation of ULAB is low from SHS, the studied effects on the growth of the informal sector in rural areas are relevant in understanding how that sector also caters to other major ULAB sources such as motorbikes and battery-run auto rickshaws.

What is certain in both rural and urban contexts is that the collection channels of the informal sector are more dispersed and effective compared to the formal recyclers. Another reason batteries flow to the informal sector is that informal recyclers pay a higher price compared to formal sector recyclers. In the informal sector, depending on the condition of ULABs, each and every part of the old batteries is usable and therefore has value (Chakraborty & Moniruzzaman, 2017), whereas the formal sector is primarily interested in the lead. This cycle of higher price offering continues down the supply chain (Waste Concern, 2006) until it eventually makes its way to battery manufacturers.

ULAB Collection Practices and Reverse Logistics

The environmentally sound recycling of ULABs requires a reverse logistics supply chain or collection system that ultimately delivers ULABs to licensed and properly operated formal sector recyclers. Figure 3 illustrates the collection chain of ULABs in both the