Assessing the Barriers to CRISPR Genome Editing in Bangladesh_ Policy, Ethical, and Socio-Economic Perspectives (1) - Kazi Nfs.pdf

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Assessing the Barriers to CRISPR Genome Editing in Bangladesh: Policy, Ethical, and Socio-Economic Perspectives

Research Aims:

This study explores why CRISPR genome editing has not been widely used in Bangladesh, even though it could have a significant impact. It aims to identify the institutional, structural, moral, and sociocultural barriers that hinder the broad use of CRISPR in national research and practice. This research will evaluate all possible benefits of CRISPR in various fields. The research will also identify potential causes of mismanagement in this industry and the causes of the projects not getting recognition and getting canceled instead. This research will create a complete analysis of study of CRISPR in Bangladesh which will help the future researchers. This will change the socio-economic perspective of CRISPR in Bangladesh.

Research Questions:

1. Why aren't there enough facilities regarding Genetic engineering in Bangladesh?
2. What are the reasons behind the projects getting halted?
3. Why aren't the authorities taking enough steps to amplify the health concerns?
4. Why don't universities in Bangladesh have enough genome editing infrastructure?
5. What strategies could improve CRISPR usage in Bangladesh?

Introduction:

The world is developing rapidly in Genetic Engineering. More modified specimens have been proven useful in our day-to-day life. Starting from agricultural to medical purposes, CRISPR is being used. CRISPR-Cas9 technology is derived from a bacterial defense system that can include bacteria like *Bacillus thuringiensis*, *Escherichia coli.* It uses a guide RNA and Cas9 enzyme to cut the DNA at precise sites, it allows low-cost and highly accurate genome editing [1], [2]. Compared with the older methods like zinc finger nucleases and TALENs, it is quite efficient for conducting genetic research [3]. CRPISR has diverse applications. It has been tested in clinical trials to treat blood disorders like Beta- Thalassemia, sickle cell anemia etc. [3]. Scientists are using it in modifying crops and thus creating more sustainable plants to tolerate salinity, drought by enhancing climate resilience [4]. Researchers are trying to find a way to use CRPISR in controlling disease carrying mosquitoes, although this can carry ecological risks [5]. CRPISR-Cas9 has global recognition and value. Japanese scientists have found a ground-breaking way to remove the extra copy of Chromosome 21 using CRISPR-Cas9 from lab growth human cells. But the situation remains different in the perspective of Bangladesh. Agriculture sustains the economy of Bangladesh, but it faces threats from salinity intrusion, flooding natural calamities [6]. The fund for health isn't

enough, leaving genetic conditions untreated or under treated due to the lack of affordable therapies [7]. While universities and laboratories have molecular biology capacity, it lacks genome editing infrastructure. In the last 20 years, Bt Brinjal and Bt Cotton have been made by modifying *Bacillus thuringiensis*. But Golden Rice Development was started in 1982. It was introduced to many countries and was approved. Unfortunately, it was halted by the Philippines Supreme Court in 2024. It was meant to cure Vitamin- A deficiency but was halted based on potential health risks. Why weren't the health risks clarified before starting mass production started? The sudden stoppage led to production loss. The risky production itself hampered the rights of civilians. Better CRISPR adoption in Bangladesh will lead to great socio-economic growth.

The Importance of Research:

Despite the bio-safety measurements and the opportunities from CRISPR addressing the agricultural challenges, CRISPR adoption in Bangladesh remains minimal. The existing biosafety policies, last updated 2012, focus narrowly on GMOs and do not cover genome editing [8]. The infrastructure is very limited, and the remaining labs are totally consumed by Molecular Biology research faculties [9]. Cultural and ethical anxieties shape the public view into framing the art of genome editing as 'unnatural' or morally questionable [10]. So, it is especially important to take necessary steps to enhance the current state of research regarding CRISPR. The top three reasons:

1. Scientific relevance: CRISPR represents a rare opportunity to improve resilience in the agriculture and medical sector of Bangladesh.

2. Governance implications: The outdated biosafety frameworks hinder innovation and leave space for unregulated practices. CRISPR can have influence here.

3. Social significance: Proper research can gain public trust. This trust can lead Bangladesh into advancement in genome editing and thus Bangladesh will gain the possibility of greater innovation.

Literature Review:

Recent Research: The global significance of CRISPR is well documented. Doudna and Charpentier demonstrated its revolutionary potential [1]. Jinek et al. established the precise mechanism as a programmable DNA endonuclease [2]. Many clinical studies from various laboratories show therapeutic promise in blood disorders [3]. Research from many agricultural forums suggests that CRISPR has the potential to regrow many extinct plants and rapidly develop climate-resilient crops [4]. Genome editing can be potential threat to the ecological balance [5]. The use of genome editing isn't new. Bangladesh got out from the regular usage of *Escherichia coli* and started new innovations like Bt Corn, Golden Rice etc. from *Bacillus thuringiensis.* But the usage and innovations are pretty short in number in comparison.

Gaps in Prior Research in Bangladesh: The developing countries like Bangladesh have weak infrastructure and limited funding which impede new biotechnology adoption [11]. Bangladesh- specific studies show that biotechnological innovations are possible (Bt brinjal, Golden Rice) [13]. But the research capacity, infrastructure and policy frameworks remain inadequate. This resulted in the 2024 trial regarding Golden Rice and its halt. CRISPR studies are scarce and thus it leaves a gap in understanding barriers to adoption and potential strategies for integration. Existing literature offers insight into biotechnology but doesn't address why CRISPR remains underutilized in Bangladesh. Socio-economic, cultural and ethical factor are largely unexplored. There is very little comparative policy analysis to guide the national regulation of Bangladesh. This research promises to fill these gaps by providing a holistic examination of barriers and proposing potential strategies.

Implications for Research Design and Focus: The gaps demand a proper research design that moves beyond technical assessments of CRISPR. It should situate with Bangladesh's Policy, social and institutional context, political stability. Since all previous research only highlight the infrastructure problems and cultural skepticism separately, this study will try a different approach by combining them. Focusing on both agriculture and health care deliberately, this study will uncover the narratives that policies, ethics and cultural values create around genome editing. Altogether, these approaches ensure that both measurable trends and deeper contextual insights are captured. In short, the research design directly responds to the identified gaps. It will integrate scientific, policy and social dimensions and will link empirical evidence with reform-oriented recommendations. This study's focus is not only to document obstacles but to chart the necessary and potential actions that can be or should be taken to create actionable pathways responsible for adoption of CRISPR in Bangladesh.

Research Methodologies:

The mixed method mentioned in the *Implications for Research Design and Focus* will be taken through these steps:

Quantitative phase: Through possible collaborations and teamwork, we can get 350+ survey samples. It will include Biologists, Genetic Engineers and more. It will be used to analyze the preference and performance of workers in this field. It will reveal most answers to the research questions. This helps us to identify important matters and thus complete the research in a professional manner.

Qualitative Phase: More than 30 experts will be interviewed through online or offline meetings. We will learn the problems and reasons behind all these challenges. These interviews will maintain professionalism and the hypothesis from these interviews will maintain a vital role in the entire research process and data collection. This will get top priority during data analysis and information writing.

Data Analysis: The data from the up given phases will be broken down into word to word and this will be added to data analysis. Regression analysis will be applied to explain the

relationship between demographic variables and preference for the correlation between the Social and technological preferences. In this way, an understanding will be gained of the occupations within the samples think of and use the materials. Data from interviews will be analyzed qualitatively for themes and coded so that the principal challenges, beliefs, and behaviors related to CRISPR use and receptiveness genome editing can be identified, thereby adding depth to the quantitative context.

Project Timeline:

- Weeks 1–3: Survey and interview design.
- Weeks 4–6: Survey distribution and interviews.
- Weeks 7–9: Data analysis and preparing transcripts.
- Weeks 10–12: Combining all findings and writing the final document.

Conclusion: This research tackles the chronic problems regarding the CRISPR adoption in Bangladesh along with the detailed review of the existing infrastructure of genome editing and genetics research in Bangladesh. The importance of the responsibilities of the higher ups and the lack of dedication of university students will be mentioned. This research will have an impact regarding not only CRISPR usage but entire biology related research that exists or will exist in the future.

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