



Adoption Gap of Agri-Technology Dissemination: Challenges and Solutions

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The agriculture of Bangladesh has witnessed a phenomenal transformation in the last few decades. From high-yielding varieties of rice to cell phone apps for weather data, technologies are changing agriculture. However, the majority of technologies remain unused. The farmers will play around with them initially, but their mass adoption is slow. This innovation-practice gap is a challenge to sustainable agriculture, rural incomes, and food security. Why should there be an adoption gap? And how can this gap be bridged? This article aims to illuminate us as to why innovations in Bangladesh's agricultural technology, promising as they are, are generally not adopted to their full potential by farmers, to carry out strengths, weaknesses, opportunities, and threats (SWOT) analysis, and to suggest practical solutions to adoption gap bridging.

Bangladesh has quality research centers devoted to agricultural innovation. There are 13 research institutions under the umbrella of National Agricultural Research System (NARS) with coordination by Bangladesh Agricultural Research Council (BARC). They are a mix of public sector research institutions in different ministries addressing different domains of agriculture such as crops, fishery, and livestock. Amongst the institutes, Bangladesh Rice Research Institute (BRRI) has published over 120 varieties of rice, including high-yielding and stress-tolerant, and biofortified varieties of rice like zinc and iron-fortified rice. Similarly, Bangladesh Agricultural Research Institute (BARI) has introduced improved varieties of wheat, maize, pulses, oilseeds, vegetables, and fruits. Agricultural universities such as Bangladesh Agricultural University, Sher-e-

Bangla Agricultural University, and Gazipur Agricultural University are contributing to the role through state-of-the-art research, human resource development, and farmer-driven innovations. This strong research potential makes the new technology accessible in a smooth chain, which is adapted to local Agro-climatic situations.

Government Support through Subsidy and Extension Services is one of our strong pillars in the agricultural sector. The Bangladesh Government has played a key role in the delivery of agricultural technologies by offering fertilizer and seed subsidies, farm mechanization incentives, and irrigation. The Department of Agricultural Extension (DAE) extension assistance ensures that farmers receive access to on-farm training, demonstration, and field visits. Policy programs such as the National Agricultural Policy are committed to the use of technology, food security, and farmer welfare. Government-backed initiatives like digital extension services, hotlines on agriculture, and ICT-based platforms also bridge the knowledge gap.

The Bangladeshi farmers are now able to adopt a wide range of new technology, one of the sector's strengths. Hybrid, high-yielding, drought-tolerant, flood-tolerant, and biofortified varieties enhance climate change resilience and nutrition concerns. Low-lift pumps, deep tube wells, solar irrigation, and water-saving technologies like Alternate Wetting and Drying (AWD) improve water efficiency. Platforms such as 'Khamari' 'Krishi Call Center', 'Kris-hoker Janala', and weather forecast apps empower farmers with

timely information. Power tillers, rice transplanters, combine harvesters, and threshers reduce labor dependency, lower production costs, and enhance efficiency. With these capacities combined, Bangladesh has a firm base to shift its agriculture from traditional, labor-based cultivation to a modern, technology-driven approach, supporting food security and rural development.

The weaknesses of the Bangladeshi Agriculture Sector are gigantic. Small-scale and predominantly engaged in conventional cultivation activities are most Bangladeshi farmers. Big groups of farmers have no idea or concept regarding modern technology, biofortified seeds, or climate-resilient technologies. Training courses are not generally available or even formulated for local contexts, and thus the farmers don't innovate. The uneconomical price of fresh machinery in relation to farmers' earnings is a problem also. Agricultural mechanization (e.g., rice transplanters, harvesters, irrigation pumps) typically involves substantial initial capital investment. Small and marginal farmers with limited earnings and poor credit access find such machinery beyond their reach. This financial constraint slows large-scale adoption. Inadequate post-sales facilities and distribution channels are a significant mechanization issue. Even if there are technologies available, rural areas usually do not have proper distribution networks, spare parts, and repairing centers. Farmers buy machines but fail to repair or service them because of weak after-sales networks, thus restricting extended use.

There are chances for the Bangladeshi Agriculture Sector increasing day by day. Growing demand for safe, nutritious, and export-quality food is one of them. Though health awareness is increasing with international demand for organic and quality food increasing, Bangladesh can venture into new markets. Opportunities such as biofortified rice, integrated pest management, and organic farming can be exploited locally and internationally to meet the demand. Young people's participation in Agri-tech startups is no less astonishing. There is an entry of a new generation of educated young stars into agriculture with new concepts from online platforms for advisory services to drone-based spraying and electronic business for farm products. Entrepreneurial zeal can revolutionize the industry and make agriculture a more sustainable vocation.

Scaling up innovations can be charted through public–private partnerships. Private industry, NGOs, and the government can collaborate to accelerate the rollout of new technology. Partnerships can offer finance, massive demonstration, and enhanced supply chains in reaching far-away farmers. Internet sources for further outreach to farmers are also a wonderful site to construct an enabling environment. Rural coverage by mobile and internet offer the potential to furnish farmers with agriculture advice, weather, and prices. Digital farming has the potential to bridge the information gap and enhance efficiency.

We are still faced with some of the dangers to the Bangladeshi Agriculture Economy posed by Climate change and unseasonal weather. Bangladesh is still very much exposed to flooding, drought, salinity, and cyclones. These weather unpredictability conditions are a danger to farm produce and make farmers hesitant to implement new, untested technology on untapped soil. Volatility in crop prices dissuades farmers from putting money into innovation. As soon as a new technology is used, when the market price falls, the farmers can lose significantly and therefore are reluctant to take risks in the future. Almost all high-tech farm machinery and hybrid seeds are imported from foreign countries. Importing increases the price, brings about the risk of supply chains, and subjects farmers to volatility in foreign countries' markets. The majority of rural farmers remain trapped in traditional methods inherited from their ancestors. This cultural resistance and apprehension of failure keep new methods from being adopted—despite their potential for increased productivity.

Field studies point to the fact that adoption gaps are largely caused by knowledge gaps, cost factors, and confidence gaps. Some, for example, adopt mechanized harvesters or biofortified rice at a slow rate because they lack concrete evidence that there is increased economic reward. Others claim that there are high initial costs and no credit facilities. Extension services, while better over the years, are still too lean to be able to provide personalized guidance. Younger farmers, however, are more likely to accept mechanization and mobile apps, a generational shift. Female farmers, more prevalent, are lesser represented in training. In general, however, while the supply of innovation is strong, demand is satisfied by socio-economics.

Finally, some of my recommendations for closing the Adoption Gap of Agricultural Technology Dissemination are: Enhance Extension Services, Low-Cost Credit, Public-Private Partnerships, Digital Integration, and Young Entrepreneurship in Agri-entrepreneurship. Bangladesh lacks nothing in agriculture innovations; it lacks nothing but adoption. Closing the gap is crucial to food security, alleviation of malnutrition, and climate change-readiness. If not narrowed down, the concern is that innovations are left behind in research stations rather than being taken to farms where they are needed most. By bridging the gap of adoption, Bangladesh can transition its agriculture from subsistence to innovation-based, and it will not just have food security, but also nutritional security and rural prosperity.