

BRACING ARTIFICIAL INTELLIGENCE FOR SOCIO-ECONOMIC DEVELOPMENT: OPPORTUNITIES, IMPLICATIONS AND CHALLENGES FOR BANGLADESH

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“We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.” - Bill Gates

Introduction

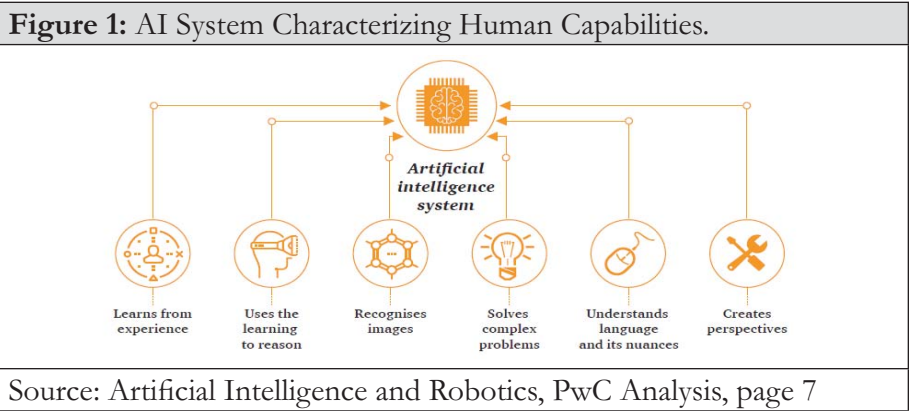
Concept of Artificial Intelligence (AI) dates back to the 1950s. However, interest in AI has been re-ignited over the last few years with an increasing number of real-world applications. It is a life changer and a complete disruptive force across technology, industry, market, employment, academic and economic dimensions and to the overall social matrix. It will create millions of new employments but will destroy thousands simultaneously as well. Countries across the globe, including our near and far neighbours, are investing heavily in AI innovations for development and sustainment in the competitive open market. AI benefits appear to be time sensitive and pioneer adopters may monopolize the opportunities in their favour. For Bangladesh also, AI applications have unending socio-economic opportunities. Timely adoption can significantly help in her divergent growth, while negligence may have adverse ramification. But there seems to be remoteness prevailing across the concerns of Bangladesh in realizing the importance and implications of AI. It is therefore imperative to study the socio-economic implications of AI for Bangladesh perspective. Unless value of AI is understood and potentials are braced, Bangladesh is likely to falter in achieving development goals, and be affected by the adverse AI fallout effects.

In light of above arguments, questions arise: what AI opportunities lay in front of Bangladesh for her socio-economic development? What are

the risks and challenges? How best she can adopt this technology? This paper principally seeks answer to these questions. In doing so, the focus will remain limited to three economic pillars of Bangladesh: agriculture, manufacturing and service sectors; and two dimensions of human resource development: education and healthcare. However, the author’s intention is not to find out a complete solution but rather to initiate a comparatively wider discussion within a defined boundary that can serve as a platform for others to study in vertical details.

Defining Artificial Intelligence

The term “Artificial Intelligence” was mentioned for the first time in 1956 by John McCarthy during a conference who defined, “Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs” (PwC and ASSOCHAM, 2017, p.7). Nils (2010) attributes AI as making machines intelligent, Kaplan (2016) notes that AI is autonomous, can learn from their own experience and take actions accordingly. Interestingly, AI has been defined by many authors, but absence of a set definition keeps the AI landscape wider and helped the field to grow. Most significant qualities of AI are: it can learn from environment, decide, suggest action and solve problems as shown in Figure 1. It must also be noted that data is the food for AI. Internet of Things (IoT) makes better AI and AI makes IoT better useful.



A Glimpse of AI Adoption in Asia

In Southeast Asia, current AI adoption rates stand at 14 percent. AI leader Singapore's government announced a national AI plan, AI. SG, to boost the country's AI capabilities (Indian Express Staff Report, 2018). In Vietnam, about 13.6% of enterprises have already invested in AI, choosing big data and cloud computing in the preferred list (Voice of Vietnam, July 2018). Neighbour Thailand started investing in AI research since 1988 and practical applications took off from 2011 (Kawtraku & Praneetpolgran, 2014). Meanwhile, Malaysia has revealed its national AI framework on 19 October 2017 (Bhunja, 2018). These countries believe that organisations that do not incorporate AI will soon lose out to their peers who brace it. In the Middle East, AI will contribute about \$320 billion to its economy by 2030. In a volatile oil-based economy, Arabs are welcoming AI to seek alternative sources for revenue and growth. UAE is poised to gain the most from AI, contributing 14% of the country's GDP. It is the first country in the world to appoint an AI State Minister (PwC, 2018, p 6). In the Far East, Japan has established a Strategic Council for AI Technologies in 2016 for developing AI research, education, skills and business. Its AI market is estimated to grow from \$33.48 Bn in 2015 to \$787.43 Bn by 2030 (EU-Japan Centre for Industrial Cooperation, 2015). China is aspiring to become the leading AI global hub, and is determined to overtake USA, not even a trade war will be able to stop it (Barhat, 2018). They account for 48% of global AI startup funding and their AI-led automation would add 0.8 to 1.4 percentage GDP growth annually (Barton et al., 2017). Meanwhile, South Korea aims to close the gap with China and reach within the global top four AI countries by 2022. Its R&D budget is 4.29% of her GDP, and plans to invest additional \$2 Bn on innovation (Peng, 2018). Our closest neighbour India has increased AI investment from 29% to 69% in last two years. It has recently formed an AI Task Force and opened up AI Institute at Mumbai. The government has made partnership with IBM and Microsoft in the field of agriculture and education. The AI Task Force is preparing India for the upcoming Industrial Revolution 4.0 and considers

manufacturing, entrepreneurship and product commercialization as top priority (Report of the AI Task Force, 2018). Examples referred above clearly manifest how concerned the major Asian countries are and the importance they attach in AI innovation. Bangladesh needs to learn from the neighbours lest they lag beyond catching up with the competitive world.

AI Opportunities and Implications for Bangladesh

Economy of Bangladesh is based on three sectors: firstly, agriculture contributing about 14% of GDP engaging 47% of labour force; secondly, manufacture around 30% GDP with 13% employment and finally service sector contributing 56% GDP housing 40% of employment (CIA Factsheet, 2017). Meanwhile, human resources are the major drivers of growth to all these sectors. Thus, following paragraphs shall discuss in brief AI opportunities in above mentioned economic sectors including HRD.

Agriculture and Aquaculture: A study conducted by Prescient & Strategic Intelligence, reveals that the AI market size in agriculture was valued at \$110.3 mn in 2016, and is forecasted to advance at 23.2% compound annual growth rate till 2023 (P&S website, 2018). The increasing penetration of IoT devices in the agriculture industry is the key factor driving this growth. In applying AI in agriculture, ‘See and Spray’ robotic spraying system is very successful in eliminating weeds (Rakestraw et al., 2017). The Berlin-based agricultural tech startup PEAT has developed an application called Plantix that reportedly identifies soil deformity and degradation (Crunchbase official website, 2018) through user’s smartphone camera (Figure 2). The company claims that its software can detect pattern with 95% accuracy having a global client base over 500,000, including India. ‘Sky Squirrel Technologies Inc’ is using drone technology to improve their crop yield and to reduce costs (Kumba, 2017). Agricultural data derived from images captured by satellites and drones are analyzed by AI to detect diseases, pests, poor plant nutrition and crop yield prediction (Rakestraw et al., 2017). India in

partnership with IBM and Microsoft is assisting farmers to improve crop productivity, soil yield and predict the best time for sowing seeds with the goal of improving economy (The Economic Times, 2018). It has resulted 30 percent more yield, in Andhra Pradesh by analysing climate data from 1986 to 2015 (Microsoft News Center India, 2018). Coming to aquaculture, AI-based computer can count fish and identify their species with 100% and 75% accuracy respectively (Wilcox, 2018). One of the amazing technologies is eFishery, which uses sensors to detect the hunger level of the fish and can reduce feed costs by up to 21%. Biosensors such as Sensorex are helping to create efficiencies in the industry through the analysis of oxygen levels, balanced pH and water temperature; even heart rate can be measured.

Figure 2: Determining Soil Quality by AI Based Application



Source: Plantix Website (<https://plantix.net/> Date 12 August 2018)

Bangladesh's present population of 166 mn is expected to raise about 186 mn in 2030 (Population Pyramid, 2018). But her current 8.5 mn hectare cultivable land is shrinking at a rate of about 0.73% per year. It still lags in crop yield efficiency compared to other Asian countries (Table 1). Rapid urbanization and unpredictable climate change add fuel to the problems. Bangladesh needs to find ways to ensure food security of the millions, and AI can certainly assist. AI technologies can be used in identifying

soil deformity and nutrient deficiencies, weed elimination, reducing and nutrient deficiencies, weed elimination, reducing use of pesticides, crop monitoring, classify plant pest, forecast rain, determine plants' water need and best time for sowing seeds etc. AI-guided drone and images captured by satellites can assist to the overall farming techniques. Similarly in aquaculture, AI technology can be used in counting and determining fish size to avoid premature catching of 'Hilsha', detect hunger level of fishes and feed them accordingly; and analyse oxygen, pH value and temperature of water for better shrimp production. However, development of AI algorithms can be challenging because of the high cost of cutting-edge AI technology, lack of expertise, collection and extensive pre-processing of data before it can be reliably used as input.

| Table 1: Paddy Yield Comparison | | |
|--|------------|--------------------------------|
| Serial | Country | Paddy Yield Ton/hectare (2014) |
| 1 | Japan | 6.70 |
| 2 | China | 6.5 |
| 3 | Vietnam | 5.75 |
| 4 | Indonesia | 5.13 |
| 5 | Bangladesh | 4.42 |
| Source: Ricepedia at http://ricepedia.org/ | | |

Manufacturing and Service Sector: In manufacturing, human free productions are getting momentum with simple economic aim of getting better products at low cost to maximize profit. Amongst pronounced AI innovations, driverless transport is gaining increased attention promising huge potentials. 3D printers are used for large scale building construction, resulting better and low cost homes for the modest income groups, but may eliminate many jobs as well. AI led smart Dubai strategy aims to construct 25 percent buildings using 3D printing and run 25 percent driverless transports reducing 12 percent accidents by 2030 (PwC, 2018, p 6). Globally automation could raise productivity growth by as much as 0.8 to 1.4 % annually (Manyika et al, 2017). To identify automation potential

of different sectors, World Economic Forum conducted a study across 800 occupations, which suggests that almost half the activities have the potential to be automated by adapting currently used technology (Table 2). Meanwhile it is estimated that AI enabled global business will reach to 3.9 Tn by 2022 (Gartner Newsroom, 25 April 2018), and AI will help in marketing, supply chain management, business continuity and risk management.

| Table 2: Sectoral Automation Potential | | |
|--|------------------------------------|--------------------------|
| Serial | Sectors by Activity | Automation Potential (%) |
| 1 | Accommodation and Food Service | 73 |
| 2 | Manufacturing | 60 |
| 3 | Agriculture | 58 |
| 4 | Transport and Warehousing | 57 |
| 5 | Retail Trade | 53 |
| 6 | Mining | 51 |
| 7 | Other Services | 49 |
| 8 | Construction | 47 |
| 9 | Utilities | 44 |
| 10 | Wholesale Trade | 44 |
| 11 | Finance and Insurances | 43 |
| 12 | Arts, Recreation and Entertainment | 41 |
| 13 | Real Estate | 40 |
| 14 | Administrative | 39 |
| 15 | Healthcare and Social Assistance | 36 |
| Source: A future that works: Automation, employment, and productivity. McKinsey Global Institute, New York, 2017, Page 7 | | |

Data is the Food for AI: Many companies across the globe are exploring alternative data coming from sources like cellphone signals, IoT sensors on industrial equipment, online videos, social media likes and satellite images. The market for alternative data was about \$200 million in 2016

and is expected to shoot to more than twice by 2020, which shall create jobs nobody even thought of before (Maney, 2018). As for jobs, a study by tech analyst firm Gartner concluded that by 2020, AI will automate 1.8 mn people out of work but will create 2.3 mn jobs - a net gain of 500,000 jobs. Deloitte, another consulting firm, studied automation in the United Kingdom and found that 800,000 low-skilled jobs were eliminated because of AI, but another 3.5 mn positions were created with better pay than before (Maney, 2018). Thus, AI is likely to create a lot more new employments than it shall kill.

In manufacturing, Bangladeshi industries are human intensive. Its markets are flooded with Chinese products. Global AI aided automation will produce better products at lower cost, impacting the markets further. Sectoral automation potential as identified at Table 2 is both a blessing and threat to Bangladesh. Meanwhile, in Bangladesh, at least 25,120 people died and 62,482 people were injured in road accidents between 2015 and 2018 (Prothom Alo, 4 August 2018). Driverless transports though shall create unemployment, appear to be a better alternative in near future to reduce accidents. Similar argument is applicable for constructing economic house by 3D printing also. For AI enabled new jobs maximum opportunities for Bangladesh are in the software industries, especially alternate data has huge potentials. Opportunities are abundant, Bangladesh needs to reskill, upskill and adapt to the changing technology needs. However the importance of time advantage must not lose sight before it is too late to recover.

AI in Education Sector

AI in education is increasingly used as a tool for better learning and also as a discipline of study. As a learning facilitator, AI powered 'Presentation Translator' supports 60 languages and allows students to understand contents in their own native language (Microsoft Garage. 2018). Seeing AI App is largely developed by a blind employee of Microsoft, gives diverse assistance to visually impaired students (Microsoft Seeing AI, 2018). Intelligent tutoring system such as Carnegie Learning can work with students directly and

facilitate teaching (Schmidt, 2017). Matthew Lynch (2017) suggests at school level, cloud based AI can predict probable school drop outs with reasons and recommends preventive measures, as was done in India by the Andhra Pradesh Government in 2017 to identify about 19,500 probable drop outs in the next academic year (Arora, 2018). AI powered ‘Gradescope’ makes assessment of assignments a lot speedier, saving 70 percent or more time and providing a detailed analysis of the students’ performance. AI chatbot can communicate with students in place of a teacher without students knowing that they are not talking to a human teacher. ‘Thinkster Math’ uses AI to determine how students learn and comprehend math concepts so they don’t fall behind. Furthermore, admission processes can also be streamlined and improved, reducing the workload for high volume admissions offices and teachers. It is accepted that AI shall take on more of a teaching role and teachers will move into the role of learning motivator.

Rapid growth of AI in multiple sectors needs huge number of expertise with relevant skills and knowledge. Appreciating the need, Thailand started teaching AI at government universities more than 30 years ago with the first AI laboratory at the Kasetsart University (Christopher, 2018) in 1992. China identified a talent gap of more than 200,000 workers in industrial robotics applications, with a projected increase of 20-30% annually. They have included discipline like Industrial Robotics, Industrial IoT applications, Industrial IoT Engineering and Smart Product Development to offer major vocational degree programs (He, 2017). Globally, Data Science, Machine Learning, Neural Network, Deep learning etc are the most common domains of AI education. Julia, invented by MIT Professor Alan Stuart Edelman, is the preferred programming language to work with AI.

For Bangladesh literacy rate has significantly increased in last few decades; however, quality remains highly questionable. For example, foreign currency earned by about 10 mn Bangladeshi expatriates is almost drained out by about 0.3 to 0.4 mn foreigners employed in Bangladesh, because they are better qualified. RMG sectors are employing thousands of foreign ‘super mangers’. Vocational training is only 10% of education curricula,

compared to 60% plus in Singapore and Germany. Bangladesh Education Statistics-2015 shows 40.29 percent of the secondary students dropped out in 2014 (Daily Star, Staff Report 2016). These indicators show, Bangladesh needs to boost her education quality and prepare the youths to brace the benefits of technology. AI powered tools can be examined, explored and gradually adopted at different education levels of Bangladesh. However, many of these are to be compatible with Bangla language also, which demands research. Most importantly our education system shall need an extensive overhaul to be able to brace the benefits of AI.

AI in Healthcare

AI is bringing a paradigm shift to healthcare, and according to Frost & Sullivan, globally healthcare AI revenues are estimated to reach USD 6.66 billion in 2021, up from USD 633.8 million in 2014 (Langen et al., 1994). In diagnosis and early detection, IBM's Watson for Oncology is now being used around the world, including 21 hospitals across China, Thailand and India, with 99% accuracy in cancer detection. AI techniques have also been used for early stroke prediction, diagnosis, treatment, as well as prognosis evaluation (Jiang et al., 2017). Cyrcadia's iTBraTM is a wearable vest being used for detection of breast cancer at earlier stages. AI can remotely monitor heart irregularities (Sennar, 2018) and translate mammogram 30 times faster than human with 99% accuracy (Arnold & Wilson, 2017). Malaysia is using AI in predicting and preventing dengue outbreaks (Poskod, 2018). They have also developed an AI-based system that interprets sign language and converts it into text (Indian AI Task Force Report, 2018). In surgery, Da Vinci Surgical Robot is a major innovation, which helps surgeons be more precise and to remove natural hand tremors during surgery (Svete et al., 2018). AI based robots can assist the elderly patients, disinfect hospital facilities using UV light and draw blood faster and more safely than a human. Oxford's AI lab has developed lip reader software to help speech-impaired to communicate. KASPAR is a child-sized humanoid robot designed to help teachers and parents support children with autism (Arnold & Wilson, 2017).

In Pharmaceuticals, AI division at the Johns Hopkins University focuses on drug discovery programmes for cancer, Parkinson's, Alzheimer's, and other ageing and age-related health issues. Atomwise found two drugs – reportedly in one day using its AI technology – that work against the Ebola virus (Arnold & Wilson, 2017). In managing medical data and records AI-enabled robots collect, store, re-format, and trace data to provide faster, more consistent access (Novatio, 2017). This equates to a work time savings of 17 % for doctors, and 51 % for registered nurses (Collier et al., 2017). IBM Watson can review and store every medical journal, symptom, and case study of treatment around the world – exponentially faster than any human, and is capable of finding evidence-based meaning even eliminating misdiagnosis (Arnold & Wilson, 2017).

In the health sector, though life expectancy of Bangladeshi people has increased over 71 years, but the overall healthcare system remains significantly poor even compared to our neighbours. Bangladeshi patients spend \$2.04 Bn annually on healthcare abroad, which is 1.94% of the country's total GDP (BIDA, 2017). Noting the innovations like: health monitoring, diagnosis, surgery, treatment, record management, aiding disabled etc Bangladesh healthcare can significantly benefit from AI adaption. To add further, Bangladeshi pharmaceutical products export revenue earning for 2016-2017 was USD 131.17 mn with a growth rate of 24%. Market almost doubled in last 5 years and is expected to be doubled in next five years as well. If Bangladesh wants to remain competitive in the global pharmaceutical sector, bracing AI can help considerably. However, although the AI technologies are attracting substantial attentions in healthcare, the real-life implementation is very challenging because of collection and processing of data, absence of policy, lack of trained manpower and finance.

AI Threats, Challenges and Strength – Bangladesh Perspective

Unemployment is the major AI threat for Bangladesh, specially affecting the employment and export earnings by the RMG sector. Transport,

construction, call centres, low skill and structured jobs shall face the significant cut. World Bank predicts automation threatens 69% of the jobs in India and 77% in China (The AI Task Force Report, 2018). Globally 800 mn jobs will be taken over by AI threatening Bangladesh as well. AI will raise the premium placed on digital skills while reducing demand for medium and low skill workers, potentially exacerbating income inequality. It will also create a digital divide amongst nations, led by advanced countries. Bangladesh is likely to lag behind significantly in this AI power race.

As for challenges in adopting AI in Bangladesh, first comes adapting to new kind of jobs. AI is constantly changing nature of jobs, so are the need for requirement of skills, reskill and upskill. The most important challenge for Bangladesh will be to manage AI-related data in terms of collection, collation, validation, storage and distribution/exchange without compromising security, privacy and ethics. But the greatest limitation Bangladesh has is the acute deficiencies in AI expertise and knowledge. It does not have any AI institute and training curriculum like that of China, India and other countries of Asia. It is further aggravated by insufficient and focusless research and innovation. She ranks lowest in Asian countries in 'Global Innovation Index 2018' (Global Innovation Index website), even behind Pakistan and Nepal. Her R&D is not result oriented and intellectual outputs are not realized into economic growth. Bangladesh is yet to formulate an AI policy; it has huge gaps in public private partnership and its home-grown infrastructure needs considerable attention to facilitate adoption of AI benefits.

Bangladesh's principal strengths are her economic development, digital base, tele-connectivity, and an intelligent and innovative young demography. ICT Division of the Ministry has started taking visible initiatives and is rendering support to the entrepreneurs. Cases in point are 'iDEA Project' and 'IoT Army of 300'. In the private sectors, individual and small business identities are investing in AI with noticeable success. AI club called 'Jumpers' has been established in Dhaka under the guidance of Professor Jamilur Reza Chowdhury that works on Julia language, 'eGeneration Ltd'

is one of the frontier companies, has recently signed an agreement with a Dubai based company to provide AI based service (eGeneration website, 2018). ‘BloodBot’ uses geolocation functionality for tracking blood donors. ‘Bengali. AI’ is working on Bangla data set. ‘Augmedix’, with office at Panthapath is providing prescription writing and health record service to the Doctors in USA. However, an organised holistic approach is yet to be taken, and a centralized data repository seems absent.

Principal Recommendations and AI Adoption Strategy for Bangladesh

Policy Response and Forming an AI Task Force: Formulating right AI policy can play a significant role in shaping the direction and effects of AI innovations. The regulatory framework must be liberal to welcome private initiatives and encourage investment. Bangladesh must also immediately form an AI Task Force under the aegis of ICT Division. Members from other line ministries, A2i project, academia, industries and service sector are to be included like that of India. Few terms of references for the Task Force, but not limited to, may be:

- Identify and prioritize probable areas where AI can help in development of Bangladesh.
- Identify probable areas where government intervention and assistance is necessary.
- Identify probable areas where public-private partnership shall be better suitable for AI-based development.
- Propose an AI implementation roadmap for Bangladesh.
- Propose a coordinating organisational structure to coordinate the national AI initiative.
- Propose an AI policy.

Education and AI Innovation: Bangladesh needs to formulate an AI Education Strategy to develop human resource with necessary skills, re-

skill or up-skill and given the opportunities for lifelong learning. This should identify a target number of expert required on a yearly basis on each AI domain. This also includes AI-related curricula for school, college, diploma, graduate and post graduate with a focus on sector specific skill. Dedicated AI institute is to be set up and vocational training curricula must be substantially reviewed to include industrial AI education. In addition, Bangladesh must substantially increase interdisciplinary research financing, from her current investment of less than 0.1 percent of GDP in R&D for AI innovation. Most importantly AI initiatives must tie up the educational institutions with the industries for translating talents into economic growth.

Data Management and Policy Formulation: Creation of an interdisciplinary large Data Center for aggregation and interpretation of data generated is of unconditional necessity. With requisite sharing related regulations, ensure availability of cross-sectoral data for re-use, such as the data held by the Election Commission, mobile operators, academic institutes, different Ministries, healthcare centers, agriculture and financial institutes etc. To take full advantage of the data benefits, formulating a comprehensive data policy by the Ministry in coordination with BTRC is of utmost importance.

Support Private Initiative: Government must support private initiatives by taking the seat of a facilitator and avoid getting involved in implementation. It should learn from the mistake of Kaliakoir High Tech Park and let the private sector to work freely. Indian Wadhvani Institute for AI is a good example and South Korean investment of \$ 8490 million in public-private AI innovation partnership spanning over six corporations is to be noted as well.

Recruit Global Talent and Seek Bilateral Cooperation: To make a firm AI base, Bangladesh needs to recruit global talents to conduct AI research and establish start-up companies at home. There are many Bangladeshi talents working abroad who may be encouraged to work back in Bangladesh with appropriate support as has been done for the jute genome research. ICT Division supported by Ministry of Foreign Affairs may take the lead.

Awareness and Encouragement: Basic condition to effect a change is that acceptance by all concerned that a change is necessary. Policy makers, academicians, industrialist, manufactures, business society and common users must understand how AI and robotics have the potential to work for and be beneficial for their interests. ‘Digital Bangladesh’ should gradually transit to ‘AI Bangladesh’. In addition, convening talent conference and announcing national award for creative contributions in AI shall motivate the mass. Moreover it is important to form robotic society in our country, like: Robotics Society of Japan, India, Korea, UK etc.

Enabling AI Based Sectoral Development: In addition to the recommendations and suggestions noted above, followings are a few sector specific propositions to enable AI-based growth.

- **Agriculture and Aquaculture**

- Agriculture sector had 21.79% export growth in 2017-18 (Prothom Alo, July 2018). Moreover, Bangladesh is the 4th largest sweet water fish producer in the world. By 2025 global demand of sweet water fish will rise to 150 million metric tons more. Using AI, Bangladesh must seize the opportunity to increase agro and aquaculture productivity and diversify her export sector and create opportunity for employment.
- Research, innovation and financing of AI system for crop yield, soil health determination, weed controls, pesticide use, weather prediction etc.
- Develop infrastructure for collection, validation and storing data and access to it.
- Manpower training on use of AI system.

- **Manufacturing**

- Introduction of hybrid man-machine team working together to improve productivity, with appropriate safety measures.
- Setting up industrial Internet connecting network of machines, products, robots, sensors, humans etc for collection of data and intelligent automation. Also lay down standards to exchange data amongst them.
- Manufacturing and business process transformation through AI, especially in SME.
- Quality through AI-based predictive maintenance and early fault detection.
- HR development to acquire new skill, upskill and re-skill for adaptation with new jobs and compensate loss of employment.
- Tax incentives to the AI based manufacturers and reduced price to the users.

- **Service Sector**

- Collection, processing, validation, sharing and trade of data under appropriate policy cover. Provide off-shore service from Bangladesh, like data export and healthcare service to the aged people of advanced countries.
- AI-based logistics and supply chain management, example warehouse management.
- Improve delivery of AI-based public service like water, gas, energy etc.
- Service mapping of different ministries, corporations and utility sectors to better coordinate and provide improved services to the public.

- **Education**

- Teachers training in developing and imparting tech-enabled solution like Chatbot, Think Master, AI Translator etc.
- Make technologies accessible to all education institutes and deploy them in ‘teacher-student-technology’ collaboration method.
- Extensive introduction of AI-supported online courses without human assistance, especially in skill up-gradation and retraining.
- Employ feedback driven teaching-learning process like ‘Byju’s learning App’.
- Introduce AI enabled courses to develop communication skill and collaborate in global village.
- Use AI to minimize school drop outs.

- **Healthcare**

- Study and introduce Malaysian model of AI based Dengue diagnosis and treatment.
- Study Indian model of AI based healthcare support to the marginalized people.
- Introduction of AI enabled healthcare to the aged, blinds and autistics.
- Introduce AI-based diagnostic system especially for early detection of cancer.
- Gradually adopt surgical robots with appropriate human support.
- Training of physicians and healthcare personnel in collaborative working with AI.

- Data collection, analysis, archiving and availability at all level.
- Management and ethical use of health data through policy and regulation.

Conclusion

“Technology - no matter how well-designed – is only a magnifier of human intent and capacity. It is not a substitute.”- Kentaro Toyama

Successful adoption of AI will depend on three factors: people, process and technology. AI adoption shall grow faster if people realize the benefits and accept the technology, understand their technical know-how and apply the process objectively. However, given Bangladesh’s education quality, technology use culture, social and economic parameters it is important that AI development should proceed with minimum social and economic disruption, while carefully noting the concerns for loss of jobs of the less skilled employees. In doing so, the government, industry, academicians, civil society and people of all walks need to work in synergy to make the best use of AI opportunities to help Bangladesh in her socio-economic development and achieve the target to become a developed nation by 2041.

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