Case Study

International Journal of SME Development
Issue 05 | June 2022

Leading through innovation: The role of BCSIR in facilitating Small and Medium Enterprises in Bangladesh

Mohammad Nashir Uddin, Shah Abdul Tarique, Md. Aftab Ali Shaikh[*]*
Muhammad Shoeb-Ur-Rahman[**]

Abstract

This paper explores and describes the innovative role of Bangladesh Council of Scientific and Industrial Research (BCSIR) in enabling technology-based Small and Medium Enterprises (SMEs) in Bangladesh. Using a descriptive research approach, this study finds that BCSIR has developed 1016 industrial production processes by its scientists from 1967 to 2021. Out of those, 372 processes have been patented while 396 processes have been leased out to entrepreneurs. So far, products of 120 lessees are now available in the market. BCSIR, representing the leading industrial research organization in Bangladesh, is relentlessly supporting small and medium entrepreneurships. As such more than 16,000 employees are engaged directly and indirectly in the industrial production and marketing processes, which have been invented by this pioneering organization. This paper sets a benchmark to (re)assess the technologies of BCSIR in view of upholding small and medium entrepreneurship in Bangladesh with necessary policy implications.

Keywords: technology-based entrepreneurship, industrial production, marketing process, SMEs, BCSIR.

[*] Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka 1205, Bangladesh. All correspondences: Md. Aftab Ali Shaikh (aftabshaikh@du.ac.bd)

[**] Department of Tourism and Hospitality Management, University of Dhaka, Dhaka 1000, Bangladesh

1. Introduction

Small and Medium Enterprises (SMEs) are increasingly considered as the nucleus for economic growth, both for the developing and developed worlds, by creating more and more job and income opportunities (Chege & Wang, 2019; Fiseha & Oyelana, 2015; Gherghina et al., 2020; Rotar et al., 2019). In Bangladesh, this sector is changing the face of the economy through employing nearly 24 million people (Hossain, 2021). The exponential growth has been evident as the sector created 1.5 million jobs between June 2009 to June 2014 (Khalily et al., 2020). SMEs are playing a crucial role for the country's accelerated industrialization, employment generation, and poverty reduction. On a rough estimate, they account for 45 percent of manufacturing value addition, 80 percent of industrial employment, 90 percent of total industrial units, and 25 percent of the labour force (Bangladesh Bank, 2008). Their collective contribution to the export earnings varies from 75 to 80 percent with a significant impact on the country's Gross Domestic Product (GDP) calculations (Khalily et al., 2020). The total number of SMEs in Bangladesh is estimated to be 79,754 establishments; of them, 93.6 percent are small and 6.4 percent are medium enterprises (Khalily et al., 2020).

Considering its relative importance to the economy, the government of Bangladesh has identified SMEs as the priority sector for transforming Bangladesh into a middle-income country. Subsequently, the Central Bank, Bangladesh Bank, has been found playing an instrumental role in designing and implementing SME sector development initiatives within its broader development financing agenda (Bangladesh Bank, 2008). One important insight highlighted in the policy document is the strength of SMEs to promote inclusive growth via bridging the urban-rural income gap since the establishments are located dispersedly throughout the country.

In search of the critical factors contributing towards the development and success of SMEs, several studies have been conducted considering diverse contexts (Akpan et al., 2020; Al-Mahrouq, 2010; Al-Mubaraki & Aruna, 2013; Al-Qershi et al., 2021; Chege & Wang, 2019; Chong et al., 2011; Lee, 1991; Ng & Kee, 2012; Subrahmanya et al., 2010; Zwolak, 2022). The empirical evidence reveals that organizational innovation, technological support, and entrepreneurial competence remain salient for SMEs success (Akpan et al., 2020; Al-Mubaraki & Aruna, 2013; Chong et al., 2011; Ng & Kee, 2012). Al-Mubaraki and Aruna (2013) found that the technology adoption in SMEs has a huge impact on their profit, growth, and market share. Subrahmanya et al. (2010) conducted a study in India and explored a positive relationship between innovation and the growth of

SMEs. Similarly, in a Polish SME context, Zwolak (2022) identified that patents have supplemented the share of process and product innovation by 10 percent, which in turn increased the number of enterprises significantly between the years 2015 to 2017. In a recent research, Akpan et al. (2020) reported that lack of adoption of state-of-the-art technologies has challenged and inhibited SMEs of the developing countries to gain sustained competitive advantage and to ensure survival during the outbreak of Coronavirus disease (COVID-19). Representing the developing economies, Bangladesh needs to facilitate continuous adoption of the modern technology in SMEs so as to create impacts on the economy. In this pursuit, Bangladesh Council of Scientific and Industrial Research (BCSIR) is playing a pivotal role by extending innovation support through technological enhancement in various processes of the enterprises.

There are two main available sources of technologies for industries. First, usually technologies for developing products are imported from abroad mostly from producing countries. Entrepreneurs prefer to import both the instruments and the technologies for production of goods on a turnkey basis. Second, the source of technologies is developed domestically by Research and Development (R&D) organizations. The majority of R&D organizations in Bangladesh, provide technologies for SMEs, are government funded including Bangladesh Atomic Energy Commission (BAEC), BCSIR, National Institute of Biotechnology, and others under the Ministry of Science and Technology. There are a few noteworthy agricultural research organizations, which are equally delved into developing new knowledge and techniques to support SMEs in Bangladesh such as Bangladesh Agricultural Research Institute, Soil Resources Development Institute, Bangladesh Jute Research Institute, Bangladesh Institute of Nuclear Agriculture, Bangladesh Rice Research Institute, and Bangladesh Sugarcane Research Institute. In addition, some public universities are involved in the development of technologies that could be used for small and medium scale industrialization.

The use of technologies in SMEs in Bangladesh mainly covers two aspects. First, developing innovative formulas to produce quality products. For instance, food processing and food product manufacturing industries need some formulae or recipe to prepare their products and to maintain their qualities. Second, exploring business opportunities and tapping marketing potentials via the use of smart technological platforms and/or devices such as mobile phone, Facebook, LinkedIn, and other social media (Dewan & Nazmin, 2007). The core focus of BCSIR is to provide innovative support by developing technology and formulas that eventually enrich the industrial production capabilities. Although a good number of researches were conducted emphasizing different issues of SMEs in

Bangladesh (Chowdhury & Salman, 2018; Dewan & Nazmin, 2007; Khalily et al., 2020), the role of innovation and technology however remains largely unexplored especially in reference to the R&D organizations. Ahmed (2014) discussed the role of BCSIR in developing appropriate technology for the SMEs in the country. However, classified technologies or industrial processes of BCSIR with in-depth analysis have not been reported yet.

Using a descriptive research method, this paper aims at unveiling different technologies invented by BCSIR with a view to backing up technology-based small and medium entrepreneurship in Bangladesh. The descriptive focus exclusively concentrates on the 'what' aspect in which a typical phenomenon is being observed and explained (Nassaji, 2015). This review article is developed following a 'literature mapping' technique where the frame of mapping includes keywords such as innovation, SMEs, technology in SMEs, development of SMEs in Bangladesh (Guerin et al., 2018). A good number of grey literature sources were utilized to collect data for this paper including newsletters, working papers, brochures, and manuals developed by the BCSIR. The collected data were analyzed by identifying patterns in the data and plotting the data through mind mapping techniques (Nassaji, 2015; Rowley & Slack, 2004).
In this paper, a brief description of BCSIR, as a technology supporter, has been presented first. Next section discusses the developed industrial production process of this organization. Afterward, the process of innovation and commercialization of technologies has been illustrated along with highlighting key features of the technologies of BCSIR. Finally, a conclusion is drawn from the perspective of providing policy feedback to develop technology-based enterprises in Bangladesh.

2. Bangladesh Council of Scientific and Industrial Research (BCSIR)

BCSIR is the largest multidisciplinary research organization in Bangladesh. It was established in 1955 bearing the name of 'East Regional Laboratories' under the Pakistan Council of Scientific and Industrial Research (PCSIR). Now the organization is in function under the Ministry of Science and Technology. It consists of 11 Research Laboratories/ Institutes (3 multidisciplinary, 7 mono-disciplinary laboratories and 1 pilot plant study centre).

2.1 Aims and Objectives of BCSIR

i. To initiate, promote, and guide scientific, industrial and technological research on problems connected with the establishment and development of industries and such other allied matters as the Government may refer to it.

ii. To adopt measures for the commercial utilization of discoveries and invention resulting from the research carried on by the council, universities or by any other research organization.

2.2 Major Activities of BCSIR

i. Conduct research and development (R&D) works for technology development and related knowledge generation.
ii. Development of industrial production process.
iii. Lease out the developed production process for industrialization.
iv. Analytical service for quality assessment of products imported from abroad, to be exported or to be consumed locally.
v. Supervision of students from universities to accomplish their MS, M.Phil and PhD level thesis.
vi. Provide fellowship to young researchers to develop science based human resources in the country.

2.3 Major Research Areas of BCSIR

i. Food and Feed Product Technology, Food Science, Nutrition and Quality Control
ii. Plant Science, Aromatic and Medicinal Plants
iii. Biological Science and Pharmacy
iv. Biotechnology and Tissue culture
v. Renewable Energy & Biogas Technology
vi. Environmental Pollution
vii. Pulp and Paper, Fiber and polymer
viii. Leather Research and Development
ix. Pilot Plant and Techno-economic Study
x. Glass, Ceramic and Housing materials
xi. Industrial Physics, Electronics and Instruments
xii. Production of various chemicals for industrial use

3. Developed Industrial Production Process of BCSIR

Data of scientific innovations of BCSIR were taken from official records of the organization. Records of 1016 scientific processes developed by scientists of this organization were analyzed. Records are from July 1967 to December 2021.

BCSIR has developed a huge variety of industrial production processes, and majority of them are appropriate for using by SMEs. Technologies for production of food or food related products are dominating in number. Being a country of very large population, Bangladesh has a huge market of food and food related

products. To start a new business with comparatively low investment, manpower and risk, and locally available raw materials, processes from BCSIR could be a very good choice. In addition, technologies for cosmetics and toiletries, aromatic and herbal products, leather and leather products have a good demand among the small and medium enterprises, and BCSIR has a good number of technologies for them. Some of these products are exported abroad after meeting local demand. BCSIR has a great bulk of technologies for processing and producing valuable products from fibre, coconut, several agricultural waste or residues, fuel and energy. The organization also has processes for production of some valuable products from green and processed jute fibre and jute sticks. As demand for glass, ceramic and other house building materials are increasing dramatically demand for technologies for production of such products is also increasing although a great portion of them are being imported from abroad. Cultivation techniques of different threatened and nearly extinct plants are available here including processing and preservation of different agricultural products. Lastly, a large number of technologies of BCSIR are for production of raw materials for other industries and for domestic use. Figure 1 summarizes the number of developed processes by BCSIR, which are used by the SMEs.

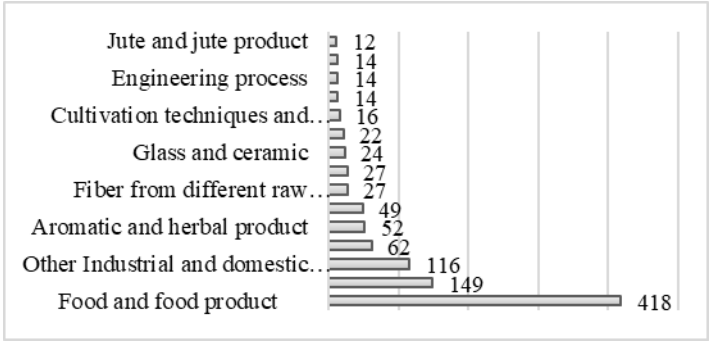

Figure 1. Numerical data of developed processes of BCSIR.

The majority of the technologies developed by the scientists of BCSIR are for production of food and food related products. Most of them are for fruit processing and preservation. For example, mango, jackfruits are seasonal, nutritious and highly demanding to all ages of people. To make these seasonal fruits and vegetables easily available throughout the year while keeping their nutritious value intact, BCSIR invented technologies, which are ready to be handed over for use in industries. Besides, industrial production processes for production of bakery products, food products for diabetic patients are also available. Baby foods, weaning foods and some other specialized foods require comparatively

sophisticated technologies to be prepared. Scientists of this organization have also developed some processes to produce these types of foods for specialized citizens of the country. Apart from human consumption, BCSIR has some technologies, which are for production of poultry and livestock feed. All these technologies are based on locally available raw materials and require comparatively low skilled manpower. Therefore, entrepreneurs from all levels can start their business with these foods and associated food product technologies. Figure 2 exhibits food and food related processes, which have been invented by BCSIR.

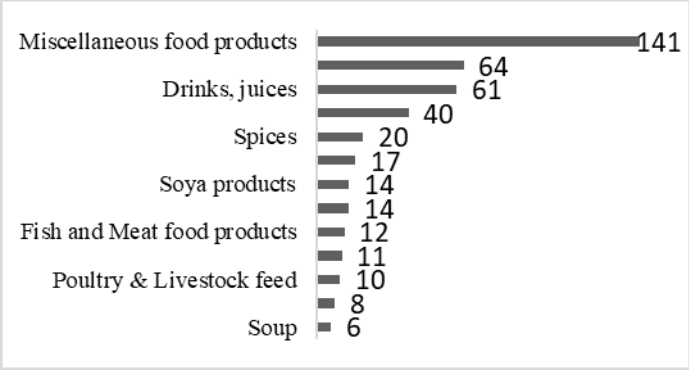

Figure 2. Statistical data of food and food related processes of BCSIR.

From a huge pool of technologies developed by BCSIR, Table 1 categorizes some specific industrial production processes, mostly suitable for small and medium enterprises.

Table 1. List of industrial production processes of BCSIR for SMEs.

Type of process	Name of product (Number of process)
Soya product	Soya flour (3), Soya bread (1), Soya milk (2), Soya dadhi (1), Soya sauce (2), Soya spread (1), Soya tofu (1), Soya nugget (1), Mixed food from soyabean (2)
Baby food, weaning food and cereal food	Weaning food (4), Baby food (2), Cereal food (1)
Oil and oil seed product	Rice bran oil (3), Essential oil (2), Patchauli oil (1), Butter and ghee seed oil (2)
Food for diabetic patients	Sweetmeat (5), Ata (1), Bread (2), Biscuit (1), Jam (1), Jelly (1), Squash (2), Others (1)
Bakery product	Biscuit (18), Bread (11), Cracker (1), Baking powder (1), Baking yeast (1), Baking flour cake (5), Handmade bread (2)
Fish and meat product	Fish product (4), Meat product (5)
Leather and leather	Leather tanning (3), Leather processing chemicals or agents (13), Leather product (10)
Pulp, paper and board	Pulp & paper (9), Board (5)
Cosmetics and toiletries	Tooth powder-toothpaste (8), Mouth wash (2), Hail oil (3), Heel cream (2), Cream (9), Powder (3), Shaving cream (4), Soup (4), Cleaner (12), Detergent (4), Nail polish (3), Hand wash (2), Lip-stick (3), Shampoo (1), Hair dye (1), Gel (1)
Herbal product	Essential oils (20), Herbal product (8), Anti-mosquito product (11)
Fuel and energy related processes	Biogass technology (9), Cooker and stove technology (20), Fuel related other technology (20)
Glass and ceramic related processes	Ceramic and glass decorating colour (8), Pigment for ceramics (6), Brick (5), Building materials (2), Glass and ceramic related other products (10)
Wood, Bamboo preservation	Wood preservation (3), Bamboo preservation (3), Varnish (9)
Fibre from different raw materials	Fibre dying materials (12), Fibre from pineapple leaves and steam (6), Fibre from other raw materials (8)
Cultivation technique and other agro processes	Tissue culture (2), Year-round banana and jackfruit (2), Cultivation techniques of Spirulina, Cassava (3), Pesticides (2), Fertilizer (3), Plant growth regulator (2), Jute and jute product (12)
Chemicals for industrial use	Inorganic chemicals (27), Organic chemicals (35), Inorganic Mixed chemicals (9), Organic Mixed chemicals (3), Organic solvent (6), Organic Acid (7), Mixed chemicals (20), Pigments (3), Dye (2)
Other industrial and domestic products	Glue & Adhesive (14), Correcting fluid (6), Shoe polish/cream (7), Ink and pencil (14), Candle (3), Apparatus (Water filter, domestic oven, digital counter) (8), Miscellaneous (40)

In total, 1016 industrial production processes have been developed by scientists of BCSIR from 1967 to 2021. Among the developed processes, 372 are patented. Of them, 396 processes have been leased out to entrepreneurs. About 120 entrepreneurs have taken the process to do their business. Products of 120 lessees are available in the market. The number of beneficiaries of BCSIR technologies, particularly employees, who are engaged directly and indirectly in the industrial production and marketing processes are more than 16,000.

4. Process of Innovation and Commercialization of Technologies from BCSIR

Initially, the scientists on the basis of national needs and contemporary demand of industries conduct research. Every R&D project is scrutinized by an expert committee and approved by the Board of BCSIR for 2-3 years. Some of the R&D projects end up with some technology or industrial production process as a final result. Successfully developed processes are submitted to the Research Development Division (RDD) headed by Member (Development) of BCSIR. Before transferring these technologies to the entrepreneurs, they have to go through a verification committee consisting of experts from universities,

representatives from the Ministry of Industry, Ministry of Science and Technology, and other relevant agencies. Before getting accepted, an industrial production process of BCSIR has to follow specific steps (see Figure 3).

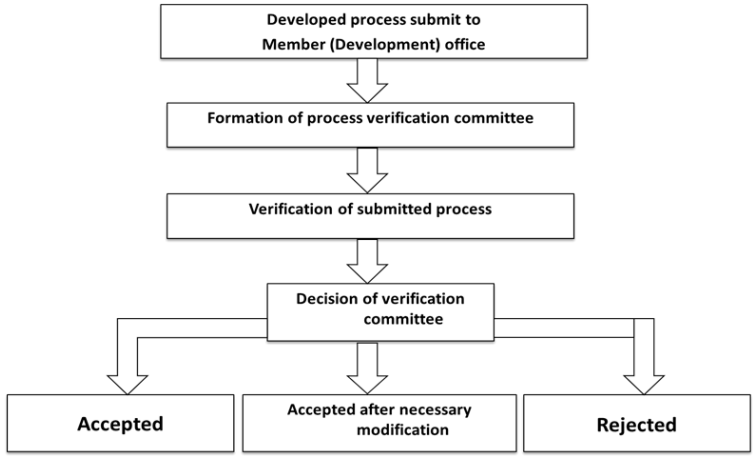

Figure 3. Schematic representation of acceptance procedure of an industrial production process of BCSIR.

Once the verification committee accepts the process or formula, it is considered ready for commercialization to industrialists for the production of products. An entrepreneur can get the industrial production process developed by BCSIR through a number of steps. At first, the authority of BCSIR invites the potential entrepreneurs to take part in an open bid for the technologies through newspaper advertisements. In a meeting, the participating bidders bid for fixing the premium money for the advertised technologies. Next, an expert team visits the factory and other facilities to assess the production feasibility of the entrepreneur. If the business entity is considered fit to get the process based on the visiting team's report, it is asked to pay the premium money for the technology or the process. The process ends with signing an agreement between BCSIR and the enterprise. The industries are followed up from time to time to ensure the quality of the products produced with the technologies of BCSIR. Figure 4 schematically describes this process of commercialization of BCSIR's industrial production processes.

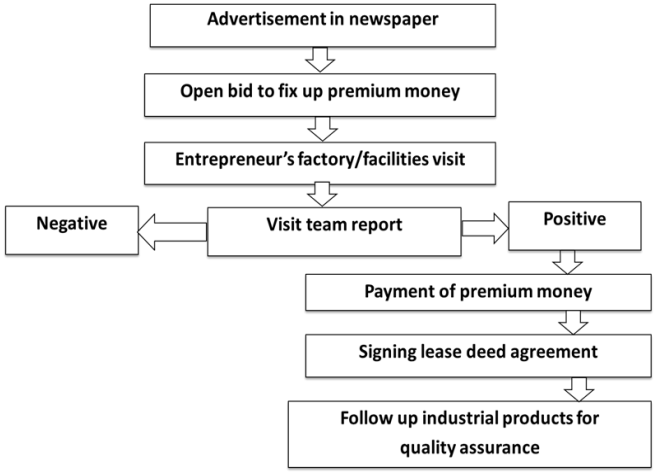

Figure 4. Schematic representation of commercialization process of an industrial production process of BCSIR.

The ultimate target of BCSIR is to handover its technologies and industrial processes to entrepreneurs for their commercial application in product development. Apart from technical and technological factors, there are some business and commercial factors as well, such as marketing network, product storage and delivery system, etc. A strong harmonization between R&D organizations and practitioners such as BCSIR and entrepreneurs are essential for an effective and functioning business model to make techno-based entrepreneurship successful.

5. Features of Technologies of BCSIR

Nature of processes developed by BCSIR is very suitable for starting a business with minimum capital, skill, and risk. Accordingly, a large number of processes are targeted for SMEs. Some of the core features of the technologies of BCSIR are as follows:

i. versatile nature of product,
ii. process for all type of industries (cottage to large industry),
iii. a good number of them are patented (372 processes),
iv. most of the processes are based on locally available raw materials,
v. incubation support to establish industries are easily available from scientists of BCSIR,
vi. premium money of the processes is very nominal,
vii. comparatively less skilled manpower is needed.

Moreover, piloting the industrial production process to conduct techno-economic feasibility study, BCSIR has a pilot plant and process developing centre from where entrepreneurs can secure support for start-up and running stages of their enterprises.

6. Conclusion and Policy Implications

In order to boost up the national economic growth, the significance of SMEs is well acknowledged. In this review article, literature (re)confirms such significance in differing contexts. In this age of technological revolution, innovative technologies have been identified as a critical success factor for the planned development of SMEs. The latest National SME Policy 2019 of Bangladesh also encourages technology transfer in this sector along with human capital development and smooth access to finance. In this vein, BCSIR is playing an instrumental role by developing new technologies for industrial production processes, which are being used by the SMEs. Being a leading research organization, BCSIR has the capacity to cater need-based technologies for entrepreneurs. All the processes of BCSIR have been developed through a series of scientific experiments, and therefore these are tested technologies appropriate for the development of SMEs in the country. This paper prepares a profile of various innovative production processes invented by BCSIR and suitable for SMEs. In addition, the commercialization process is also highlighted in this study.

Majority of the technologies invented by BCSIR are befitting with starting a new business and running them with very low capital and locally available raw materials. Initial technical support to the entrepreneurs in SMEs is available at BCSIR. The concerned team of scientists also provides training to technicians and related staff. There might be some limitations of these technologies in view of their soundness in producing products that could be minimized by the scientists of BCSIR in consultation with entrepreneurs and consumers. However, to mitigate the risks of investing in technology-based entrepreneurship, quality of technology is not the only factor. Other factors enable the effectiveness of SMEs including initial capital of investors, availability of skilled manpower, availability and quality of raw materials, and management of the enterprises. Within the broader national policy framework, these issues must be duly addressed to harness benefits from this emerging sector.

With specific reference to BCSIR, a few issues require attention from the policymakers. The commercialization mechanism of the invented processes in the setup of BCSIR is not well developed. A particular need for a marketing and promotion department is noteworthy. There are entrepreneurs who have a negative mental image formed towards the local technologies. To get rid of this, awareness campaigns and allocation of budget in this regard are much needed. On a final note, joint efforts of BCSIR and SMEs are necessary for establishing technology-based small and medium enterprises throughout the country, which could contribute to the development of the national economy collectively.

Acknowledgement

We express our gratitude to all the scientists who have developed the technologies and industrial production processes presented in this study. We are equally thankful to the officials of the Research Development Division of BCSIR for providing us with the relevant data to complete our study.

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