Biotechnology for Rural Development:

Scopes of Economic Advancement Using Biotechnology

In Perspective of Rural Bangladesh

Submitted by:

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A thesis (Review Paper) submitted to the Department of Mathematics and Natural Sciences in partial fulfillment of the requirements for the degree of

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BRAC University

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Declaration

It is hereby declared that

1. The thesis submitted is my original work while completing my degree at BRAC University.

2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.

3. The thesis does not contain material that has been accepted or submitted, for any other degree or diploma at a university or other institution.

4. I have acknowledged all main sources of help

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Approval

The thesis project titled "**Scopes of Economic Advancement using Biotechnology in perspective of rural Bangladesh**" submitted by Afruza Khatun Tanzi (17336008) has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science in Biotechnology on December 22nd, 2021.

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Acknowledgment

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Abstract

Besides contributing to academics, industry, and healthcare, Biotechnology has immense potential to directly improve the lives of socially and economically weaker sections of the country. In a developing country like Bangladesh, technological advancement is happening drastically. Yet the question remains if we are utilizing the fullest potential of Biotechnological advancement to eliminate poverty and improve the sustainability of rural communities. In this review article, I will be going through some of the Bio-technological innovations, which, with slight modifications, can improve the life of 61.82% population (101,815,917 people) of Bangladesh who are still living in rural areas with limited access to resources. However, I am focusing on the intervention which can be done with minimal resources and technology keeping feasibility in mind.

In this paper, I will be discussing each of its potential and benefits which I believe can be integrated with rural development projects by the Government, private sector, and development organizations. Moreover, I have taken over-the-phone interviews with a few of the organizations that are specifically working on these projects for rural development. The interview findings and summaries are described in each section.

Keywords

Poverty Reduction, Sustainability, Genetically Engineered Crop, Bio-economy

Table of Content

Introduction

The fruits of biotechnology-based research and innovation can be utilized to provide platforms for self-employment generation among the target population by diffusion of proven and field-tested technologies in a plethora of fields ranging from agriculture to secondary products of agriculture, food processing, animal husbandry, and many others. Notably, the benefits of biotechnology-based interventions are all-encompassing and cut across sectors that have a direct influence on means of daily livelihood and income. Poverty reduction, food security, and agricultural sustainability require that the livelihoods of poor farmers be improved. The potential of biotechnology to improve the livelihoods and agricultural sustainability of farmers has been hotly debated and primarily focused on "modern" agricultural biotechnology. Different biotechnology types have different effects and these impacts are molded by the macro-economic policies of the countries where they are implemented.

While writing this review, I have noticed that only a limited number of agricultural Biotech practices are well-known in our country. Hence I have taken India, Pakistan, Philippines as example countries. Following are three major areas where Bangladesh has extraordinary scope to improve rural livelihoods.

- Biotechnological Agriculture
- Vermicomposting
- Biotechnology in Sericulture
- Biogas Plants
- Bio Entrepreneurship

Current Scenario of Rural Bangladesh

To further understand the distribution of the population based on employment and income I have gathered the following statistics –

Annual Household Agricultural Income by Source and Division, 2018

Division	Major sources of annual household agricultural Income (taka)								
	Total	Crops	P.crops (Forest)	P. crops (fruit)	Livestock	Poultry	Fishing	Ag. Labor	Others
	Number (Taka)								
Total	77458	38343	975	1277	10981	960	3537	18620	2765
Barishal	80783	37832	2208	2196	8231	2177	2777	22990	2371
Chattogram	67885	32461	1629	859	8542	1034	2289	19058	2013
Dhaka	66312	33142	854	1150	12594	1236	1272	11626	4437
Khulna	88036	40614	1106	1131	10171	698	9707	21237	3373
Mymensingh	80667	39929	1190	464	9560	748	12302	14288	2196
Rajshahi	82908	42900	411	2057	13208	755	1685	19247	2646
Rangpur	92522	47864	380	807	14261	642	778	25777	2013
Sylhet	63421	32566	483	2370	6501	749	715	18467	1570
	Percentage								
Total	100	49.5	1.26	1.65	14.18	1.24	4.57	24.04	3.57
Barishal	100	46.83	2.73	2.72	10.19	2.69	3.44	28.46	2.94
Chattogram	100	47.82	2.4	1.27	12.58	1.52	3.37	28.07	2.97
Dhaka	100	49.98	1.29	1.73	18.99	1.86	1.92	17.53	6.69
Khulna	100	46.13	1.26	1.28	11.55	0.79	11.03	24.12	3.83
Mymensingh	100	49.5	1.48	0.58	11.85	0.93	15.25	17.71	2.72
Rajshahi	100	51.74	0.5	2.48	15.93	0.91	2.03	23.21	3.19
Rangpur	100	51.73	0.41	0.87	15.41	0.69	0.84	27.86	2.18
Sylhet	100	51.35	0.76	3.74	10.25	1.18	1.13	29.12	2.48

Note: P.Crops=Permanent Crops

Income = Production Value- Production Cost (without self-employee and family worker)

Source: **Report on Agriculture and Rural Statistics 2018**

The major sources of annual household agriculture income have been presented in Table. It follows from the table that the highest household annual agricultural income is generated from crops (49.50%) followed by agricultural labor (24.04%), livestock (14.18%), fishing (4.57%), and so on. The table further indicates that the household average annual agricultural income varies from division to division: the average annual agricultural household income in the Rangpur division is the highest (Taka 92522) while that in the Sylhet division is the lowest (Taka 63421).

Distribution of Employed Population of age 15 years and above by Sector and Sex, 2018.

Sex	Sector				Sector			
	Total	**Agriculture**	**Industry**	**Service**	**Total**	**Agriculture**	**Industry**	**Service**
	Number				Percentage			
Total	47019071	24392878	8187493	14439231	100	51.88	17.41	30.71
Male	32339660	15748076	3646597	12944987	68.78	33.49	7.76	27.53
Female	14679411	8640697	4544470	1494244	31.22	18.38	9.67	3.18

The economic sector-wise employed population is presented in Table. It is observed that 24392878 people are engaged in the agricultural sector (51.88%) followed by 14439231 in service (30.71%) and 8187493 in the industry (17.41%). In terms of employment, the table also shows that male-female-wise variation exists: 32339660 people are male (68.78%) compared to 14679411 are female (31.22%).

Source: Report on Agriculture and Rural Statistics 2018

<u>The objective of Biotechnology for rural development projects:</u>

The specific aim of a Biotechnology based program for societal development is the socio-economic upliftment of the underprivileged section of society with the following objectives:

• To promote the use of biotechnological processes and tools for the benefit of the underprivileged comprising of women, rural, SC/ST population, and weaker sections.

• To develop programs on agriculture and allied areas, health, hygiene and nutrition, biodiversity conservation and sustainable utilization of resources for societal benefit.

• To create a platform for livelihood, self-employment generation and entrepreneurial activities among the target population by diffusion of proven and field-tested technologies through demonstration, training and extension activities.

Biotechnological Intervention for Agro-economy

Biotechnology in agriculture has found application in rDNA technology, tissue culture, somatic hybridization, embryo rescue, molecular diagnostics, etc. All of these tend to increase productivity in agriculture and protect crops from damage or infestation.

Crops are dependent on environmental conditions. Drought can destroy crop yields, as can too much rain or floods. The salinity of soil is another major threat to the agriculture of Bangladesh. However, using Biotechnology, crops could be developed to withstand these harsh conditions. Biotechnology can allow the development of crops containing genes that will enable them to tackle biotic and abiotic stresses. Biotechnologists and plant geneticists are studying plants that can cope with these extreme conditions, trying to identify and isolate the genes that control these beneficial traits. The genes could then be transferred into more desirable crops, with the hope of producing the same phenotypes in those crops. Small-scale Plant Tissue Culture can be a tool used in this progress. Tissue culture means the cultivation or culture of specific plant tissues under aseptic conditions. Plants are grown in specific glassware or plastic containers with the addition of nutrients that suit each plant species. Plant tissue culture is based on a specific ability in plant cells, termed “totipotency”. This bio-technique can increase yield and decrease the loss of 16.5 million farmers in Bangladesh.

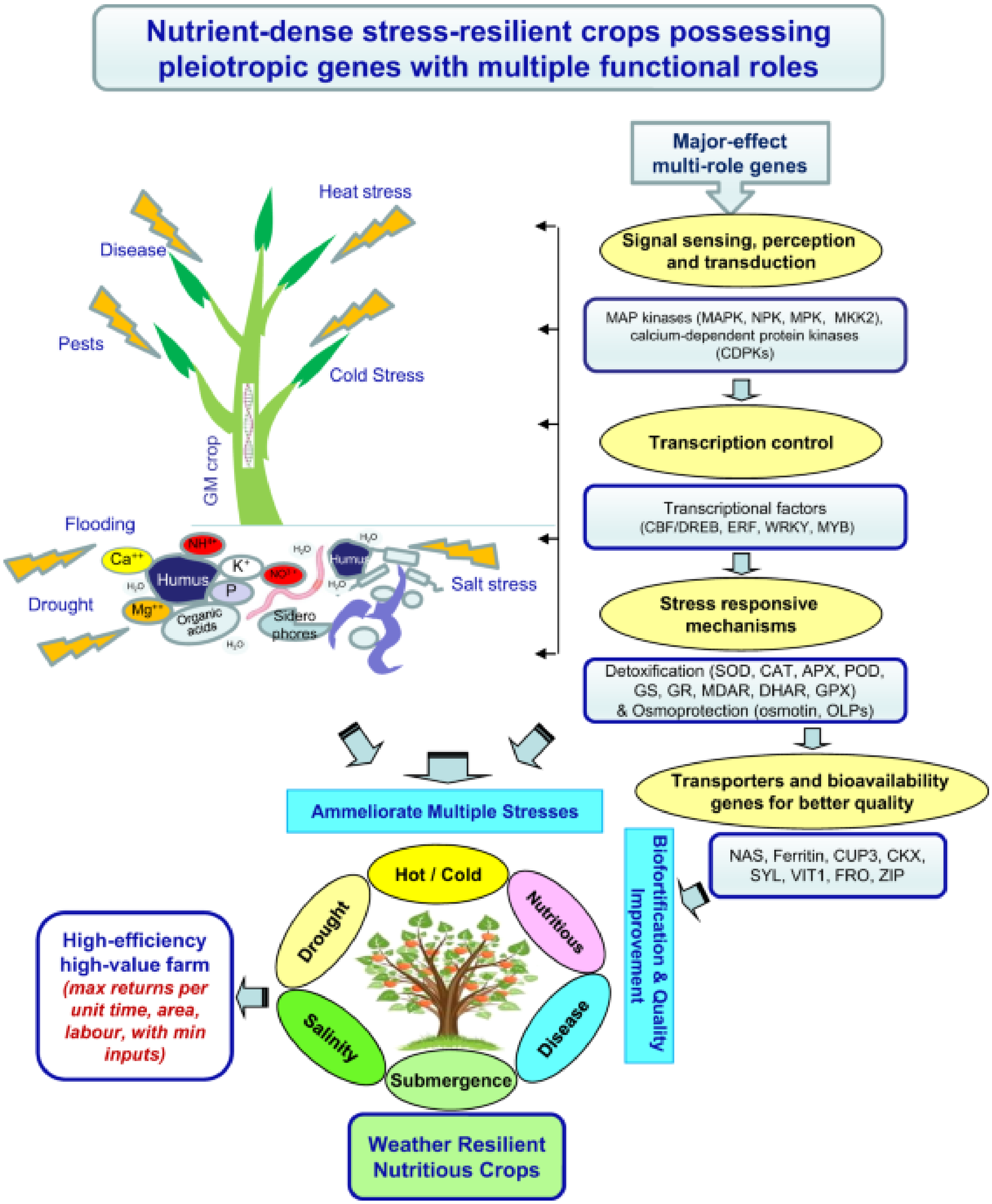
According to a International Fund for Agricultural Development (IFAD) press release, small-scale farmers, who produce 70-80 percent of Bangladesh's food, are most vulnerable to the impacts of climate change – and, ironically, contribute to it the least. There is no doubt that global warming is affecting developing countries like ours most severely, where agricultural systems are very vulnerable to climatic conditions and where small temperature increases are very detrimental to productivity.

A recent Food and Agriculture Organization (FAO) report identifies drought as the single greatest culprit of agricultural production loss, followed by floods, storms, pests and diseases, and wildfires. Adverse environmental factors, of which water scarcity represents the most severe constraint to agriculture, account for about 70 percent of potential yield losses worldwide. The development of crop varieties with increased tolerance to drought, by conventional breeding methods and by genetic engineering, is an important strategy to avoid yearly damages and losses to thousands of rural farmers in Bangladesh.

Developing Stress Tolerant Crops using CRISPR

Plant stress is a state where the plant is growing in non-ideal growth conditions that increase the demands made upon it. The effects of stress can lead to deficiencies in growth, crop yields, permanent damage, or death if the stress exceeds the plant tolerance limits. Plant stress can be divided into two primary categories namely abiotic stress and biotic stress. Abiotic stress imposed on plants by the environment may be either physical or chemical, while biotic stress exposed to crop plants is a biological unit like diseases, insects, etc.

Conventional breeding requires the identification of genetic variability to drought among crop varieties, or among sexually compatible species, and the introduction of this tolerance into lines with suitable agronomic characteristics. Although conventional breeding for drought tolerance has and continues to have some success, it is a slow process that is limited by the availability of suitable genes for breeding. The development of tolerant crops by genetic engineering, on the other hand, requires the identification of key genetic determinants underlying stress tolerance in plants, and the introduction of these genes into crops. Significant progress has been made in elucidating the genetic mechanisms underlying drought tolerance, but considerable challenges remain. In field conditions, crops are subjected to variable levels of multiple stresses, thus one area of studies that deserves much more attention is the response of plants to a combination of stresses. There, a plant's response to multiple stresses cannot be inferred from the response to individual stress. It is thus essential to test newly developed varieties to multiple stresses and to carry out extensive field studies in a large range of conditions that assess tolerance as absolute yield increases.



Thale cress, a species of Arabidopsis (A. thaliana), is a tiny weed that is often used for plant research because it is very easy to grow and its genome has been extensively characterized.

Scientists have identified a gene from this plant, At-DBF2, that confers resistance to some environmental stresses. When this gene is inserted into tomato and tobacco cells, the cells were able to withstand environmental stresses like salt, drought, cold, and heat far better than ordinary cells. If these preliminary results prove successful in larger trials, then At-DBF2 genes could help in engineering crops that can better withstand harsh environments.

Photos: from the internet

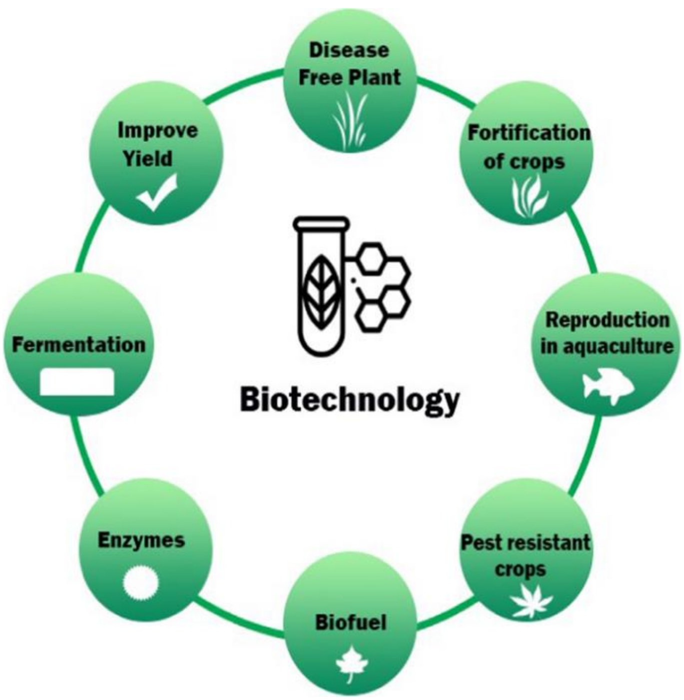
Researchers have also created transgenic rice plants that are resistant to the rice yellow mottle virus (RYMV). In Africa, this virus destroys much of the rice crops and makes the surviving plants more susceptible to fungal infections. Not to mention, Bt cotton, Bt brinjal, and golden rice are some of the significant transgenic crops in Bangladeshi agriculture. We need to use the same technology for vulnerability to climate change crops like corn, wheat, etc. According to NASA, Climate change may affect the production of maize (corn) and wheat as early as 2030 under a high greenhouse gas emissions scenario, according to a new NASA study published in the journal, Nature Food. Corn crop yields are projected to decline 24%, while wheat could potentially see a growth of about 17%.

<u>Successful Example in Bangladesh:</u>

Farmers in flood-prone northern Bangladesh turned to corn when floods destroyed their livelihoods in the 1990s. Corn needs less water and brings in more money than most other staple crops in the area. The people of the Shaniazan union, in northern Bangladesh, still remember when a river burst its banks in the early 1990s and engulfed their homes, leaving the land too sandy to grow traditional rice and tobacco crops. Back then, they desperately struggled to feed their families. Today, the collection of villages in Lalmonirhat district has a bustling marketplace, well-built homes with TVs inside and solar panels on the roofs, and thriving fields of a crop that pulled the community out of poverty: corn. Farmers can earn up to 850 taka for about 40 kg (88 pounds) of corn, about 15% more than they would earn growing rice and 40% more than wheat, said Rafiqul Islam, an agriculture officer in Hatibandha upazila, where Shaniazan is located.

Using biotechnology, we need to ensure that climate-vulnerable crops like Corn can survive natural disasters.

<u>Improved Yield from Crops</u>



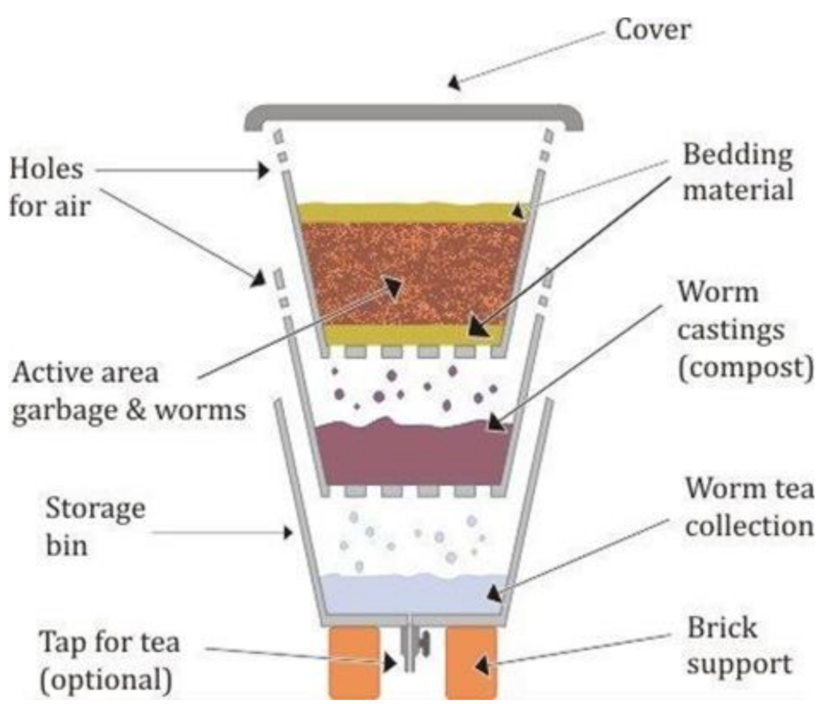
The UN claims that in 2050, humanity will need to produce 70% more food than we do today. Using biotechnology techniques, one or two genes can be transferred into a crop to give a new trait to that crop. This is done in the hope of increasing its yield. However, these increases in yield have proved to be difficult to achieve. Biotechnology allows farmers to grow more food on less land using environmentally sustainable farming practices. Through biotechnology, seeds yield more per acre, plants naturally resist specific insect pests and diseases, and farming techniques improve soil conservation. Current genetic engineering techniques work best for single-gene effects - that is traits inherited in a simple Mendelian fashion. Many of the genetic characteristics associated with crop yield, such as enhanced growth, are controlled by a large number of genes, each of which just has a slight effect on the overall yield. There is, therefore, still much research, including plant genetic research, to be done in this area.

If we can create a supply chain from laboratories to agricultural fields, where the genetically engineered crops can go to farmers' hands, it will bring a revolution in rural agriculture.

Developing better crops is a significant aspect of biotechnology. A few Agricultural aspects are mentioned here, which has the potential to ensure sustainable earning opportunity for areas facing challenges in agriculture. Improved yield has the potential to increase the economic sustainability of a farmer by up to 23%. Using Biotechnology we can ensure reduced vulnerability of crops and plants to environmental stresses. It is high time we bring these GMOs from the laboratory to the fields for the financial security of farmers.

Vermicomposting:

The term vermicomposting refers to the use of earthworms for composting organic matter. Latest biotechnology helps in using bio-fertilizers in the term of vermicomposting, for agricultural uses and a high-priority protein (earthworm biomass) for supplementing the nutritional energy needs of animals. Vermicomposting is bringing extra income to many farmers in rural Bangladesh, especially Rangamati. Bangladeshi Vermicomposting worms are earthworms fauna predominantly represented by native species, and constitute 89% of the total earthworm diversity in the country.



An extensive survey has been carried out to find out more about vermicomposting species. *Drawida willsi, Lennogaster pusillus* and *Perionyx cyclensis,* and *Peronyx sansibaricus* have been added as potential species for vermicomposting in addition to common Vermicomposting worms. Earthworm Activates Cellouloysis. The data obtained in experimentations suggests there is a microbial succession during cellulose decomposition in vermireactors containing earthworms at the initial stage during which fungi played an important role, triggering speedy cellulolysis, and at a later stage, bacteria act as a principal decomposer.

Enzymatic Activities and Microflora of Earthworm guts function as sensitive indicators. Hydrolases (β-gloucosidase, N-benzoyL-1- argininamide (BAA) hydrolyzing protease, urease, phosphatase, cellulase) and dehydrogenase activities of earthworm gutare are sensitive indicators of a particular state and evolution of organic matters stabilization process. It is recorded that Aspergillus flavus, A.fumigatus, and Streptomyces aureus are not digested by earthworms due to the production of antibiotic-inhibitory substances or production of phytotoxic metabolites. Further, the microbial population in the cast increases due to environmental conditions, prevailing microbial status in the gut of earthworms, or multiplication of microbes while passing through the gut of worms or large surface area of the casts ideally suited for better feeding and multiplication of microbes demonstrated the enhanced enzyme activity due to microbial flora. Finally, the dehydrogenase, hydrolytic activities, and Microflora correspond with the production of the maximum biomass of the worm from a maturation phase. This indicates the dynamics of organic matter degradation and allows us to distinguish the end of the hydrolytic and maturation phase that could be useful in characterizing the status of vermireactors.

Earthworms selectively inhibit the growth of bacterial pathogens present in the organic wastes. The presence of pathogenic organisms namely, Shigella, Escherichia, and Flexibacter were observed at the initial stage of waste and other vermistabilization, reduced to zero concentration. This amply demonstrates that these pathogens have been eliminated as they enter the food chain of earthworms. However, Pseudomonas and Streptosporangium seem to be responsible for the reduction of pathogens and metabolization of other organics in the waste degradation process and availability of nutrients, particularly solubilization of phosphorous to the soil, thereby, improving the quality of vermicompost.

Livelihood Opportunity for Rural Women: production of bio-fertilizer

As the activity caught on, it was observed that in most farm holdings, vermicompost had become the responsibility of women as it required continuous involvement without hard manual labor. The simple production process and flexibility in terms of time needed to attend to the activity allowed the women to readily incorporate it into their routine of household chores. To take advantage of the skills of women in managing this activity and to convert the dung, leaves and other bio-wastes found littered in rural areas. The task of vermicompost making developed into an income–generating activity.

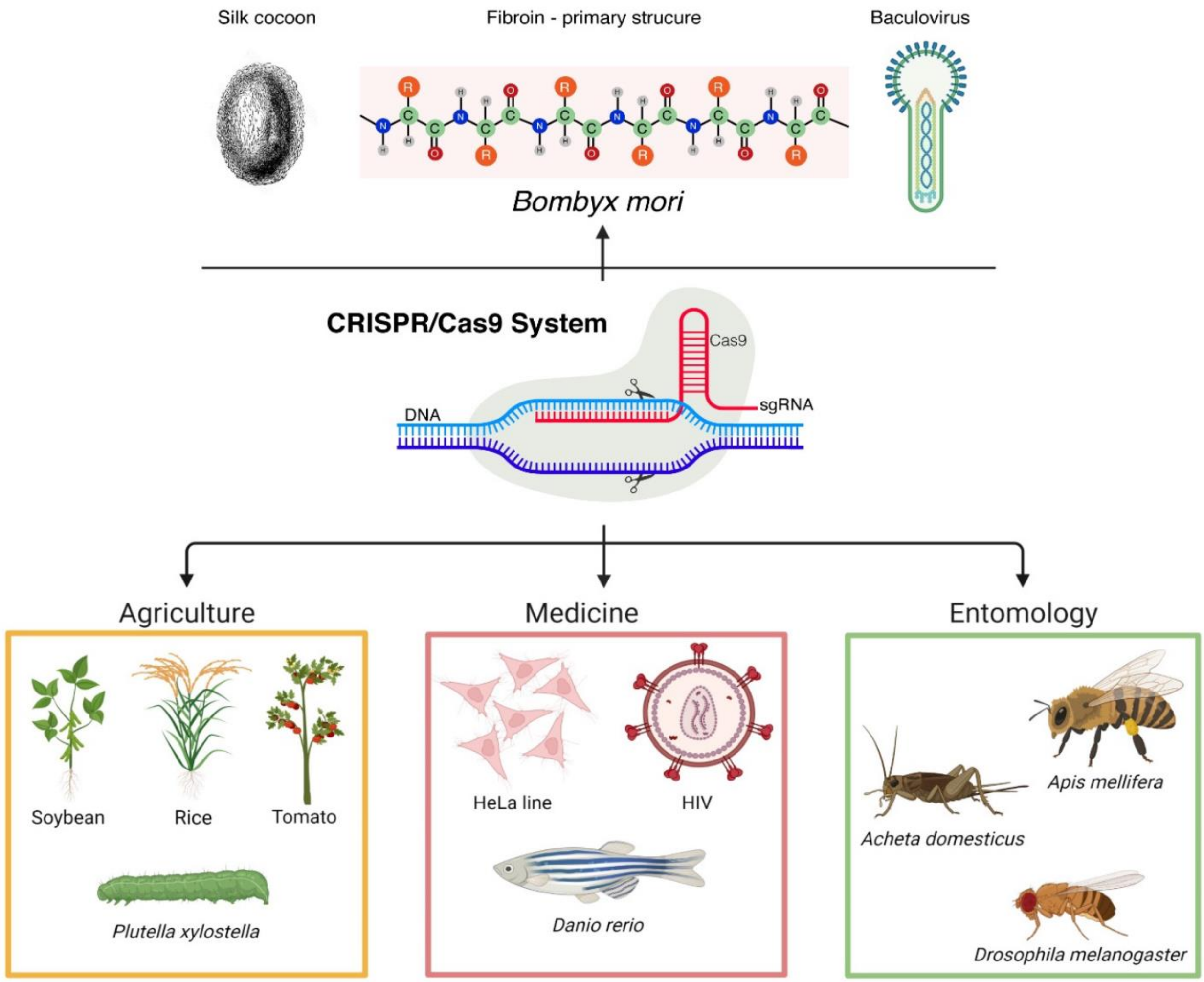
Besides, producing and using vermicompost in their cropland, rural women can earn earning an extra sum by selling the natural fertilizer. It costs about Tk 7 to produce one kilogram of vermicompost whilst the cost of one kilogram of chemical fertilizer in the local market is Tk 40 to Tk 50.

An organization, ADRA in Bangladesh Community Empowerment Project (CEP) – Gouripur, Mymensingh is playing an inevitable role to transform lives in its project area by promoting Vermicompost. Vermicompost has already gained popularity among peasant communities. Many farmers and their wives have been involved in producing Vermicompost and have been able to bring out a positive change in their lives. A number of farmers have been able to achieve financial emancipation by producing and selling Vermicompost in the local market.

"I've received training from ADRA and learned how to prepare Vermicompost. Now, I'm producing Vermicompost and earning a good sum of money by selling them in the local market. I'm happy as I can arrange three meals a day for my family and I've been able to do savings from my earnings as well," said Najma Begum, a farmer who has got benefited from producing Vermicompost.

Biotechnology in Sericulture

Traditional sericulture represents the rearing of silkworms for the production of silk that provides livelihood opportunities to millions of people in the country besides earning foreign exchange. The time has come to diversify the whole sericulture process for the meaningful realization of its output under the present-day scenario. The advent of modern biotechnology and its application has opened a new arena of synthesized science for silk production. The vast potential of the silk industry can effectively be exploited by the application of modern-day biotechnological approaches like marker-assisted selection and expression of foreign protein through transgenic approaches. On the other hand, the silk quality has been enhanced using probiotics and providing artificial feed to the silkworm. The potential of silk has been further exploited for biomedical applications. In this communication, the comprehensive account of biotechnological applications in sericulture and its byproducts for the development of the sericulture industry are compiled while emphasizing the need of applying modern biotechnology for meaningful growth and development of the sericulture and silk industry.



Our country is bestowed with an extraordinarily rich silkworm genetic base in the form of mulberry silkworms and wild silk-producing insects. Despite having such a wide silkworm genetic base, information is hardly available either on the unique features of many of these genotypes or the extent of genetic diversity between or within the genotypes. To date, genetic improvement of these precious insects is usually ascertained based on their morphological characteristics which, are highly biased and environmentally dependent, thus requiring an authentic technique like MAS for genotype characterization and evaluation. As far as the mulberry silkworm, Bombyx mori L., is concerned, more than 400 visible mutations have been placed in the linkage maps [64] which represent 217 loci consisting of mostly morpho-logical and a few isozyme markers. Research on the genetics of silkworms across the world has helped in establishing a silkworm genome database called “silk base”. This has become an integral part of exploring the genome of silkworms for the improvement of the sericulture industry. Exploring the genome of silkworms has revolutionized the sericulture industry by identifying molecular markers using linkage mapping. This led to identifying key regions in the genome of silkworms for specific phenotypes that have changed the face of silkworm breeding. Hence, a lot of work on DNA-based genetic markers in silkworms started emanating in the 1990s and a preliminary linkage map of 169 loci using RFLPs and RAPD was constructed. Studies on PCR-based markers, RAPD markers, and DNA fingerprinting with minisatellite probes concerning Indian silkworms have also been carried out. Further, thirteen silkworm strains were used for genetic characterization using inter simple sequence repeats (ISSR). The ISSR-PCR produced 39 fragments of which 76.98 percent were polymorphic and the diversity index was observed to be 0.957 percent. Afterward, for complete genome analysis of the silkworm, Bombyx mori L. expressed sequence tag (EST) database was constructed covering about 55% of all the genes of a silkworm. To identify and mapping of sex-linked traits in the silkworm genetic mapping of Z chromosome and identification of W chromosome- specific markers in the silkworm were carried out while studying genomic analysis of cocoon and associated traits in silkworm through restriction-site-associated DNA sequencing (RAD-Seq) reported identification of a total of 11 cocoon yield-related QTLs on 7 chromosomes using the composite interval mapping (CIM) algorithm.

Potential of Bio-altered Modern Sericulture in Bangladesh

Bangladesh has had a rich history of traditional textiles for many generations. When the country gained its independence, Sir Fazle Hasan Abed searched for income-generating activities targeted toward people in rural areas living in poverty. There was a high demand for silk in Bangladesh. Sir Fazle decided that the cultivation of silk is an opportunity for people to empower themselves out of poverty, keeping alive the tradition of silk rearing in the process. Thus, in 1978, BRAC started its sericulture project.

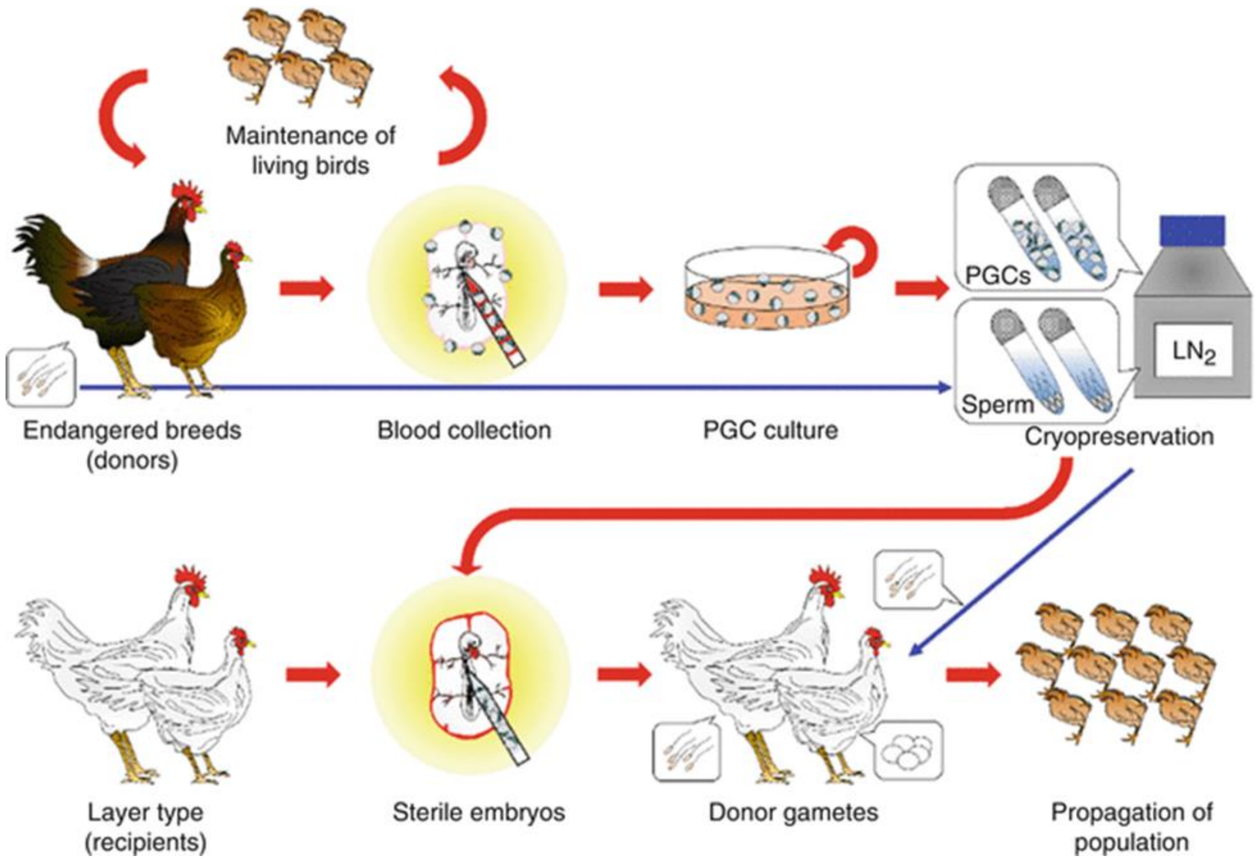
BRAC Sericulture is the only institute in Bangladesh that maintains the total chain of sericulture activities - from cultivating silkworm eggs to finished products. At present, 5,927 participants are under BRAC Sericulture Enterprise, involved in sericulture activities, including silkworm rearing and cocoon production, silk reeling, spinning, raw silk production, silk twisting, warping, dyeing, and silk weaving. BRAC has introduced two improved mulberry varieties named S1635 and Victory-1 to increase mulberry leaf production. Multi-bi hybrids and bivoltine hybrids in silkworm rearing are being adopted to increase cocoon production and cocoon quality. BRAC

Sericulture is working to improve silk quality and increase its volume of production by introducing a bivoltine silkworm race during favorable rearing seasons.

Talking to,Mr. Serajul Islam, Member of Bangladesh Sericultute Development Board-BSDB, said that the sericulture and silk industry, by its nature, is a family-based labor-intensive economic activity that employs the rural people. More than six lakh people have been involved in this industry of which one lakh are cocoon growers and the rest are engaged in silk reeling, spinning, weaving, dyeing, printing, finishing, and trading activities. The multidisciplinary activities provide unique job opportunities to the marginal farmers, landless poor, rural artisans, and also the urban silk fabric manufacturing industries and contribute a lot to poverty reduction, he added. He said, there are around 80 small and medium silk factories in the private sector with a capacity of manufacturing 25.50 million meters of fabrics annually. Apart from this, there are about 10,000 private handlooms with the capacity of producing 30 million meters of silk fabric. Serajul Islam mentoned that the project will help alleviate the poverty of some 50,000 people by directly supporting them through employment generation side by side with developing 4,200 new cocoon producers who will produce at least 650 tonnes of healthy cocoons along with increasing overall silk production in the country.

Biotechnology in Poultry Development:

Global meat consumption is growing exponentially because of rapid urbanization, and population growth including lifestyle changes in developing countries. Amongst the sources of meat consumption, the maximum proportion comes from poultry birds as white meat. The advancement of the biotechnology revolution triggers numerous opportunities in the poultry industry to mitigate such emerging demand for meat and meat products. According to the Bangladesh Poultry Industry Central Council (BPICC), Bangladesh's poultry sector currently produces 1.5 to 1.6 percent of the country's GDP. In addition, the sector employs approximately 6 million people directly and indirectly in the country.

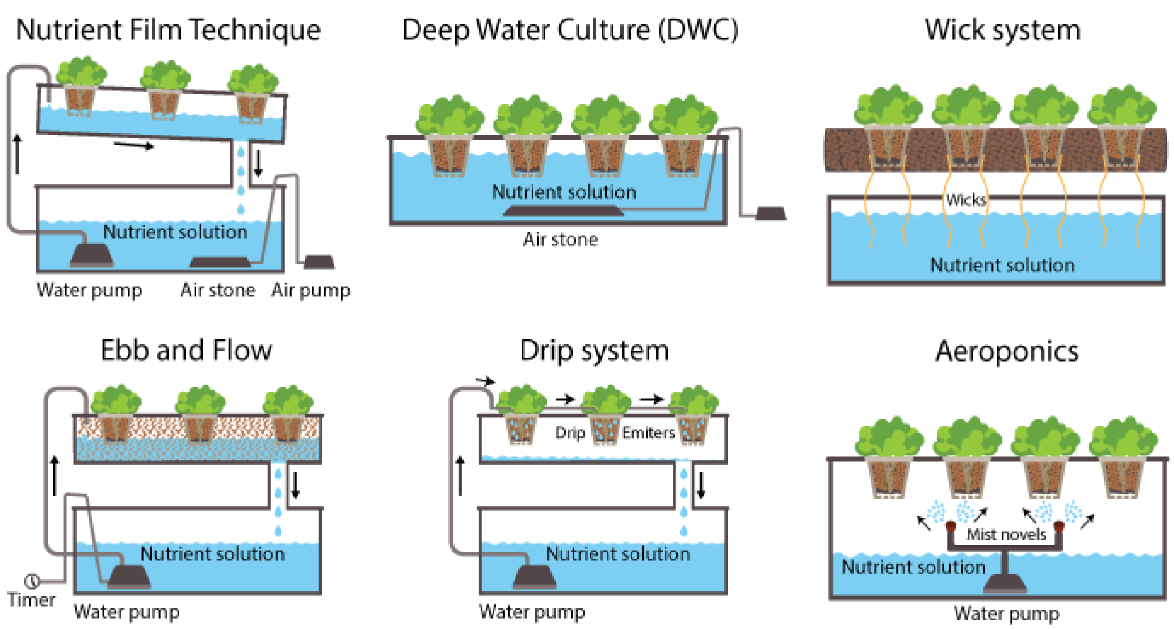


Biotechnology in poultry that never been regarded only for better farming, but its multifaceted impacts on the poultry production food systems in recent times. Breed development, health, nutrition, disease prevention and control, preservation of poultry-origin meat and meat products along with food safety are mostly achieved enormous improvements. The biotechnological tools based on modern techniques offer enormous prospects for the production of biologics and vaccines and medicinal products including disease diagnostic assays as a part of disease control and prevention. The advancement and application of these technologies are mostly used in developed countries, however, these are being used moderately in developing countries in different segments of poultry science. Both conventional and modern biotechnologies in poultry can contribute enormously to enhance productivity and optimize income generation activities and reduce poverty, lessen the burdens of diseases, and guarantee environm entally sustainable livestock production in developing countries.

The major biotechnological advances that can be applied in the poultry industry will include molecular genetics, molecular immunology, and solid-state reactions. The elucidation of the genetic code and the development of techniques to manipulate genes offer new opportunities for changing pathogenic agents and changing chickens to reduce the effect of disease and improve productivity. The monoclonal antibody technique and the discovery that cells of the immune response communicate with one another through peptide factors will permit improved diagnostic techniques and enhanced immune responses to vaccines. Immunologic and biochemical reactions that occur on a solid substrate can be used to simplify and accelerate diagnostic tests and to purify antigens and antibodies. These advances will lead to improvements in diagnosis, disease resistance, and productivity of poultry.

Hydroponics:

Hydroponics, or growing plants in a nutrient solution root medium, is a growing area of commercial food production and also is used for home food production. It is a kind of hydroculture and is a technique for growing plants using solutions rich in mineral nutrients without soil. Hydroponic systems constitute a promising biotechnology for food production and wastewater treatment. Some plants have revealed capacities to grow in hydroponic systems fed with wastewater, reducing the pollutant loads. A well-designed hydroponic system, with a multi-level bedding structure, is characterized by less wastage of water and nutrients than soil-based farms. Both water and nutrients are fed directly to the root structure of the plants and recycled through the hydroponic system.



The soilless farming technique which is gaining popularity these days is called hydroponic farming. People are bringing nature hands as per their needs. Hydroponic farming has come in its continuity. A lot of research in the world is being implemented bout hydroponics farming. Hydroponics is a technique of growing plants in nutrient solutions with or without the use of an inert medium such as gravel, vermiculite, rock wool, peat moss, saw dust, coir dust, and coconut fiber to provide mechanical support.

Currently, hydroponic cultivation is gaining popularity all over the world because of efficient resource management and quality food production. Commercially Nutrition film technique has been used throughout the world for the successful production of leafy as well as other vegetables with 70 to 90% savings of water. Climate-vulnerable households in the country's coastal region are showing interest in adopting the soilless hydroponic farming system to grow vegetables to meet their nutritional demand. Deluti Union Parishad is implementing a hydroponic project to encourage the local people to adopt the soilless farming method for growing vegetables.

Photosynthesis process:

Carbon Dioxide + Water Glucose + Oxygen

$6CO2 + 6H2O C6H12O6 + 6O2$

The question is what is needed for a plant to survive?

Water + Sunlight + Air + Anchorage (root system) + Nutrients

There is no mention of soil anywhere in there and that’s all the proof we need that plants can grow without it. It is possible by hydroponic techniques to achieve better than normal farm production, immune to natural weather variations, as well as organic and more nutritive, in just about 5% of the space and 5% of the irrigation water. Hydroponic fodder production requires only about 2-3% of that water used under field conditions to produce the same amount of fodder.

These days, Bangladesh experiences a shorter winter season due to climatic reasons which are liable for less food production. To be sustainable in food production, it is high time for Bangladesh to adopt a hydroponic farming system. Due to rapid urbanization and industrialization not only the cultivable land decreasing but also conventional agricultural practices causing a wide range of negative impacts on the environment. To sustainably feed the world's growing population, methods for growing sufficient food have to evolve. Modification in the growth medium is an alternative for sustainable production and to conserve fast-depleting land and available water resources. It is possible to effectively grow high-value, good-quality vegetables under controlled hydroponic conditions using 85 to 90% less water than traditional soil-based production.

Bio-entrepreneurship for the rural population, especially youth

Bio entrepreneurship is the integration of two different disciplines science (bio) and entrepreneurship. It can also be defined as the use of biological entities or any idea, related to sciences for purpose of acquiring profit and establishing a business. Bio entrepreneurship is the sum of all activities necessary to build an enterprise that creates, builds, and commercializes biotech products. On one hand, biotechnology has opened several opportunities for bio-industrialization while on the other hand, Organic farming has also become one of the fastest growing sectors of agriculture production and provides products which were never available before: products that are currently in short supply, new methods this will reduce cost substantially; provide safer, better, cheaper, quality products, products which use cheap raw materials, smart materials for several applications and many more.

Rural bio-entrepreneurship is most commonly developing entrepreneurship by taking agricultural activities/enterprises/rural bioresources as a business venture. It may deal with the entire value chain like production, processing, or distribution. There is ample scope and opportunity for developing entrepreneurship by focusing on bio-resources in rural areas. The activities such as:

Vermicomposting
Bio-pesticides
Off-season cultivation of high-value vegetables
Cultivating field crops in post-monsoon season using a modified bamboo drip irrigation system.
Setting up of soil testing labs at the village level
Mushroom cultivation
Aquaculture
Floriculture (cut flowers)

Post-harvest technology
Bio-fertilizers
Fish seed production
Dairy farm with fodder cultivation
Broiler goat rearing
Beekeeping
Production of bio-control agent
Poultry feed production

Major Challenges

For this paper, I have gathered some qualitative data through interviews and surveys from mostly two sources:

- Development Organizations that are working with rural project
- Rural representatives from different parts of the country

After analyzing the data collected from mentioned sources I could come to a conclusion that following are the major challenges in establishing Biotechnological usage for rural development.

1. Traditional Mindset
2. Electricity
3. Resource Management
4. Educated workforce

Conclusion

At the beginning of this paper, I have given a statistical summary of the current situation of rural Bangladesh in terms of economy, agriculture and employment. All these three are majors factors for economic development. Throughout the paper, I have tried to gather possibilities of Biotechnology which can be used to improve the current scenarios. This review paper recognizes the tremendous opportunities offered by biotechnology to improve the livelihood of the population of rural Bangladesh. The Biotech solution to farming, employment, and nutrition problem can transform Bangladesh into a truly developed country. The sector deserves and needs more research, focus, and utilization to be harnessed at its true potential.

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