Towards Building Advanced Intelligent System for Agriculture

Human Resource Development Plan For National Agricultural Research System 2023-2041

NATP-2
BARC Component
Enhancing Agricultural Technology Generation

Human Resource Development Plan For National Agricultural Research System 2023-2041

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Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council
New Airport Road, Farmgate, Dhaka-1215, Bangladesh.

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New Airport Road, Farmgate, Dhaka-1215, Bangladesh

May 2023

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Message

I am very much delighted to know that Bangladesh Agricultural Research Council (BARC) has prepared an expedient plan entitled "Human Resource Development Plan for National Agricultural Research System 2023-2041" through National Agricultural Technology Program Phase II project (NATP-2) which is commensurate with the Bangladesh Perspective Plan 2041. It is realized that this Human Resource Development (HRD) plan is made with a vision of developing effective and efficient, knowledge and skilled based scientific manpower of National Agricultural Research Systems (NARS) institutes for sustainable growth and development of agricultural sector. Soon after independence, the Father of the Nation Bangabandhu Sheikh Mujibur Rahman revitalized the agricultural research, education and extension system, and introduced technology based modern agriculture in the country. Bangabandhu put a milestone to engage talented students in agriculture. Following his visionary work, Bangladesh has been advancing remarkably with agricultural production through technological innovations and the human resources involved in agricultural research of the NARS institutes are the front-liners of this advancement.

With the multifaceted efforts of the Governments led by the Honorable Prime Minister Sheikh Hasina, Bangladesh is now self-sufficient in rice, fish, meat and egg production and on the verge of self-sufficiency in vegetable production. Nevertheless, there is an urgent need to develop quality human resources to face the complex challenges of the Bangladesh agriculture arising due to increasing population, declining land, changing climate, and depleting quality of the natural resources and rising competitiveness under the globalization pressure. Keeping this need in mind, the present Government has put forward a specific activity in the 8th Five-year Plan (2021-2025) for escalating human resource development for undertaking frontier research and delivery services aligning with the Bangladesh Perspective Plan 2041 (BPP2041). Our government has also emphasized on modernizing agricultural research, education, extension, input management and developing skilled workforce for sustainable technology innovation through the National Agriculture Policy (NAP) 2018. I strongly believe that the HRD plan for the NARS institutes 2023-2041will significantly contribute to achieving the success of BPP2041.

Finally, I would like to appreciate the initiatives of Dr. SM Bokhtiar, Executive Chairman, BARC and Dr. Md. Harunur Rashid, Director, P1U-BARC, NATP-2 and his team for preparing an overwhelming HRD plan for the NARS institutes 2023-2041. I believe that this plan will serve as an excellent vehicle for developing the capacity of NARS institutes and their scientists towards building a smart Bangladesh by 2041 through sustainable food and nutrition security without undermining quality.

Joy Bangla
May Bangladesh live forever   **Wahida Akter**

Foreword

Human resources constitute the most critical inputs relying on the use of science and technology, which are sine qua non for economic development and social progress. Agriculture being the backbone of Bangladesh economy, the human resources need to meet various activities related to agricultural development towards sustainable growth and development. Agricultural Research and Development (R&D) through auspicious initiatives of NARS institutes have progressed leaps and bounds which helped Bangladesh transform subsistence agriculture into commercial agriculture in the recent years. This growth achieved in Bangladesh agricultural sector has been attributed to the concerted efforts of available skilled human resources. Under the direct guidance of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman, Bangladesh Agricultural Research Council (BARC), an apex of the NARS institutes, was revived and upgraded, and the scope of research and dynamics of the agricultural extension service were increased. With the combined efforts of all the NARS institutes, BARC has been continuously developing the scientists through training, higher education (MS and PhD degree) and seminar/workshop/study tour under the periodic Human Resource Development (HRD) plan. The unprecedented result of BARC prepared HRD plan 2009-2025 has paved the way for preparing the current HRD plan for the NARS institutes 2023-2041 with the novel initiative of the Project Implementation Unit (PIU)-BARC under the World Bank and IFAD funded National Agricultural Technology Program (NATP) Phase 2 project.

Bangladesh has fared commendably well moving away from the bane of poverty and despair to the boon of prosperity and high hopes today. The country has achieved unimaginable successes in recent years under the visionary and dynamic leadership of the Honorable Prime Minister Sheikh Hasina in increasing food security and nutrition, poverty alleviation and improvement of other social indicators. Through the Bangladesh Perspective Plan (BPP) 2041, the present Government has pledged of transforming Bangladesh into a developed country by 2041 and has already laid the foundation through the 8th Five Year Plan (2021-2025) giving priority to the human resource development for undertaking effective research.

Nevertheless, the situation of increasing population, degrading natural resources, shrinking arable land and pernicious impacts of climate change has compelled us to improve human resources of the NARS institutes both in terms of quality and quantity to achieve the goal of BPP2041. Underpinning the achievement of BPP2041, the HRD plan for the NARS institutes 2023-2041 has emphasized on phase-wise development of scientists aligning with the country's five-year plan with a special priority to increase the proportion of PhD degree from 40% to 70%. There is a horrendous need for increasing the proportion of PhD holders because NARS institutes and BARC having 41.2% PhD holders remain far below that of ICAR in India (77.5%).

I presume that the HRD plan 2023-241 will help all the NARS institutes and BARC reckon the milestones of improving the capacity of their scientists to face the formidable future challenges. I cordially recognize Dr. Harunur Rashid, Director, PIU-BARC, NATP-2 and all who worked hard for preparing such a commendable HRD plan.

Joy Bangla
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Dr. Shaikh Mohammad Bokhtiar

Director
Project Implementation Unit
National Agricultural Technology Program-Phase II Project
Bangladesh Agricultural Research Council

Preface

Bangladesh has achieved immense success in increasing food production from the agricultural sector (crop, livestock, and fisheries) to feed for an increasing population under threats of dwindling natural resources, changing climate, and competitive transboundary issues. Providing food and nutrition security for the people of Bangladesh has always been high on the nation-building agenda of the present Government led by Honorable Prime Minister Sheikh Hasina. Following the long-waited dreams of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman, the Government has formulated many policies, strategies, and plans, of which National Agricultural Policy (NAP) 2018, Bangladesh Perspective Plan (BPP) 2041, 8th Five Year Plan (2021-2025) and Bangladesh Delta Plan (BDP) 2100 are of prime importance for the development of skilled human resources.

The emerging future challenges and opportunities in the agricultural sector require a pragmatic research direction for incredible advancement of technologies towards safe, sustainable, and commercial production to achieve the goal of the BPP 2041 and beyond, the BDP 2100. To tackle the magnificent targets of agricultural research in the future, a competitive competence-based Human Resource Development (HRD) plan for all the 13 NARS institutes and BARC is indispensable which will not be accomplished with the existing BARC-prepared HRD plan 2009-2025. Therefore, an initiative has been taken to prepare a long-term HRD plan aligning the plans and policies of the country and the demand of different institutes. While preparing the HRD plan 2023-2041, the existing capacity of each NARS scientist and the institute they belong to, and corresponding future requirements for the skilled scientific manpower to be developed through higher studies (MS, Ph.D., and Post-Doc), short-term training and seminars/workshop/study tour are taken into account. The relevant information is collected mainly through the Training Need Assessment (TNA), skill gap analysis, Focus Group Discussion (FGD), and Key Informant Interviews (KII) following both bottom-up and top-down approaches.

This HRD Plan 2041 is by far the most precise planning document among similar other documents due to its institute-wise periodic planning in congruence with the country's five-year plan. I am highly grateful to Dr. Shaikh Mohammad Bokthiar, Executive Chairman, BARC for his empiric leadership and support provided during the entire period of preparing this HRD plan. My heartfelt thanks and gratitude go to my colleagues and team members in BARC and the related others who took enormous hardship with patience in capturing the opinions from the grass-root level and ushering potential opinions into the planning document. I strongly believe that the HRD Plan 2041 will be a road map for the NARS institutes in pursuit of transforming Bangladesh into a developed country by 2041. Definitely, this document will guide the policy makers and the donors for investing in developing strong science base community in the agricultural research system.

Joy Bangla
May Bangladesh live forever

Dr. Md. Harunur Rashid

Abbreviations and Acronyms

ACIAR	:	Australian Centre for International Agricultural Research
AFACI	:	Asian Food and Agriculture Cooperation Initiative
APAARI	:	Asia Pacific Association of Agricultural Research Institute
ARI	:	Agricultural Research Institute
BARI	:	Bangladesh Agricultural Research Institute
BARC	:	Bangladesh Agricultural Research Council
BAU	:	Bangladesh Agricultural University
BCR	:	Benefit Cost Ration
BFRI	:	Bangladesh Forest Research Institute
BFRI	:	Bangladesh Fisheries Research Institute
BIMSTEC	:	Bengal Initiative for Multi-Sectorial Technical and Economic Cooperation
BINA	:	Bangladesh Institute of Nuclear Agriculture
BJRI	:	Bangladesh Jute Research Institute
BLRI	:	Bangladesh Livestock Research Institute
BRRI	:	Bangladesh Rice Research Institute
BSRTI	:	Bangladesh Sericulture Research and Training Institute
BSRI	:	Bangladesh Sugarcrop Research Institute
BTRI	:	Bangladesh Tea Research Institute
BWMRI	:	Bangladesh Wheat and Maize Research Institute
CABI	:	Centre for Agriculture and Bioscience International
CDB	:	Cotton Development Board
CIP	:	International Potato Centre
CIMMYT	:	International Maize and Wheat Improvement Centre
CSO	:	Chief Scientific Officer
EC	:	Executive Chairman
FAO	:	Food and Agriculture Organization
FGD	:	Focused Group Discussion
GB	:	Governing Body
GIS	:	Geographical Information System
GIFS	:	Global Institute for Food Security , University of Saskatchewan
GoB	:	Government of Bangladesh
HRD	:	Human Resource Development
ICAR	:	Indian Council of Agricultural Research
ICT	:	Information and Communication Technology
ICARDA	:	International Centre for Agricultural Research in the Dry Areas
ICRISAT	:	International Crops Research Institute for the Semi-Arid Tropics
ICIMOD	:	International Centre for Integrated Mountain Development
IPGRI	:	International Plant Genetic Resources Institute
IFPRI	:	International Food Policy Research Institute
IFAD	:	International Fund for Agricultural Development
IDA	:	International Development Association
IFAD	:	International Fund for Agricultural Development
IRRI	:	International Rice Research Institute
JAICA	:	Japan International Cooperation Agency
KII	:	Key Informant Interviews
KSA	:	Knowledge, Attitude and Skill
MARDI	:	Malaysian Agricultural Research and Development Institute
MD	:	Member Director
MoA	:	Ministry of Agriculture
MS	:	Master of Science

NARI	:	National Agricultural Research Institute
NARS	:	National Agricultural Research System
NATP	:	National Agriculture Technology Program
NARC		Nepal Agricultural Research Council
NGO	:	Non-Governmental Organization
NRM	:	Natural Resource Management
P&E	:	Planning and Evaluation
PCARRD	:	Philippines Council for Agricultural Research & Development
PCU	:	Project Coordination Unit
PhD	:	Doctor of Philosophy
PSO	:	Principal Scientific Officer
RARS	:	Regional Agricultural Research Station
SAARC	:	South Asian Association for Regional Cooperation
SLCARP	:	Sri Lankan Council for Agricultural Research Policy
SDG	:	Sustainable Development Goal
SRDI	:	Soil Resources Development Institute
SO	:	Scientific Officer
SSO	:	Senior Scientific Officer
TNA	:	Training Need Assessment
TTMU	:	Technology Transfer and Monitoring Unit
WVC	:	The World Vegetable Centre
USAID	:	United States Agency for International Development
WFC	:	World Agroforestry Center
WB	:	The World Bank
World Fish	:	World Fish Center
YAAS	:	Yunnan Academy of Agricultural Sciences

Contents

Contents

Introduction

Background

The economy of Bangladesh is primarily dependent on agriculture. A lion shares of the total population lives in rural areas of Bangladesh and is directly or indirectly engaged in a wide range of agricultural activities. Bangladesh is one of the most densely populated countries in the world and its agricultural land is decreasing as the population is increasing rapidly. Agricultural land of Bangladesh has been decreasing by 0.24% per year (Bakhtiar et al., 2023). The population of Bangladesh is 165.16 million in 2022 (BBS 2022), which is expected to reach 204 million by 2050 (*https://www.populationpyramid.net/bangladesh/2100/*). Hence, to meet the demand of this increasing population it is quite logical that smart and sustainable agricultural technologies essentially be developed by the research organizations to increase agricultural production in achieving self-sufficiency of food.

The scientific and technological advancements are the main driving forces of growth and development in agriculture and allied sectors. These factors enable the country to be achieving food and nutrition security with reasonable degree of resilience. The agricultural development in Bangladesh faces many challenges such as reducing natural resources, climate change, conversion of agricultural land into nonagricultural uses, saline water intrusion, floods (including flash floods), cyclones, drought, and other natural calamities. To address these challenges impacting agriculture and remain globally competitive, it is essential that the research institutes are able to foresee the challenges and prioritize research programs so that the country's agriculture is not constrained due to lack of appropriate technologies.

The Agricultural Research Institutes (ARIs) working under the umbrella of National Agricultural Research System (NARS) play a vital and pioneering role in generating technologies to meet the future challenges and demands of the country. It would be possible to keep the above role continuing with even higher level, if the ARIs can increase their capacities in both scientific manpower and infrastructures. Capacity development for conducive research management and maximizing the resource management at all levels are crucial for the ARIs to be successful in achieving their overall objective of increasing agricultural production. To be an effective and efficient research institute for achieving desired agricultural production, each and every NARS institute should have its own human resources development plan.

Present status of agriculture

Agriculture sector plays an important role in overall economic development of Bangladesh. The agricultural sector (crops, livestock, fisheries, and forest subsectors) contributed 12.07% share of the country's GDP, provided employment about 40.6% of the labor force during the financial year 2020-2021 (BBS 2021). Moreover, agriculture is the source of a wide range of consumer demanded agricultural commodity markets, especially, in rural areas. Indeed, Bangladesh is one of the most densely populated countries in the world with a density of 1,265 people living per square kilometer. The overall data about Bangladesh Agriculture are depicted in Box 1. The yield and production of major crops in Bangladesh have shown an increasing trend (BBS 2021).

Box 1. Bangladesh at a glance	
1. Total Land Area	: 130,170 sq. km
2. Total Population	: 165,158,616
3. Density of population	: 1,265 per sq. km
4. Total Households	: 286,95,763
5. Total Households Involved in Agriculture	: 151,83,183
6. Total Cultivable Land	: 8.577 million hectares
7. Total Irrigated Land	: 7.448 million hectares
8. Fallow Land	: 0.223 million hectares
9. Single Cropped Area	: 2.253 million hectares
10. Double Cropped Area	: 3.914 million hectares
11. Triple Cropped Area	: 1.763 million hectares
12. Quadruple Cropped Area	: 0.017 million hectares
13. Net Cropped Area	: 7.947 million hectares
14. Gross Cropped Area/ Total Cropped Area	: 15.438 million hectares
15. Share of Agricultural Sector to GDP	: 12.07 % (at constant prices)
16. Share of Crop Sector to GDP	: 5.70 % (at constant prices)
17. Share of Animal Sector to GDP	: 1.98% (at constant prices)
18. Share of Fisheries Sector to GDP	: 2.64% (at constant prices)
19. Share of Forestry Sector to GDP	: 1.75% (at constant prices)
20. Manpower Involvement in Agriculture	: 40.6 %

Source: (1) BBS, 2022; (2) BBS, 2021; (3) UNDP, 2022; (4) World Bank, 2022

Rice, wheat, pulses, oilseeds, vegetables, fruits, fish, milk, meat and egg are the major sources of food for the people of Bangladesh. Total production of the above foods has increased to 89.4 million tons in 2020-2021 (BBS, 2021) from 57.5 million tons in 2010-2011 (BBS, 2012).

Total production from crop sector (rice, wheat, pulses, oilseeds, spices, vegetables and fruits) has increased to 63.3 million tons in 2020-2021 from 50.5 million tons in 2010-2011 (BBS, 2012; BBS, 2021). Rice production has increased to 37.6 million tons in 2020-2021 from 32.0 million tons in 2010-2011. Wheat production has increased to 1.1 million tons from 0.9 million tons while maize output increased to 4.11 million tons from 0.89 million tons during the same period (BBS, 2012; BBS, 2021).

Livestock sector also plays an important role in the overall agricultural production. About 2.9% national GDP is covered by the livestock sector with its annual growth rate of 5.5% (Bhuyan, 2020). The livestock population in Bangladesh is estimated to comprise 25.7 million cattle, 0.83 million buffaloes, 14.8 million goats, 1.9 million sheep, 118.7 million chicken and 34.1 million ducks in 2020 (Bhuyan, 2020). Meat production has increased from 1.26 million tons in 2020-2021 to 8.4 million tons in 2010-2011 while milk and egg production increased from 2.37 to 11.9 million tons and from 6.1 to 20.6 billion eggs respectively, during the same period (BBS, 2012; BBS, 2021). Fisheries sector contributes about 3.69% to the GDP and 22.60% to the country's total agricultural products (Bhuyan, 2020). Fish production has also increased from 3.06 million tons in 2010-2011 to 4.50 million tons in 2020-2021 (BBS, 2012; BBS, 2021).

Despite all limitations and many other odd agro-climatic and environmental situations, Bangladesh has made a remarkable growth and development in agriculture during the last 50 years. The visible impact of growth in agriculture has been reflected by many social, economic and livelihood indicators which have resulted in significant reduction of poverty (BARC, 2021a). Bangladesh ranks 3rd in the world rice production, 2nd in jute production, 3rd in vegetable, 7th in potato and mango production, eighth in guava production, 1st in *hilsha* fish production, 3rd in inland freshwater fish production and 4th in goat meat production.

The agriculture sector although plays the key role in food security and livelihood improvement, it faces many challenges created by both human and nature. The agricultural arable land is shrinking with an alarming rate due to expansion of urbanization, roads, infra-structure, etc. Serious degradation of natural resources like soil, water, climate, etc. occurs due to frequent devastating flood and drought that appear on a regular basis. Salinity increases in the coastal region due to frequent tidal floods causing intrusion of saline water from the Bay of Bengal. Further, the change of climate and its adverse effect on agriculture in Bangladesh is considered as the worst resulting in the following:

i)   temperature rise,
ii)   abnormal rainfalls,
iii)   sea-level rise,
iv)   cyclone and storm surges in high frequency and volume,
v)   encroachment of more areas by salinity,
vi)   further aggravation of drought problem and
vii)   reducing availability of surface and ground water, etc.

In other words, Bangladesh agriculture is going to face serious natural problems in the 21st century that warrant special attention to this sector.

Agricultural research in Bangladesh

Agricultural research in Bangladesh is conducted mainly by 13 NARS institutes and some agricultural universities. Research on crop varieties is conducted by 10 commodity based research institutes while there are separate institutes for conducting research for livestock, fisheries and forestry. Each of these research institutes has developed so far a considerable number of technologies. The 13 institutes under NARS have developed 655 high yielding varieties and 591 advanced technologies since 2009 (BARC, 2021b).

A considerable progress has also been made in case of digitalization in agriculture: The notable among agricultural digitalization is mobile apps of agricultural technology, community rural radio, agricultural call center, agri-website, e-book, ICT lab and agricultural information (e.g. *kiosk*). Print media, radio and television are working as co-actors of these activities.

Emerging challenges in agriculture

While narrating the 100 years of agricultural development in Bangladesh, Bohktiar et al., (2021b) have identified the following major emerging constraints in agriculture:

i)   Reduction of cultivable lands and natural resources
ii)   Soil degradation
iii)   Limitations of agro-processing industries
iv)   Narrowing diversity of agricultural production
v)   Shortage of agricultural laborer
vi)   Climate change impacts
vii)   Skill gap in scientists and academicians in agricultural research and education.

Rahman (2017) has also identified the following upcoming challenges in agricultural sector in Bangladesh:

i)   Increasing agricultural production through sustainable use of resources
ii)   Promoting agricultural research for enhancing productivity

iii) Commercialization of agriculture
iv) Sustaining self-sufficiency in rice production
v) Diversification toward high value crops
vi) Farm mechanization
vii) Overcoming the socioeconomic constraints
viii) Managing open water fisheries
ix) Sustainable development of shrimp farming
x) Conserving marine fishery resources and expanding marine fishing zone
xi) Developing and preserving improved breeds of livestock
xii) Conservation of forest resources
xiii) Mitigating the climate change impacts

The above challenges have to be addressed by the agricultural research institutes. However, in conformity with the National Agricultural Policy-2018 the agricultural research institutes, in addition to the above challenges, have to address the following issues:

i) Developing climate change adaptive and environment-friendly technologies.
ii) Conservation of environment and natural resources.
iii) Developing technologies for:
   - coastal agriculture
   - haor and wetland agriculture
   - hill agriculture
   - barind agriculture
   - charland agriculture.
iv) Ensuring development of technologies, which are able to produce safer, nutritious and demand driven foods.
v) Developing human resources capable of generating smart agricultural technologies

Human resource development (HRD)

Human resource (HR) is the most important and key resource to organizational development and success. The HR acquiring and mobilizing other organizational resources performs to achieve organizational goals. Being crucial for an organization, updating capacity of its human resources to address emerging challenges and meet changing working situation under diversified threats is a must. Therefore, regular capacity development of human resources is an important aspect in management and development of organizations. Capacity development of human resources can be achieved through Human Resources Development (HRD) plan and effective implementation of this HRD plan. Human resource development refers to the training, higher studies, exposure trips to learning centers etc., that organizations provide to their human resources so that they can develop the skills needed to achieve the organizational goals and success. Human resource development is organized learning experiences gained by employees to bring about possibility of performance growth or personal growth within the specified period (Giley and Eggland, 1989). It is a process of developing and unleashing human expertise through personal training and organizational development for the purpose of improving performance (Swanson and Holton, 2001). Many employees come into an organization with only a basic level of skills and experience and hence must receive training to do their jobs effectively. Others may already have the necessary skills to do the job, but do not have adequate knowledge and skills related to the organizations they join. The HR development is designed to give employees the information they need to adapt to the organization's culture, mandates, and to do their jobs effectively as per roles and responsibilities.

The HRD efforts should fit in with the developmental needs of organizations. It is the institutionalization of all effective components of human resource management such as training and development, performance management and career development. The HRD activities can take place in different forms in organizations

such as job rotation, job enlargement, job enrichment, training and development. Strengthening human resources in agricultural research can be a significant contribution to increasing agricultural production to the levels required to feed the country's growing population.

Framework of human resources development

Human resource development is a set of systematic and planned activities designed by an organization to provide its members with opportunities to learn necessary skills to meet current and future job requirements. The HRD activities begin when an employee joins an organization and continue throughout the development of his or her career, irrespective of the authority and responsibility level that the employee holds. Human resource development plans are action steps, which indicate how resources will be allocated and which activities will be funded, encouraged and implemented so that the   development goals of human resources will be achieved. The basic HRD process is shown in Figure 1.

Figure 1. Basic HRD Process

Need of human resource development

Human resources of an organization are required to be developed due to the following needs:

i)   Ensure availability of capable and committed manpower,
ii)   Improve competencies of manpower,
iii)   Enhance their effectiveness,
iv)   Foster teamwork,
v)   Facilitate career development,
vi)   Increase job satisfaction,
vii)   Improve decision-making ability of manpower, and
viii) Increase capability of manpower to manage and adapt to changing environment and conflicts,

Objectives of HRD for NARS Institutes

i)   To develop the competence of human resources of the NARS institutes to achieve the desired goals.
ii)   To create an environment of commitment and dedication among employees of the research institutes.
iii)   To develop a conducive organizational culture to achieve the mission for existence.
iv)   To create policies, procedures and systems to train the employees for better performance that is based on trust, commitment, dedication, loyalty and growth.

Types of HRD

Human resource development usually begins as soon as an employee is hired, which continues throughout that employee's tenure with the organization. HRD starts in different forms including on-the-job training or job shadowing, textbook or online education, growth opportunities, compliance training, intellectual or professional development etc.

On-the-job training: Through on-the-job training, an employee may know the basics of what the job requires, which forms to use, where materials are stored, and how to get access to the computer systems.

Job shadowing: Job shadowing is that an employee watches another employee, who performs the job in order to develop the proper skills.

Intellectual or professional development: It includes certification courses at the colleges/ universities, or job specific short or higher training including MS and PhD, and seminars/ workshops related to how an employee can do his or her job better. It is widely recognized that the knowledge and skills of scientists can be improved through advanced studies like MS and PhD.

Many organizations invest heavily in providing training to their employees to increase their knowledge and skills. However, with the growth of online learning many training programs have now become available via webinars and online courses. But it is still very essential to conduct in-person trainings, seminars and conferences with other professionals. Many professionals also voluntarily take additional training and development courses to make them experts in their fields.

HRD practices

Bringing competencies among the researchers is not an easy task. It involves series of actions such as:

   i)   fair recruitment of the scientists,
   ii)   training and motivations among the employees of the research institutes,
   iii)   creating congenial atmosphere for research and development activities, and
   iv)   developing policies, procedures and systems to train the researchers for their better performances.

Anjum and Zahan (2021) described the basic processes and practices of human resources management in the context of Bangladesh. The summary of the practices is stated below:

Recruitment and Selection: Recruitment is the practice carried out by an organization for identifying and attracting potential employees to build a pool of job seekers. Selection is the process of picking the right candidates from this pool of job seekers.

Training and development: Training involves the use of formal processes to impart knowledge, and helps people acquire the skills necessary for them to improve their performance.

Performance appraisal: Performance appraisal is the assessment of an individual's performance against well-defined standards of his or her job descriptions. It highlights employee's potential, their strengths and weaknesses as well as helps in determining the needs of training and development programs for that employee. Most importantly, an effective appraisal scheme can improve the future performance of staff and act as a basis for review of financial rewards and planned career progression.

Compensation and benefit: Compensation includes both financial and nonfinancial rewards, which the employees receive in exchange of their contribution to the organization. It is composed of the basic wage or salary, incentives or bonuses and benefits.

Increasing knowledge, skills and changing attitude for HRD

Efficient human resources are essential for developing innovative technologies, institutional skills and entrepreneur development. It is possible to develop skilled human resources by introducing a system of reward for work-based training and important contributions (NAP 2018). To achieve professional skills, the implementation of appropriate training and education package-based programs that accelerate agricultural development activities is essential. For increasing efficiency and productivity of an organization, three basic elements are important. These are: (i) fair recruitment of staff (ii) capacity building, and (iii) working environment.

Fair recruitment of manpower in a research organization is one of the pre-conditions for increasing organizational efficiency. For human resource development of any organization, each and every person working in the organization has to acquire adequate knowledge in his or her area. Secondly, for better performance of the researchers in the organization, there should have strong manpower development programs for capacity development. This would greatly help the researchers to show his/her abilities, capabilities and commitment in all matters related to his/her job performance and efficiency. Finally, a congenial working environment is essential for the researchers to contribute significantly to the organization. Conducive working environment is related to good governance. Unless good governance is established, and congenial working environment is created it becomes difficult even for the most knowledgeable, sincere and committed researchers to contribute to his/her organization. Thus, fair recruitment of manpower in the organization, capacity building and above all establishment of good governance greatly contribute to increase organizational efficiency and productivity.

However, for overall agricultural development of the country, the scientists working in the agricultural research institutes (ARIs) need not only the latest scientific knowledge on the subject but also adequate skills for conducting research activities and favorable attitude to work whole-heartedly for the institutes. The following five elements of information and knowledge management approach have been identified in the Bangladesh Delta Plan – 2100: (a) knowledge needs and agenda, (b) knowledge accumulation, (c) knowledge availability, (d) value realization, and (e) delta knowledge community (GoB, 2018). Without the integration of knowledge, skills, and attitude (KSA), the researchers may not be able to contribute significantly and prove his/her worth in research and development (R & D) activities. It is quite likely that lower is the integration of KSA, lower would be the performance vis-à-vis agricultural development (AgDev). Based on the above discussions about the human resource development practices, the individual NARS institute should take initiatives for HRD in their own way. However, apart from strong knowledge base, arrangements should be made for providing adequate skills to the scientists in their respective disciplines/areas and developing favorable attitudes of the scientists to work for the research institutes. The BARC, as the apex body and coordinating agency of NARS institutes, should take responsibilities for training and development of their scientists.

HRD Vision 2041 for the NARS institutes

A vision statement for any plan describes the purpose, what the particular plan is striving for, and what it wants to achieve. The HRD plan for the NARS institutes up to 2041 has the following vision:
"To develop effective and efficient, knowledge and skilled based manpower for sustainable growth and development of agricultural sector."

Mission

Sustainable growth and development of agricultural sector through developing efficient and skilled human resources, strengthening and modernizing research activities of the NARS institutes in collaboration with universities, private sectors and other stakeholders for generating need-based technologies and information appropriate for the end users.

Methodology

Methodology is a way to systematically conduct a study following a standard and acceptable procedures. It explains various steps that are adopted in conducting the study, along with logics behind it. While developing HRD plan 2041, the following methods, tools and sources were adopted to identify actual competency and functional gaps of human resources in the NARS institutes:

Methods

    i)   Workshops
    ii)   Interview
    iii)   Training Need Assessment (TNA)
    iv)   Focus group discussion (FGD)
    v)   Key Informant Interview (KII)

Tools

    i)   Structured questionnaire for collecting data from the individual scientist
    ii)   Structured questionnaire for collecting data from the NARS institutes
    iii)   Structured questionnaire for collecting data from BARC scientists
    iv)   Semi-structured questionnaires for conducting FGDs with scientists of NARS institutes
    v)   Format for TNA (Training Need Assessment)
    vi)   Checklist for conducting interviews with KIs (Key Informants)

Sources

  a. **Primary sources:**

    i)   Scientists working in the NARS institutes
    ii)   Director Generals, Executive Director (CDB) and Directors (BTRI, BFRI-forest, and BSRTI) of NARS institutes
    iii)   Director (Research/Agriculture) of NARS Institutes
    iv)   Senior agricultural scientists working in the NARS institutes
    v)   Senior and veteran agricultural researchers of Bangladesh

  b. **Secondary sources:**

    i)   Previous records, reports and publications
    ii)   Existing policies and practices

Process for finalization of tools

Structured questionnaires for the individual scientists and the NARS institutes, semi-structured questionnaires for conducting FGDs, checklists for interviews with the key informants, tools for conducting Training Need Assessment (TNA) of different categories of scientists were prepared. These draft data collecting instruments were presented in a virtual workshop on 09 September 2022 in BARC. The Director Generals, Director (Research/Agriculture) and concerned others of the NARS institutes were present in the workshop. The Executive Chairman (in-charge), BARC presided over the workshop. Considerable feedbacks were received from the workshop to improve the instruments. Based on the feedback, the draft instruments were modified/ amended as required. Finally, the structured questionnaires were sent to the Director Generals, Executive Director, Director and Director (Research/Agriculture) of the NARS institutes. A link was also sent to them with a request to send the same to individual scientists for uploading their individual data profile. Copies of different structured questionnaires, semi-structured questionnaire, TNA tools and checklists are furnished in *Appendix- I, II, III, IV, V, and VI,* respectively.

In consultation with the head of the institute, a date was finalized by the Director, PIU-BARC, NATP-2 to conduct the TNA and FGD (Focus Group Discussion). The TNAs and FGDs were conducted as per schedule (Appendix VII and VIII). Training Need Assessments (TNA) and Focus Group Discussions (FGDs) were conducted directly by visiting and discussing with every NARS institute (*Appendix VII)*. The photographs of the TNA and FGD sessions are presented in *Appendix-VIII.* Dates of key interview sessions and photos are presented in *Appendix-IX and X,* respectively. The scientists of all the NARS institutes uploaded their data profile individually via a link sent to them and subsequently sent their profiles through their respective institutional heads (DG/ED/Director). The data are given in Appendix XI.

Description of the methods

The information from both primary sources (TNA, FGD and KII) and secondary sources (documents review) was tabulated and cross tabulated. Based on the available scientific manpower information from NARS institutes and recommendations of different seminars, conferences, and face to face discussion with the scientists of NARS institutes and concerned other related personnel, the HRD plan for NARS institutes -2041 has been prepared.

Available documents and existing literatures relevant to human resource development have been consulted prior to prepare the present document. BARC developed HRD plan 2009-2025 for the NARS scientists has also been reviewed during preparation of the current document of HRD plan. As discussed earlier, adequate attempts were made to gather information on the manpower development from the NARS institutes.

Training Need Assessment

Training needs of the scientists in NARS institutes were identified in two methods: (i) information were collected from the individual scientists of all the NARS institutes through an internet link provided to them. The scientists themselves uploaded their profile data along with their training needs; and (ii) Training Need Assessments (TNAs) were conducted to find out skill gaps of the scientists in each NARS institute during 25 September to 24 October 2022 (Appendix VII). The TNAs were conducted by using standard tools that had been developed by FAO (Food and Agriculture Organization) of the United Nations. The tools are composed of three sets of Worksheets: (a) Job Analysis Worksheets, (b) Task Analysis Worksheets, and (c) Skill-Gap Analysis worksheets (Appendix V).

Training needs identified from individual scientists of the NARS institutes: A total of 316 scientists in all categories (SO/RO/, SSO/SRO, PSO and CSO) from the NARS institutes uploaded their personal data indicating their training needs for different areas. The scientists had the options to indicate the types of training (MS, PhD, Short Term Training, Professional Training and post-Doc) they need during the period from 2023 to 2025, 2026 to 2030, 2031 to 2035, and 2036 to 2041. Many scientists of the NARS institutes categorically indicated their needs. This information is indeed very useful when the scientists of the NARS institutes will be selected for higher training. The detail of the training needs as identified by individual scientists of the NARS institutes are presented in Appendix XII a.

Skill gaps of NARS scientists identified through TNAs (Training Need Assessments): Training need assessment (TNA) sessions for identifying the skill gaps were conducted in each NARS institute including BARC (Appendix VII and VIII). After the practical session, the scientists of each NARS institute were advised to conduct TNAs involving all categories of the scientists and identify their skill gaps and training needs. Skill gaps analysis was determined by using Job Analysis (JA) and Task Analysis (TA) of the scientists. Job Analysis and Task Analysis scores ranged from 3 – 12. However, the job and tasks with scores ranging from 9 - 12 were considered for Skill Gap Analysis. The skill gaps were identified based on the tasks they perform in their daily routine activities. Finally, the training needs of scientists in NARS institutes were identified considering their skill gaps. The composite training needs of the NARS institutes have been presented in Appendix XII b.

Focus Group Discussion: Focus Group Discussions (FGDs) were conducted in each NARS institute with the selected scientists of all categories (SO, SSO, PSO, CSO, CSO and Head) (Appendix VII). Information was noted down by the respective consultant himself and by a representative nominated by the Director, NATP-2 project. Moreover, with the consent of participating scientists FGDs were also recorded electronically for its subsequent use at the time of compilation and preparation of this report.

Key Informant Interview (KII): Key interviews were conducted in order to get information regarding HRD plan for 2041 for the NARS institutes from the very learned and experienced persons in the field of agricultural research in Bangladesh. Four Key Informants Interviews (KIIs) were conducted. A total of 4 eminent scientists in different disciplines of agricultural research (e.g. crop, livestock, fisheries, and agricultural engineering and natural resources were interviewed as the key informants. The excerpts of interviews are shown in Appendix VI b.

Preparation of the HRD plan

The HRD plan report has been arranged under the following headings:

   (i)   Existing scientific manpower of the NARS institutes,
   (ii)   Major research achievements,
   (iii) Present skilled manpower and future need of skilled manpower.

The collected data were compiled, coded and analyzed through MS Excel program. Different statuses of the completed degree programs (MS, PhD and Post-Doc), retirement and ongoing degree programs as well as future needs for different degree programs were taken into consideration.

HRD Plan for the NARS Institutes: 2023-2041

To make the NARS institutes innovative, productive and more useful to fulfill the country's emerging needs for ensuring food security of ever increasing population, it is essential to develop an effective and functional HRD plan in consultation with all the stakeholders.

Human resources requirement and their training

Skilled human resources are the prerequisites for overall growth and developments of the NARS institutes. The NARS institutes should give emphasis on strengthening its HRD program by incorporating newer and need-based course curriculum, and training programs (short, medium and long term). Each NARS institute should develop its own tailor-made training programs based on Training Need Assessments (TNAs). Once the TNAs are done, the manpower of the NARS institutes can be developed through training according to their skill gap or need identified in TNAs. However, emphasis may be given on the integrated farming systems, soil and water productivity improvement, gene editing, biotechnology, conservation agriculture, pest and disease prevention, integrated aquaculture, bio-informatics, artificial intelligence etc.

Existing status of scientific manpower of BARC and the NAR institutes (NARIs)

Before going to plan HRD, it is quite logical to have clear-cut ideas and basic information about the BARC and each NARS institute. The background, organogram, present achievements, existing manpower and future human resource development plan (2023 -2041) of BARC and NARS institutes are stated below.

Bangladesh Agricultural Research Council (BARC)

Bangladesh Agricultural Research Council (BARC) was established in the year 1973 under the Ministry of Agriculture. Since its inception in 1973, vide ordinance No. 32. Amendments made vide Act No. 28 of 1988 and 1996 have provided clear definition and broad authority for the quality improvement of agricultural research manpower in the country.

The authority of BARC is specified in four categories (BARC, 2020). They are to-

i) prepare a master plan for NARS manpower development, select candidates and award fellowships and scholarships within country and abroad.

ii) advise Government to represent Bangladesh in international conferences or seminars related to agricultural research.

iii) arrange national and international short courses of training, higher studies (MS, PhD), study visit, seminar, workshop, conference concerning agriculture as deemed necessary.

iv) sponsor and finance the travel expenses of researchers to visit appropriate institutes, universities and laboratories abroad where outstanding work relevant to Bangladesh context in their respective fields is conducted.

Due to the above authority, the Bangladesh Agricultural Research Council (BARC) acts as the apex of the National Agricultural Research System (NARS). It has the responsibility to strengthen the capability of national agricultural research through planning, training and integration of resources. It is the umbrella under which the entire efforts of agricultural research is coordinated.

Mandate

i) Prioritize the areas of agricultural research in line with the framework of the policies developed by the Government for the agricultural sector;

ii) Formulate essential and appropriate agricultural research plans for NARS institutes, and coordinate the same;

iii) Review and monitor the progress, and evaluate research activities of the institutes as per the schedule set in the approved research programs and proposals;

iv) Monitor the transfer of agricultural technology at the field level and advise the concerned organizations to address the bottlenecks in the dissemination of technology;

v) Undertake necessary steps for human resource and capacity development of the NARS institutes;

vi) Advise the Government in respect of problems and prospects of agricultural research and appropriate external assistance in the agricultural sector.

Organizational Structure

BARC has been implementing collaborative activities in several ministries of the Government like Agriculture, Environment, Forest and Climate Change, Fisheries and Livestock, Local Government, Rural Development and Cooperatives, Education, Industries, Commerce, Science and Technology, etc. BARC is organized into three main constituents i)the Governing Body (GB), ii) the Executive Council (EC) and iii) the Secretariat.

BARC Organogram

BARC has seven divisions headed by the Member Directors. The divisions are: (i) Administration and Finance, (ii) Planning and Evaluation, (iii) Crops, (iv) Natural Resource Management, (v) Agricultural Economics and Rural Sociology, (vi) Livestock, and (vii) Fisheries. These divisions are responsible for conducting activities in the specific fields or program areas. The BARC Secretariat, consisting of technical and general staff, has ten units i) Soils, ii) Forestry, iii) Agricultural Engineering, iv) Manpower and Training, v) Technology Transfer and Monitoring, vi) Computer and GIS, vii) Agricultural Information Centre, viii) Nutrition, ix) Support Service and x) Finance. Each division and unit of BARC is responsible for implementing policies and guidelines formulated by the Governing Body. They are also responsible for identifying problem areas and setting priorities for research, reviewing project proposals and reports, improving research extension linkages, developing capacity building to address emerging research issues, and keeping abreast of the progress of research. An organogram of BARC has been depicted in Figure 2.

HRD plan for national agricultural research system 2023-2041
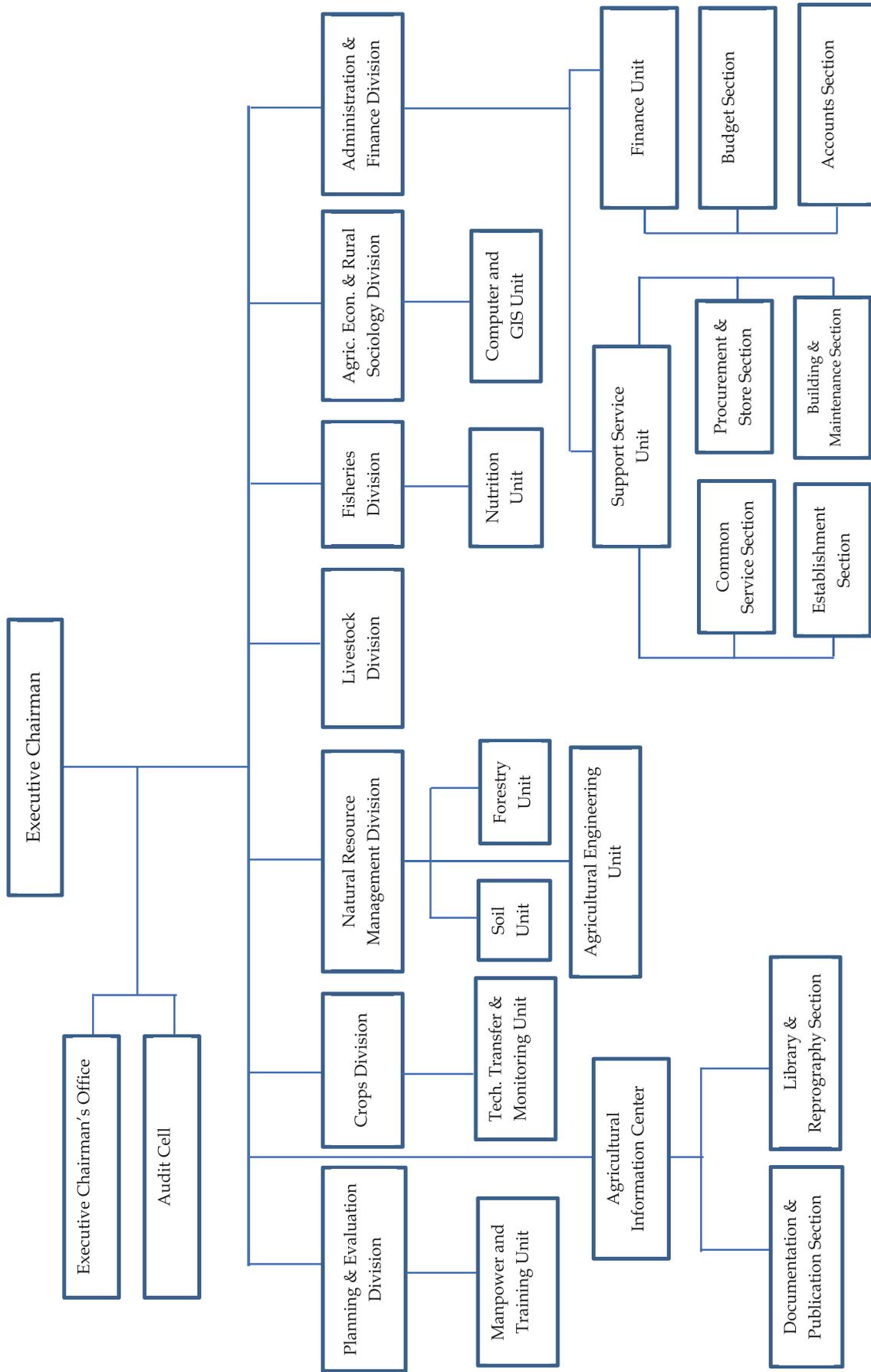
Figure 2. Organogram of BARC

13

Achievement of Human Resource Development and Future Human Resource Development Plan of BARC: The BARC has been developing and training its human resources since 1976. Quite a good number of scientists had been trained in different disciplines in various durations including MS and PhD degrees. Discipline-wise and Institute-wise manpower development of BARC from 1976 to 2022 are summarized in Table 1 and 2 respectively. In 47 years since 1976, BARC arranged PhD programs from foreign countries for 251 scientists and from in-country for 282 scientists (Table 1). The scientists from the crop subsector received the highest share of these PhD programs (195 from overseas i.e. 77.7% and 239 from in-country i.e. 95.2%) compared to that in livestock (22 overseas and 14 in-country), fisheries (21 overseas and 19 in-country) and forestry (13 overseas and 11 in-country) subsector. Similar distribution is true for MS programs (total 60 foreign and 83 local), short-term training (total 834 foreign and 15,571 local) and seminar/workshop/study tour (total 992 foreign and 21,399 local) as the scientists of livestock, fisheries and forestry subsectors together received less than 20% of these assistances. Out of the 13 NARS institutes, BARI is by far the largest one receiving the highest share of all these skills development programs (25-50% overseas and 20-39% in-country) for its scientists during the same period due to many departments and scientists involved in each department (Table 2). BLRI, BFRI-fisheries and BFRI-forest contributing significantly to country's food security, nutrition and environment received lower share of these assistances compared to most of the crop-based NARS institutes. This skewed distribution of skills development programs to the crop subsector is primarily due to many disciplines in this sub-sector. However, skill gap in scientists is evident in the livestock, fisheries and forestry subsectors due to poor share of assistance for higher studies (MS and PhD), training, study tour etc., and hence care should be taken in future to increase the share of these skill development programs.

Table 1. Discipline-wise manpower development activities of BARC under various projects during 1976-2022 (cumulative)

Field of Training	Foreign					Local			
	PhD	MS	S.T.T.	S.W.ST.		PhD	MS	S.T.T.	S.W.ST
Agronomy	30	12	78	72		49	11	1825	1560
Plant Breeding	39	4	82	78		28	10	620	1515
Entomology	20	5	42	43		17	9	1094	1081
Plant Pathology	12	1	33	35		16	7	533	1025
Horticulture	18	1	46	46		20	6	1060	1220
AERS	18	7	45	38		21	4	856	1068
Farming Systems Research	12	1	52	69		12	3	617	1335
Soils	18	4	78	52		30	7	984	1425
Agricultural Engineering	7	3	22	61		8	3	485	710
Irrigation	8	3	23	25		2	2	632	775
Library & documentation	1	0	12	18		0	0	336	420
Training &Communication	0	1	32	26		0	0	469	1070
Planning & Research Management	3	3	90	135		0	0	1596	1649
Livestock	22	4	26	41		14	8	636	920
Fisheries	21	5	23	18		19	5	515	996
Forestry	13	3	15	19		11	0	305	545
Jute Technology	3	0	0	11		4	0	322	470
Computer	0	0	35	19		0	0	460	450
Agricultural Extension	2	2	10	30		15	2	1176	1015

Field of Training	Foreign					Local			
	PhD	MS	S.T.T.	S.W.ST.		PhD	MS	S.T.T.	S.W.ST
Nutrition	1	1	12	17		2	0	510	630
Others	3	0	78	139		14	6	540	1520
Total	251	60	834	992		282	83	15,571 (530)	21,399 (334)

PhD=Doctor of Philosophy, MS=Master of Science, S.T.T.=Short Term Training, S.W.ST.= Seminar/Workshop/ Study Tour; () Parenthesis indicates number of courses.

Table 2. Institute-wise manpower development under various projects of BARC during 1976-2022 (cumulative)

Organization	Foreign						Local			
	Post Doc.	PhD	MS	S.T.T.	S.W.ST.		PhD	MS	S.T.T.	S.W.ST.
1. BARI	2	82	30	265	252		110	25	5,649	4,198
2. BRRI	1	41	16	97	54		36	4	1,182	1,768
3. BJRI	1	11	5	63	23		18	6	778	1,115
4. BSRI	4	16	4	34	47		18	17	459	685
5. BINA	1	10	0	29	19		11	1	646	1,097
6. BFRI-Fisheries	0	20	0	25	15		18	5	551	717
7. SRDI	0	4	0	7	7		10	0	277	412
8. BLRI	4	21	0	38	35		6	0	753	667
9. BTRI	0	2	0	2	1		2	0	167	166
10. BFRI-Forest	3	10	3	18	43		4	0	201	381
11. CDB	0	1	0	2	4		1	0	277	248
12. BSRTI	0	0	0	0	0		3	0	61	37
13. BWMRI	0	0	0	0	0		0	0	8	53
14. BARC	14	18	2	173	319		9	0	1,904	6,796
15. BAU	0	10	0	30	45		10	11	421	62
16. DAE	0	0	0	3	21		11	3	513	459
17. DLS	0	0	0	0	0		5	0	122	197
18. DOF	0	0	0	0	0		5	0	88	205
19. MoA	0	3	0	14	38		1	0	0	32
20. Others	0	2	0	34	69		4	11	1,514	2,104
Total	30	251	60	834	992		282	83	15,571 (530)	21,399 (334)

() Parenthesis indicates number of courses.

Discipline-wise scientific manpower provision, existing and vacant posts as well as discipline wise present scientific manpower with MS and PhD degrees including their retirement status as of June 2022 are presented in Table 3 and 4 respectively. BARC had the provision of 39 researchers out of which 23 scientists existed and 16 positions were vacant in 2022 (Table 3) indicating its significant vacancies (41%), albeit it increased number of scientists from 18 in 2020 (Bakhtiar et al., 2021). However, the number of scientists in BARC abruptly fell down from 37 in 2009 (BARC 2010) to 23 in 2023 (Table 3). This shortage of scientists in BARC due to vacancies cannot extenuate challenges of managing and coordinating NARS institutes for technology development to meet the demand of increasing population in future. Moreover, out of 23 existing scientists 21 will be retired during 2023-2041 that will add an extra burden on BARC to cope with future challenges if the current and future vacancies are not filled in. Furthermore, BARC has been running with a significant vacancy in senior level scientists i.e. PSO (39%; 9 out of 23 total existing). Unfilled vacancies in BARC, the retirement of senior researchers and the exodus of many PhD researchers in the late 1990s and early 2000s are cause for urgent action. Earlier, BARC put together a human resource development plan to implement during 2009–2025. So, special efforts need to be taken into consideration for addressing the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees. It is noteworthy that almost all the scientists (22 out of 23 existing) acquired PhD degree indicating that BARC is equipped with highly qualified scientists (Table 4).

The human resource development plan of BARC for the period of 2023-2041 is furnished in Table 5. Local human resource development plan of BARC for NARS scientists during 2023-2041 has been presented in Table 6. Moreover, manpower development programs implemented by BARC under (i) different projects during 1976-1979, (ii) IDA Credit-2815 BD during 1997-2001, (iii) NATP Phase-1 during 2009-2014, and (iv) NATP Phase-2 during 2017-2022 are presented in *Appendix-X*I and Tables 1-4.

 Considering shrinking of foreign aid for technical assistance and limited revenues of the country, the HRD Plan 2023-2041 is envisioned for improvement of scientists in BARC by providing them with the scholarship for higher studies like PhD and Post-Doc from either home or abroad (Table 5). Most of them will receive support for availing Post-Doc and short-term training and attending seminar/workshops/study tours. Investments in these areas are expected to improve the quality of scientists to effectively coordinate NARS institutes for conducting critical research programs contributing to vertical gains of agricultural production under increasing population and changing climate. This HRD plan 2023-2041 concentrates mainly on post-Doc (18) from abroad (Table 5) to fetch advanced knowledge and on local PhD (520), short-term training (4,440) and seminar/workshop/study tour (8,000) (Table 6) to develop replicable skills adapting to local context. The other feature is that the supports to Post-Doc, short-term training and seminar/workshop/study tour will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of 21 scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of highly qualified staff with no less than PhD degree and further development of their capacity providing support for Post-Doc studies.

HRD plan considers the major proposals on the need for training areas/disciplines as identified through TNAs, skill gap analysis, FGDs and KIIs which are enumerated below:

    i)   Research management
    ii)   Project management
    iii)   Research methodology
    iv)   Scientific report writing
    v)   Foundation training
    vi)   Modern biotechnological techniques in crops, livestock and fisheries
    vii)   Genomics & bioinformatics
    viii) Good governance in agriculture
    ix)   Action plan preparation

x)   Research gap identification
xi)   DPP preparation
xii)   Impact analysis of transferred technology
xiii)   Information delivery services
xiv)   Graphic design and audio-visual creation
xv)   Human resource management
xvi)   Knowledge management
xvii)   Yield gap analysis
xviii) Climate smart agriculture
xix)   Communication and leadership development
xx)   GIS and crop modeling
xxi)   ICT in agriculture
xxii)   4IR in agriculture
xxiii) Speed breeding
xxiv)   Hybrid research

Table 3. Discipline and position wise scientific manpower provision, exiting and vacant post of BARC as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)/ Director			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement status of the scientists			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Crops	2	2	--	5	2	3	--	--	--	--	--	--	7	4	3	--	3	--	1
TTMU	1	1	--	1-2	1	--	2	1	1	--	--	--	4	3	1	1	--	--	2
Agril. Engineering	1	1	--	2	2	--	--	--	--	--	--	--	3	3	--	1	--	--	2
Soil	1	--	1	2	2	--	--	--	--	--	--	--	3	2	1	--	--	--	2
Forestry	1	1	--	2	1	1	--	--	--	--	--	--	3	2	1	--	1	1	--
Planning and Evaluation	1	--	1	2	2	--	--	--	--	--	--	--	3	2	1	--	--	--	2
Agril.Econ. and Rural Sociology	1	--	1	2	1	1	--	--	--	--	--	--	3	1	2	--	--	--	-
Fisheries	1	--	1	2	--	2	--	--	--	--	--	--	3	--	3	--	--	--	--
Nutrition	1	--	1	1	--	1	1	--	1	--	--	--	3	--	3	--	--	--	--
Livestock	1	1	--	2	1	1	--	--	--	--	--	--	3	2	1	--	--	2	--
Training	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	1	--	--	--
Computer	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	1
AIC	1	1	--	--	--	--	1	1	--	1	1	--	2	2	--	--	1	--	-
Sub-total	**14**	**9**	**5**	**21**	**12**	**9**	**4**	**2**	**2**	**--**	**--**	**--**	**39**	**23**	**16**	**3**	**5**	**3**	**10**
Administration	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--	1	--	--
Finance	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--	1	--	--
Sub-total	**2**	**2**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**2**	**2**	**--**	**--**	**2**	**--**	**-**
Total	**16**	**11**	**5**	**21**	**12**	**9**	**4**	**2**	**2**	**--**	**--**	**--**	**41**	**25**	**16**	**3**	**7**	**3**	**10**

NB: Prov.=Provision, Ext.= Existing, Vac.=Vacant

Table 4. Discipline wise present scientific manpower with MS and PhD positions in BARC as of June 2022

Type of posts / Discipline	Director/Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Total		Status of Retirement of the scientists having MS and PhD degrees during:					
									2025-2030		2031-2035		2036-2041	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Crops	--	2	--	2	--	--	-	4	--	3	--	--	--	1
TTMU	--	1	--	1	--	1	-	3	--	1	--	--	--	2
Agril. Engineering	--	1	--	2	--	--	-	3	--	1	--	--	--	2
Soil	--	--	--	2	--	--	-	2	--	--	--	--	--	2
Forestry	--	1	--	1	--	--	-	2	--	1	--	1	--	--
Planning& Evaluation	--	--	--	2	--	--	-	2	--	1	--	1	--	--
Agril. Econ.& RS	--	--	--	1	--	--	-	1	--	--	--	--	--	--
Livestock	--	1	--	1	--	--	-	2	--	--	--	2	--	--
Training	--	1	--	--	--	--	-	1	--	1	--	--	--	--
Computer, ICT, MIS	1	--	--	--	--	--	1	--	--	--	--	--	1	--
AIC	--	1	--	--	--	1	-	2	--	1	--	--	--	--
Sub-total	1	8	--	12	--	2	1	22	--	9	--	4	1	7
Administration	1	--	--	--	--	--	1	--	1	--	--	--	--	--
Finance	1	--	--	--	--	--	1	--	1	--	--	--	--	--
Sub-total	2	--	--	--	--	--	2	--	2	--	--	--	--	--
Total	3	8	--	12	--	2	3	22	2	9	--	4	1	7

Table 5. HRD plan of BARC for the period of 2023-2041

Year → Discipline	2023-2025 PhD	Post Doc.	S.T.T.	S/W/ST	2026-2030 PhD	Post Doc.	S.T.T.	S/W/ST	2031-2035 PhD	Post Doc.	S.T.T.	S/W/ST	2036-2041 PhD	Post Doc.	S.T.T	S/W.ST	Total PhD	Post Doc.	S.T.T	S/W/ST
Crops	0	3	1	1	0	1	1	1	0	1	2	1	0	0	2	1	0	5	6	4
TTMU	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	0	2	4	4
Agril. Engineering	0	1	1	1	0	1	1	1	0	0	1	1	0	0	1	1	0	2	4	4
Soil	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	0	2	4	4
Forestry	0	0	1	1	0	1	1	1	0	0	0	1	0	1	0	0	0	2	2	3
Planning & Evaluation	0	0	1	1	0	1	1	1	0	1	1	1	0	0	2	1	0	2	5	4
Agri. Econ. & RS	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	1	0	0	2	3
Fisheries	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1	0	1	3	3
Nutrition	0	0	1	1	0	0	1	0	0	1	1	1	0	0	1	1	0	1	4	3
Livestock	0	1	1	1	0	1	1	1	0	0	1	1	0	0	1	1	0	2	4	4
Training	1	0	0	0	0	0	1	1	0	0	1	1	0	0	1	1	1	0	3	3
Computer, ICT, MIS	0	0	1	1	0	0	2	1	0	0	1	1	0	0	2	1	0	0	6	4
AIC	0	0	1	1	0	0	1	1	0	1	1	1	1	0	1	1	1	1	4	4
Sub-total	**1**	**5**	**10**	**10**	**0**	**8**	**14**	**12**	**0**	**6**	**13**	**13**	**1**	**1**	**14**	**12**	**2**	**20**	**51**	**47**
Administration	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	4	4
Finance	0	0	1	1	0	0	1	1	0	0	1	1	0	0	2	1	0	0	5	4
Sub-total	**0**	**0**	**2**	**2**	**0**	**0**	**2**	**2**	**0**	**0**	**2**	**2**	**0**	**0**	**3**	**2**	**0**	**0**	**9**	**8**
Total	1	5	12	12	0	8	16	14	0	6	15	15	1	1	17	14	2	20	60	55

Table 6. BARC's local HRD plan for NARS personnel for the year 2023-2041

Sl. No.	Types of training/ Training course	PhD (2023-2025)	Short-term training (2023-2025)	Seminar/ workshop /Meeting (2023-2025)	PhD (2026-2030)	Short-term training needed (2026-2030)	Seminar/ workshop /meeting (2026-2030)	PhD needed (2031-2041)	Short-term training (2031-2041)	Seminar/ workshop /meeting (2031-2041)	Total PhD (2023-2041)	Total Short-term training (2023-2041)	Total Seminar/ workshop / meeting (2023-2041)
1.	PhD (all disciplines)	100	0	0	120	0	0	300	0	0	520	0	0
2.	Foundation Training	0	80	0		160	0	0	400	0		640	0
3.	Research methodology	0	60	0	0	120	0	0	300	0	0	480	0
4.	Administration and financial management	0	60	0	0	120	0	0	300	0	0	480	0
5.	Procurement	0	60	0	0	120	0	0	300	0	0	480	0
6.	Financial management	0	60	0	0	120	0	0	300	0	0	480	0
7.	Monitoring & evaluation	0	60	0	0	120	0	0	300	0	0	480	0
8.	Research management	0	80	0	0	160	0	0	400	0	0	640	0
9.	Personnel management	0	80	0	0	160	0	0	400	0	0	640	0
10.	ICT/MIS	0	30	0	0	30	0	0	60	0	0	120	0
11.	Seminar, workshop, field days, etc	0	0	1000	0	0	2000	0	0	5000	0	0	8000
	Total	100	570	1000	120	1110	2000	300	2760	5000	520	4440	8000

Integration, Coordination and Memorandum of Understandings (MoUs)

Integration, cooperation, coordination and memorandum of understandings (MoUs) with other relevant organizations are indeed necessary today to make an organization efficient in delivering its responsibilities effectively. Although it is not mandatory to have MoUs with other agencies, if this is done it may yield a desirable outcome and impact. The BARC at present has several MOUs and bilateral agreements with the following agencies (BARC 2021):

1. YAAS (Yonnan Academy of Agricultural Sciences), China (2014)

2. ICRAF (World Agroforestry Centre), (2016)

3. SLCARP (2016)

4. ICIMOD, Nepal (2016)

5. Bangladesh CGIAR-IRRI (2017)

6. KWPA, Iran (2018)

Through the above MoUs and initiatives, BARC gets unique opportunities to exchange technological advancements in the agricultural field. The NARS institutes get benefits of fetching advanced technologies, genetic materials, training etc., from these activities through BARC. The scientists of the NARS get opportunities for visiting institutes having MoUs to gain knowledge and expertise and develop their skills as per need. These attempts, if used properly and effectively, can significantly contribute to developing human resources of NARS institutes in Bangladesh.

National Coordination

BARC regularly coordinates research activities of the NARS institutes. Although agricultural research is mainly conducted by NARS institutes, its scope and coverage are not only limited to these research institutes but good quality agricultural research programs are also conducted by the agricultural universities. Moreover, agricultural research is conducted by the NGOs (such as BRAC, RDRS, and PROSHIKA), and private companies (such as ACI, Supreme Seed, and Lal Teer). Apart from coordinating all research activities of the NARS institutes, BARC should play an active role to coordinate the research activities of other agencies engaged in agricultural research activities e.g. agricultural universities, NGOs, private organizations etc.

International Cooperation and Linkages

BARC for its own human resource development as well as for the development of NARS scientists need effective international cooperation and linkages. These, of course, open the horizon for the development of manpower in an international standard. Many organizations outside Bangladesh and also international organizations especially design skill development courses in specific areas of agricultural research. Once an effective and functional linkages are established with these organizations, it will be very useful for human resource development in the NARS institutes including BARC. Keeping this in consideration, BARC has linkages with the following national, regional and international organizations (BARC, 2021):

1) International Rice Research Institute (IRRI)
2) International Maize and Wheat Improvement Centre (CIMMYT)
3) International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
4) International Plant Genetic Resources Institute (IPGRI)
5) International Potato Centre (CIP)
6) International Food Policy Research Institute (IFPRI)
7) International Water Management Institute (IWMI)
8) International Centre for Agricultural Research in the Dry Areas (ICARDA)
9) World Fish Centre (WorldFish)
10) World Agroforestry Center (WFC)

11) Food and Agriculture Organization (FAO) of the United Nations
12) Indian Council of Agricultural Research (ICAR)
13) Sri Lankan Council for Agricultural Research Policy (SLCARP)
14) Nepal Agricultural Research Council (NARC)
15) Malaysian Agricultural Research and Development Institute (MARDI)
16) Australian Centre for International Agricultural Research (ACIAR)
17) Philippines Council for Agricultural Research & Development (PCARRD)
18) The World Vegetable Centre (WVC)
19) South Asian Association for Regional Cooperation (SAARC)
20) Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)
21) International Centre for Integrated Mountain Development (ICIMOD)
22) Japan International Cooperation Agency (JICA)
23) International Fund for Agricultural Development (IFAD)
24) Asia Pacific Association of Agricultural Research Institute (APAARI)
25) Centre for Agriculture and Bioscience International (CABI)
26) Asian Food and Agriculture Cooperation Initiative (AFACI)
27) Yunnan Academy of Agricultural Sciences (YAAS)
28) Global Institute for Food Security (GIFS), University of Saskatchewan

National Agricultural Research System (NARS)

Bangladesh, soon after independence in 1971, realized that the systems of agricultural research the country had inherited from the British colonial and Pakistan time were inadequate to provide technologies for accelerating food production. The country felt the need to reorganize its research systems, so that it could be self-sufficient in food supplies and produce surplus of exportable commodities for earning the much-needed foreign exchange. During the early 1970s, the need for agricultural research was established as a powerful instrument for increasing output from scarce land resources. This stimulated reorganization of agricultural research and the evolution of the National Agricultural Research System (NARS). The aim has been to create highly effective and coordinated research organizations, devoting special attention to commodity and farming systems research, and meeting the needs for training to agricultural extension and development agencies.

The objectives of agricultural research were to (Bokhtiar et al., 2021):

(a) Transform agricultural production into a modern science-based market-oriented agriculture capable of greater efficiency, profitability and sustainability that will ultimately contribute to food self- sufficiency and poverty eradication;

(b) Promote agriculture and related industry for the purpose of contributing to the improvement of the quality of life and livelihoods of the people, protecting the environment; and

(c) Support the development and implementation of national policy with relevant information and knowledge.

Under the provision of BARC Act 2012, National Agricultural Research System (NARS) has been formed with BARC as the apex body. The agricultural universities, NGOs and private sector though not integrated but linked with NARS in terms of research collaboration. The NARS comprises 13 Agricultural Research Institutes (ARIs) under the umbrella of the Bangladesh Agricultural Research Council (BARC) as shown in Table 7 (Bokhtiar et al., 2021). The role of BARC as an effective coordinating council is expected to strengthen the governance of NARS for addressing future challenges. The research system should play an efficient role in the generation, refinement, and adoption of technologies so that they may become locally relevant and globally competitive. Agricultural education, research and extension are interrelated and interdependent to each other. To achieve the goal, these three components should have to work in close

collaboration. However, in Bangladesh agricultural education, research and extension are separated from each other and controlled by several ministries. This creates, in some cases, barriers to undertake collaborative and holistic approaches for conducting agricultural research. However, to achieve the national goal in the light of National Agriculture Policy 2018, scientific manpower development is essential for generating new agricultural technologies and transferring the technologies for increasing agricultural productivity and national development at large.

Table 7. NARS Institutes and their year of establishment

Sl. No.	Name of the Research Institute	Year of Establishment
1.	Bangladesh Agricultural Research Institute (BARI)	1976
2.	Bangladesh Rice Research Institute (BRRI)	1970
3.	Bangladesh Jute Research Institute (BJRI)	1951
4.	Bangladesh Institute of Nuclear Agriculture (BINA)	1984
5.	Bangladesh Sugarcrop Research Institute (BSRI)	1994
6.	Bangladesh Wheat and Maize Research Institute (BWMRI)	2017
7.	Soil Resources Development Institute (SRDI)	1983
8.	Bangladesh Tea Research Institute (BTRI)	1958
9.	Bangladesh Forest Research Institute (BFRI)	1955
10.	Cotton Development Board (CDB)	1972
11.	Bangladesh Sericulture Research and Training Institute (BSRTI)	1978
12.	Bangladesh Fisheries Research Institute (BFRI)	1984
13.	Bangladesh Livestock Research Institute (BLRI)	1984

Training Status of Scientists in NARS Institutes: The Skill Gap Scenario

Quite a good number of trainings was provided to the scientists of the NARS institutes by BARC. However, it is not documented anywhere that proper skill gap analysis has been conducted to identify the training needs through Training Need Assessment (TNA). Also reviewing the available data and documents, it appears that no systematic studies have so far been conducted from any corner to measure the impact of these training programs. Both of these aspects are indeed very important to make the training programs effective and useful. Even prior to provide scholarships for higher training especially for MS and PhD degree, there should be proper assessments and evaluations of country's research needs for utilization of the knowledge gained by the degree holders. But unfortunately, this initiative has not been observed so far. In some cases, it is observed that the scientists having their higher degrees especially PhD degree from a renowned university of an advanced country cannot utilize his/her knowledge on return to their own place of posting. This is mainly due to lack of prior identification of country's research needs and setting of research goals and objectives accordingly.

Knowledge, Skills and Attitude (KSA) of the scientists are the fundamental and basic prerequisites for efficiencies and job performances. These attributes can be achieved through short-term training, participating in the workshops, seminars and conferences and largely through achieving MS and PhD degrees. The KSA of the scientists are equally important for all the disciplines related to agricultural

research domain. However, there was no clear-cut guidelines for equal share of all disciplines in case of offering PhD scholarships (Tables 8 and 9).

According to BARC HRD plan 2009-2025 (Table 8), a very poor share of scientists with PhD degree (0.6–1.4%) out of total 350 was in different disciplines of animal science compared to that in major disciplines of agriculture viz, Agronomy (13.1%), Horticulture (7.4%), Genetics and Breeding (10.0%), Soil Science (9.1%), Plant Pathology (10.3%) etc. Similar was the case (0.3-1.1%) in different disciplines of fisheries.

Table 8. Discipline-wise NARS Scientific Manpower with MS and PhD (as of June 2009)

Discipline	MS		PhD	
	Number	% Total	Number	% Total
Genetics and Breeding	86	8	35	10.0
Biotechnology	10	0.9	4	1.1
Genetic Resources	28	2.6	5	1.4
Agronomy	151	14.1	46	13.1
Plant Physiology	17	1.6	8	2.3
Soil Science	69	6.4	32	9.1
Plant Pathology	70	6.5	36	10.3
Entomology	58	5.4	17	4.9
Horticulture	99	9.2	26	7.4
Agricultural Engineering	42	3.9	20	5.7
Agricultural Economics	30	2.8	18	5.1
Agricultural Statistics	4	0.4	1	0.3
Planning, Training and Coordination	41	3.8	13	3.7
Adaptive and Farming Systems	70	6.5	11	3.1
Jute Fiber Quality	6	0.6	0	0.0
Pilot Plant and Processing	9	0.8	2	0.6
Mechanical Processing	8	0.7	2	0.6
Chemistry, Microbiology & Biochemistry	35	3.3	10	2.9
Textile Physics	13	1.2	2	0.6
Silviculture	6	0.6	1	0.3
Seed Orchard	7	0.7	0	0.0
Minor Forest Production	2	0.2	1	0.3
Forest Processing	8	0.7	2	0.6
Technology	3	0.3	3	0.9
Fish Nutrition	0	0.0	4	1.1
Fish Breeding	3	0.3	1	0.3
Fish Health Management	10	0.9	4	1.1
Fisheries Toxicology	3	0.3	2	0.6
Aquaculture	7	0.7	4	1.1
Animal Production	4	0.4	3	0.9
Animal Health	5	0.5	2	0.6

Discipline	MS		PhD	
	Number	% Total	Number	% Total
Poultry and Goat Production	7	0.7	5	1.4
System Research	1	0.1	1	0.3
Soil Classification	49	4.6	4	1.1
Soil Physics and Microbiology	66	6.2	8	2.3
Research Management	45	4.2	17	4.9
Total	1072	100	350	100

Source: Bokhtiar et al., 2021

The government of Bangladesh (GOB) has been implementing the National Agricultural Technology Project (NATP) with financial assistance from the World Bank through credit assistance from IDA and IFAD. NATP is a comprehensive project with its primary focus on revitalizing the agricultural technology system and increasing overall agricultural productivity in Bangladesh. NATP phase 1 and 2 awarded a higher share of PhD scholarship (Table 9) to Agronomy (10-25%), Soil Science (13-17%), Biotechnology/Plant Breeding (7-30%) etc. compared to disciplines of animal science (0-5%), fisheries (1-5%), Agricultural Engineering (3-5%), Entomology (4-10%), Horticulture (3-7%) and Environmental Science (1%). Horticulture, Entomology and Environmental Science play an important role in addressing vulnerabilities of climate change while Agricultural Engineering contributes to farm mechanization.

Table 9. Discipline-wise Distribution of PhD Scholarships under NATP Phase 1 and 2 to the NARS Institutes

Field of Study	NATP phase 1 (2007-2014)				NATP phase 2 (2016-2020)			
	In-country	% Total	Abroad	% Total	In-country	% Total	Abroad	% Total
Agronomy	15	25	7	24	13	16	6	10
Soil Science	10	17	4	14	11	14	8	13
Agricultural Economics	7	12	1	3	4	5	2	3
Entomology	4	7	3	10	3	4	3	5
Horticulture	4	7	1	3	5	6	4	7
Plant Pathology	4	7	2	7	5	6	5	8
Agril. Engineering	3	5	1	3	3	4	2	3
Biotechnology	4	7	5	17	10	13	18	30
Agricultural Extension	3	5	0	0	4	5	0	0
Crop Physiology	3	5	1	3	0	0	0	0
Other Crop Area	1	2	2	6	4	4	0	0
Fish Breeding	0	0	0	0	1	1	3	5
Fisheries management	0	0	0	0	2	3	0	0
Fisheries Biodiversity	0	0	0	0	3	4	0	0
Fisheries Pathology	0	0	0	0	0	0	1	2
Fisheries Genetics	0	0	0	0	1	1	0	0
Shrimp Culture	0	0	0	0	0	0	1	2

Field of Study	NATP phase 1 (2007-2014)				NATP phase 2 (2016-2020)			
	In-country	% Total	Abroad	% Total	In-country	% Total	Abroad	% Total
Aquaculture	2	3	1	3	3	4	0	0
Forestry	0	0	0	0	1	1	2	3
Agribusiness	0	0	0	0	1	1	0	0
Environmental Science	0	0	0	0	1	1	0	0
Animal Nutrition	0	0	1	3	2	3	0	0
Animal Production	0	0	0	0	0	0	3	5
Animal Breeding	0	0	0	0	1	1	0	0
Parasitology	0	0	0	0	1	1	0	0
Microbiology	0	0	0	0	1	1	1	2
Women in Agriculture	0	0	0	0	0	0	1	2
Total	60	100*	29	100	80	100	60	100

* % Total may exceed 100 due to making round figure, Source: Bokhtiar et al., 2021

Through NATP or some other project, there is scope to improve the capacity of NARS scientists by providing

i) in-country and international post-graduate degrees (MS and PhD),
ii) international post-doctoral programs,
iii) national and international short-term training and
iv) participation of scientists in national and international seminar/workshop and study visit abroad.

The total manpower developed through PIU-BARC, NATP: Phase-1 during 2008 to 2013 and Phase-2 during 2014 to 2022 is shown in Table 10 (Siddique et al., 2013) and Table 11.

Table 10. Total number of personnel trained under PIU-BARC, NATP: Phase-1 (2008-2013)

Name of the organization	International					National		
	PhD	Post-Doc	S.T.	S/W	S.V.	PhD	S.T.	S/W
BARI	12	02	67	30	38	25	1412	2245
BRRI	05	01	23	03	09	10	443	860
BJRI	03	01	12	02	11	07	247	413
BSRI	03	01	09	05	21	05	178	318
BINA	-	01	09	-	05	03	195	316
SRDI	01	-	03	01	03	04	131	199
BFRI -Fisheries	01	-	01	01	-	04	102	213
BFRI-Forestry	01	-	-	06	-	-	58	192
BTRI	01	-	-	-	01	01	32	79
BLRI	01	-	02	01	03	-	108	293
MoA	01	-	09	01	22	01	-	32
BARC	01	05	24	22	16	-	342	793
CDB	-	-	01	-	03	-	141	92
BSRTI	-	-	-	-	-	-	61	-
Others	-	-	-	01	01	-	1059	151
Total	30	11	160	73	133	60	4509	6196

S.T. = Short Training, S/W= Seminar/Workshop. S.V. =Study Visit

27

Table 11. Total number of personnel trained under PIU-BARC, NATP: Phase-2 (2014-2022)

Name of the organization	International				National		
	PhD	S.T.	S/W	S.V.	PhD	S.T.	S/W
BARI	19	17	05	04	21	1,002	2,232
BRRI	10	04	07	03	6	504	1,594
BJRI	4	02	0	0	5	399	368
BSRI	4	04	0	0	5	325	310
BINA	5	05	02	0	4	488	1,483
SRDI	3	02	01	0	4	161	210
BFRI-Fisheries	5	0	0	0	6	293	263
BFRI -Forestry	2	0	01	0	2	147	105
BTRI	1	01	0	0	1	105	106
BLRI	4	0	01	0	2	272	206
MoA	2	03	0	12	0	0	06
BARC	0	11	02	15	0	83	1,705
CDB	1	01	01	0	1	126	107
BSRTI	0	0	0	0	3	11	34
Others	0	02	0	05	20	275	1,791
Total	**60**	**52**	**20**	**39**	**80**	**4,191**	**10,520**

S.T. = Short Training, S/W= Seminar/Workshop. S.V. =Study Visit

Source: Rahman, 2022, Mahmud, 2022

Bangladesh Agricultural Research Institute (BARI)

Bangladesh Agricultural Research Institute (BARI) has a long historical background of its own. The emergence of the Institute in its present form has occurred through several changes starting from simply a sub-ordinate status under the Department of Land Records in the then Bengal. On the recommendation of the Famine Commission in 1880, the Bengal Department of Agriculture was established as a sub-ordinate part of the Department of Land Records in the then Bengal. In 1906, Lord Curzon, the then Vice Roy of India had granted separate status to the Bengal Department of Agriculture and in the same year, a nuclear agricultural research laboratory under this department was established at Tejgaon, Dhaka. In 1908, an experimental station what has become known as Dhaka Farm was established on an area of 161.20 hectares of land. This Dhaka Farm was the predecessor of BARI and some other research institutes. Establishment of Dhaka Farm offered a good scope for conducting research in the field. In 1947, Bengal Department of Agriculture was renamed as East Pakistan Department of Agriculture. The two constituent divisions of the department were Research and Extension. In 1962, there was a severe blow to agriculture research when the land of Dhaka Farm was acquired for establishing Second Capital (today called Sher-e-Bangla Nagar). In 1968, two separate directorates were established - one was Directorate of Agriculture (Extension and Management) and the other was Directorate of Agriculture (Research and Education). The Directorate of Agriculture (Research and Education) was mostly concerned with research. This Directorate as well was responsible for the management of Bangladesh Agricultural Institute (BAI) at Sher-e-Bangla Nagar, Dhaka. Later in eighties and nineties, two other agricultural colleges, one in Patuakhali and the other in Dinajpur, were established. These two agricultural colleges were also administered by BARI until

these became universities. In 1971, the former provincial organization took on national responsibilities. Like many other sectors, agriculture as well inherited poor manpower and insufficient administrative set ups. Therefore, it was rightly thought to have established a coordinated and comprehensive research and some major decisions were taken up in 1973. Another important development in the year was the Presidential Order No. XXXII that helps strengthen and reconstitute agricultural research organizations and system in the country. Upon subsequent developments of research institutions led to further restructuring. In 1976, through the Presidential Order No. LXII, the Bangladesh Agricultural Research Institute (BARI) was emerged as an autonomous and effective research organization following the dissolution of the Directorate of Agriculture (Research and Education) with sufficient operational flexibility, structural modification, and improvement of regional and sub-stations (BARI, 2022).

Achievements of BARI: BARI has so far developed a total of 1,050 technologies of which 545 are improved crop varieties (commodity) and 505 technologies on different non-commodity areas. The detail of these technologies is given below:

A. Commodity:

Named of crops	No. of released varieties
Cereal crops	78
Oilseed Crops	46
Pulse Crops	42
Tuber Crops	109
Vegetable Crops	120
Fruit Crops	85
Flower Crops	19
Spices Crops	39
Fibre Crops	06
Narcotic Crops	01
Sub-Total	**545**

B. Non-Commodity:

Research Fields	No. of technologies
Crop, Soil, Water and Insect & Disease Management	225
Farm Machinery	39
Irrigation and Water Management	36
Post-harvest Technology	29
Farming Systems Research	156
Biotechnology	20
Sub-Total	**505**

Source: BARI 2022

Apart from varietal improvement of different crops, BARI is also intensively involved, among many others, in conducting research on crop husbandry, pest and disease management, irrigation and water management, agricultural machinery and equipment, farming systems research, hill farming, maintenance and preservation of genetic resources, and post-harvest technology.

Present manpower and future need of skilled manpower at BARI: Data were collected through structured questionnaires from the NARS institutes on (i) discipline-wise provision, existing and vacant posts of CSO, PSO, SSO and SO, (ii) discipline wise scientific manpower with MS and PhD degrees as of 30 June 2022, and (iii) scientific manpower development plan and enhancement of PhD level up to 70% during the period of 2023-2041. The findings have been furnished in Tables 12 to 14.

BARI, being the multi-crop research institute, has been running with 554 existing scientists with shortage of 131 scientists compared to its provision of 685 scientists (Table 12) indicating its significant vacancies (19.1%) . The number of scientists in BARI decreased by 13% from 637 in 2009 (BARC, 2010) to 554 in 2023. BARI contributed to increasing production of different crops e.g. wheat, maize, pulses, oilseeds, potato, vegetables, spices, fruits etc. by many folds since its inception. This shortage of scientists in BARI due to vacancies could be a challenge for technology development to meet the demand of increasing population in future. Moreover, BARI has been running with a significant vacancy in entry level scientists i.e. SO (64.3%; 128 out of 199 approved posts) who are the frontline researchers. So, special efforts need to be

taken into consideration for addressing the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

More than half of the scientists (340 out of 554 existing i.e. 61.37%) acquired PhD degree and the remaining scientists earned MS degree indicating that BARI is equipped with highly qualified scientists (Table 13). All the PhD holders will retire by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (60% i.e. 204 SSOs out of total 340 PhD holders) and the lowest share was with the position of SO (3.82% i.e. only 13 SOs). It indicates that there is dire need for enhancement of skills in many scientists holding the position of Scientific Officer (SO).

In BARI, more emphasis has been given in the HRD Plan 2023-2041 for improvement of scientists by ensuring 70% of the total scientists with PhD degree aligning with the provision of ICAR (ASTI 2022) (total provision is 3,705) as shown in Table 4. It means that as per demand of BARI there will be at least 5,293 scientists in 19 years by 2041 if 70% PhD holders (3,705) is considered, which indicates an enormous increase of the total scientists by 9.5 times compared to 554 existing scientists in 2022. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can effectively conduct critical research programs contributing to vertical gains of agricultural production under increasing population and changing climate. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 14) to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, short term training and seminars/workshops/study tours.

The main interests on the training areas/disciplines as identified through TNAs, skill gap analysis, FGDs and KIIs are considered in this HRD plan for BARI. These training areas are stated below:

i) Gene identification and characterization
ii) Genetic transformation and gene editing
iii) Gene mapping/genomic prediction, speed breeding
iv) Crop bioinformatics and genomics
v) GIS, remote sensing and crop modeling
vi) Climate smart and nutrition sensitive agriculture
vii) Integrated farming system
viii) Stress management in major crops
ix) Agro-processing, value chain and marketing
x) Cloud computing
xi) Artificial intelligence & IoT
xii) Integrated water, nutrient, pest and disease management
xiii) Carbon sequestration and adaptation
xiv) Data management

Table 12. Discipline wise scientific manpower provision, existing and vacant posts in BARI as of 30 June 2022

Type of posts / Discipline	CSO			PSO			SSO			SO			Total		
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.
Agronomy		9			19			56			45			129	
Agricultural Economics		2			6			5			8			21	
Entomology		4			14			12			9			39	
Pathology		4			10			26			13			53	
Plant Breeding		5			3			46			31			85	
Horticulture		8			32			41			49			130	
Soil Science		4			9			24			19			56	
Agricultural Engineering		1			3			6			18			28	
Postharvest Technology		1			0			5			1			7	
Statistics		0			0			0			6			6	
Open scientists		0			0			0			0			0	
Total	39*	38	01	98	96	02	221	221	0	327	199	128	685	554	131

* Only the total number in case of provision and vacant posts of the scientists has been received from BARI

Table 13. Discipline wise scientific manpower with MS and PhD degrees in BARI as of 30 June 2022

Types of post / Discipline	CSO		PSO		SSO		SO		Total	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Agronomy	0	9	0	19	8	48	42	3	50	79
Agricultural Economics	0	2	1	5	0	5	7	1	8	13
Entomology	0	4	2	12	1	11	6	3	9	30
Pathology	1	3	0	10	0	26	9	0	14	39
Plant Breeding	0	5	0	3	5	41	30	1	35	50

Discipline	Types of post									
	CSO		PSO		SSO		SO		Total	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Horticulture	0	8	0	32	0	41	47	2	47	83
Soil Science	0	4	2	7	22	18	18	5	22	34
Agricultural Engineering	0	1	0	3	0	1	18	1	18	10
Post-harvest Technology	1	0	0	0	0	5	6	0	6	1
Agricultural Statistics	0	0	0	0	0	0	5	1	5	1
Total	2	36	5	91	17	204	186	13	214	340

Table 14. Human resource development plan with enhancement of PhD level from 40% to 70% in BARI during the period of 2023-2041

Discipline \ Year	2023-2025 (PhD level 40%)					2026-2030 (PhD level 50%)					2031-2035 (PhD level 60%)					2036-2041 (PhD level 70%)					Total				
	PhD	Post Doc.	MS	STT	ST/S/W	PhD	Post Doc.	MS	STT	ST/S/W	PhD	Post-Doc	MS	STT	ST/S/W	PhD	Post-Doc	MS	STT	ST/S/W	PhD	Post-Doc	MS	STT	ST/S/W
Agronomy	111	4	4	4	4	167	6	6	6	6	267	10	10	10	10	454	17	17	17	17	999	37	37	37	37
Agricultural Economics	18	4	4	4	4	27	6	6	6	6	43	10	10	10	10	73	17	17	17	17	161	37	37	37	37
Entomology	42	4	4	4	4	63	6	6	6	6	101	10	10	10	10	172	17	17	17	17	378	37	37	37	37
Pathology	55	4	4	4	4	83	6	6	6	6	133	10	10	10	10	226	17	17	17	17	497	37	37	37	37
Plant Breeding	70	4	4	4	4	105	6	6	6	6	168	10	10	10	10	286	17	17	17	17	629	37	37	37	37
Horticulture	116	4	4	4	4	174	6	6	6	6	278	10	10	10	10	473	17	17	17	17	1041	37	37	37	37
Total	412	24	24	24	24	619	36	36	36	36	990	60	60	60	60	1684	102	102	102	102	3705	222	222	222	222

STT= Short Term Training, ST= Study Tour, S=Seminar, W=Workshop

Bangladesh Rice Research Institute (BRRI)

Bangladesh Rice Research Institute (BRRI) is a major component of the National Agricultural Research System (NARS) of Bangladesh, dealing with research and development in relation to rice production, the staple food for the people of the country. The institute was established on 01 October 1970 as the East Pakistan Rice Research Institute (EPRRI) in Joydebpur, a small township 36 km north of the capital city Dhaka. After the independence in 1971, the institute was renamed as the Bangladesh Rice Research Institute (BRRI) through the Bangladesh Rice Research Institute Act-1973 (Act X of 1973). Presently, in accordance with the provisions of the Bangladesh Rice Research Institute (Amendment) Act-1996 (Act V of 1996) and BRRI Act-2017, a Board of Management holds full responsibility to implement the policies of the institute within the framework of policy directives issued by the Government of Bangladesh. The Director General, who is an ex-officio Chairman of the Board of Management, is the executive head of the institute. The institute operates with 19 research divisions, 11 regional stations, 3 support service divisions and 8 sections. BRRI has been running with a total manpower of 786 including 308 scientists/agriculture engineer/officer. About one third of the scientists are highly trained professionals with MS and PhD degrees.

The rice-growing environments in Bangladesh are very diverse, varying from the drought-prone high lands in the north-west through the flood-affected central region to the coastal saline zone in the south. This diversity is indicated by the thirty major Agroecological Zones (AEZ) into which the country has been divided on the basis of land, soil, hydrology and climate. This diversity in the rice-growing environments makes the tasks of BRRI scientists more challenging. Research programs for the development of new rice varieties and other production technologies appropriate for the diverse ecosystems are conducted at the main station of BRRI in Gazipur and eleven regional stations situated in Cumilla, Habiganj, Sonagazi of Feni, Bhanga of Faridpur, Barishal, Rajshahi, Kushtia, Satkhira, Sirajganj and Gopalganj districts.

The institute is equipped with modern research facilities that include laboratories, greenhouses and experimental fields. BRRI has a modern germplasm bank, twenty major laboratories, ten greenhouses, ten net houses and a 76.83 ha experimental farm at its headquarter in Gazipur. Besides, nine of the eleven regional stations also have reasonably good research facilities at field level.

BRRI breeders are now working beyond the original IRRI concept of dwarfism for high yield and have restructured the IR8 plant type to suit the environment of local agro-ecology and socio-economic conditions. The new intermediate-height plant gives equally high yield and, at the same time, grows in uncontrolled water regime better than the semi-dwarf varieties. Bangladeshi farmers also prefer tall plants to produce cattle feed and roofing materials apart from grain production (BRRI, 2022).

Achievements of BRRI: Bangladesh Rice Research Institute (BRRI) carries out research programs in all aspects of rice viz, development of new varieties through breeding, improvements of yields, plant protection measures, fertilizer management and cultivation practices etc. BRRI, since its establishment in 1970, has developed 108 high-yielding modern rice varieties (101 inbred and 7 hybrid rice's) which are suitable for various environments and ecosystems. Among them, 10 are salt-tolerant, 4 drought-tolerant transplanted Aman, 4 submergence tolerant, 6 nutrient-rich and 4 export quality premium rice varieties (BRRI, 2022).

Apart from the development of rice varieties, BRRI has generated the following commodity technologies:

	Research area	Number of technology
1	Crop Management	50
2	Grain Quality and Nutrition	4
3	Farming Systems and Socioeconomics	56
4	Irrigation and Water Management	27
5	Farm Machinery	35
6	Soil and Fertilizer Management	18
7	Disease management	6
	Total	

Source: BRRI, 2022

Present manpower and future need of skilled manpower in BRRI: Information on the existing
manpower, vacant posts and retirement status of the scientists have been presented in Table 15 – 18.

BRRI had a total of 248 existing scientists with shortage of 57 scientists compared to its provision of 305 scientists (Table 15) indicating its significant vacancies (18.7%). Nonetheless, the number of scientists in BRRI increased by 33.3% from 186 in 2009 (BARC, 2010) to 248 in 2023. Bangladesh already achieved self-sufficiency and even surplus in rice due to colossal development of HYV and hybrid varieties by BRRI. However, the shortage of scientists in BRRI due to vacancies in 2022 could be a challenge for technology development to meet the demand of increasing population in future. Moreover, BRRI has been running with a significant vacancy in entry level scientists i.e. SO (20%; 24 out of 120 approved posts) who are the frontline researchers. Furthermore, a total of 126 scientists i.e. 51% of 248 existing scientists will retire by 2041. So, special efforts need to be taken for addressing the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A significant proportion of scientists (43.1%; 107 out of 248 existing) acquired PhD degree and the remaining scientists (123) earned MS degree indicating that BRRI is equipped with highly qualified scientists (Table 16). Out of 107 PhD degree holders working in BRRI, 99 (92.5%) scientists with PhD degree will retire by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (25% i.e. 62 SSOs out of total 248 PhD holders) and the lowest share was with the position of SO (only 06 SOs). It indicates that it is extremely needed for enhancement of skills in many scientists holding the position of Scientific Officer (SO).

Table 15. Discipline wise scientific manpower provision, existing, vacant posts and retirement status in BRRI as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status by the year			
	Prov.	Ext.	Vac.	Prov	Ext.	Vac	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Agronomy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	4	12
Agricultural Economics	1	1	0	2	1	1	6	5	1	8	4	4	17	11	6	1	1	0	1
Entomology	1	1	0	3	2	1	7	6	1	5	5	0	16	14	2	1	3	1	1
Pathology	2	1	1	4	4	0	7	5	2	10	7	3	23	17	6	2	3	3	9
Plant Breeding	4	3	1	5	5	0	17	10	7	10	10	0	36	26	10	3	1	5	9
Plant Physiology	1	1	0	2	2	0	4	3	1	7	3	4	14	9	5	0	1	2	1
Hybrid Rice	0	0	0	2	2	0	5	5	0	6	6	0	13	13	0		1	1	3
Grain Quality & Nutrition.	1	1	0	2	2	0	4	4	0	1	1	0	8	8	0	2	2	1	1
Biotechnology	1	1	0	1	1	0	3	3	0	6	4	2	9	7	2	1	2	1	1
Genetic Resources and Seed	1	1	0	1	1	0	3	3	0	8	5	3	15	12	3	-	-	-	-
Soil Science	2	2	0	3	3	0	8	8	0	9	9	0	22	22	0	-	-	-	-
Farm Mach. & Post Harvest Technology	1	0	1	2	1	1	7	5	2	10	7	3	20	13	7	-	3	1	2
Workshop Machinery and Maintenance	0	0	0	1	0	1	2	2	0	1	1	0	4	3	1	-	-	-	2
Irrigation and Water Management	1	0	1	1	1	0	9	9	0	4	4	0	15	14	1	1	3	0	3
Statistics	1	1	0	1	0	1	3	3	0	3	1	2	8	5	3	1	1	-	3
Adaptive Research	1	1	0	3	3	0	6	6	0	10	9	1	20	19	1	2	2	1	2
Rice Farming Systems	1	0	1	4	2	2	10	9	1	10	10	0	25	21	4	1	3	1	4
Farm Management	1	1	0	2	1	1	2	2	0	3	3	0	8	7	1	-	2	0	2
Training Division	1	0	1	1	1	0	2	2	0	0	0	0	4	3	1	-	-	1	1
Open scientists	5	3	2	0	0	0	0	0	0	0	0	0	5	3	2	-	-	-	-
Total	**27**	**19**	**8**	**43**	**35**	**8**	**115**	**100**	**15**	**120**	**96**	**24**	**305**	**248**	**57**	**16**	**31**	**22**	**57**

Source: BRRI, 2022

Table 16. Discipline wise scientific manpower with MS and PhD degree in BRRI as of June 2022

Disciplines	Chief Scientific Officer (CSO) MS	CSO PhD	Principal Scientific Officer (PSO) MS	PSO PhD	Senior Scientific Officer (SSO) MS	SSO PhD	Scientific Officer (SO) MS	SO PhD	Total MS	Total PhD	Retirement status of the MS and PhD degree holders 2022-2025 MS	2022-2025 PhD	2026-2030 MS	2026-2030 PhD	2031-2035 MS	2031-2035 PhD	2036-2041 MS	2036-2041 PhD
Agronomy	0	1	0	3	3	6	7	0	10	10	0	1	0	3	2	2	8	4
Agricultural Economics	--	1	1	-	3	2	4	0	8	3	-	5	1	1	-	-	-	-
Entomology	-	02	01	01	02	02	02	-	05	05	-	01	01	02	-	01	-	01
Pathology	0	2	0	4	2	4	7	0	10	9	0	2	0	3	0	3	-	9
Plant Breeding	-	3	-	5	4	7	12	-	16	15	-	3	-	1	-	5	-	9
Plant Physiology	0	0	0	2	0	3	3	0	3	5	0	0	0	1	0	2	-	1
Hybrid Rice	2	2	3	2	4	1	9	5	-	-	1	-	-	1	-	-	1	3
Grain Quality and Nutrition Division	-	01	-	02	01	03	01	-	02	06	-	02	-	02	-	01	-	01
Biotechnology	0	1	0	1	1	3	4	0	5	5	1	0	2	-	1	0	1	-
Genetic resources & seed	-	-	-	1	-	4	5	-	5	5	-	-	-	1	-	1	-	1
Adaptive Research	0	1	0	3	2	3	9	0	11	7	-	2	-	3	-	1	-	2
Rice Farming Systems	-	1	-	2	5	4	9	1	14	8	-	1	-	3	-	1	-	2
Soil Science	0	2	0	3	1	7	8	0	8	12	-	-	-	-	-	-	-	-
Farm Machinery and Post-harvest Technology	-	1	-	1	02	03	04	-	06	05	-	-	-	03	-	01	01	01
Workshop Machinery and Maintenance	-	-	-	-	01	01	02	-	03	01	-	-	-	-	-	-	01	01
Irrigation and Water Management	-	-	0	1	3	6	2	0	7	5	0	1	0	3	0	0	0	3
Agricultural Statistics	1	1	0	0	4	0	1	0	6	1	0	1	-	-	-	1	6	1
Farm Management	1	0	0	1	0	2	3	0	4	3	0	0	1	0	0	1	0	2
Training Division	-	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	1	1
Total	4	19	5	33	38	62	92	6	123	107	2	19	4	27	3	20	30	33

Including all areas; Source: BRRI 2022

Special emphasis has been given in the HRD Plan 2023-2041 of BRRI for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 168) as shown in Table 17. It means that as per demand of BRRI there will be at least 240 scientists in 19 years by 2041 if 70% PhD holders (168) is considered, which is almost similar to the number of existing scientists (248) in 2022. Investments in PhD scholarships enabling BRRI to increase its PhD degree holders from 40% to 70% without increasing the total scientists are expected to improve the quality of scientists by fetching advanced knowledge so that they can contribute to vertical gains of agricultural production through effective research. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 17) to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree and short-term training.

Table 17. Human resource development plan with enhancement of PhD degrees from 40% to 70% in BRRI during the period of 2023-2041

Year / Discipline	2023-2025 (PhD level 40%)	2026-2030 (PhD level 50%)	2031-2035 (PhD level 60%)	2036-2041 (PhD level 70%)	Total
Agronomy	-	4	7	10	21
Agricultural Economics	5	1	-	-	6
Agricultural Statistics	2	2	2	2	8
Adaptive Research	2	8	8	10	28
Rice Farming System	2	3	6	4	15
Pathology	1	2	4	6	13
Plant Breeding	2	3	3	4	12
Plant Physiology	3	2	3	2	10
Hybrid Rice	2	2	-	-	4
Grain quality & Nutrition Division	1	1	1	1	4
Biotechnology	3	1	-	-	5
Agricultural Engineering	2	1	1	-	4
Irrigation & Water Management	1	4	4	4	13
Soil Science	5	3	4	6	18
Farm Management	2	2	1	2	7
Total	**33**	**39**	**44**	**51**	**168**

Source: BRRI, 2022

Suggestions were sought from BRRI for the new areas to be opened and manpower as well as training required by 2041 beginning from 2030. Information on these aspects is provided in Table 18. BRRI proposed for establishment of several new disciplines/areas e.g. molecular plant pathology, precision agriculture, rice marketing and price policy, biotic and abiotic stress management, remote sensing and GIS, water quality and waste water management, C4 rice development etc., to address the disastrous impacts of climate change in future (Table 18 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO than that of PSO and CSO in all the phases of HRD plan (201 and 129 by 2030, 96 and 107 during 2031-2035, 131 and 92 during 2036-

2041, respectively). The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BRRI conduct many research programs to meet the future demand of the country under challenges of climate change and population increase.

Table 18. Discipline/area wise manpower and training requirement in BRRI by the year 2041

(a) Manpower requirement in different disciplines from 2023 to 2041

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required during 2031 - 2035				Number of manpower required during 2036 - 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
Plant Pathology:													
1	Mycology	2	2	2	1	3	3	3	1	3	4	3	1
2	Virology	2	2	2	1	2	2	2	1	2	2	2	1
3	Bacteriology	2	2	2	1	2	2	2	1	2	2	2	1
4	Nematology	2	2	2	0	2	2	2	1	2	2	2	1
5	Molecular plant pathology	2	2	3	1	3	3	3	1	4	5	3	1
Soil Science:													
1	Soil Science	3	4	4	4	2	2	2	3	4	2	3	2
Agricultural Engineering													
1	Precision Agriculture	3	2	1	-	-	-	-	-	-	-	-	-
Agricultural Economics:													
1	Rural Institution & Economic Consequences	6	4	2	1	-	-	-	-	6	4	2	1
2	Production Economics	6	4	2	1	-	-	-	-	6	4	2	1
3	Rice marketing and Price Policy	6	4	2	1	-	-	-	-	6	4	2	1
4	Agricultural Policy and Development	6	4	2	1	-	-	-	-	6	4	2	1
Agronomy:													
1	Rice weed management	8	4	2	1	5	3	2	1	6	4	2	2
2	Soil microbiology management	8	4	2	1	-	-	-	-	-	-	-	-
3	Applied Herbicide Chemistry	8	4	2	1	-	-	-	-	-	-	-	-
4	Molecular trait management	8	4	2	1	-	-	-	-	-	-	-	-
5	Biotic and abiotic stress management	8	4	2	1	-	-	-	-	-	-	-	-
Entomology:		10	10	7	4	12	12	8	5	16	16	9	6
Agricultural Statistics:													
1	Remote sensing and GIS	4	2	1	1	4	3	2	1	4	3	2	1
Adaptive Research:													
1	On-farm research	40	20	10	-	40	60	5	5	40	20	10	5

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required during 2031 - 2035				Number of manpower required during 2036 - 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
Irrigation and Water Management:													
1	Water resources development & Management	6	6	3	2	-	-	-	-	-	-	-	-
2	Water quality and waste water management	3	3	1	1	-	-	-	-	-	-	-	-
Grain quality and nutrition													
1	Molecular Grain Quality Characterization	3	2	1	1	-	-	-	-	-	-	-	-
2	Imaging Technique for Quality Analysis & Remote Sensing	3	2	1	1	-	-	-	-	-	-	-	-
3	Hybrid Rice	-	-	-	1	4	-	-	-	6	-	-	-
Plant Physiology:													
1	Stress physiology (salinity)	2	2	1	1	2	2	1	1	2	2	1	1
2	Stress physiology (submergence)	2	2	1	1	2	2	1	1	2	2	1	1
3	Stress physiology (drought)	2	2	1	1	2	2	1	1	2	2	1	1
4	Stress physiology (cold)	2	2	1	1	2	2	1	1	2	2	1	1
5	Stress physiology (high temperature)	2	2	1	1	2	2	1	1	2	2	1	1
6	C4 rice development	2	2	1	1	2	2	1	1	2	2	1	1
Total		**201**	**129**	**74**	**39**	**96**	**107**	**39**	**27**	**131**	**92**	**54**	**33**

Source: BRRI, 2022

Further emphasis has been given in the HRD Plan 2023-2041 of BRRI for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), post-Doc and professional short training (Table 18 b). A good number of scientists under different new disciplines will be provided with PhD degrees (77 by 2030, 88 during 2031-2035 and 45 during 2036-2041). The other feature is that many scientists will be supported for availing professional short training (>180 in each phase of HRD plan), Post-doc (>30 in each phase) and MS (>40 in each phase). These supports will be possible subject to the availability of financial resources and infrastructure facilities.

The main need of training disciplines/areas as identified through TNAs, skill gap analysis, FGDs and KIIs are considered in this plan and the training area listed below:

- i) Farming in meta verse
- ii) Integrated farming
- iii) Artificial intelligence & IoT
- iv) Gene bank management
- v) Image processing and precision agriculture
- vi) Climate smart agriculture
- vii) Crop modeling

viii) Genomic analysis of abiotic and biotic stress tolerance
ix) Application of bioinformatics tools
x) Breeding value estimation for rice, SNP marker design, DNA, RNA or protein sequence analysis
xi) Mapping of pest and diseases incidence
xii) Improvement of renewable technology
xiii) Biofortification in rice
xiv) Efficient nutrient, water and energy management
xv) Research methodology
xvi) Scientific report writing
xvii) Demand, production and supply chain policy research

(b) Training requirement by the scientists of new disciplines in BRRI from 2023 to 2041

Sl. No.	Training requirement	Number of training required by 2030				Number of training required during 2031-2035				Number of training required during 2036 - 2041			
		Prof. ST	MS	PhD	Post Doc.	Prof. ST	MS	PhD	Post Doc.	Prof. ST	MS	PhD	Post-Doc
1.	Rice weed management	5	1	1	1	8	1	1	1	10	1	1	1
2.	Mycology	2	2	2	1	3	3	3	1	3	4	3	1
3.	Virology	2	2	2	1	2	2	2	1	2	2	2	1
4.	Bacteriology	2	2	2	1	2	2	2	1	2	2	2	1
5.	Nematology	2	2	2	0	2	2	2	1	2	2	2	1
6.	Molecular plant pathology	2	2	3	1	3	3	3	1	4	5	3	1
7.	Soil Science	18	10	8	4	10	5	4	2	8	5	6	2
8.	Rice weed management	5	1	1	1	8	1	1	1	10	1	1	1
9.	Entomology	3	2	2	-	5	-	5	2	7	-	5	5
10.	ICT	4	2	2	1	4	2	2	1	4	2	2	1
11.	On-farm research	100	10	5	2	100	20	15	8	100	20	20	12
12.	Groundwater resources management	5	1	1	1	5	1	1	1	10	1	1	1
13.	Surface water resources management	5	1	1	1	5	0	1	1	5	0	1	1
14.	Water quality analysis	6	1	1	0	4	0	1	1	3	0	1	1
15.	Waste water management	6	1	1	0	4	0	1	1	3	0	1	1
16.	Molecular Grain Quality characterization	8	1	3	1	8	-	4	2	7	-	4	2
17.	Imaging Technique for Quality Analysis	9	1	3	1	7	-	4	2	6	-	3	2

Sl. No.	Training requirement	Number of training required by 2030				Number of training required during 2031-2035				Number of training required during 2036 - 2041			
		Prof. ST	MS	PhD	Post Doc.	Prof. ST	MS	PhD	Post Doc.	Prof. ST	MS	PhD	Post-Doc
18.	Stress physiology (salinity)	0	0	6	2	0	0	6	2	0	0	6	2
19.	Stress physiology (submergence)	0	0	6	2	0	0	6	2	0	0	6	2
20.	Stress physiology (drought)	0	0	6	2	0	0	6	2	0	0	6	2
21.	Stress physiology (cold)	0	0	6	2	0	0	6	2	0	0	6	2
22.	Stress physiology (high temp.)	0	0	6	2	0	0	6	2	0	0	6	2
23.	C4 rice development	0	0	6	2	0	0	6	2	0	0	6	2
24.	Farm Management	3	2	1	1								
Total		187	44	77	30	180	42	88	40	186	45	94	47

Source: BRRI, 2022

Bangladesh Jute Research Institute (BJRI)

Bangladesh Jute Research Institute (BJRI) was established in 1951 and conducts research on variety development and cultural practices to increase yield of jute. However, systematic research was started during the British Rule and the first white jute variety named Oocarpus under *Corchorus capsularis* was developed in 1910. BJRI conducts research to develop short duration high yielding varieties of jute, kenaf and mesta, and develop crop production and crop protection technologies (Bokhtiar et al., 2021).

Achievements of BJRI: Since its inception the BJRI has developed a total of 266 technologies, out of which 54 are varietal technologies and 212 are non-commodity management technologies (BJRI 2022).

Present manpower and future need of skilled manpower at BJRI: Information on the existing manpower, vacant posts and retirement status of the scientists were collected through survey. Information on these aspects have been presented in Tables 19 – 22. The scientific manpower of BJRI was 138 in 2022 and the institute has been running with shortage of 54 scientists compared to its provision of 192 scientists (Table 19) indicating its significant vacancies (28.13%). Nonetheless, the number of scientists in BJRI increased by 21.1% from 114 in 2009 (BARC, 2010) to 138 in 2022. However, the shortage of scientists in BJRI due to vacancies in 2022 could be a challenge for technology development to meet the demand of increasing population in future. Moreover, BJRI has been running with a significant vacancy in entry level scientists i.e. SO (38.4%; 28 out of 73 approved posts) who are the functional researchers in the field. Furthermore, a total of 69 scientists i.e. 50% of 138 existing scientists will retire by 2041. So, special efforts need to be taken for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A total of 46 scientists out of 138 total (33.3%) acquired PhD degree and even a few of them (26) earned MS degree indicating that BJRI is running with a shortfall of qualified scientists (Table 20). All PhD degree holders working in BJRI will retire from the service by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of PSO (43.5% i.e. 20 PSOs out of total 46 PhD holders) and no SO level scientists possessed PhD degree. Moreover, even a few SOs (13) have MS degree.

It is, therefore, needed for enhancement of skills in many scientists holding the position of Scientific Officer with support for MS and PhD degree.

The HRD Plan 2023-2041 of BJRI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 56) as shown in Table 21. It means that there will be at least 80 scientists in 19 years by 2041 if 70% PhD holders (56) is considered. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 21). The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours. Moreover, the highest number of scientists will acquire PhD degree by 2041 in Agronomy (14) followed by the scientists in Entomology (12) and Plant Breeding (12) because of developing alternate technologies needed for addressing impacts of pests and diseases, and climate change.

BJRI proposed for establishment of several new disciplines/areas to address the disastrous impacts of climate change in future (Table 22 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (42 each by 2030, 40 each by 2035 and 144 each by 2041, respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BJRI conduct many research programs to meet the future demand of the country under challenges of climate change and population increase. BJRI will give special emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), Post-Doc and professional short training (Table 22 b). A good number of scientists under different new disciplines will be provided with PhD degrees (219 by 2030, 253 by 2035 and 276 by 2041). The other feature is that many scientists will be supported for availing professional short training. These supports will be possible subject to the availability of financial resources and infrastructure facilities.

The HRD plan considers the need for main disciplines/areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs which are enumerated below:

i) Molecular plant breeding and bioinformatics
ii) Isolation and identification of effective jute retting bacteria
iii) Production of nucleus & breeder seed of JAF crops
iv) Hydroponic culture
v) GIS, remote sensing and IoT
vi) Improvement of jute fiber, yarn and fabric
vii) Blending technology for natural and synthetic fiber
viii) Basic and advanced statistical analysis
ix) Gene bank management
x) Precision agriculture
xi) Genome analysis for stress tolerance
xii) Nano-technology for agriculture

HRD plan for national agricultural research system 2023-2041

Table 19. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Jute Research Institute as of June 2022

Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status of the scientists			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2022-2025	2026-2030	2031-2035	2036-2041
Scientists:																			
Agronomy	1	1	-	3	3	-	5	3	2	4	4	-	13	11	2	-	3	-	2
Agricultural Economics	1	-	1	1	-	1	2	-	2	3	-	3	7	-	7	-	-	-	-
Pest management	1	1	-	2	2	-	3	1	2	4	2	2	10	6	4	-	1	1	1
Genetic Resources & Seed	1	1	-	4	4	-	4	2	2	4	2	2	13	9	4	-	4	1	1
Plant Breeding	1	1	-	3	3	0	5	4	1	4	3	1	13	11	2	-	1	2	3
Fiber Quality	1	1	-	1	1	-	2	2	-	2	2	-	6	6	-	-	1	2	-
Jute Farming	1	-	1	1	1	-	2	2	-	3	2	1	7	5	2	1	-	1	1
Chemistry	1	1	-	2	1	1	3	3	-	3	1	2	9	6	3	-	2	1	1
Dyeing & Printing	1	1	-	2	-	2	2	2	-	2	-	2	7	3	4	-	1	-	1
Mechanical Processing	1	-	1	3	3	-	3	3	-	3	3	-	10	9	1	-	3	-	2
Textile Physics	1	1	-	3	-	3	5	5	-	6	3	3	15	9	6	-	1	-	3
Pilot plant	1	-	1	3	3	-	4	4	-	4	3	1	12	10	2	1	2	1	1
Product Development	1	1	-	3	-	3	4	4	-	5	1	4	13	6	7	1	2	1	0
Scientist (general)	1	1	-	12	10	2	18	17	1	26	19	7	57	47	10	1	5	7	6
Total	14	10	4	43	31	12	62	52	10	73	45	28	192	138	54	4	26	17	22

Table 20. Discipline wise scientific manpower with MS and PhD degree in Bangladesh Jute Research Institute in June 2022

Types of post \ Discipline	Chief Scientific Officer (CSO) PhD	Principal Scientific Officer (PSO) MS	Principal Scientific Officer (PSO) PhD	Senior Scientific Officer (SSO) MS	Senior Scientific Officer (SSO) PhD	Scientific Officer (SO) MS	Scientific Officer (SO) PhD	Total MS	Total PhD	Status of Retirement 2026-2030 PhD	2026-2030 MS	2031-2035 PhD	2031-2035 MS	2036-2041 MS	2036-2041 PhD
Agronomy	3	-	5	-	2	1	1	8	6	1	-	-	-	-	-
Agril. Economics	-	-	1	-	-	-	3	-	1	-	-	1	-	-	-
Entomology	1	1	1	1	1	1	2	3	2	2	-	1	1	2	-
Pathology	-	1	1	1	-	3	1	3	-	-	-	1	3	-	1
Plant Breeding	3	-	7	2	2	4	4	2	17	8	7	2	4	7	2
Horticulture	2	-	2	1	1	1	2	5	4	1	-	1	-	-	1
Soil science	1	-	1	1	1	1	2	2	3	1	1	2	-	1	-
Physics	5	1	1	2	3	3	6	6	7	6	3	-	-	3	3
Chemistry	1	-	-	1	3	3	2	2	2	1	2	1	2	-	4
Microbiology	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-
Total	16	2	20	11	14	13	26	46	31	6	9	16	13	16	13

Table 21. HRD plan with enhancement of PhD degree from 40% to 70% in BJRI during the period of 2023-2041.

Year \ Discipline	2023-2025 (PhD level 40%) PhD	Post Doc	STT	ST/S/W	2026-2030 (PhD level 50%) PhD	Post Doc	STT	ST/S/W	2031-2035 (PhD level 60%) PhD	Post Doc	STT	ST/S/W	2036-2041 (PhD level 70%) PhD	Post Doc	STT	ST/S/W	Total PhD	Post Doc	STT	ST/S/W
Agronomy	2	-	2	3	3	1	2	2	4	1	4	3	5	1	4	4	14	3	13	11
Agril. Economics	-	-	1	-	1	-	1	1	1	-	2	2	-	-	2	2	2	-	6	6
Entomology	2	-	1	3	1	1	1	1	3	1	2	1	4	1	2	2	12	3	6	6
Pathology	1	-	1	1	1	1	1	1	2	-	1	1	2	1	1	1	6	2	4	4
Plant Breeding	2	-	2	2	3	1	2	2	3	1	2	2	4	1	2	2	12	3	8	8
Horticulture	2	-	2	3	1	1	2	2	3	2	2	2	4	1	2	2	10	3	8	8
Total	9	-	9	10	13	6	9	9	16	6	13	11	20	5	14	13	56	15	45	43

STT=Short Term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 22. New disciplines/areas to be opened by 2041 in BJRI with skilled scientists' requirement

(a) Suggested disciplines/areas and scientists required

Sl. No.	Suggested Disciplines/Areas	Number of scientists required by 2030				Number of scientists required by 2035				Number of scientists required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Agronomy (Crop Management)	2	2	1	0	2	2	1	0	10	10	5	3
2.	Soil Science	2	2	1	1	2	2	1	1	10	10	5	3
3.	Physiology	2	2	1	1	2	2	1	1	10	10	5	3
4.	Plant Pathology	2	2	1	0	2	2	1	1	10	10	5	3
5.	Entomology	2	2	1	1	2	2	1	1	10	10	5	3
6.	Genetic Resources & Seed	3	3	1	0	3	3	1	1	10	10	5	3
7.	Biotechnology	2	2	1	1	2	2	1	1	10	10	5	3
8.	Plant Breeding	3	3	1	1	3	3	1	2	10	10	5	3
9.	Fiber Quality	1	1	1	0	1	1	1	1	10	10	5	3
10.	Jute Farming	2	2	1	0	2	2	1	1	10	10	5	2
11.	Farm Mechanization	3	3	1	1	3	3	2	2	10	10	5	1
12.	Farm Management	1	1	1	1	1	1	1	4	10	10	5	5
13.	Chemistry	2	2	1	0	2	2	1	1	2	2	1	1
14.	Dyeing & Printing	2	2	1	0	2	2	1	1	2	2	1	1
15.	Mechanical Processing Division	3	3	1	0	3	3	1	1	2	2	1	1
16.	Textile Physics	2	2	1	0	2	2	1	1	2	2	1	1
17.	Pilot plant & Process Development	2	2	1	0	2	2	1	1	2	2	1	1
18.	Jute-Textile	2	2	1	1	2	2	1	1	2	2	1	1
19.	Planning, Training & Communication	2	2	1	1	2	2	1	1	2	2	1	1
20.	Agricultural Economics	2	2	1	0	2	2	1	1	10	10	5	1
Total		42	42	20	9	40	40	21	24	144	144	72	43

b) Training required by the scientists of different disciplines

Sl. No.	Training requirement	Categories of scientists	Number of trainings required by 2030			Categories of scientists	Number of trainings required by 2035			Categories of scientists	Number of trainings required by 2041		
			MS	PhD	Post Doc		MS	PhD	Post Doc		MS	PhD	Post Doc
1.	Agronomy	SO	10	0	0	SO	12	0	0	SO	15	2	0
		SSO	5	5	0	SSO	6	6	0	SSO	7	6	0
		PSO	0	15	2	PSO	0	17	2	PSO	0	16	2
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
2.	Breeding	SO	11	0	0	SO	11	0	0	SO	16	2	0
		SSO	6	7	0	SSO	7	5	0	SSO	8	5	0
		PSO	0	15	3	PSO	0	15	2	PSO	0	17	2
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
3.	Genetic Resources and Seed	SO	11	0	0	SO	15	0	0	SO	16	2	0
		SSO	6	6	0	SSO	7	7	0	SSO	8	7	0
		PSO	0	12	1	PSO	0	18	2	PSO	0	17	2
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
4.	Farming System	SO	5	0	0	SO	6	0	0	SO	7	1	0
		SSO	2	2	0	SSO	3	3	0	SSO	3	3	0
		PSO	0	7	1	PSO	0	7	1	PSO	0	6	1
		CSO	0	1	1	CSO	0	1	1	CSO	0	2	1
5.	Pest Management	SO	12	0	0	SO	13	0	0	SO	18	2	0
		SSO	6	7	0	SSO	7	5	0	SSO	9	5	0
		PSO	0	15	3	PSO	0	17	2	PSO	0	18	2
		CSO	0	1	1	CSO	0	2	2	CSO	0	1	1
6.	Post-Harvest	SO	4	0	0	SO	5	0	0	SO	6	1	0
		SSO	2	2	0	SSO	3	3	0	SSO	2	3	0
		PSO	0	7	1	PSO	0	7	1	PSO	0	5	1
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
7.	Physics	SO	11	0	0	SO	13	0	0	SO	15	2	0
		SSO	5	5	0	SSO	7	6	0	SSO	7	6	0
		PSO	0	15	2	PSO	0	18	2	PSO	0	16	2
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
8.	Chemistry	SO	9	0	0	SO	11	0	0	SO	16	2	0
		SSO	5	5	0	SSO	6	6	0	SSO	7	6	0
		PSO	0	14	2	PSO	0	16	2	PSO	0	17	2

HRD plan for national agricultural research system 2023-2041

Sl. No.	Training requirement	Number of trainings required by 2030				Number of trainings required by 2035				Number of trainings required by 2041			
		Categories of scientists	MS	PhD	Post Doc	Categories of scientists	MS	PhD	Post Doc	Categories of scientists	MS	PhD	Post Doc
		CSO	0	2	2	CSO	0	2	2	CSO	0	2	2
9.	Mechanical Processing	SO	8	0	0	SO	11	0	0	SO	15	2	0
		SSO	4	4	0	SSO	5	4	0	SSO	7	6	0
		PSO	0	13	2	PSO	0	16	2	PSO	0	16	2
		CSO	0	1	2	CSO	0	2	2	CSO	0	2	2
10.	Pilot Plant and Processing	SO	7	0	0	SO	10	0	0	SO	14	2	0
		SSO	4	4	0	SSO	5	4	0	SSO	6	6	0
		PSO	0	12	2	PSO	0	15	2	PSO	0	15	2
		CSO	0	1	2	CSO	0	2	2	CSO	0	2	2
11.	Dyeing and Printing	SO	5	0	0	SO	6	0	0	SO	7	1	0
		SSO	2	2	0	SSO	3	3	0	SSO	3	3	0
		PSO	0	7	1	PSO	0	7	1	PSO	0	6	1
		CSO	0	1	1	CSO	0	1	1	CSO	0	1	1
12.	Micro-biology	SO	4	0	0	SO	5	0	0	SO	6	1	0
		SSO	1	1	0	SSO	2	2	0	SSO	2	3	0
		PSO	0	5	1	PSO	0	6	1	PSO	0	6	1
		CSO	0	1	1	CSO	0	1	1	CSO	0	1	1
13.	Biochemistry	SO	3	0	0	SO	4	0	0	SO	5	1	0
		SSO	1	1	0	SSO	2	2	0	SSO	2	2	0
		PSO	0	4	1	PSO	0	4	1	PSO	0	5	1
		CSO	0	1	1	CSO	0	1	1	CSO	0	1	1
14.	Jute Textile	SO	6	0	0	SO	7	0	0	SO	8	1	0
		SSO	2	3	0	SSO	3	4	0	SSO	4	4	0
		PSO	0	5	1	PSO	0	8	1	PSO	0	7	1
		CSO	0	1	1	CSO	0	1	1	CSO	0	1	1
Total			157	219	44		195	253	44		239	276	44

Bangladesh Institute of Nuclear Agriculture (BINA)

The Bangladesh Institute of Nuclear Agriculture (BINA) started its journey initially in a small radio-tracer laboratory (RAGENE) in 1961 under the Atomic Energy Commission (erstwhile PAEC) in Dhaka. A center named "Institute of Nuclear Agriculture (INA)" was established in July 1972 with a more organized group under BAEC (Bangladesh Atomic Energy Commission) in Dhaka. INA was shifted to the campus of Bangladesh Agricultural University, Mymensingh in 1975. In 1982, INA was given the status of an independent national agricultural research institute like BARI and BRRI, and was placed under the administrative control of Ministry of Agriculture. In 1984, it was declared as a national institute and renamed as Bangladesh Institute of Nuclear Agriculture (BINA) through promulgation of Ordinance No. II of 1984. BINA Ordinance was amended and enacted by Bangladesh Parliament vide Act No. IV of 1996.

The headquarter of BINA is located in the campus of the Bangladesh Agricultural University (BAU), Mymensingh. Its infrastructure and related facilities cover an area of 13.37 ha within the BAU campus. In addition to its office campus, BINA has another residential campus in Mymensingh town covering an area of 3.32 ha.

Director General is the Chief Executive of the institute assisted by Director (Research), Director (Administration and Support Service) and Director (Training and Planning). The general direction, administration and supervision of the affairs of the Institute is vested in the Management Board, which is guided by the policies and related instructions as may be given to it by the Government from time to time. As the chief executive of the institute, the Director General is the *ex-officio* Chairman of the Management Board.

Total manpower of the Institute in its Headquarter, Regional office and sub-stations are 578 comprising the DG, 3 Directors, 170 scientists, 36 class-I officers, 40 class-II officers, 211 class-III employees and 117 class-IV employees.

There are 11 full-fledged research divisions in BINA viz. Plant Breeding, Soil Science, Crop Physiology, Entomology, Plant Pathology, Agronomy, Agricultural Engineering, Training, Communications &Publications, Biotechnology, Horticulture, and Agricultural Economics. At present, BINA has 1 regional office at Sreepur, Gazipur and 13 substations located in various parts of the country namely Rangpur, Ishurdi, Magura, Satkhira, Comilla, Jamalpur, Khagrachari, Sunamganj, Sherpur, Barisal, Gopalganj, Noakhali and Chapainawabganj. BINA has also developed a rich soil museum with collections of various soil samples of Bangladesh (BINA 2022).

Achievements of BINA: Since its inception, BINA has developed and released 124 crop varieties and 119 management technologies (BINA 2022). The varieties were developed during 1975 - 2022 on the following 19 crops:

Name of the crop	Varieties released (no.)	Name of the crop	Varieties released (no.)	Name of the crop	Varieties released (no.)
Rice	25	Mungbean	12	Tomato	14
Wheat	01	Chickpea	11	Onion	02
Mustard	11	Black gram	03	Garlic	01
Groundnut	10	Grass pea	02	Pepper	02
Jute	03	Sesame	04	Lemon	02
Soybean	07	Lentil	12	Turmeric	01
				Plum	01
				Total	**124**

Source: BINA, 2022

The following non-commodity technologies have been generated by the BINA over a period of years.

Research Fields	Technologies (no.)
Crop Management	18
Insect Pest Management	14
Irrigation and Water Management	21
Farming Systems and Socio-Economics	4
Soil Science	35
Disease Management	24
Biotechnology	1
Adaptive Research	2
Total	**119**

Source: BINA, 2022

Present manpower and future need of skilled manpower in BINA: Information on the existing manpower, vacant posts and retirement status of the scientists of BINA have been presented in Table 23-26**.** BINA had 132 existing scientists in 2022 but with a shortage of 38 scientists compared to its provision of 170 scientists (Table 23) indicating its significant vacancies (22.4%). Nonetheless, the number of scientists in BINA increased greatly by 88.6% from 70 in 2009 (BARC, 2010) to 132 in 2022. However, the shortage of scientists in BJRI due to vacancies in 2022 particularly in SO level (19.7% vacancy) could be a challenge for conducting huge research programs in future. Moreover, a total of 52 scientists i.e. 39.4% of 132 existing scientists will retire by 2041. So, special efforts need to be taken into consideration for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A total of 47 scientists out of 132 total (35.6%) acquired PhD degree indicating that BINA is running with a shortfall of highly qualified scientists (Table 24). All PhD degree holders working in BINA will retire from the service by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (40% i.e. 19 SSOs out of total 47 PhD holders) and no SO level scientists possessed PhD degree. It is, therefore, needed for enhancement of skills in many scientists holding the position of SSO and SO with support for PhD degree.

BINA has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 235) as shown in Table 25. It means that as per demand of BINA there will be at least 335 scientists in 19 years by 2041 if 70% PhD holders (235) is considered. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively. The other feature is that the supports to scientists for PhD degree will continue with similar trend over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 25). The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours. Moreover, the highest number of scientists will acquire PhD degree by 2041 in Plant Breeding (16) followed by the scientists in Soil Science (15) and Biotechnology (14) because of developing genetically engineered varieties needed for addressing impacts of pests and diseases, and climate change.

BINA proposed for establishment of several new disciplines/areas to address the pernicious impacts of climate change in future (Table 26 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO (61) and SSO (45) by 2041 than that of PSO (30) and CSO (16). Emphasis has been given on Plant Breeding, Biotechnology, and Genetic resources and Seed with placement of more scientists compared to the other disciplines. The establishment of these new

disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BINA conduct many research programs to meet the increasing demands of safe and nutritious food production under challenges of climate change and population increase. BINA will give more emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), Post-Doc and professional short training (Table 26 b). A good number of scientists under different new disciplines will be provided with PhD degrees (31 by 2030, 40 by 2035 and 51 by 2041) and with Post-Doc (21 by 2030, 31 by 2035 and 40 by 2041). The other feature is that many scientists will be supported for availing professional short training. These supports will be possible subject to the availability of financial resources and infrastructure facilities.

The main disciplines/areas of interest for training as identified through TNAs, skill gap analysis, FGDs and KIIs are considered in this plan, which are stated below:

i)   Crop improvement through mutation breeding
ii) Biochemical analysis of crop varieties
iii) Use of nanotechnology
iv) Sterile insect technology
v)   Nutrient use efficiency (e.g. ^{15}N isotope)
vi) C-sequestration (e.g. ^{13}C, ^{15}N isotope)
vii) Water hydrology (e.g. ^{18}O, ^{2}H isotope)
viii) Measurement of critical limit (e.g. ^{65}Zn, ^{35}S)
ix) Bioinformatics (SNP to GWS)
x)   Molecular technology (MAS, MABC, Mapping, QTL and gene identification)
xi) Research project development and management
xii) Scientific report writing
xiii) Research methodology
xiv) Foundation training

Table 23. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Institute of Nuclear Agriculture (BINA) as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status by:			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Scientists:																			
Agronomy	1	1	-	1	1	-	2	2	-	3	3	-	7	7	-	1	1	1	-
Agricultural Economics	1	1	-	1	1	-	2	2	-	2	2	-	6	4	2	1	1	-	1
Entomology	1	1	-	1	1	-	2	2	-	3	2	1	7	6	1	1	1	-	-
Pathology	1	1	-	1	1	-	2	2	-	3	2	1	7	6	1	-	2	-	1
Plant Breeding	3	3	-	5	1	4	9	9	-	12	8	4	29	21	8	3	1	1	4
Horticulture	1	1	-	1	1	-	2	2	-	4	3	1	8	7	1	1	1	1	-
Soil Science	2	2	-	4	3	1	6	6	-	8	5	3	20	16	4	2	3	-	-
Agricultural Engineering	1	1	-	1	-	1	2	2	-	3	3	-	7	6	1	1	-	-	-
Crop Physiology	1	-	1	2	1	1	3	3	-	4	2	2	10	6	4	1	-	1	1
Adaptive Research and Extension	1	1	-	1	1	-	2	2	-	5	2	3	9	6	3	1	1	-	-
Biotechnology	1	1	-	1	1	-	2	2	-	4	3	1	8	7	1	1	1	-	-
Electronics	-	-	-	1	-	1	1	1	-	2	-	2	4	1	3	-	-	-	1
Planning and Development	1	1	-	1	1	-	1	-	1	2	2	-	5	4	1	1	1	-	-
Director Research	1	1	-	-	-	1	1	1	-	1	-	1	3	2	1	1	-	1	-
Publication	-	-	-	-	-	-	-	-	-	1	-	1	1	-	1	1	1	1	1
Sub Station	-	-	-	-	-	-	13	13	-	26	20	6	39	33	6	-	-	1	6
Sub-total	**16**	**15**	**1**	**21**	**13**	**8**	**50**	**49**	**1**	**83**	**57**	**26**	**170**	**132**	**38**	**16**	**14**	**7**	**15**
Management/Discipline:																			
Administration	7	3	4										7	3	4	-	2	1	-
Finance	5	1	4										5	1	4	-	1	-	-
Procurement	1	-	1										1	-	1	-	-	-	-
Sub-total	**13**	**4**	**9**										**13**	**4**	**9**	**-**	**3**	**1**	**-**
Total	**29**	**19**	**10**	**21**	**13**	**8**	**50**	**49**	**1**	**83**	**57**	**26**	**183**	**136**	**47**	**16**	**17**	**8**	**15**

Table 24. MS and PhD degree holders in Bangladesh Institute of Nuclear Agriculture (BINA) as of June 2022

Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total		Status of Retirement							
MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	2022-2025 MS	2022-2025 PhD	2026-2030 MS	2026-2030 PhD	2031-2035 MS	2031-2035 PhD	2036-2041 MS	2036-2041 PhD
-	15	13	29	19	57	-	86	47	-	16	-	16	-	11	3	-	

Table 25. Human resource development plan with enhancement of PhD level from 40% to 70% in BINA during the period of 2023-2041

Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
Agronomy	02	01	05	03	02	01	05	03	02	01	05	03	02	01	05	03	08	04	20	12
Agricultural Economics	03	01	03	06	02	03	10	15	02	02	10	15	02	02	15	20	09	08	38	56
Entomology	01	02	-	03	-	02	-	04	02	-	-	05	02	-	06	06	06	08	14	18
Plant Pathology	01	03	05	-	02	02	10	-	02	02	-	03	08	03	10	-	13	10	33	-
Plant Breeding	05	03	07	-	06	04	06	-	03	02	-	-	02	02	04	-	16	11	22	-
Horticulture	05	04	08	07	03	03	06	05	02	01	04	03	01	01	04	03	12	09	22	18
Crop Physiology	02	03	04	04	03	03	06	06	02	02	04	04	04	04	08	06	11	13	26	24
Soil Science	03	04	05	12	04	03	06	15	04	03	06	04	04	04	06	15	15	15	23	59
Adaptive Res. & Extn	02	02	06	07	03	01	08	08	03	02	10	10	04	02	10	15	12	07	24	40
Agricultural Engineering	02	03	05	02	02	02	05	02	02	02	05	03	03	03	05	03	09	10	20	10
Biotechnology	05	04	06	05	04	02	06	04	02	02	05	04	03	02	05	04	14	10	22	18
Electronics Section	02	02	03	03	02	02	03	03	02	02	03	03	02	02	03	03	08	08	12	12
Planning and dev. Section	02	-	-	-	01	01	-	-	01	01	-	-	01	01	-	-	05	03	-	-

HRD plan for national agricultural research system 2023-2041

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
Reg. Res. Centre, Gazipur	03	01	05	05	03	02	05	05	04	03	05	04	03	02	06	04	13	08	21	18
Sub-Station, Ishurdi	01	-	03	01	02	-	05	02	02	01	09	02	02	02	12	03	07	03	29	08
Sub-Station, Rangpur	03	01	05	04	03	01	06	05	03	01	06	05	03	02	06	06	12	05	23	20
Sub-Station, Magura	01	-	03	01	01	-	05	02	01	01	08	02	01	01	10	03	04	03	26	08
Sub-Station, Cumilla	-	01	06	01	01	-	09	02	01	01	16	02	01	01	25	03	03	02	56	08
Sub-Station, Satkhira	-	01	03	01	01	-	05	02	01	01	08	02	01	01	10	03	04	03	26	08
Sub-Station, Jamalpur	02	01	04	03	02	01	04	03	02	01	04	03	02	01	04	03	08	04	16	12
Sub-Station, Nalitabari	02	01	04	03	02	01	04	03	02	01	04	03	02	01	04	03	08	04	16	12
Sub-Station, Gopalganj	02	01	04	03	02	01	04	03	02	01	04	03	02	01	04	03	08	04	16	12
Sub-Station, Barishal	01	-	06	-	01	02	06	-	-	01	06	-	-	01	06	-	02	03	24	-
Sub-Station, Noakhali	-	-	04	01	02	01	05	02	01	01	08	02	01	01	05	02	04	03	22	07
Sub-Station, Chapainawabganj	02	01	04	04	03	02	06	04	04	03	08	04	04	04	12	04	13	10	30	16
Sub-Station, Khagrachori	-	-	03	01	03	-	05	02	-	-	08	02	-	03	10	03	03	03	26	08
Sub-Station, Sunamgonj	02	01	04	03	02	01	04	03	02	01	04	03	02	01	04	03	08	04	16	12
Total	54	41	135	73	62	41	154	103	55	61	159	107	63	51	191	120	235	175	601	416

STT=Short Term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 26. New disciplines/areas to be opened by 2041 in BINA and training required for skilled scientists

(a) New disciplines/areas and scientists required from 2023 to 2041

Sl. No.	Suggested Disciplines/Areas	Number of scientists required by 2030				Number of scientists required by 2035				Number of scientists required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Plant Breeding	4	3	2	1	-	-	-	-	4	3	2	1
2.	Soil Science	3	4	2	2	-	-	-	-	3	4	2	2
3.	Crop Physiology	5	3	2	1	-	-	-	-	5	3	2	1
4.	Entomology	4	3	2	1	-	-	-	-	4	3	2	1
5.	Plant Pathology	4	3	2	1	-	-	-	-	4	3	2	1
6.	Agronomy	4	3	2	1	-	-	-	-	4	3	2	1
7.	Agricultural Engineering	4	3	2	1	-	-	-	-	4	3	2	1
8.	Adaptive Research & Extension	4	3	2	1	-	-	-	-	4	3	2	1
9.	Agricultural Economics	4	3	2	1	-	-	-	-	4	3	2	1
10.	Biotechnology	5	4	3	1	-	-	-	-	5	4	3	1
11.	Horticulture	4	3	2	1	-	-	-	-	4	3	2	1
12.	Genetic Resource and Seed	-	-	-	-	4	3	2	1	4	3	2	1
13.	Vegetables, tuber crops and flower research	-	-	-	-	5	3	2	1	5	3	2	1
14.	Spices research	-	-	-	-	5	3	2	1	5	3	2	1
15.	Post Harvest Technology	-	-	-	-	2	1	1	1	2	1	1	1
Total		45	35	23	12	16	10	7	4	61	45	30	16

(b) Types of training required from 2030 to 2041

Training requirement in	Number of training required by 2030				Number of training required by 2035				Number of training required by 2041			
	Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc
Agronomy Division:												
1. Modern Statistical analysis	10	-	-	-	15	-	-	-	30	-	-	-
2. Modern Crop Management Techniques Considering the 4IR	10	-	03	02	15	-	08	05	25	-	12	08
3. Weed Management	05	-	01	-	10	-	02	02	20	-	04	03
4. Seed Science and Technology	10	-	01	01	20	-	02	02	25	-	03	02
5. Seed management software development	10	-	-	-	20	-	-	-	30	-	-	-
Agricultural Economics Division:												
1. Agricultural Production Economics	04	01	02	01	04	01	02	01	04	01	02	01
2. Agricultural Marketing	04	01	02	01	04	01	02	01	04	01	02	01
Plant Breeding Division:												
Genetic Resource and Seed Division	05	02	02	01	05	03	03	03	01	04	04	02
Horticulture Division:												
Horticulture (breeding, & biotechnology)	08	06	05	04	10	07	06	05	12	08	08	07
Soil Science Division:												
Soil Microbiology and Bio-fertilizer	05	05	05	04	06	04	05	05	06	04	04	07
Adaptive Research and Extension Division:												
Agricultural extension/Socioeconomic study	06	02	02	01	08	05	05	03	10	08	05	03
Agricultural Engineering Division:												
Nuclear Application (IWM)	05	02	02	01	05	03	03	01	10	04	04	03
Electronics Section & Health Physics:												
1. Electronics/ Condensed matter physics/Solid State Physics	02	01	01	01	01	01		01	-	-	-	-
2. Radiation Safety & protection	02	01	01	01	01	01	01	01	01	-	-	-
3. Radiation Monitoring	01	01	01	01	01	-	-	-	01	01	01	01
4. Artificial Intelligence & remote sensing	01	01	01	01	-	-	-	-	01	01	01	01
Planning and Development Section:												
1. Planning and Development Section	04	-	02	01	04	01	01	01	05	01	01	01
Total	92	23	31	21	129	27	40	31	185	33	51	40

Bangladesh Sugarcrop Research Institute (BSRI)

The Sugarcane Seedling Testing Station (SSTS) was established in Dhaka in 1931. Subsequently the Sugarcane Research Station was established at Ishurdi, Pabna in 1951 and placed under the Department of Agriculture. Sugarcane Research Station was again upgraded to Bangladesh Sugarcane Research Institute (BSRI) in 1973, and placed under Sugar and Food Industries Corporation. In 1996, Bangladesh Sugarcane Research Institute was made an autonomous institute by an act of the parliament and placed under the Ministry of Agriculture. BSRI conducts research on the development of varieties, production technologies and multipurpose uses of sugarcrops. Based on sugarcane, major sweetener sources i.e. sugar and gur industries were developed in the country. Along with sugarcane, BSRI is presently conducting research on other sweetener crops such as sugar beet, palmyra palm, date palm, stevia, golpata, honey bee and liquor rice as well.

Achievement of BSRI: Since its establishment, BSRI developed and released 48 varieties of sugarcane including 2 chewing type varieties. It registered 2 varieties of sugarbeet, 1 year-round palmyra palm variety and 1 stevia variety (Bokhtiar et al., 2021). Moreover, BSRI has developed 152 non-commodity based technologies as shown below:

Sl.no.	Crops	Variety released (no.)
1.	Sugarcane	48
2.	Sugar beet	02
3.	Palmyra palm	01
4.	Stevia	01
Total		**52**

Research Fields	Technology (no.)
1. Crop Management	32
2. Insect Pest Management	40
3. Disease Management	08
4. Farm Machinery	16
5. Irrigation and Water Management	09
6. Post-harvest Technology	03
7. Farming Systems and Socio-Economics	10
8. Agricultural Economics	20
9. On Farm Research Technology	14
Total	**152**

Source: BSRI, 2022

Present manpower and future need of skilled scientists in BSRI: Information on the existing manpower, vacant posts and retirement status of the scientists were collected. Information on these aspects have been presented in Table 27-30. BSRI had a total of 51 existing scientists in 2022 and the institute has been running with shortage of 21 scientists compared to its provision of 72 scientists (Table 27) indicating significant vacancies (29.2%) of scientists. The number of scientists in BSRI decreased by 23.9% from 67 in 2009 (BARC, 2010) to 51 in 2022. This shortage of scientists due to vacancies in 2022 could be a challenge for technology development under compulsion of climate change and population pressure in future. Moreover, most of the vacancies are in the frontline scientist's position i.e. SO (28.6%; 8 out of 28 approved posts) and SSO (31.5%; 6 out of 19 approved posts). Furthermore, a total of 28 scientists i.e. 54.9% of 51 existing scientists will retire by 2041. So, special efforts should be taken to fill in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A total of 21 scientists out of 51 total scientists (41.1%) acquired PhD degree and many of them (41) earned MS degree (Table 28) indicating that BSRI is running with similar proportion of PhD holder compared to that of total NARS scientists with 41,2% PhD. All PhD degree holders will retire by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of PSO (66.7% i.e. 14 PSOs out of total 21 PhD holders) and only 5 SSO level scientists possessed PhD degree (22.3%). Even a few SOs (2) had PhD degree. It is therefore, needed for enhancement of skills in many scientists holding the position of SSO and SO with support for MS and PhD degree.

BSRI will give a special emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 58) as shown in Table 29 if the financial resources required will be at lower scale. It means that as per demand of BSRI there will be at least 83 scientists in 19 years by 2041 if 70% PhD holders (58) is considered. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively on varieties of sugarcrops enabling the country to reduce the import of sugars. The other feature is that the supports to scientists for Post-Doc will progressively increase over the period of 2023-2025, 2026-2030, 2031-2035 and 2036-2041 by 17, 20, 24 and 24 respectively (Table 29) to build the capacity of scientists for conducting critical research. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for short training and seminars/workshops/study tours. Moreover, the higher number of scientists will acquire PhD degree by 2041 in Soil Science (7), Plant Breeding (6) and Biotechnology (6) compared to other disciplines. Strengthening of these disciplines is very essential in future for developing alternate technologies through advanced genetic engineering e.g. genome editing, bioinformatics etc.

BSRI proposed for establishment of several new disciplines/areas to address the mischievous impacts of climate change in future (Table 30 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (56 and 40 by 2030, 69 and 59 by 2035, and 81 and 61 by 2041, respectively) than that of PSO and CSO. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BSRI conduct many research programs to meet the future demand of the country. HRD Plan 2023-2041 of BSRI will give more emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), Post-Doc and professional short-term training (Table 30 b). A good number of scientists (119) under different new disciplines will be provided with PhD degrees (37 by 2030, 42 by 2035 and 40 by 2041) assuming that large-scale financial resources and infrastructure facilities will be available as per demand of BSRI. The other feature is that many scientists will be supported for availing professional short-term training.

The HRD plan of BSRI considers the main interest on the disciplines/areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs which are summarized below:

    i)   Precision agriculture
    ii)   Robotics, GPS, GIS
    iii)   Management of Agricultural Knowledge System (AKS)
    iv)   Genomics, QTL mapping and CRISPR-Cas9 based genome editing
    v)   Good governance and farm management
    vi)   DPP/TAPP formulation
    vii)   Data management
    viii)   Econometric models
    ix)   Genotyping and association mapping
    x)   Date palm breeding

Table 27. Discipline wise scientist provision, existing and vacant posts in Bangladesh Sugarcrop Research Institute as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Scientists:																			
Agronomy	1	0	1	2	2	0	1	0	1	3	2	1	7	4	3	0	0	1	1
Agricultural Economics	1	0	1	1	1	0	1	0	1	2	2	0	5	3	2	1	-	-	-
Entomology	1	-	1	1	2	-	2	2	-	3	2	1	7	6	1	1	1	3	3
Pathology	1	1	-	1	-	1	2	2	-	3	3	-	7	6	1	1	-	-	-
Plant Breeding	1	-	1	3	3	-	3	3	-	3	3	-	10	9	1	-	3	2	-
Biotechnology	1	0	1	1	1	0	2	2	0	3	2	1	7	5	2	-	1	0	1
Soil Science	1	1	0	2	2	0	2	1	1	3	1	2	8	5	3	1	1	1	0
Physiology and Sugar Chemistry	1	0	1	2	2	0	3	2	1	4	2	2	10	6	4	-	-	3	
On-Farm Research Division	1	0	1	1	1	0	2	0	2	3	2	1	7	3	4	-	-	-	1
Training & Technology Transfer	1	0	1	1	1	0	1	2	0	1	1	0	4	4	0	-	1	1	
Sub-total	**10**	**2**	**8**	**15**	**15**	**1**	**19**	**14**	**6**	**28**	**20**	**8**	**72**	**51**	**21**	**4**	**7**	**11**	**6**
Management/discipline																			
Planning and Development	1	0	1	1	1	0	1	0	1	1	2	0	4	3	2	0	0	0	1
Sub-total	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**2**	**0**	**4**	**3**	**2**	**0**	**0**	**0**	**1**
Total	**11**	**2**	**9**	**16**	**16**	**1**	**20**	**14**	**7**	**29**	**22**	**8**	**76**	**54**	**23**	**4**	**7**	**11**	**7**

Table 28. Discipline wise scientific manpower with PhD degree in Bangladesh Sugarcrop Research Institute as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total		Status of Retirement of the scientists having MS and PhDs							
											2022-2025		2026-2030		2031-2035		2041-2041	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Agronomy	0	0	2	1	0	0	2	0	4	1	0	0	0	0	1	1	1	1
Agricultural Economics	-	-		1		-	2	-	2	1	-	1	-	-	-	-	-	-
Entomology	-	-	2	2	2	-	2	-	6	2	-	-	1	1	1	2	2	2
Pathology	-	-	-	1	1	1	3	-	4	2	-	1	-	-	-	-	-	-
Plant Breeding	-	-	-	3	3	-	3	-	6	3	-	-	-	3	2	-	-	-
Biotechnology	0	0	0	1	1	1	2	0	3	2	0	0	0	1	0	0	0	1
Soil Science	1	-	2	1	-	1	-	2	3	4	1	4	1	-	1			1
Agricultural Engineering	-	-	1	1	-	-	1	0	2	1	-	-	-	-	-	1	-	1
Physiology and Sugar Chemistry	0	0	0	2	0	2	2	0	2	4	0	0	0	0	0	3	0	0
On-Farm Research	0	0	1	1	0	0	2	0	3	1								1
Training & Technology Transfer	0	0	1	0	2	0	1	0	4	0	0	0	1	0	0	1	0	0
Planning and Development Division	-	-	1	-	-		1	-	2	-	-	-	-	-	-	-	-	-
Total	1	0	10	14	9	5	21	2	41	211	1	2	3	5	5	8	3	7

HRD plan for national agricultural research system 2023-2041

Table 29. Human resource development plan with enhancement of PhD level from 40% to 70% in BSRI during the period of 2023-2041

Year	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
Discipline	PhD	Post-Doc	SST.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
Agronomy	1	0	3	4	1	0	5	3	1	1	7	5	0	1	5	3	3	1	20	15
Agricultural Economics	-	1	4	3	2	2	2	4	2	2	4	4	2	2	6	4	6	7	16	15
Entomology	1	3	4	4	2	2	4	4	-	3	3	3	2	3	2	2	5	11	13	13
Pathology	1	1	4	5	3	1	2	2	-	3	5	5	-	-	5	5	4	5	16	17
Plant Breeding	-	-	6	9	4	3	7	9	1	2	9	9	1	3	8	9	6	8	30	36
Biotechnology	1	2	3	3	2	2	5	3	2	3	5	2	1	2	3	5	6	9	16	13
Soil Science	1	3	3	3	2	4	4	4	2	5	5	5	2	6	6	6	7	18	18	18
Agricultural Engineering	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	4	4	12	12
Physiology and Sugar Chemistry	1	4	6	5	1	1	5	4	1	1	5	4	2	2	6	5	5	8	20	18
On-Farm Research Division	2	1	10	10	1	2	10	10	1	1	10	15	1	1	10	15	5	5	40	50
Training & Technology Transfer	1	1	4	4	2	1	5	5	1	1	6	6	1	2	8	8	5	5	23	23
Planning and Development	1	-	2	-	1	1	2	1	-	1	3	1	-	1	3	-	2	3	10	2
Total	11	17	52	53	22	20	54	52	12	24	65	64	13	24	64	65	58	84	234	232

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

60

Table 30. New disciplines/areas to be opened by 2041 in BSRI with skilled manpower requirement

(a) Suggested disciplines/areas and scientists required from 2023 to 2041

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1	Agriculture Meteorology	3	2	1	1	4	3	2	1	5	3	2	1
2	Agricultural Statistics	2	2	1	1	3	5	3	1	4	4	2	1
3	Honeybee research strengthening and insect pest management	4	3	2	1	5	4	2	1	6	4	3	1
4	Toxicity analysis laboratory for chemical insecticide residue	3	2	1	1	4	3	2	1	5	3	2	1
5	Insect molecular laboratory	3	2	1	1	4	3	2	1	5	3	2	1
6	Genetic Resource Division	5	3	2	1	-	-	-	-	-	-	-	-
7	Genetic Engineering &Biotechnology	1	1	1	0	2	2	1	0	2	2	1	0
8	Soil Fertility	4	3	2	1	5	4	3	1	5	4	3	1
9	Soil Microbiology	4	3	2	1	5	4	3	1	5	4	3	1
10	Soil Micronutrient	4	3	2	1	5	4	3	1	5	4	3	1
11	Soil Chemistry	4	3	2	1	5	4	3	1	5	4	3	1
12	Farm Machinery and Post-Harvest Process Engineering Division	5	3	2	1	6	4	3	1	7	4	3	1
13	Irrigation and Water Management Division	5	3	2	1	6	4	3	1	7	4	3	1
14	Agril. Machine Tools Fabrication Workshop and Maintenance Division	3	2	1	1	4	3	2	1	5	3	2	1
15	Entrepreneurship development	1	1	1	1	2	2	2	2	3	3	3	3
16	Information & communication technology	1	1	1	1	2	2	2	2	3	3	3	3
17	Agricultural Journalism	1	1	1	1	2	2	2	2	3	3	3	3
18	Mass communication & e-commerce	1	1	1	1	2	2	2	2	3	3	3	3
19	Agribusiness	2	1	1	1	3	2	2	2	3	3	3	3
Total		56	40	27	18	69	59	42	22	81	61	47	7

HRD plan for national agricultural research system 2023-2041

b) Training required for the scientists during 2023 to 2041

Sl. No.	Training requirement in:	Number training required by 2030				Number of training required 2035				Number of training required by 2041			
		Prof. ST	MS	PhD	Post Doc	Prof. ST	MS	PhD	Post Doc	Prof. ST	MS	PhD	Post Doc
1	Weed Dynamics	3	0	1	0	5	0	1	1	7	0	1	1
2	Crop production Stress Management	9	0	1	0	13	0	0	1	18	0	1	1
3	Crop Modeling	5	0	0	0	9	0	1	0	13	0	1	1
4	Honey research & insect pest management	2	1	1	0	3	1	1	1	3	2	2	2
5	Residual Toxicity analysis of chemical insecticides	2	1	1	2	3	1	1	1	2	1	1	2
6	Bio-resource management and molecular work on insect pest management	2	1	1	1	2	2	1	2	2	2	1	1
7	Technique for mass rearing of bio-agents and their field validation	2	1	1	1	2	1	1	1	3	1	1	1
8	Red palm weevil management of date palm	2	1	1	1	2	2	1	2	2	2	1	1
9	Genetic Resource Management	5	2	3	1	5	1	4	1	5	-	1	1
10	Genome Editing	5	1	1	1	5	1	1	1	5	1	1	1
11	Soil Fertility	3	2	2	1	4	3	2	1	-	3	2	1
12	Soil Microbiology	3	2	2	1	4	3	2	1	4	3	2	1
13	Soil Micronutrient	3	2	2	1	4	3	2	1	4	3	2	1
14	Soil Chemistry	3	2	2	1	4	3	2	1	4	3	2	1
15	Engineering Drawing	3	-	-	-	4	-	-	-	5	-	-	-
16	4IR (Forth Industrial Revolution)	3	2	1	1	6	4	2	1	6	4	2	1
17	Smart Agriculture	3	2	1	1	6	4	2	1	6	4	2	1
18	Modeling on Industrial Production (Agro based industry)	3	2	1	1	6	4	2	1	6	4	2	1
19	IOT Based Agril. Machine Development	3	2	1	1	6	4	2	1	6	4	2	1
20	Climate smart and IOT based Irrigation	3	2	1	1	6	4	2	1	6	4	2	1

HRD plan for national agricultural research system 2023-2041

Sl. No.	Training requirement in:	Number training required by 2030				Number of training required by 2035				Number of training required by 2041			
		Prof. ST	MS	PhD	Post Doc	Prof. ST	MS	PhD	Post Doc	Prof. ST	MS	PhD	Post Doc
21	Sustainability development	3	1	1	1	2	1	1	1	3	1	1	1
22	Community development	3	2	2	2	2	1	1	1	3	1	1	1
23	Rural development	3	2	1	1	3	2	2	2	4	1	1	1
24	Monitoring & Evaluation	4	1	1	1	4	1	1	1	5	1	1	1
25	Entrepreneurship development	4	1	1	1	4	2	1	1	4	2	1	1
26	Information & communication technology	4	1	1	1	4	2	1	1	4	2	1	1
27	Agricultural Journalism	4	1	1	1	5	2	1	1	5	2	1	1
28	Mass communication & e-commerce	5	1	1	1	5	2	1	1	6	2	1	1
29	Agribusiness	4	1	1	1	4	2	1	1	4	2	1	1
30	Human resource management	4	1	1	1	4	2	1	1	4	2	1	1
31	Gender issues	4	1	1	1	4	1	1	1	5	1	1	1
Total		109	39	37	29	140	59	42	32	150	58	40	32

Bangladesh Wheat and Maize Research Institute (BWMRI)

Bangladesh Wheat and Maize Research Institute (BWMRI) is a newly established research institute. Wheat research was started in Bangladesh after the independence under the visionary leadership of the father of the nation Bangabandhu Sheikh Mujibur Rahman. Wheat Research Centre was established in Dinajpur in 1984 under Bangladesh Agricultural Research Institute. The Honorable Prime Minister Sheikh Hasina publicly made a commitment on 28 February 1998 to upgrade Wheat Research Centre to a full-fledged Wheat Research Institute. Maize was incorporated with wheat research in 2006. Bangladesh Wheat and Maize Research Institute Bill 2017 was passed in the National Parliament on 13 November 2017 and was published on 22 November 2017 through gazette notification aiming at increasing production of wheat and maize and conducting related research and training activities in the country. The headquarter of the institute is located at Nashipur, Dinajpur. The Director General works as the chief executive of the institute. The Director General conducts all the activities of the organization through three wings i.e., i) Research, ii) Administration and finance, and iii) Training, planning and technology transfer. There are 5 regional stations, 2 seed production stations, 14 divisions and 10 sections according to the draft organogram of the institute (BWMRI, 2022).

Achievement of BWMRI: Since the beginning of its journey in conducting research towards generating technologies, BWMRI developed so far 65 wheat and maize varieties (36 wheat varieties, and 08 open pollinated maize and 21 hybrid maize varieties) and 06 non-commodity based technologies (crop management – 5, and insect pest management– 01).

Present status of scientists and future need of skilled scientists in BWMRI: Existing manpower, vacant posts and retirement status of the scientists of BWMRI were collected. The findings are presented in Tables 31-34. BWMRI has been running with a total of 49 existing scientists in 2022 but with shortage of 39 scientists compared to its provision of 88 scientists (Table 31) indicating its significant vacancies (44.31%). Despite BWMRI is the youngest NARS institute, the number of scientists increased by 19.5% in only 2 years from 41 in 2020 (Bokhtiar *et.al.,* 2021) to 49 in 2022. However, the shortage of scientists in BWMRI due to vacancies in 2022 could be a challenge for technology development to meet the demand of increasing population for the 2nd staple food of the country in future. Moreover, BWMRI has been running with a significant vacancy in both the SO and SSO level (each with 66.7%), who are the functional in researchers. Furthermore, a total of 30 scientists i.e. 61.2% of 49 existing scientists will retire by 2041. This plan, therefore, has considered filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A total of 25 scientists out of 49 total (51%) acquired PhD degree, which ran above the average of all NARS institutes (40%) indicating that BWMRI is running with a higher presence of qualified scientists (Table 32). Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO and PSO (40% and 36% out of total 25 PhD holders) while only 2 SO level scientists possessed PhD degree. It is, therefore, needed for enhancement of skills in many scientists holding the position of Scientific Officer with support for MS and PhD degree.

BWMRI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 54) as shown in Table 33. It means that as per demand of BWMRI there will be at least 77 scientists in 19 years by 2041 if 70% PhD holders (54) is considered. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 33) to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours. Moreover, the highest number of scientists will acquire PhD degree by 2041 in Plant Breeding (18) and Plant Pathology (8) compared to that of the

other disciplines because of advanced technology development through genome editing for addressing impacts of pests and diseases, and climate change.

BWMRI proposed for establishment of several new disciplines/areas mentioned in Table 29 to address the emerging challenges in future (Table 34 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (15 and 11 by 2030, 8 in each position by 2035 and 2041, respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BWMRI conduct many research programs to meet the future demand of increasing wheat and maize production and thereby reducing burden of huge imports of wheat. HRD Plan 2023-2041 of BWMRI will give more emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), Post-Doc and professional short-term training (Table 34 b). A good number of scientists under new disciplines will be provided with PhD degrees (4 each by 2030, 2035 and 2041). These additional supports will be possible subject to the availability of financial resources and infrastructure facilities.

Considering the main disciplines/areas of interest for training as identified through TNAs, skill gap analysis, FGDs and KIIs, the HRD plan of BWMRI is developed. These training areas of interest are summarized below:

i) Maintenance of varietal purity
ii) Fingerprinting of BWMRI released varieties
iii) Germplasm screening
iv) Wheat genomics, phenomics and transcriptomics
v) Molecular wheat breeding
vi) MAS, QTLs
vii) Genetic engineering in abiotic stress tolerant wheat variety
viii) e-file management

Table 31. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Wheat and Maize Research Institute as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Officer of Grade 10/11			Total			Retirement Status			
	Prov	Ex	Va	Prov	Ext	Vac	Prov.	Ex	Va	Pro	Ex	Va	Pro	Ext.	Va	Pro	Ex	Va	2025	2030	2035	2041
Scientists:																						
Wheat Breeding	1	0	1	3	3	0	8	9	-1	3	0	3	-	-	-	15	12	3	0	1	6	5
Maize Breeding	1	1	0	2	1	1	2	2	0	4	4	0	-	-	-	9	6	3	1	1	1	-
Genetic Resources, Seed Resources & Seed Division	0	-	-	2	1	1	2	1	1	3	2	1	-	-	-	7	4	3	0	0	2	0
Plant Pathology	1	1	0	1	0	1	3	3	0	4	2	2	-	-	-	9	6	3	1	-	-	2
Agronomy	1	1	0	3	3	0	3	0	3	4	2	2	-	-	-	11	5	6	1	2	1	1
Biotechnology	1	0	1	1	0	1	2	1	1	2	0	2	-	-	-	6	1	5	0	0	0	1
Soil Science	0	-	-	1	1	0	2	0	2	2	2	0	-	-	-	4	3	1	0	0	1	0
Agricultural Engineering	0	-	-	1	0	1	1	0	1	2	2	0	-	-	-	4	2	2	0	0	0	0
Planning & Evaluation	0	-	-	1	0	1	1	0	1	2	1	1	-	-	-	4	1	3	0	0	0	0
Training & Technology Transfer	0	-	-	1	0	1	1	0	1	1	1	0	-	-	-	3	1	2	0	0	0	0
Entomology	1	0	1	1	0	1	1	1	0	1	1	0	-	-	-	4	2	2	0	0	1	0
On-Farm Research	0	-	-	1	0	1	1	0	1	2	1	1	-	-	-	4	1	3	0	0	0	0
Postharvest Technology & Nutrition	0	-	-	1	0	1	1	0	1	2	1	2	-	-	-	3	1	2	0	0	0	0
Farm	1	1	0	1	0	1	2	1	1	0	0	-	-	-	-	3	2	1	1	0	1	0
ICT	-	-	-	-	-	-	-	-	-	2	2	0	-	-	-	2	2	0	0	0	0	0
Sub-total	**7**	**4**	**3**	**20**	**9**	**10**	**30**	**18**	**12**	**34**	**21**	**14**	**-**	**-**	**-**	**88**	**49**	**39**	**4**	**4**	**13**	**9**
Management/discipline																						
Administration	-	-	-	1	1	0	1	1	0	2	1	0	5	4	1	1	1	0	1	0	0	0
Finance	-	-	-	-	-	-	1	1	0	1	0	1	3	2	1	1	0	1	0	1	0	-
Procurement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Sub-total	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**0**	**3**	**-**	**-**	**8**	**6**	**2**	**2**	**2**	**0**	**1**	**0**	**0**	**-**
Total	**7**	**4**	**3**	**20**	**10**	**10**	**32**	**20**	**12**	**37**	**23**	**14**	**8**	**6**	**2**	**90**	**50**	**40**	**5**	**4**	**13**	**9**

Table 32. Discipline wise scientists with PhD degree in Bangladesh Wheat and Maize Research Institute (BWMRI) as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Agronomy	0	1	0	5	0	1	1	1	1	8
Entomology	0	0	0	0	0	1	0	0	0	1
Pathology	0	1	0	0	2	1	2	0	4	2
Plant Breeding	0	2	1	3	6	7	3	1	10	13
Soil Science	0	0	0	1	0	0	1	0	1	1
Agricultural Engineering	0	0	0	0	0	0	2	0	2	0
Post Harvest Technology	0	0	0	0	0	0	1	0	1	0
Agricultural Statistics	0	0	0	0	0	0	0	0	0	0
Planning & Evaluation	-	-	-	-	-	-	1	0	1	0
Training & Technology Transfer	-	-	-	-	-	-	1	0	1	0
Open Scientists in various fields of agriculture	-	-	-	-	-	-	-	-	-	-
Total		4	1	9	8	10	12	2	21	25

Table 33. Human resource development plan with enhancement of PhD level from 40% to 70% during the period of 2023-2041.

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total requirement			
	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD-Doc	Post	Short T	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
Agronomy	1	1	1	1	1	1	2	2	2	1	1	2	1	1	1	2	5	4	4	7
Soil Science	1	0	1	1	1	1	2	2	2	1	2	2	1	1	2	2	6	3	7	7
Entomology	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	7	7	7	7
Pathology	1	1	2	4	2	2	2	4	4	1	2	4	1	1	2	4	8	5	8	16
Plant Breeding — Wheat	1	1	3	4	1	1	3	2	2	2	2	2	2	2	3	3	6	6	11	11
Plant Breeding — Maize	2	1	3	4	1	1	3	2	3	2	2	2	5	2	3	3	12	6	11	11
Genetic Res. & Seed	0	2	5	3	1	2	5	3	1	2	5	3	2	2	5	3	4	8	20	12
Agricultural Engineering.	1	0	1	1	1	1	2	2	2	1	2	2	2	1	2	2	6	3	3	7
Total	8	7	17	19	11	11	21	19	18	12	18	19	17	12	20	21	54	42	61	78

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

HRD plan for national agricultural research system 2023-2041

Table 34. New disciplines/areas to be opened by 2041 in BWMRI with skilled scientist requirement

(a) Suggested Disciplines/Areas of manpower to be required by BWMRI during 2023 to 2041

Sl. No.	Suggested Disciplines/Areas	Number of scientists required by 2030				Number of scientists required by 2035				Number of scientists required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Crop Physiology	4	3	1	1	2	2	1	1	2	2	1	1
2.	Sociology & Agricultural Economics	4	3	1	1	2	2	1	1	2	2	1	1
3.	Publication and Public Relation	3	2	1	1	2	2	1	1	2	2	1	1
4.	Agricultural Statistics and Information & Communication Technology (ASICT)	4	3	1	1	2	2	1	1	2	2	1	1
Total		15	11	4	4	8	8	4	4	8	8	4	4

(b) Suggested training to be required during 2023 to 2041 in BWMRI

Sl. No.	Training requirement	Number training required by 2030				Number of training required by 2035				Number of training required by 2041			
		Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc
1.	Crop Physiology	4	3	1	0	3	2	1	1	4	1	1	1
2.	Sociology and Agricultural Economics	4	3	1	0	3	2	1	1	4	1	1	1
3.	Publication and Public Relation	3	2	1	0	2	2	1	1	3	2	1	1
4.	Agricultural Statistics and Information and communication Technology (ASICT)	4	3	1	0	2	2	1	1	3	2	1	1
Total		15	11	4	0	10	8	4	4	14	6	4	4

Soil Resources Development Institute (SRDI)

Soil Resources Development Institute (SRDI) is a government organization under the administrative control of Ministry of Agriculture. Director General is the chief executive of the institute. He is assisted by Directors, CSOs and PSOs and Assistant Director (Admin.) in the headquarter for smooth functioning of the institute. The institute has two wings, two divisions and 9 sections including Administration, Cartography, Data Processing, Statistical and ICT Section, Publication and Record Section, 7 divisional offices, 33 regional offices, 7 divisional laboratories, 16 regional laboratories and 2 research centers. Besides these, 10 Mobile Soil Testing Laboratories (MSTL) is also providing on farm soil testing facilities including balanced fertilizer recommendations to the farmers (BARC, 2020).

Achievement of SRDI: Soil Resources Development Institute has so far developed 22 technologies related to soils and its management (SRDI, 2022). Some innovative technology for slopping hill soil management was generated by Soil Conservation and Watershed Management Centre (SCWMC), Meghla, Bandarban of which the following activities are most important (Bokhtiar et al. 2021):

i) Development of Integrated watershed management, management and economic value of Murtai Patibet,
ii) Selection of different plant species for controlling soil erosion,
iii) Bench terrace for year-round crop production,
iv) Gabion check dam for gully erosion control,
v) Jute Geo-Textile for rehabilitating degraded land,
vi) Establishment of hedge rows in farmer's field for soil erosion control

Some innovative technology for saline soil management was generated by Salinity Management and Research Centre (SMRC), Batiaghata, Khulna of which maize transplanting and dibbling cultivation under zero tillage, floating bed for vegetable cultivation, selection of different suitable variety cultivation in saline soil were proved worthy.

Present manpower and future need of skilled manpower at SRDI: Information on the existing manpower, vacant posts and retirement status of the scientists of SRDI have been presented in Tables 35 and 36. The existing scientific manpower of SRDI was 204 in 2022 and the institute has been running with shortage of 207 scientists compared to its provision of 411 scientists (Table 35) indicating its significant vacancies (49.6%). The number of scientists in SRDI increased by 55.7% from 131 in 2009 (BARC, 2010) to 204 in 2022. However, the shortage of scientists in SRDI due to vacancies in 2022 could be a challenge for soil fertility improvement to meet the demand of increasing agricultural production in future. Moreover, SRDI has been running with a significant vacancy in entry level scientists i.e. SO (60.3%; 120 out of 199 approved posts) who are the frontline researchers. Although at a very low extent, a total of 18 scientists i.e. 8.8% of 204 existing scientists will retire by 2041.

SRDI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 170) as shown in Table 36. It means that as per demand of SRDI there will be at least 243 scientists in 19 years by 2041 if 70% PhD holders (170) is considered. Investments in PhD scholarships are expected to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively for soil fertility improvement under pernicious impacts of climate change. The other feature is that the supports to scientists for PhD degree will be maintained at 40 numbers or more in each period of 2023-2025, 2026-2030, 2031-2035 and 2036-2041 (Table 32) matching with increasing demand of the country. The plan also considers further development of their capacity providing support for Post-Doc, short-term training and seminars/workshops/study tours.

The main disciplines/areas of interest for training as identified through TNAs, skill gap analysis, FGDs and KIIS are considered for the HRD plan of SRDI and these training areas are enumerated below:

      i)   Soil map preparation
      ii)   Quality control of chemical analysis of soil
      iii)   Data interpretation
      iv)   Field survey
      v)   Preparation of Upazila Nirdeshika
      vi)   Heavy metal analysis in soil
      vii) Problematic soil management
      viii) Lab management

Table 35. Discipline wise scientific manpower provision, existing and vacant post in SRDI as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Scientists	18	8	10	73	24	49	121	93	24	199	79	120	411	204	207	2	9	7	-

Table 36. Human resource development plan and enhancement of PhD level from 40% to 70% in SRDI during the period of 2023-2041

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD Doc	Post-Doc	Short T.	ST/ S/W	PhD Doc	Post-Doc	Short T.	ST/S/ W	PhD Doc	Post-Doc	Short T.	ST/ S/W	PhD Doc	Post-Doc	Short T.	ST/S/ W	PhD Doc	Post Doc	Short T.	ST/ S/W
Soil Fertility Management	40	10	30	30	40	10	30	30	40	10	30	30	50	20	40	40	170	50	130	130

Short T= Short term training, ST= Study Tour, S=Seminar, W=Workshop

Bangladesh Tea Research Institute (BTRI)

The then Pakistan central Government (under the Ministry of Commerce in its 5th meeting) in 1952 adopted a resolution to create a separate tea research station for its own industry. Later, in 1957 Pakistan Tea Research Station (PTRS) was established at Sreemangal. It started functioning in the same year from 28th February. After the liberation, the research station was raised to the status of an institute naming as Bangladesh Tea Research Institute (BTRI) in 1973. Now BTRI has 4 sub stations at Kality of Moulvibazar District, Fatiikchari of Chittagong District, Tetulia of Panchagarh District and Sualok of Bandarban District. BTRI is one of the 13 National Agricultural Research System (NARS) Institutes of Bangladesh (BTRI, 2022).

Achievement of BTRI: The Bangladesh Tea Research Institute (BTRI) has generated 28 tea technologies (23 Clone BT, and 5 Bi-Clone Seed BTS) and 26 non-commodity technologies (crop management-12, insect pest management-8, irrigation and water management-2, post-harvest technologies-2, and farming systems and socio-economics-2).

Present manpower and future need of skilled manpower at BTRI: Information on the existing manpower, vacant posts and retirement status of the scientists of BTRI have been presented in Tables 3**7-40**. The scientific manpower of BTRI was 22 in 2022 and the institute has been with shortage of 13 scientists compared to its provision of 35 scientists (Table 37) indicating its significant vacancies (37.1%). Nevertheless, there was a slight decrease of scientists (8.33%) in BTRI from 24 in 2009 (BARC, 2010) to 22 in 2022. However, the shortage of scientists in BTRI due to vacancies in 2022 could be a challenge for technology development to meet the increasing tea consumption of the country and increasing need for tea export in future. Moreover, BTRI has been running with a significant vacancy in the level of SO (46.7%; 7 out of 15 approved posts) and SSO (40%; 4 out of 10 approved posts) who are the functional researchers. Furthermore, a total of 9 scientists i.e. 40.9% of 22 existing scientists will retire by 2041. So, special efforts need to be taken into consideration for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

It is reported that BTRI had a total of 8 scientists with PhD degree out of 22 total scientists (36.3%) (Table 38) indicating that BTRI is running with a shortfall of qualified scientists which is also below the average status of all NARS institutes (41.2% PhD). Higher PhD holders prevailed in Agronomy (2), Plant Breeding (2) and Entomology (2) while higher PhD holders were in the position of CSO (3) and PSO (3) than the other disciplines and positions. No SO acquired the PhD degree. All PhD degree holders will retire from the service by 2041. It is, therefore, needed for enhancement of skills in many scientists with support for PhD degree.

The HRD Plan 2023-2041 of BTRI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 40) as shown in Table 39. It means that as per demand of BTRI there will be at least 57 scientists in 19 years by 2041 if 70% PhD holders (40) is considered. This increase of scientists with PhD degree will improve the quality of scientists by fetching advanced knowledge so that they can tackle emerging issues of tea production through effective research. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for Post-Doc (56), short-term training (96) and seminars/workshops/study tours (120).

BTRI proposed for establishment of several new disciplines/areas to address the pernicious impacts of climate change in future (Table 40 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (9 and 6 by 2030, 15 and 9 by 2035 and 18 and 9 by 2041, respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of functional researchers (SO and SSO) will help BTRI conduct many research programs to meet the future demand of the country under challenges of climate change and population increase. During this plan period, BTRI will give more emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), Post-Doc and professional short-term training (Table 40 b). A good number of scientists under different new disciplines will be provided with PhD degrees (3 by 2030,

6 by 2035 and 6 by 2041). These supports will be possible subject to the availability of financial resources and infrastructure facilities.

The HRD plan of BTRI considers the main disciplines/areas of interest for training as identified through TNAs, skill gap analysis, FGDs and KIIs, which are given below:

- i) Development of high yielding clone
- ii) Pesticide residue analysis
- iii) Components analysis through HPLC/UV-VIS spectrophotometer
- iv) Development of mass rearing technique
- v) Socio-economic analysis
- vi) Plucking standard of oolong tea
- vii) Tea cutting methods
- viii) Drought management
- ix) Safe tea production and processing
- x) Research methodology

Table 37. Discipline wise scientific manpower provision, existing and vacant posts in BTRI as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Scientists:																			
Agronomy	-	-	-	1	1	-	2	1	1	2	2	-	5	4	1	-	-	-	2
Plant Breeding	1	1	-	1	-	1	1	1	-	3	2	1	6	4	2	-	1	-	-
Soil Science	1	1	-	1	1	-	2	2	-	4	3	1	8	7	1	1	-	1	1
Biochemistry	-	-	-	1	-	1	1	-	1	1	1	-	3	1	2	-	-	-	-
Entomology	1	1	-	1	1	-	1	1	-	2	-	2	5	3	2	-	-	1	-
Pathology	-	-	-	1	1	-	1	1	-	2	-	2	4	2	2	-	-	1	-
Statistics & Economics	-	-	-	1	1	-	1	-	1	-	-	-	2	1	1	-	-	-	1
Technology	-	-	-	-	-	-	1	-	1	1	-	1	2	-	2	-	-	-	-
Open scientists	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total	**3**	**3**	**-**	**7**	**5**	**2**	**10**	**6**	**4**	**15**	**8**	**7**	**35**	**22**	**13**	**1**	**1**	**3**	**4**
Management/discipline																			
Administration (Director BTRI)	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
Finance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Procurement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**
Total	**4**	**3**	**1**	**7**	**5**	**2**	**10**	**6**	**4**	**15**	**8**	**7**	**36**	**22**	**14**	**1**	**1**	**3**	**4**

HRD plan for national agricultural research system 2023-2041

Table 38. Discipline wise scientific manpower with PhD degree in BTRI in June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO) MS	CSO PhD	Principal Scientific Officer (PSO) MS	PSO PhD	Senior Scientific Officer (SSO) MS	SSO PhD	Scientific Officer (SO) MS	SO PhD	Total MS	Total PhD	Status of Retirement: 2022-2025 MS	2022-2025 PhD	2026-2030 MS	2026-2030 PhD	2031-2035 MS	2031-2035 PhD	2036-2041 MS	2036-2041 PhD
Agronomy	-	1	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	2
Plant Breeding	-	2	-	-	-	-	-	-	-	2	-	-	-	1	-	1	-	-
Soil Science	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Biochemistry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entomology	-	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	-	2
Pathology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics & Economic	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	-	-
Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	3	-	3	-	2	-	-	-	8	-	-	-	1	-	2	-	5

Table 39. Human resource development plan with enhancement of PhD level from 40% to 70% in BTRI during the period of 2023-2041.

Year / Discipline	2023-2025 (PhD level 40%) PhD Doc	Post-Doc	Short T.	ST/S/W	2026-2030 (PhD level 50%) PhD Doc	Post Doc	Short T.	ST/S/W	2031-2035 (PhD level 60%) PhD Doc	Post Doc	Short T.	ST/S/W	2036-2041 (PhD level 70%) PhD Doc	Post-Doc	Short T.	ST/S/W	Total PhD Doc	Post-Doc	Short T.	ST/S/W
Agronomy	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Plant Breeding	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Soil Science	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Biochemistry	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Entomology	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Pathology	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Statistics & Economic	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Technology	1	1	3	5	2	2	3	5	1	2	3	5	1	2	3	-	5	7	12	15
Total	8	8	24	40	16	16	24	40	8	16	24	40	8	16	24	-	40	56	96	120

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 40. Suggested disciplines/areas to be opened by 2041 in BTRI with skilled manpower requirement

(a) Suggested disciplines/areas and manpower required from 2031 to 2041.

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Agricultural Engineering	3	2	1	1	5	3	2	1	6	3	2	1
2.	Physiology	3	2	1	1	5	3	2	1	6	3	2	1
3.	Post-harvest Technology	3	2	1	1	5	3	2	1	6	3	2	1
Total		9	6	3	3	15	9	6	3	18	9	6	3

(b) Suggested training requirement from 2023 to 2041

Sl. No.	Training requirement in:	Number of training required by 2030				Number of training required by 2035				Number of training required by 2041			
		Professional ST	MS	PhD	Post D.	Professional ST	MS	PhD	Post D.	Professional ST	MS	PhD	Post D.
1.	Agricultural Engineering	5	4	1	-	10	4	2	2	15	4	2	4
2.	Physiology	5	4	1	-	10	4	2	2	15	4	2	4
3.	Post-harvest Technology	5	4	1	-	10	4	2	2	15	4	2	4
Total		15	12	3	0	30	12	6	6	45	12	6	12

Bangladesh Forest Research Institute (BFRI)

The Bangladesh Forest Research Institute (BFRI) was set up as a Forest Products Research Laboratory (FRL) in 1955 by the Government of the then Pakistan. In 1965, the Laboratory was named as the East Pakistan Forest Research Laboratory (EPFRL) under the Ministry of Agriculture to conduct research on the management of the Forest. The main objective of the FRL was to conduct research on the utilization of wood and wood products. Later, the need for forestry management research was felt by the administrators and planners of the country due to rapid decline in stock density of trees in forest land. Consequently, in 1968, the Forest Management Research Branch was created with the assistance of FAO/UNDP, and after the independence of Bangladesh the FRL was reorganized as BFRI. In 1985, the BFRI was separated from the Forest Department, and its administrative control went under the Ministry of Agriculture (MoA) and then in 1988 under the Ministry of Environment and Forest (MoEF). BFRI, headed by a Director (NPS Grade-II), has two research Branches, namely, the Forest Management Branch and the Forest Products Branch. Each research branch is headed by a Chief Research Officer. The Forest Products Branch has 06 research divisions while the Forest Management Branch has 11 research divisions. In addition, there are two other common service divisions viz, Administration and Service Engineering which are directly under the Director. Research on scientific and efficient utilization of forest produces are the responsibilities of the Forest Products Branch. Major contributions of this Branch are as follows:

i)   designing of a low cost solar-kiln for seasoning timbers,
ii)   devising preservative treatment techniques for rural housing materials,
iii) development of composite products from wood and bamboo,
iv)   generation of technology for good quality pulp from inferior quality jute & lesser-used wood,
v)   classification of end-uses of the lesser-used and village wood species, etc.

Research in the Forest Management Branch is aimed at increasing the productivity of forest land through improved management, conservation of soil and water, protection of trees from pests and diseases, tree improvement through biotechnology & genetic engineering, etc. Mentionable achievements of the Forest Management Branch are:

i)   determination of growth & yield models for preparing volume & biomass tables for forest & village tree species,
ii)   determination of economic rotations of those species,
iii) selection of site-specific tree species,
iv)   propagation of bamboos from branch cuttings,
v)   development of nursery and tissue-culture techniques for raising plantations,
vi)   soil conservation & water-shed management, etc.

BFRI has pioneering contribution on artificial regeneration of mangrove species and raising man-made mangrove plantations which at present cover about 0.10 million hectare land along the coastal belt of Bangladesh. The Forest Department (FD), Department of Agriculture Extension (DAE), Bangladesh Forest Industries Development Corporation (BFIDC), Bangladesh Chemical Industries Development Corporation (BCIC), Bangladesh Tea Board, Chittagong Hill Tracts Development Board (CHTDB), NGOs and private entrepreneurs are the major clienteles of BFRI (BFRI, 2022).

Achievement of BFRI: Bangladesh Forest Research Institute (BFRI) since its inception developed a total of 94 non-commodity-based technologies (forest management-74, and forest product utilization-20). It also developed tissue culture protocol for 13 bamboos, 7 medicinal and 6 tree species. It conserved 33 species of bamboo and 221 medicinal species (Bokhtiar et al., 2021).

Present manpower and future need of skilled manpower in BFRI: Information on the existing manpower, vacant posts and retirement status of the scientists are presented in Tables 41 – 43. BFRI had a total of 59 scientists in 2022 and the institute has been running with shortage of 85 scientists compared to its provision of 144 scientists (Table 41) indicating its significant vacancies (59%). The number of scientists

in BFRI increased slightly by 13.5% from 52 in 2009 (BARC, 2010) to 59 in 2022. However, the shortage of scientists in BFRI due to vacancies in 2022 could be a challenge for technology development to address climate change induced forest and environment degradation in future. Moreover, BFRI has been running with a significant vacancy in entry level scientists ie, Research Officer (51.5%; 34 out of 66 approved posts) who are the frontline researchers. Furthermore, all the 59 existing scientists will retire by 2041. So, special efforts need to be taken into consideration for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

There was a total of 15 PhD holders out of total 59 existing scientists (25.42%) indicating that BFRI is running with a significant shortage of qualified scientists (Table 42) and even the proportion is far below the average status of all NARS institutes (41.2% PhD holders). All PhD holders will retire from the service by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of Senior Research Officer (40% i.e. 6 SROs out of total 15 PhD holders) and only 2 Research Officer level scientists possessed PhD degree. It is, therefore, needed for enhancement of skills in many scientists holding the position of Senior Research Officer and Research Officer with support for PhD degree.

BFRI will give emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 120) as shown in Table 43. It means that as per demand of BFRI there will be at least 171 scientists in 19 years by 2041 if 70% PhD holders (120) is considered. Investments in PhD scholarships will be higher in the Forest Management branch (100) to improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively for addressing forest degradation and protection of forest. The other feature is that the supports to scientists for PhD degree will be maintained at a constant level (30) in each period of 2023-2025, 2026-2035 and 2036-2041 (Table 43). The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours.

The need for the major areas/disciplines of training as identified through TNAs, skill gap analysis, FGDs and KIIs are considered in the HRD plan and these training areas are stated below:

i)   Gene detection, expression and exploitation
ii)   Mapping climate change and biodiversity conservation
iii)   Improvement of pulp and paper production
iv)   Climate change adaptation and mitigation
v)   Forest species improvement: somatic hybridization and mutation breeding
vi)   "Boot Camp" in wildlife study design and data analysis
vii)   Meta data analysis, bioacoustics, biotechnology and genetic analysis
viii)   Nanotechnology, natural fiber and polymer technology
ix)   Data analysis and report writing

Table 41. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Forest Research Institute as of June 2022

Type of posts / Discipline	Chief Research Officer (CRO)			Divisional Officer (DO)			Senior Research Officer (SRO)			Research Officer (RO)			Total			Retirement Status			
	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	2025	2030	2035	2041
Scientists of Forest Management Wings																			
Forest Botany Division	1	0	1	1	0	1	2	1	0	4	1	3	8	1	7	-	-	-	1
Forest Inventory Division	1	0	1	2	1	1	2	0	2	4	2	2	9	3	6	-	1	-	2
Forest Economics and Social Forestry Division	1	0	1	1	1	0	1	0	1	2	1	1	5	2	3	-	-	-	2
Silviculture Research Division	1	0	1	1	0	1	3	2	1	5	4	1	10	6	4	-	-	-	6
Biotechnology and Genetics Engineering Division	1	0	1	2	1	1	2	2	0	4	1	3	9	4	6	-	1	-	3
Forest Genetics and Breeding	1	0	1	1	1	0	4	1	3	8	5	3	14	7	7	1	2	-	4
Minor Forest Product Division	1	0	1	1	0	1	2	2	0	3	1	2	7	3	4	-	-	-	3
Forest Soil and Watershed Management Division	1	0	1	1	0	1	2	1	1	3	2	1	7	3	4	-	-	-	3
Forest Protection Division	1	0	1	2	1	1	2	1	1	4	1	3	9	3	6	-	-	-	3
Plantation Trial Unit Division	1	0	1	1	1	0	3	2	1	5	3	2	10	5	5	1	3	-	1
Mangrove Silviculture Division	1	0	1	1	1	0	2	1	1	3	2	1	7	4	3	1	-	-	3
Climate Change Adaptation and Mitigation Research Division	1	0	1	2	0	2	2	0	2	4	0	4	9	0	9	-	-	-	-
Wildlife Research Division	1	0	1	1	0	1	2	1	1	3	0	3	7	1	6	-	-	-	1

HRD plan for national agricultural research system 2023-2041

Type of posts / Discipline	Chief Research Officer (CRO)			Divisional Officer (DO)			Senior Research Officer (SRO)			Research Officer (RO)			Total			Retirement Status			
	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	Prov	Ext	Vac	2025	2030	2035	2041
Regional Bamboo Research and Training Centre	1	0	1	1	0	1	1	0	1	2	2	0	5	2	3	-	-	-	2
Sub-total	**14**	**0**	**14**	**18**	**7**	**11**	**30**	**14**	**15**	**54**	**25**	**29**	**116**	**44**	**72**	**3**	**7**	**0**	**34**
Scientists of Forest Products Utilization Wings																			
Forest Chemistry and wood preservation Division	1	0	1	1	1	0	2	1	1	3	1	2	7	3	4	1	-	-	2
Biomaterial and Nanotechnology Research Division	1	0	1	1	1	0	2	1	1	3	1	2	7	3	4	-	-	-	3
Wood Fiber and Composite products Division	1	0	1	1	0	1	2	2	0	3	3	0	7	5	2	-	1	-	4
Wood Engineering and Timber Technology Division	1	0	1	1	0	1	2	2	0	3	2	1	7	4	3	1	2	-	1
Sub-total	**4**	**0**	**4**	**4**	**2**	**2**	**8**	**6**	**2**	**12**	**7**	**5**	**28**	**15**	**13**	**2**	**3**	**0**	**10**
General and Administration Service Division																			
Administration	-	-	-	-	-	-	-	-	-	4	1	3	4	1	3	-	-	-	1
Planning	-	-	-	1	0	1	1	1	0	2	2	0	4	3	1	-	-	-	3
Training and Technology Transfer Unit	-	-	-	1	0	1	1	1	0	2	0	2	4	1	3	-	1		
Liaison Office	-	-	-	-	-	-	1	0	1	1	1	0	2	1	1	-	-	-	1
Sub-total	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**2**	**1**	**9**	**4**	**5**	**14**	**6**	**8**	**0**	**1**	**0**	**5**
Total	**18**	**0**	**18**	**24**	**9**	**15**	**41**	**22**	**18**	**75**	**36**	**39**	**158**	**65**	**93**	**5**	**11**	**0**	**49**

81

Table 42. Discipline wise scientific manpower with MS and PhD degree in Bangladesh Forest Research Institute in June 2022

Type of posts / Discipline	Chief Research Officer (CRO)		Divisional Officer (DO)		Senior Research Officer (SRO)		Research Officer (RO)		Total		Status of Retirement of the scientists having MS and PhD									
											2022-2025		2026-2030		2031-2035		2036-2040		2041 or beyond	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Forest Management Wing	–	1	2	5	11	3	27	2	40	11	1	2	4	3	–	–	10	3	26	4
Forest Products Utilization Wing	–	–	1	1	2	3	3	–	6	4	–	–	–	–	–	–	2	1	3	2
Total	–	1	3	6	13	6	30	2	46	15	1	2	4	3	–	–	12	4	29	6

Table 43. Human resource development plan with enhancement of PhD level from 40% to 70% during the period of 2023-2041

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
Forest Management	25	3	20	10	25	3	20	20	25	3	20	10	25	3	20	10	100	12	80	40
Forest Product utilization	5	2	10	5	5	2	10	5	5	2	10	5	5	2	10	5	20	8	40	20
Total	30	5	30	15	30	5	30	15	30	5	30	15	30	5	30	15	120	20	120	60

Short T=Short term Training, ST=Study Tour, S=Seminar, W=Workshop

Cotton Development Board (CDB)

Cotton Development Board (CDB) was formed on 14th December 1972 under the Ministry of Agriculture with the aim of expanding cotton cultivation and increasing production in Bangladesh for the sustainable development of textile industry of the country. CDB started functioning in 1974-75 and started growing American Upland Cotton (*Gossypium hirsutum*) on experimental basis. Extensive program of Upland Cotton was taken up in 1974-75 with the introduction of new variety from the USA. The responsibility of cotton research was transferred from Bangladesh Agricultural Research Institute to Cotton Development Board in 1991. CDB is currently carrying out research activities under the umbrella of NARS (CDB, 2022).

Achievement of CDB: Cotton Development Board (CDB) developed 52 technologies through research during 30 years from 1991 to 2020. A total of 16 upland cotton and 3 hill cotton varieties, and 33 crop management technologies for hybrid and modern cotton were developed by CDB (Bokhtiar et. al. 2021).

Present manpower and future need of skilled manpower in CDB: Existing manpower, vacant posts and retirement status of the scientists of CDB are presented in Tables 44 – 47. CDB has been running with 8 scientists since 2022 against the provision of 26 scientists as per approved position in its organogram (Table 44). It indicates that there are huge vacancies (69.2%) of scientists due to 18 vacant posts. This shortage of scientists in CDB due to vacancies in 2022 could be a challenge for technology development to meet the demand of country for cotton production and export. Moreover, all the positions of CSO and PSO were vacant in 2022 while there was a significant vacancy in the level of SO (53.8%; 7 vacant out of 13 approved posts) and SSO (75%; 6 vacant out of 8 approved posts) who are the functional researchers. Furthermore, all the 8 existing scientists will retire by 2035. So, special efforts need to be taken for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

Out of 8 existing scientists, only 3 acquired PhD degree (37.5%) and the other 5 earned MS degree indicating that CDB is running with a shortfall of highly qualified scientists (Table 45) and this proportion of PhD is lower than the average status of all NARS institutes (41.2%). All PhD and MS degree holders will retire from the service by 2035. Among the PhD and MS degree holders as of June 2022, highest share was with the scientists holding the position of SO (25% i.e. 2 SSOs out of total 8 PhD holders), and no PSO and CSO level scientists possessed PhD degree. So, there is serious skill gap and capacity in CDB due to poor status of scientific manpower and PhD degree holders. It is, therefore, needed for enhancement of skills in many scientists holding the position of SO and SSO with support for MS and PhD degree.

CDB will give emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 42) as shown in Table 46. It means that there will be at least 60 scientists in 19 years by 2041 if 70% PhD holders (42) is considered. This investments in PhD scholarships will improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 46) to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours. Moreover, the highest number of scientists will acquire PhD degree by 2041 in Agronomy (10) and Plant Breeding (10). Highly qualified scientists in these disciplines will be able to address impacts of climate change by developing stress tolerant varieties (drought, submergence, salinity etc.) and disease resistant varieties.

HRD plan considers the need for main disciplines and areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs, which are listed below:

i)   Stress tolerant hybrid cotton development
ii)   Fiber improvement
iii)   Transgenic cotton development
iv)   Cotton production management
v)   Cotton based farming

CDB also proposed for placement of additional scientists under the existing disciplines in future (Table 47). During this plan period, there will be a higher scale of requirement in the position of SO and SSO (30 and 15 by 2030, 30 and 17 by 2035, and 30 and 17 by 2041 respectively) than that of PSO and CSO in all the phases of HRD plan. The placement of higher numbers of frontline researchers (SO and SSO) will help CDB conduct many research programs to meet the future demand of the country under challenges of climate change and population increase.

Table 44. Discipline wise scientific manpower provision, existing and vacant posts in Cotton Development Board as of June 2022

Type of posts Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status		
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035
Scientists:																		
Agronomy	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	1	-	-
Entomology	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	1	-
Botany	-	-	-	-	-	-	1	-	1	-	-	-	1	-	1	-	-	-
Pathology	-	-	-	-	-	-	-	-	-	1	-	1	1	-	1	-	-	-
Plant Breeding	-	-	-	-	-	-	1	-	1	2	1	1	3	1	2	-	-	1
Open scientists	1	-	1	4	-	4	6	2	4	8	3	5	19	5	14	-	2	3
Sub-total	1	-	1	4	-	4	8	2	6	13	6	7	26	8	18	1	3	4
Management/discipline																		
Administration	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-	-
Sub-total	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-	-
Total	3	2	1	4	-	4	8	2	6	13	6	7	28	10	18	3	3	4

Table 45. Discipline wise scientific manpower with MS and PhD degree in Cotton Development Board in June 2022

Type of posts \ Discipline	Chief Scientific Officer (CSO) MS	PhD	Principal Scientific Officer (PSO) MS	PhD	Senior Scientific Officer (SSO) MS	PhD	Scientific Officer (SO) MS	PhD	Total MS	PhD	Status of Retirement 2022-2025 MS	PhD	2026-2030 MS	PhD	2031-2035 MS	PhD
Agronomy	-	-	-	-	-	-	1	1	1	1	-	1	-	-	-	-
Entomology	-	-	-	-	-	-	1	-	1	-	-	-	1	-	-	-
Plant Breeding and bio-technology	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-
Soil Science	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-
Scientists in various fields of agriculture	-	-	-	-	1	1	2	2	2	2	-	-	1	2	2	-
Total	-	-	-	-	1	1	4	2	5	3	-	1	2	2	4	-

Table 46. Human resource development plan with enhancement of PhD level from 40% to 70% in CDB during the period of 2023-2041

Year \ Discipline	2023-2025 (PhD level 40%) PhD	Post Doc	Short T.	ST/S/W	2026-2030 (PhD level 50%) PhD	Post Doc	Short T.	ST/S/W	2031-2035 (PhD level 60%) PhD	Post Doc	Short T.	ST/S/W	2036-2041 (PhD level 70%) PhD	Post Doc	Short T.	ST/S/W	Total PhD	Post Doc	Short T.	ST/S/W
Agronomy	1	-	1	-	2	1	1	-	3	2	1	-	4	2	1	1	10	5	4	1
Soil science	1	-	-	-	1	1	-	-	2	1	-	-	-	-	1	-	4	2	1	-
Plant Breeding	1	-	1	1	2	1	-	-	3	2	1	-	4	2	1	1	10	5	3	2
Entomology	1	-	1	-	1	1	1	-	2	1	1	-	2	1	1	1	6	3	2	1
Pathology	-	-	-	-	1	-	-	1	2	1	1	-	2	1	1	1	5	2	3	1
Biotechnology	1	-	1	-	1	-	-	-	1	1	1	-	1	1	1	1	4	2	3	1
Agricultural Engineering	-	-	-	-	1	-	-	-	1	1	1	-	1	1	1	-	3	2	2	-
Total	5	-	4	1	9	4	2	1	14	9	6	-	14	8	7	5	42	21	18	6

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 47. Requirement of scientists in CDB by 2041

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Agronomy	5	3	2	1	5	3	2	1	5	3	2	1
2.	Soil Science	4	3	2	1	4	3	2	1	4	3	2	1
3.	Breeding	5	3	2	1	5	3	2	1	5	3	2	1
4.	Entomology	4	2	2	-	4	2	2	1	4	2	2	1
5.	Plant Pathology	4	2	1	-	4	2	1	1	4	2	1	1
6.	Bio-Technology	5	2	-	-	5	2	1	1	5	2	1	1
7.	Agricultural Engineering	3	-	-	-	3	2	1	-	3	2	1	-
Total		30	15	9	3	30	17	11	6	30	17	11	6

Bangladesh Sericulture Research and Training Institute (BSRTI)

The BSRTI was established on 3 January 1962 comprising two units a) Silk cum Lac Research Institute and b) Silk Technological Institute under the then East Pakistan Small and Cottage Industries Corporation (EPSCIC). In 1974, these two units were combined together and named as Silk Research and Training Institute.

In 1978, Bangladesh Sericulture Board (BSB) was created and the Institute was brought under the control of BSB and renamed as Bangladesh Sericulture Research and Training Institute (BSRTI) in 1980.

The Government separated BSRTI from BSB and established as an Independent Institute through the Act no. 25 of 2003.

In 2013, Bangladesh Sericulture Development Board (BSDB) is formed through unification of Bangladesh Sericulture Board, Bangladesh Sericulture Research and Training Institute and Bangladesh Silk foundation. Later, the Institute is included as a member of National Agriculture Research System (NARS) in 2012 by the act of BARC- 2012.

Achievement of Bangladesh Sericulture Research and Training Institute (BSRTI): So far, the Bangladesh Sericulture Research and Training Institute (BSRTI) developed 373 technologies out of which 82 were mulberry plant varieties (indigenous – 50 and exotic – 32), 112 silkworm races (indigenous-75 and exotic-37), 16 silk production machineries) and non-commodity technologies 163 (BSRTI, 2022).

Present manpower and future need of skilled manpower in BSRTI: Information on the existing manpower, vacant posts and retirement status of the scientists of BSRTI are presented in Tables 48 -50. The scientific manpower of BSRTI was only 5 in 2022 and the institute has been running with huge shortage of 15 scientists compared to its provision of 20 scientists (Table 48) indicating its significant vacancies (75%). No scientists were placed in the position of SSO, PSO and CSO except 5 scientists in SO level. There was a serious cut down of scientists by 72.2% from 18 in 2020 (Bokhtiar et. al., 2021) to 5 in 2022. This huge shortage of scientists in BSRTI due to vacancies in 2022 could be a challenge for technology development to meet the demand of country in future. Although few scientists (5) are working in BSRTI, 60% (3 scientists) of them possessed PhD degree. However, special efforts need to be taken for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

The HRD Plan 2023-2041 of BSRTI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 42) as shown in Table 49. It means that as per demand of BSRTI there will be at least 60 scientists in 19 years by 2041 if 70% PhD holders (42) is considered. This increased number of PhD scholarships as planned will improve the quality of scientists by fetching advanced knowledge so that they can conduct many demand driven research programs effectively. The other feature is that the supports to scientists for PhD degree will increase by double from 7 each in the period of 2023-2025 and 2006-2030 to 14 each in the period of 2031-2035 and 2036-2041 (Table 49) matching with increasing demand of the country. The plan also considers further development of their capacity providing support for Post-Doc, short-term training and seminars/workshops/study tours.

BSRTI proposed for establishment of 18 new disciplines/areas instead of 7 existing to address the mischievous impacts of climate change and demands of the country in future (Table 50a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (162 and 90 by 2030, 108 and 54 by 2035 and 72 and 54 by 2041, respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BSRTI conduct many research programs to meet the future demand of the country. A good number of scientists under different new disciplines will be provided with PhD degrees (36 each by 2030, 2035 and 2041) and each of the 18 new disciplines will have equal number of PhD holders across the periods (Table 50b). The other feature is that many scientists will be supported for availing MS degree (36 in every period) and professional short training (90

in every period). These supports will be possible subject to the availability of financial resources and infrastructure facilities.

The need for main disciplines and areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs has been considered in the HRD plan of BSRTI and these training areas are stated below:

i) Improve mulberry and silkworm
ii) Silkworm disease management
iii) Scientific report writing
iv) Data management and analysis
v) Research methodology
vi) Production management of mulberry plant

Table 48. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Sericulture Research and Training Institute as of June 2022.

Type of posts / Discipline	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total		
	Prov	Ext.	Vac.	Prov	Ext.	Vac.	Prov	Ext.	Vac.	Prov	Ext.	Vac.	Prov	Ext.	Vac.
Open scientists	01	0	01	00	0	0	11	0	11	08	05	03	20	05	15

Table 49. Human resource development plan with enhancement of PhD level from 40% to 70% in BSRTI during the period of 2023-2041.

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post Doc.	Short T.	ST/S/W	PhD	Post-Doc.	Short T.	ST/S/W	PhD	Post Doc.	Short T.	ST/S/W	PhD	Post Doc.	Short T.	ST/S/W	PhD	Post Doc.	Short T.	ST/S/W
Agronomy	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Entomology	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Pathology	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Plant Breeding	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Chemistry	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Open Scientists	01	01	02	03													06	04	15	16
Horticulture	01	01	02	03	01	01	03	03	02	01	05	05	02	01	05	05	06	04	15	16
Total	07	7	14	21	7	7	21	21	14	7	35	35	14	7	35	35	42	28	105	112

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 50. New disciplines/areas to be opened by 2041 in BSRTI with skilled manpower requirement

(a) Suggested disciplines/areas and manpower required

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Mulberry Agronomy	09	05	02	01	06	03	02	01	04	03	02	01
2.	Mulberry Pathology	09	05	02	01	06	03	02	01	04	03	02	01
3.	Mulberry Soil Science	09	05	02	01	06	03	02	01	04	03	02	01
4.	Mulberry Breeding	09	05	02	01	06	03	02	01	04	03	02	01
5.	Mulberry Physiology	09	05	02	01	06	03	02	01	04	03	02	01
6.	Mulberry Horticulture	09	05	02	01	06	03	02	01	04	03	02	01
7.	Mulberry Biotechnology	09	05	02	01	06	03	02	01	04	03	02	01
8.	Farm Machinery	09	05	02	01	06	03	02	01	04	03	02	01
9.	Silkworm Breeding	09	05	02	01	06	03	02	01	04	03	02	01
10.	Silkworm Pathology	09	05	02	01	06	03	02	01	04	03	02	01
11.	Silkworm Biology	09	05	02	01	06	03	02	01	04	03	02	01
12.	Silkworm Biotechnology	09	05	02	01	06	03	02	01	04	03	02	01
13.	Silkworm Rearing	09	05	02	01	06	03	02	01	04	03	02	01
14.	Sericulture Chemistry	09	05	02	01	06	03	02	01	04	03	02	01
15.	Silk Testing & Quality Control	09	05	02	01	06	03	02	01	04	03	02	01
16.	Silk Reeling & Spinning	09	05	02	01	06	03	02	01	04	03	02	01
17.	Silk Weaving	09	05	02	01	06	03	02	01	04	03	02	01
18.	Silk Dying and Printing	09	05	02	01	06	03	02	01	04	03	02	01
Total		162	90	36	18	108	54	36	18	72	54	36	18

HRD plan for national agricultural research system 2023-2041

(b) Training requirement for scientists in BSRTI during 2023 to 2041

Sl. No.	Training requirement	Number training required by 2030				Number of training required by 2035				Number of training required by 2041			
		Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc	Prof. ST	MS	PhD	Post-Doc
1.	Mulberry Agronomy	05	02	02	01	05	02	02	01	05	02	02	01
2.	Mulberry Pathology	05	02	02	01	05	02	02	01	05	02	02	01
3.	Mulberry Soil Science	05	02	02	01	05	02	02	01	05	02	02	01
4.	Mulberry Breeding	05	02	02	01	05	02	02	01	05	02	02	01
5.	Mulberry Physiology	05	02	02	01	05	02	02	01	05	02	02	01
6.	Mulberry Horticulture	05	02	02	01	05	02	02	01	05	02	02	01
7.	Mulberry Biotechnology	05	02	02	01	05	02	02	01	05	02	02	01
8.	Farm Machinery	05	02	02	01	05	02	02	01	05	02	02	01
9.	Silkworm Breeding	05	02	02	01	05	02	02	01	05	02	02	01
10.	Silkworm Pathology	05	02	02	01	05	02	02	01	05	02	02	01
11.	Silkworm Biology	05	02	02	01	05	02	02	01	05	02	02	01
12.	Silkworm Biotechnology	05	02	02	01	05	02	02	01	05	02	02	01
13.	Silkworm Rearing	05	02	02	01	05	02	02	01	05	02	02	01
14.	Sericulture Chemistry	05	02	02	01	05	02	02	01	05	02	02	01
15.	Silk Testing & Quality Control	05	02	02	01	05	02	02	01	05	02	02	01
16.	Silk Reeling & Spinning	05	02	02	01	05	02	02	01	05	02	02	01
17.	Silk Weaving	05	02	02	01	05	02	02	01	05	02	02	01
18.	Silk Dying and Printing	05	02	02	01	05	02	02	01	05	02	02	01
Total		90	36	36	18	90	36	36	18	90	36	36	18

Bangladesh Fisheries Research Institute (BFRI)

Bangladesh Fisheries Research Institute (BFRI) is an autonomous research organization. It was established in 1984 as a national institution for planning, coordination and implementation of fisheries research programs in Bangladesh. Though this institute was established in 1984, it started functioning in 1986 with the recruitment of manpower and initial development of infrastructure.

The major objectives of the institute are given as follows:

- i) to carry out and coordinate basic and adaptive research for development and optimum utilization of all living aquatic resources;
- ii) to develop low-cost, less labor intensive, environment friendly improved fish culture and management technologies;
- iii) to develop technologies for commercially important aquatic products including shrimps and;
- iv) to develop skilled technical manpower through training and demonstration (BARC, 2020).

Achievement of BFRI: The Bangladesh Fisheries Research Institute (BFRI) has so far generated 75 technologies in various aspects of fisheries, out of which, 64 are on the varietal development and 11 are management technologies. Details of the technologies are furnished below:

Major Research Achievement of Bangladesh Fisheries Research Institute (BFRI)

1. Improved Nursery Management of Rui

2. Collection and preservation of pituitary gland for artificial breeding of fish

3. Poly-culture of Rui in Pond

4. Breeding and fry production of endangered species of Mohashol (*Tor putitora*), Sarpunti (*Barbonymusgonionotus*), Gonia (*Labeogonius*), Bata (*Labeobata*) and Guji (*Sperataseenghala*) fish

5. Breeding and fry Production of Thai Pangus (*Pangasianodonhypophthalmus*)

6. Culture of Pangus Fish: Mono-culture of Thai Pangus (*Pangasianodonhypophthalmus*) in Pond

7. Fry Production and Cultivation of BFRI Super Tilapia (*Oreochromisniloticus*): Production of improved varieties of tilapia by selected methods from different sources of strain.

8. Fry production and cultivation of Monosex Super Tilapia (*Oreochromisniloticus*)

9. Cultivation of rajpunti in seasonal ponds

10. Fry production and cultivation of Pabda (*Ompokpabda*)

11. Fry production and cultivation of Gulsha (*Mystuscavasius*)

12. Fry production and cultivation of Magur (*Clariasbatrachus*)

13. Fry production and cultivation of Koi (*Anabas testudineus*)

14. Fry production and cultivation of Shing (*Heteropneustesfossilis*)

15. Indoor hatchery model and fry production of Golda (*Macrobrachiumrosenbergii*): Golda fry production by biofilter method.

16. Polyculture of Golda with Rui fish

17. Production of Rui fish using over wintered fry: Techniques of producing large fish with less time using winter tolerant fish fry

18. Development of improved variety (16% more productive than existing variety) of Rui (*Labeorohita*)

19. Development of improved variety (50% more productive than existing variety) of Tilapia (*Oreochromisniloticus*)

20. Development of improved variety (35% more productive than existing variety) of Sharpunti (*Systomussarana*)

21. Development of Thai koi (*Anabas testudineus*) variety

22. Development of Red tilapia (*Oreochromisniloticus*) variety
23. Breeding and fry production of Chital (*Chitalachitala*)
24. Integrated fish farming in paddy fields
25. Integrated farming of fish and duck in ponds
26. Integrated farming of fish and poultry in ponds
27. Low cost fish feed production with indigenous inputs
28. Manufacture of BFRI model pellet machine for low cost fish feed
29. Pearl culture in freshwater mussel
30. Artificial breeding and fry production techniques of endangered species of Foli (*Notopterusnototerus*)
31. Breeding and fry production technique of Cuchia (*Monotpteruscuchia*)
32. Aquaponic gardening: safe fish and vegetable production
33. Poly-culture of koi (*Anabas testudineus*) fish with Shing (*Heteropneustesfossilis*) and Tilapia (*Oreochromisniloticus*)
34. Artificial breeding and fry production techniques of endangered species of Tengra fish (*Mystusvittatus*)
35. Cage culture of Magur (*Clariasbatrachus*)
36. Poly-culture of Tilapia (*Oreochromisniloticus*) fish with Magur (*Clariasbatrachus*) and Gulsha (*Mystuscavasius*)
37. Artificial breeding and fry production techniques of endangered species of Gutum fish (*Lepidocephalusguntea*)
38. Artificial breeding techniques of Boirali fish (*Bariliusbarila*)
39. Artificial breeding techniques of Angus (*Labeoangra*)
40. Artificial breeding techniques of Balachata fish (*Somileptesgongota*)
41. Artificial breeding techniques of Kholisa fish (*Colisafasciatus*)
42. Artificial breeding techniques of Jatputi fish (*Puntiussophore*)
43. Artificial breeding techniques of Kursha (*Labeodero*)
44. Artificial breeding techniques of Loittatengra (*Mystusbleekeri*)
45. Development of highly productive "BFRI Suborno Rui"
46. Artificial breeding and fry production techniques of Dhela fish (*Osteobramacotio*)
47. Artificial breeding and fry production techniques of Meni/Bheda fish (*Nandusnandus*)
48. Crab fattening techniques: Marketing technique of crab through rearing and feeding of small crablet
49. Eco-friendly shrimp and fish farming based on crop cycle
50. Culture of Vetki fish with Tilapia
51. Semi-intensive Bagda culture in converted confined water bodies
52. Eco-friendly Bagda and Galda farming based on crop cycle
53. Poly-culture of Bagda (*Penaeusmonodon*) with Tilapia (*Oreochromisniloticus*) and Rajpunti (*Systomussarana*)
54. Poly-culture of Golda (*Macrobrachiumrosenbergii*) and Monosex Tilapia (*Oreochromisniloticus*)
55. Breeding and fry production of Nona tengra fish (*Mystusgulio*)
56. Early Brood Production of Galda: Galda Brood Development by Green House Method
57. Arteficial Breeding and fry production of Parshe (*Chelonsubviridis*)

58. Collection of shrimp larvae from natural sources and assessment of harmful effects on biodiversity
59. Production of quality dried fish by using "BFRI Mechanical Fish Dryer".
60. Breeding and fry production of Mud crab (*Scylla olivacea*)
61. Seaweed (*Hypnea* sp.) culture technique in Sea-coast
62. Isolation and culture management of marine life feed (*Skeletonemacostatum* and*Chaetocerosgracilis*)
63. Culture and management technique of commercially important seaweed (*Ulvaintestinalis*) in sea-coast
64. Artificial breeding, fry rearing and nursery management of Chitra (*Scatophagusargus*)

Non-commodity technology generated.

1. Diagnosis, remedy and health management of fish
2. Conservation and management of Hilsha fisheries: Identification of nursery ground and migratory route, conservation of Jatka, establishment of hilsha sanctuary and identification of hilsha catching periods.
3. Development and management of floodplain fisheries: Identification of harmful nets for fishing in floodplains and beels, techniques for assessment of fry stock and establishment of sanctuary.
4. Evaluation of pesticide toxicity in fish and aquatic environment
5. Fish culture in Pen
6. Fish culture in pen at hill|
7. Identification and conservation management of Halda river fisheries
8. Identification 6th Hilsha sanctuary for conservation and protection of Hilsha fisheries
9. Identification of standing biomass and determination of maximum sustainable yield of Hilsha fisheries.
10. Culture of Bagda in cages with improved techniques|
11. Diaognosis, remedy and health management of Chingri fish

Present manpower and future need of skilled manpower in BFRI: Information on the existing manpower, vacant posts and retirement status of BFRI are presented in Tables 51 – 54. Bangladesh has been self-sufficient in fish with even surplus primarily due to development of advanced technologies by BFRI. But this institute had a total of 125 existing scientists in 2022 against 225 approved positions meaning shortage of 100 scientists (Table 51) which indicate its significant vacancies (44.4 %). Nonetheless, the number of scientists in BFRI increased by 95.3% from 64 in 2009 (BARC, 2010) to 125 in 2022 and this enormous increase of scientists in 14 years eventually contributed to developing effective technologies and making the country self-sufficient in fish. However, the shortage of scientists in BFRI due to vacancies in 2022 may be a big challenge for further advancement in technology development to continue maintaining self-sufficiency in fish and its surplus for export. Moreover, BFRI has been running with a significant vacancy in entry level scientists i.e. SO (44.2%; 46 out of 104 approved posts) and in the senior level scientist i.e. PSO (78.9%; 30 out of 38 approved posts) who are the frontline researchers and planers respectively in fisheries research. Furthermore, a total of 57 scientists ie, 45.6% of 125 existing scientists will retire by 2041. So, special efforts need to be taken into consideration for filling in the current and future vacancies of the scientist's position through recruitment of qualified graduates with MS and PhD degrees.

A total of 20 scientists out of 125 total existing (16%) acquired PhD degree indicating that BFRI is running with a huge shortfall of qualified scientists (Table 52). However, most of the existing scientists (77.6%) had MS degree. All PhD degree holders will retire from the service by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (45% i.e. 9 SSOs out of total 20 PhD holders) and no SO level scientists possessed PhD degree. It is, therefore, needed for enhancement of skills in many scientists holding the position of SO and SSO with support for PhD degree.

The HRD Plan 2023-2041 of BFRI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total provision is 473) as shown in Table 53. It means that as per demand of BFRI there will be at least 676 scientists in 19 years by 2041 if 70% PhD holders (473) is considered. This large investments in PhD scholarships will improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively to maintain self-sufficiency and even surplus in fish. The other feature is that the supports to scientists for PhD degree will progressively increase over the period of 2023-2025, 2026-2035 and 2036-2041 (Table 53) to build the capacity of scientists matching with increasing demand of the country. The plan also considers retirement of scientists during 2023-2041 and subsequent filling in their vacant positions through recruitment of qualified staff and further development of their capacity providing support for PhD degree, Post-Doc, short-term training and seminars/workshops/study tours.

HRD plan considers the need for major disciplines/areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs, which are enumerated below:

    i)   Fish stock assessment/population dynamics/ remote sensing
    ii)   Bio-flock technology in fish and shrimp culture
    iii)   Fish geonomics, phenomics and improvement
    iv)   Tagging in aquaculture
    v)   Mapping pollution, heavy metal toxicity and food safety
    vi)   Domestication of wild fish
    vii)   AMR and climate change
    viii) Non-conventional fisheries
    ix)   Fish health management
    x)   10. Marine aquaculture and breeding
    xi)   Bivalves ecology, breeding, culture
    xii)   Data management and machine learning
    xiii) Bioinformatics
    xiv) Pearl culture
    xv)   Climate smart aquaculture and mericulture

BFRI proposed for establishment of 20 new disciplines/areas to address the disastrous impacts of climate change in future (Table 54). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (241 and 81 by 2030, 295 and 190 by 2035 and 437 and 195 by 2041, respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BFRI conduct many research programs to maintain self-sufficiency and even surplus in fish in future.

Table 51. Discipline wise scientific manpower provision, existing and vacant post in Bangladesh Fisheries Research Institute as of June 2022

Types of post	Chief Scientific Officer			Principal Scientific Officer			Senior Scientific Officer			Scientific Officer			Total			Retirement status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2040
Scientists	08	05	03	38	08	30	75	54	21	104	58	46	225	125	100	11	4	35	7
Total	**08**	**05**	**03**	**38**	**08**	**30**	**75**	**54**	**21**	**104**	**58**	**46**	**225**	**125**	**100**	**11**	**4**	**35**	**7**

Table 52. Discipline wise scientific manpower with MS and PhD degree in Bangladesh Fisheries Research Institute as of June 2022

Types of post	Chief Scientific Officer		Principal Scientific Officer		Senior Scientific Officer		Scientific Officer		Total		Retirement status							
											2025		2030		2035		2040	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Scientists	5	5	8	6	54	9	30	0	97	20	11	20	4	4	35	2	7	7
Total	**5**	**5**	**8**	**6**	**54**	**9**	**30**	**0**	**97**	**20**	**11**	**20**	**4**	**4**	**35**	**2**	**7**	**7**

Table 53. Human resource development plan with enhancement of PhD level from 40% to 70% during the period of 2023-2041

Year / Discipline	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post Doc.	Short T.	ST/S/W	PhD	Post Doc	Short T	ST/S/W	PhD	Post Doc.	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W
Scientists	69	87	90	40	112	112	100	50	135	135	120	60	157	157	112	70	473	491	422	220
Total	**69**	**87**	**90**	**40**	**112**	**112**	**100**	**50**	**135**	**135**	**120**	**60**	**157**	**157**	**112**	**70**	**473**	**491**	**422**	**220**

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 54. Disciplines / areas are suggested to be opened by 2041 in BFRI with skilled manpower requirement during 2023 to 2041

Sl No.	Suggested disciplines/area	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
01	Soil, Water and Productivity Management	12	4	2	1	14	10	5	3	22	15	5	3
02	Fish Reproduction and Genetics	11	5	2	1	15	10	6	2	24	15	5	3
03	Aquaculture	18	4	2	1	14	10	5	2	22	14	4	3
04	Fish Nutrition and feeding technology	10	5	2	1	15	10	5	2	20	15	5	1
05	Fish disease diagnosis & health management	12	4	2	1	17	11	5	2	22	15	5	3
06	Fisheries Socio-economics	12	4	2	1	14	10	4	2	23	16	5	4
07	Stock assessment and resource dynamics	14	5	2	1	25	9	5	2	30	15	6	3
08	Fisheries resources management & conservation	18	5	2	1	26	10	5	1	31	15	5	3
09	Culture based fisheries management	14	5	2	1	18	10	7	2	24	13	5	3
10	Environment and Aquatic Pollution	12	4	2	1	13	10	5	2	22	15	5	3
12	Estuarine Ecology and Environment	12	4	2	1	14	10	5	1	22	15	3	4
13	Aquaculture engineering	12	5	2	1	14	12	3	2	21	17	5	3
14	Fish processing and quality control	12	4	2	1	13	10	5	2	22	15	5	3
15	Mari culture	11	4	2	1	14	10	5	3	22	15	5	2
16	Marine biology	12	4	2	1	14	10	5	2	23	16	7	3
17	Oceanography, exploratory fishing & stock assessment	12	4	2	1	14	8	5	2	21	14	5	4
18	GIS and remote sensing	12	4	2	1	13	10	5	2	22	15	5	3
19	Climate change and resources management	12	3	2	1	14	10	5	2	22	15	5	3
20	Non-conventional fisheries management	13	4	2	1	14	10	5	2	22	15	5	3
Total		241	81	38	19	295	190	95	38	437	285	95	57

Bangladesh Livestock Research Institute (BLRI)

Bangladesh Livestock Research Institute (BLRI) is a national research organization under the Ministry of Fisheries and Livestock. It has a mandate to conduct research on livestock and poultry development of the country. The institute started functioning in 1986 after the promulgation of Presidential Ordinance No. 28 in 1984. A 14-member Board of Management led by the Honorable Minister, Ministry of Fisheries and Livestock provide direction and supervise different affairs of the institute. The Director General is the Chief Executive, who directs all activities including administrative and research of BLRI (BLRI 2022).

Achievement of BLRI: BLRI developed 70 technologies including 4 breeds (02 livestock and 02 poultry), 01 fodder variety and 65 management technologies (53 on livestock and 12 on poultry production). The institute also conserved 24 different types of farm animals and poultry species, and 43 different varieties of fodder crops of native and exotic origins (BLRI, 2021). Among the above technologies, the following are notable:

i)   BLRI developed layer strains "Shuvra" and "Swarna",
ii)   Avian Influenza H5NI antigen,
iii)   preservation technique of green forage by dole method,
iv)   FMD control model,
v)   TMR technology,
vi)   buffalo fattening technology,
vii)   commercial model of Bangla lamb production from local sheep,
viii)   sheep rearing techniques in hilly areas and bio-security model for commercial poultry farm

Present manpower and future need of skilled manpower in BLRI: Information on the existing manpower, vacant posts and retirement status of BLRI are presented in Tables 55 – 58. BLRI contributed incredibly to achieving self-sufficiency in meat, milk and egg with even some surplus in Bangladesh mainly due to advancement of technological development on improved breeding, disease control and other management of livestock and poultry. The scientific manpower of BLRI was 98 in 2022 and the institute has been running with shortage of 40 scientists compared to its provision of 138 scientists (Table 55) indicating its significant vacancies (28.9%). The number of scientists in BLRI increased enormously by 164.8% from 37 in 2009 (BARC, 2010) to 98 in 2022. This abrupt increase of scientists in BLRI during 14 years since 2009 has helped develop many advanced technologies and brought the country to the level of self-sufficiency and even surplus in meat and egg. However, the shortage of scientists in BLRI due to vacancies in 2022 could be a challenge for technology development to continue maintaining this self-sufficiency and surplus in future. Moreover, among the active researchers BLRI has been running with a significant vacancy in entry level i.e. SO (28.6 %; 22 out of 77 approved posts) and mid-level i.e. SSO (37.5%; 15 out of 40 approved posts). Furthermore, a total of 34 scientists i.e. 34.7% of 98 existing scientists will retire by 2041. So, special efforts need to be taken for filling in the current and future vacancies of the scientist's position through recruitment of qualified manpower.

There is a skill gap in BLRI due to poor proportion of scientists with PhD degree (40.8%; 40 out of 98 existing scientists) as per data in Table 56. About half of PhD degree holders (19 out of 40 existing) will retire from the service by 2041. Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (50% i.e. 20 SSOs out of total 40 PhD holders) and only a few SO level scientists (6) possessed PhD degree. It is, therefore, needed for enhancement of skills in many scientists holding the position of Scientific Officer and Senior Scientific Officer with support for PhD degree.

BLRI has given emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total projection is 65 by 2041) as shown in Table 57. It means that there will be at least 93 scientists in 19 years by 2041 if 70% PhD holders (65) is considered. This investments in PhD scholarships will improve the quality of scientists by fetching advanced knowledge so that they can conduct research

effectively for maintaining self-sufficiency and even surplus in meat. milk and egg under any burden of risk and vulnerability in future. The plan also considers subsequent filling in vacant positions through recruitment of qualified staff and further development of their capacity providing support for post-Doc (58), short-term training (118) and seminars/workshops/study tours (645) by 2041.

A total of 11 new disciplines/areas will be opened to address the pernicious impacts of climate change in future (Table 58 a). Corresponding requirement of scientists to manage these new disciplines is proposed at a higher scale in the position of SO and SSO (120 and 60 by 2030, 176 and 88 by 2035, and 264 and 132 by 2041 respectively) than that of PSO and CSO in all the phases of HRD plan. The establishment of these new disciplines and corresponding higher numbers of frontline researchers (SO and SSO) will help BLRI conduct many research programs to meet the future demand of the country for continued self-sufficiency in livestock and poultry products. The plan considers recruiting more SOs and SSOs in Animal Production Research Division, Animal Health Research Division and Biotechnology Division than those of the other divisions in different phases of the plan due to horrendous need of boosting production using genome editing and other advanced tools of genetic engineering. BLRI will give more emphasis for skills development of scientists under the proposed new disciplines by providing assistance for higher studies (MS and PhD degree), post-Doc and professional short training (Table 58 b). A good number of scientists under different new disciplines will be provided with PhD degrees (120 by 2030, 56 by 2035 and 88 by 2041). The other feature is that many scientists will be supported for availing professional short training (1242), post-Doc (64) and MS (56). These supports for recruitment of huge scientists under new disciplines, and training of these scientists will be possible subject to the availability of financial resources and infrastructure facilities.

The need for main disciplines/areas of training as identified through TNAs, skill gap analysis, FGDs and KIIs are considered in the HRD plan of BLRI and these training areas are given below:

i) Blood/tissue/samer sample analysis
ii) Nutritional biotechnology
iii) Molecular biology
iv) Genomics, phenomics and bioinformatics
v) AMR and Vaccine development
vi) Climate smart fodder and cost effective feed production
vii) Livestock product processing, value chain analysis and marketing
viii) Research methodology
ix) Scientific report writing
x) Climate smart livestock development
xi) Precision animal farming
xii) Pollution and waste management

Table 55. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Livestock Research Institute as of June 2022

Type of posts / Division	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2022-2025	2026-2030	2031-2035	2036-2041
Scientists																			
Animal Production Research Division	1	0	1	2	2	0	4	3	1	7	3	4	14	8	6	0	0	2	4
Poultry Production Research Division	1	0	1	3	3	0	4	4	0	8	5	3	16	12	4	0	0	5	0
Sheep Production Research Division	0	0	0	1	1	0	3	2	1	4	4	0	8	7	1	0	0	1	2
Goat Production Research Division	1	0	1	1	1	0	3	2	1	5	2	3	10	5	5	0	0	0	2
Animal Health Research Division	1	0	1	1	1	0	4	2	2	7	3	4	13	6	7	0	0	0	3
Biotechnology Division	1	1	0	1	1	0	2	1	1	5	4	1	9	7	2	0	1	0	2
Farming System Research Division	0	0	0	1	1	0	2	2	0	5	5	0	8	8	0	0	0	1	0
Socio-Economics Division	1	0	1	1	0	1	1	1	0	4	2	2	7	3	4	0	0	0	1
Training Planning and Technology Testing Division	0	0	0	0	0	0	3	3	0	2	0	2	5	3	2	0	0	0	1
Buffalo Production Research Division	0	0	0	0	0	0	1	1	0	4	4	0	5	5	0	0	0	0	1
Dairy Research & Training Center	0	0	0	2	2	0	2	2	0	5	5	0	9	9	0	0	0	2	1
Trans boundary	0	0	0	1	1	0	4	3	1	7	7	0	12	11	1	0	0	1	2
Regional Station (Baghabari.)	1	1	0	0	0	0	2	1	1	4	2	2	7	4	3	0	1	0	1
Regional station (Naikhongchari, Bandarban.)	0	0	0	0	0	0	2	0	2	4	4	0	6	4	2	0	0	0	0
Regional station (Jessore)	0	0	0	0	0	0	1	0	1	2	2	0	3	2	1	0	0	0	0

Table 55. Discipline wise scientific manpower provision, existing and vacant posts in Bangladesh Livestock Research Institute as of June 2022

Type of posts \ Division	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2022-2025	2026-2030	2031-2035	2036-2041
Scientists																			
Regional station (Rajshahi)	0	0	0	0	0	0	1	0	1	1	1	2	2	1	3	0	0	0	0
Regional station (Bhanga, Faridpur)	0	0	0	0	0	0	0	1	2	1	2	0	1	3	2	0	0	0	0
Total	8	1	7	14	12	2	40	25	15	77	55	22	138	98	40	0	2	2	12	20

Table 56. Discipline wise scientific manpower with MS and PhD degree in BLRI as of June 2022

Type of posts \ Discipline	Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total		Status of Retirement by PhD degree holders by:				
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	2022-2025	2026-2030	2031-2035	2036	2041
											PhD	PhD	PhD	PhD	PhD
All disciplines of Livestock Production and Treatment	2	2	12	12	25	20	48	6	84	40	0	2	4	5	8

Table 57. Human resource development plan with enhancement of PhD level from 40% to 70% in BLRI during the period of 2023-2041

Discipline \ Year	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post Doc	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W	PhD	Post Doc	Short T.	ST/S/W
All disciplines of Livestock Production and Treatment	22	20	42	225	20	18	40	293	15	13	24	381	8	7	12	496	65	58	118	645

Short T= Short term Training, ST= Study Tour, S=Seminar, W=Workshop

Table 58. New disciplines/areas proposed to be opened by 2041 in BLRI with skilled manpower requirement

(a) Suggested disciplines/areas and manpower required.

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.	Animal Production Research Division	16	8	4	2	24	12	6	3	32	16	8	4
2.	Poultry Production Research Division	16	8	4	2	24	12	6	3	32	16	8	4
3.	Sheep Production Research Division	8	4	2	1	16	8	4	2	24	12	6	3
4.	Goat Production Research Division	8	4	2	1	16	8	4	2	24	12	6	3
5.	Animal Health Research Division	16	8	4	2	24	12	6	3	32	16	8	4
6.	Biotechnology Division	16	8	4	2	24	12	6	3	32	16	8	4
7.	Farming System Research Division	8	4	2	1	8	4	2	1	16	8	4	2
8.	Socio-Economics Division	8	4	2	1	8	4	2	1	16	8	4	2
9.	Training Planning and Technology testing Division	8	4	2	1	8	4	2	1	16	8	4	2
10.	Buffalo production research Division	8	4	2	1	8	4	2	1	16	8	4	2
11.	Dairy Research & Training Center	8	4	2	1	16	8	4	2	24	12	6	3
Total		**120**	**60**	**30**	**15**	**176**	**88**	**44**	**22**	**264**	**132**	**66**	**33**

(b) Suggested training requirement in BLRI from 2023 to 2041

Suggested Disciplines/Areas	Number training required by 2030				Number of training required by 2035				Number of training required by 2041			
	Professional ST	MS	PhD	Post Doc	Professional ST	MS	PhD	Post Doc	Professional ST	MS	PhD	Post Doc
All the proposed disciplines of Livestock Production and Treatment	312	24	120	24	405	12	56	15	525	20	88	25

Summary of the Proposed HRD Plan

Overall, the NARS institutes have been running with 1,722 scientists since 2022 but with shortage of 842 scientists compared to the approved position of 2,564 scientists (Table 59) indicating significant vacancies (32.8%). Almost half of the NARS institutes viz, BWMRI, SRDI, BFRI- Forest, CDB, BSRTI and BFRI-Fisheries have been suffering seriously due to higher vacancies of scientists (44.3%, 50.4%, 58.9%, 69.2%, 75% and 44.4%, respectively) compared to the other institutes. Across the position, vacancies were significant in the level of Scientific Officer (40.7%; 471 vacant out of 1,156 approved posts) who are the frontline researchers. Nonetheless, the number of scientists in NARS institutes increased by 21.3% from 1,419 in 2009 (BARC, 2010) to 1,722 in 2022. This increase of the total scientists in NARS institutes during 14 years since 2009 contributed to developing many advanced technologies under mischievous impacts of climate change, and brought the country to the level of self-sufficiency and even surplus in rice, vegetables, meat and egg. However, the overall shortage of scientists in NARS institutes due to vacancies in 2022 could be a big challenge for technology development to make the country self-sufficient in the deficit areas of agricultural production and continue maintaining the self-sufficiency and surplus in the production areas being achieved. So, special efforts need to be taken into consideration for filling in the current and future vacancies of the scientist in NARS institutes, particularly in SO and SSO level.

There was a significant skill gap in NARS institutes as of June 2022 due to poor proportion of scientists with PhD degree (41.2%; 709 out of 1,722 existing scientists) as per data in Table 60. All PhD degree holders will retire from the service by 2041. Among the NARS institutes, BARI had the highest PhD holders (61.37%) and SRDI held the lowest proportion (8.33%) although BARC (95.65% PhD holders) being the apex of NARS institutes remained top of all institutes. Highest proportion of PhD degree holders was with the male scientists (73.8% i.e. 523 out of total 709 PhD holders) and the proportion of female PhD holders was very poor in every institute (<30%) indicating that these institutes were not gender sensitive in this regard. It is, therefore, needed for enhancement of skills in many scientists and female scientists, in particular, with support for PhD degree to make harmony and balance among the scientists.

Table 59. Provision, existing and vacant positions of scientific manpower at NARS (post-wise) in June, 2022

Organization	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement of scientists during:			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2023-2025	2026-2030	2031-2035	2036-2041
BARI	39	38	1	98	96	2	221	221	0	327	199	128	685	554	131	56	54	142	130
BRRI	27	19	8	43	35	8	115	100	15	120	96	24	305	248	57	16	31	32	57
BJRI	17	10	4	43	31	12	62	52	10	73	45	28	192	138	54	4	26	17	22
BINA	16	15	1	21	13	8	50	49	1	83	57	26	170	132	38	16	14	7	15
BSRI	10	2	8	15	15	0	19	14	5	28	20	8	72	51	21	4	7	11	6
BWMRI	7	4	3	20	9	11	30	18	12	34	21	13	88	49	39	4	4	13	9
SRDI	18	8	10	73	24	49	121	93	28	199	79	120	411	204	207	2	9	7	0
BTRI	3	3	0	7	5	2	10	6	4	15	8	7	35	22	13	1	1	3	4
BFRI	18	0	18	24	9	15	41	22	19	75	36	39	158	65	93	5	11	0	49
CDB	1	0	1	4	0	4	8	2	6	13	6	7	26	8	18	1	3	4	0
BSRTI	1	0	1	-	-	-	11	0	11	8	5	3	20	5	15	-	-	-	-
BFRI - Fisheries	8	5	3	38	8	30	75	54	21	104	58	46	225	125	100	11	4	35	7
BLRI	8	1	7	14	12	2	40	25	15	77	55	22	138	98	40	0	2	12	20
BARC	14	9	5	21	12	9	4	2	2	-	-	-	39	23	16	3	5	3	12
Grand Total	184	114	70	421	269	152	807	658	149	1156	685	471	2564	1722	842	123	171	276	331

Table 60. Status of PhD degree holders by gender as of June 2022 and their retirement status during 2023–2041

NARS Institutes	Existing researchers at the NARS institutes (as of June 2022)			Total number of PhD degree holders (as of June 2022)			% of PhD degree holders (as of June 2022)			Status of Retirement (2023–2041)		
	Total	Male	Female	Total	Male	Female	Male*	Female*	Total**	MS	PhD	Total
BARI	554	429	125	340	284	56	83.5	16.5	61.37	0	382	382
BRRI	248	185	63	107	82	25	76.6	23.4	43.15	12	99	111
BJRI	138	113	25	46	41	5	89.1	10.9	33.33	22	53	75
BINA	132	106	26	47	35	12	74.5	25.5	35.61	0	58	58
BSRI	51	41	10	16	13	3	81.2	18.8	31.37	12	22	34
BWMRI	49	44	5	25	24	1	96.0	4.0	51.02	0	0	0
SRDI	204	133	71	17	13	4	76.5	23.5	8.33	0	18	0
BTRI	22	18	4	8	7	1	87.5	12.5	36.36	0	8	8
BFRI	65	50	15	15	12	3	80.0	20.0	23.08	46	15	61
CDB	8	8	0	3	3	0	100.0	0.0	37.50	5	3	8
BSRTI	5	4	1	3	2	1	66.7	33.3	60.00	0	0	0
BFRI -Fisheries	125	89	36	20	16	4	80.00	20.00	16.00	57	56	113
BLRI	98	65	33	40	31	9	77.5	22.5	40.82	0	19	19
BARC	23	19	4	22	18	4	81.8	18.2	95.65	1	21	22
Total	1722	1304	418	709	523	186	73.8	26.2	41.2	155	736	891

* % of total PhD degree holders, ** % of the total scientific manpower

During 2009–2022, the total number of scientists in NARS institutes increased by 26.6% from 1,419 in 2009 to 1,797 in 2020 but declined a little by 4.2% in 2022 (1,722) as per Table 61. BARI is by far the largest institute employing 554 researchers in 2022 compared to 754 in 2020 and 637 in 2009 indicating a decrease by 14.9% during 2009-2022. Moreover, BARC, BSRI, BTRI, CDB and BSRTI experienced a decline of their scientific manpower during 2009-2022. Total NARS institutes scientists with PhD degree increased abruptly by 104.9% from 346 in 2009 to 709 in 2022 and among them BLRI had the highest increase (233.3%) followed by BARI (163.5%) and BJRI (142.1%) while BFRI-Fisheries and CDB had 25.9% and 50% decrease, respectively, during the same period (Table 61). The share of scientists in NARS institutes with PhD degree increased progressively from 24.3% in 2009 to 36.3% in 2020 and 41.2% in 2022.The highest share (95%) in scientists with PhD was noticed in BARC followed by 61% in BARI and 51% in BWMRI in 2022 compared to their respective share in 2009 (51%, 20% and 0%, respectively) and in 2020 (83%, 42% and 21%, respectively). However, BFRI (Fisheries), BINA and CDB encountered a decrease in share of their scientists with PhD during the same period. As per the report of Agricultural Science and Technology Indicators (ASTI), in 2016 the share of scientists with PhD degree in Nepal and Sri Lanka were 12.2% and 28.5%, respectively, while in India it was 77.5% in 2018 (ASTI, 2022). Therefore, NARS institutes and BARC having 41.2% PhD holders remained far below that of ICAR in India (77.5%).

Among the PhD holders as of June 2022, highest share was with the scientists holding the position of SSO (49.8% i.e. 353 SSOs out of total 709 PhD holders) followed by PSO (32.6% i.e. 231 PSOs out of total 709 PhD holders) and only a few SO level scientists (36) possessed PhD degree (Table 62). It is, therefore, needed for enhancement of skills in many scientists holding the position of Scientific Officer and Senior Scientific Officer with support for PhD degree.

NARS institutes and BARC have given special emphasis for improvement of scientists by ensuring 70% of the total scientists with PhD degree (total projection is 5,738 by 2041) as shown in Table 63. It means that there will be at least 8,197 scientists in 19 years by 2041 if 70% PhD holders (5,738) is considered. This investments in PhD scholarships will improve the quality of scientists by fetching advanced knowledge so that they can conduct research effectively for maintaining self-sufficiency and even surplus in agricultural production under continued risks and vulnerabilities in future. The supports for PhD degree will progressively increase across the phases of the plan (798 i.e. 40% during 2023-2025, 1120 i.e. 50% during 2026-2030, 1531 i.e. 60% during 2031-2035 and 2289 i.e. 70% during 2036-2041). The plan also considers further skills development of scientists providing support for Post-Doc (1,284), short-term training (11,108) and seminars/workshops/study tours (13,061) by 2041.

Table 61. Total number of scientists and % of PhD degree holders in NARS institutes in 2009, 2020 and 2022.

NARS institutes	Total number of scientists			Scientists with PhD degrees			% of PhD degree holders		
	2009	2020	2022	2009	2020	2022	2009	2020	2022
BARI	637	754	554	129	321	340	20.25	42.57	61.37
BRRI	186	243	248	69	116	107	37.09	47.74	43.15
BJRI	114	135	138	19	42	46	16.67	31.11	33.33
BINA	70	123	132	35	48	47	50.00	39.02	35.61
BSRI	67	70	51	11	27	16	16.42	38.57	31.37
BWMRI	0	41	49	0	9	25	0.00	21.95	51.02
SRDI	131	70	204	11	7	17	8.40	10.00	8.33
BTRI	24	22	22	4	7	8	16.67	31.82	36.36
BFRI	52	89	65	10	10	15	19.23	11.24	23.08
CDB	0	59	8	0	6	3	0.00	10.17	37.50
BSRTI	0	18	5	0	0	3	0.00	0.00	60.00
BFRI - Fisheries	64	94	125	27	28	20	42.18	29.79	16.00
BLRI	37	61	98	12	17	40	32.43	27.87	40.82
BARC	37	18	23	19	15	22	51.35	83.33	95.65
Total	1419	1797	1722	346	653	709	24.38	36.33	41.20

Table 62. Category-wise scientific manpower with MS and PhD degree in NARS institutes as of June 2022

Type of posts / Organization	Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total		Retirement of MS and PhD degree holders during:							
											2022-2025		2026-2030		2031-2035		2036-2041	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
BARI	2	36	5	91	17	204	186	13	214	340	-	56	-	54	-	142	-	130
BRRI	4	19	5	33	38	62	96	6	123	107	2	19	4	27	3	20	3	33
BJRI	-	16	2	20	11	14	13	-	26	46	-	-	-	31	6	9	16	13
BINA	-	15	-	13	29	19	57	-	86	47	-	16	-	16	-	11	-	15
BSRI	1	0	10	14	9	5	21	2	44	16	1	2	3	5	5	8	3	7
BWMRI	0	4	1	7	8	9	12	2	21	25	-	-	-	-	-	-	-	-
SRDI	9	6	30	4	40	7	41	-	120	17	-	2	-	9	-	7	-	-
BTRI	-	3	-	3	-	2	-	-	-	8	-	-	-	1	-	2	-	5
BFRI	-	1	3	6	13	6	30	2	30	15	1	2	4	3	-	-	41	10
CDB	-	-	-	-	1	1	4	2	5	3	-	1	1	2	4	-	-	-
BSRTI	-	-	-	-	-	-	2	3	2	3	-	-	-	-	-	-	-	-
BFRI (Fisheries)	5	5	8	6	54	9	30	0	97	20	11	11	4	4	35	34	7	7
BLRI	2	2	12	12	25	20	48	6	84	40	0	2	0	4	0	5	0	8
BARC	9	8	12	12	2	2	-	-	23	22	-	-	-	9	-	4	1	8
Total	23	109	58	231	207	353	499	36	771	709	15	109	16	156	53	235	71	236

Source: Survey data, 2022

109

Table 63. Human resource development plan with enhancement of PhD level from 40% to 70% at the NARS institutes during the period of 2023 - 2041

Year / NARS Institutes	2023-2025 (PhD level 40%)				2026-2030 (PhD level 50%)				2031-2035 (PhD level 60%)				2036-2041 (PhD level 70%)				Total			
	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Shor T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W	PhD	Post-Doc	Short T.	ST/S/W
BARI	412	24	24	24	619	36	36	36	990	60	60	60	1684	102	102	102	3705	222	222	222
BRRI	23	-	-	-	39	-	-	-	44	-	-	-	51	-	-	-	157	-	-	-
BINA	54	41	135	73	62	41	154	103	55	61	159	106	63	51	191	120	234	194	639	402
BJRI	9	-	9	10	13	6	9	9	16	6	13	11	20	5	14	13	58	17	45	43
BSRI	11	17	52	53	22	20	54	52	12	24	65	64	13	24	64	65	58	85	235	234
BWMRI	8	7	17	19	11	11	21	19	18	12	18	19	17	12	20	21	54	42	76	78
SRDI	40	10	30	30	40	10	30	30	40	10	30	30	50	20	40	40	170	50	130	130
BTRI	8	8	24	40	16	16	24	40	8	16	24	40	8	16	24	40	40	56	96	160
BFRI	30	5	30	15	30	5	30	15	30	5	30	15	30	5	30	15	120	20	120	60
CDB	5	-	4	-	9	4	2	-	14	9	6	-	14	8	7	5	42	21	19	6
BSRTI	7	7	15	20	7	7	21	21	14	7	35	35	14	7	35	35	42	28	106	111
BFRI-Fisheries	69	87	90	40	112	112	100	50	135	135	120	60	157	157	112	70	473	491	422	220
BLRI	22	20	42	225	20	18	40	293	15	13	24	381	8	7	12	496	65	58	118	1395
BARC	100	-	570	1000	120	-	1110	2000	140	-	2760	3000	160	-	4440	4000	520	-	8880	10000
Total	798	226	1042	1549	1120	286	1631	2668	1531	358	3344	3822	2289	414	5091	5022	5738	1284	11108	13061

Short T= Short term Training; ST= Study Tour, S=Seminar, W=Workshop

Conclusions and Recommendations

The world is changing very fast with the advancement of science and scientific developments. There is no way to ignore the changing demand of the society. To cope with the changing situations and demand of the time, it is important to reshape the NARS institutes so that they will contribute significantly to increasing agricultural production for feeding an increasing population of the country. However, based on the Training Need Assessment (TNA), skill gap analysis, Focus Group Discussion (FGD) and Key Informant Interview (KII), the following conclusions and recommendations are put forward:

1. Upgradation of Manpower and Training Unit of BARC to expedite effective training on research management and capacity building of NARS scientists: Research management and leaderships of several NARS institutes were found relatively weak. Especially, the managerial capabilities of several top leaders of NARS institutes need improvement. This can be achieved through proper guidance, monitoring and providing training on research management and capacity building. Almost in every sector, there is a platform for providing intensive training for improving the skills and efficiency of its workers. There are independent and well established training institutes e.g. BPATC, BIAM, BARD, and RDA for the administrative cadre, NATA for the extension service providers, BMA and BPA for the military and police officers, and NAPE, PTI, TTC, NAEM, GTI etc. for the teachers of primary school, secondary school, college and university. It is noteworthy that a National Institute for Training of University Teachers is going to be established soon in the country. Training for the agricultural researchers has also duly been emphasized in the National Agricultural Policy-2018 (NAP 2018). But unfortunately, till now there is no specific training institute in Bangladesh for providing training to the scientists of NARS institutes on research management and leadership development. This is a dire need now in Bangladesh to expedite the work efficiency of the scientists in the NARS institutes. Therefore, it is recommended that the Manpower and Training Unit of BARC may be upgraded to a full-fledged division for providing effective training on research management and capacity building to the scientists of all the NARS institutes. For smooth functioning, a pool of very competent trainers may be developed for providing fruitful, practical-based, and demand-led effective training on research management to the scientists.

2. Upgradation of Technology Transfer and Monitoring Unit (TTMU) of BARC to effectively assess the status of technology dissemination and adoption by the end users: Mere development of technologies by the NARS institutes would be of little use unless these are effectively disseminated among the farmers for wider use. Even after the dissemination of technologies at farmers' level, it is very important to monitor and assess the extent of adoption of these technologies by the farmers. The role and functions of the TTMU of BARC should not be only to concentrate its activities for technology dissemination but also for monitoring and impact evaluation of the technologies. Hence, the TTMU of BARC may be upgraded to a full-fledged division to effectively and competently supervise, monitor and assess the status of technology dissemination and adoption by the end users.

3. Increase of budget allocation for NARS institutes: The mission of BARC is to make efficient, effective and sustainable research system in the country (BARC, 2022). To achieve this mission, BARC has to take active leadership roles and responsibilities and bring dynamism in the NARS institutes. BARC should be strengthened and more empowered through the enactment of law by the Government to handle all matters related to agricultural research systems in the country and lead the NARS institutes with international standards. The individual as well as institutional capacity of NARS scientists and institutes, respectively, need to be significantly increased for attaining self-sustainable and profitable agriculture. For increasing the capacities (both individual and institutional) there should be adequate budgetary provision. But, the present allocations for all the NARS institutes are not adequate. Hence, the budget allocation of the NARS institutes needs to be increased for conducting demand-led quality research as well as for increasing capacity building of the scientists and the institutes.

4. Formation of Recruitment Board for NARS scientists (RBNS) under the umbrella of BARC for the recruitment of quality scientists in the NARS institutes: It has been observed that there are lot of frustrations, lack of willingness and commitment among the young scientists to work whole-heartedly for the institutes. There is no alternative than to have knowledgeable, skilled and committed agricultural scientists in the

research institutes. Human resource development in the NARS institutes largely depend on the recruitment of quality scientists. At present, there is no clear-cut guidance and principles for recruiting the quality scientists in the NARS institutes. If the NARS institutes expect efficient, devoted and committed scientists, there should be competitive and fair recruitment policy. For example, for the recruitment of entry level agricultural scientists in 102 research institutes under the umbrella of ICAR (Indian Council of Agricultural Research), there is an Agricultural Scientists Recruitment Board (ASRB) (ICAR, 2022). The ASRB selects the best candidates through very competitive and comprehensive tests. After selection, they send the list of candidates to ICAR for deployment. In Bangladesh, a Recruitment Board for NARS scientists (RBNS) may be formed under the umbrella of BARC for the recruitment of best available candidates for the NARS institutes. This board may also form a Search Committee (SC) for finding and selecting the higher positions in the NARS institutes (such as PSO, CSO, Director and Director General). This process would help not only to find out the best candidates in the higher positions in the NARS institutes but also would create opportunities to get good leaders in the top positions. The role of RBNS may further be extended to formulate a unified service rule for researchers of NARS institutes working under the Ministry of Agriculture. BARC should take the initiatives and an active role in materializing this through the Ministry of Agriculture and concerned others.

5. Arrangement of Foundation Training for the NARS scientists by BARC: NARS institutes often have to recruit scientists to fill in the vacant positions and run the institutes properly. After joining, the newly recruited scientists do not understand properly what their roles in the research institute are. At the very beginning of their career, they need to understand clearly what their roles in the research systems should be and how can they develop their brilliant future career. Hence, for the newly recruited scientists in the NARS institutes 4 (four) months foundation training on different aspects of research management should be organized by BARC. In the foundation training, research planning, monitoring, evaluation, project management, leadership, communication, behavioral aspects should be covered. These would create adequate scope and opportunities for the young scientists to be a good research manager.

6. Extension of retirement age for the NARS scientists: Each NARS institute should have its own strategic plan. Human resource development plans for the scientists as well as for the other managerial staff (support staff) should be developed and maintained in the NARS institutes. After a thorough TNA (Training Need Assessment) analysis, regular skill-based training should be offered to the scientists. The training should be followed by the feedback and impact studies to make the future training programs more fruitful and effective. It may be mentioned here that after higher degrees and many short-term skill-based training, agricultural scientists working in the agricultural research institutes (ARIs) leave their jobs for other avenues, especially, some of them leave the country for better livelihood. This is a serious brain drain since lot of country's taxpayers' money had to be invested for producing a highly qualified scientist. This tendency should not be continued. Another important issue is the retirement age of the research scientists working in the NARS institutes, which at present is 59 years. But with the advancement of science and development, the longevity and life span of the people of Bangladesh has increased notably in the last 72 years: it was 38.55 years in 1950 and rose to 72.00 years in 2020 (World Bank, 2022). The life expectancy in Bangladesh has been expected to be about 80 years in the year 2041 (GoB, 2021). People are now able to work steadily even after the age of 60 years. As already mentioned, a huge amount of money has to be spent to produce a scientist and logically it is important for the country to utilize their contribution as maximum as possible. More importantly, research needs long time to produce the outcome or result and the scientists involved in the research need to continue tracking on the good result to come. So, the scientists who started working in any research before they are 59 years old need to continue working till the expected result is ensured. In Bangladesh, there is evidence in the universities where the retirement age of teachers is fixed at 65 years. In this consideration, the retirement age of the scientists working in the NARS institutes may be extended to the age of 65 years in congruence with that of the teachers in the universities. It may also be relevant to mention here that the present retirement age for all the scientific posts in ICAR, India is now 62 years (ASRB, 2022).

7. Studies on specific issues: To make the NARS institutes more dynamic, active and productive, research on the internal resource management, increasing managerial abilities, capacity building, leadership development, lack of cooperation among the scientists, internal conflicts, conflict resolution etc., are required. Some of the NARS institutes are now suffering due to weak leadership, inadequate managerial ability and lack of

teamwork spirit. Studies may be undertaken on these aspects not only for the benefit of the institute but also for the benefit of scientists as well.

8. Strengthening of teamwork and collaborative research with other organization home and abroad: For human resource development in the research institutes, teamwork with international partnership, private sector participation, and collaborative research with international centers are required. Through these practices, the scientists would get more scope to increase their knowledge and skills and would get a unique opportunity to build their professional career towards desired destination.

9. Strengthening of linkages among the NARS institutes, agricultural universities and agricultural extension organizations: The existing linkage, cooperation, coordination and integration among the agricultural related universities (where agricultural research is conducted), NARS institutes and agricultural extension agencies (DAE, DoF, DLS, BRDB, RDA etc.,) are not congenial and effective as expected. But for the technological advancement in agricultural sector (crop, livestock, fisheries and forestry), there should be strong linkages among these organizations. As an apex body for coordinating the research activities of NARS institutes, BARC should take an active role and responsibility to make these linkages effective with the direction and guidance of the Ministry of Agriculture.

10. Introduction of Good Scientist Award (GSA) System: To encourage and give incentives to the young scientists, Good Scientist Award (GSA) system may be introduced for outstanding performance of the scientists in each and every NARS institute through the active support of BARC. The awardee should be given a certificate of achievement for their extra-ordinary job performances with a monetary grant (as permissible). In some cases, the outstanding scientists may be offered an opportunity to have a professional training abroad to develop his/her further skills. This would encourage the young scientists to devote more time in doing quality research and publish articles in the reputed journals. There should also be a system to penalize the scientists for their negligence and bad performance, if they are found to be guilty.

11. Implementation of plan for the training areas/disciplines as identified through TNAs and skill gap analysis: Types of training (short, medium and long) needed for the scientists, which were identified in this report for a period of 2023 to 2041, have been proposed from the corresponding NARS institutes. Similarly, the disciples/areas of training have been identified through TNA and skill-gap analysis by the scientists of the NARS institutes. Hence, for any future training program, these aspects of training should duly be considered for implementation by the concerned authority.

12. Selection of international universities for PhD degrees with opportunities of research based theoretical course systems: Merely acquiring higher degrees by the scientists especially PhD from the advanced countries do not contribute much to the research institutes although the degrees are achieved at the cost of huge amount of foreign currency. To get rid of this and make such universities and institutes effective, centers should be selected where the research-based degrees are of prime importance apart from advanced theoretical courses. There are many universities in the world where research-based degrees are offered along with advanced theoretical courses. For example, the WUR (Wageningen University of Research, The Netherlands), UTM (University of Technology Malaysia, Johor Bahru, Malaysia), UPLB (The University of the Philippines, Los Banos, The Philippines), UQ (University of Queensland, Australia), AIT (Asian Institute Technology, Bangkok, Thailand) and IARI (Indian Agricultural Research Institute, New Delhi, India). In USA, there are quite a good number of research-intensive universities. Therefore, at the time of selecting candidates, especially, for higher degrees the candidates must be asked to get their admissions into these universities/institutes/centers where the prime importance is to conduct quality research/dissertation work apart from advanced theoretical courses.

Way Forward

It is of course very important to implement the human resource development plan (HRDP) to increase productivity and efficiency of the NARS institutes. It is quite likely and expected that through the implementation of human resource development plan, the trained scientists would be equipped with the research programs more efficiently and effectively in order to develop need-based technology (NATP, 2015).

Effective implementation of HRD plan depends on three main elements:

1. The degree to which the training adds to productive output meets the standards of quantity, quality, and timeliness of the people who receive, review, and/or use the HRD Programs.
2. The degree to which the HRD process of carried out the work enhances the capability of members to work together interdependently in the future.

3. The degree to which the group experience contributes to the growth of the trainees and eventually the organizations.

This is the most crucial of all phases since it is directly related to the output of the Program. It is the real show that takes place on an actual level, a point when the developers/trainers and trainee are in direct contact. The success depends on the extent to which trainees experience meaningfulness of the developmental exercise, active responsibility for the exercise and its outcomes and knowledge of actual benefits of the training.

References

Anjum, N. and M. Zahan (2021). Contemporary Practices, Problems and Challenges of Human Resource Management - Bangladesh Perspective. *Research Gate.*

ASRB (2022). Agricultural Scientists Recruitment Board (ASRB) website: *www.asrb.org.in*

ASTI (2022). *Agricultural Science and Technology Indicators.* AST Database. International Food Policy Research Institute. website: http://www.asti.cgiar.org/

BARC (2010). *Human Resource Development Plan for National Agricultural Research System in Bangladesh: 2009-2025.* Project Implementation Unit, National Agricultural Technology Project. Bangladesh Agricultural Research Council (BARC), New Airport Road, Dhaka-1215.

BARC (2012). *Agricultural Research Vision 2030.* Consultancy Report. Project Coordination Unit (PCU) National Agricultural Technology Project (NATP): Phase-1, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka. March 2012.

BARC (2020). *BARC at a Glance.* Bangladesh Agricultural Research Council (BARC), New Airport Road, Dhaka-1215, Bangladesh.

BARC (2021). *The 100 Agro Technologies Atlas.* Bangladesh Agricultural Research Council (BARC), New Airport Road, Dhaka-1215, Bangladesh.

BARI (2022). Bangladesh Agricultural Research Institute (BARI) website: *bari.gov.bd*

BBS (2012). *Statistical Yearbook of Bangladesh.* Bangladesh Bureau of Statistics. Statistics and Informatics Division (SID), Ministry of Planning. Government of the People's Republic of Bangladesh.

BBS (2019). *Yearbook of Agricultural Statistics – 2018.* Bangladesh Bureau of Statistics. Statistics and Informatics Division (SID), Ministry of Planning. Government of the People's Republic of Bangladesh

BBS (2021). *Statistical Yearbook of Bangladesh.* Bangladesh Bureau of Statistics. Statistics and Informatics Division (SID), Ministry of Planning. Government of the People's Republic of Bangladesh.

BBS (2022). *Statistical Yearbook of Bangladesh - 2021.* Bangladesh Bureau of Statistics. Statistics and Informatics Division (SID), Ministry of Planning. Government of the People's Republic of Bangladesh.

BFRI (2022). Bangladesh Forest Research Institute (BFRI) website: *bfri.gov.bd*

Bhuyan, M.O.U. (2020). "Agricultural inputs import-export: challenges – way forward", Pp 11-124 *in:* Rahman, K. (ed), *Farm Sector of Bangladesh: Prospects and Challenges.* Dhaka: Palak Publishers.

BINA (2022). Bangladesh Institute of Nuclear Agriculture (BINA) website: *bina.gov.bd*

BLRI (2021). Bangladesh Livestock Research Institute (BLRI) website: *www.blri.gov.bd*

BLRI (2022). Bangladesh Livestock Research Institute (BLRI) website: *www.blri.gov.bd*

Bokhtiar, S., S. Samsuzzaman, and J.K. Biswas (2021). *100 Years of Agricultural Development in Bangladesh.* Bangladesh Agricultural Research Council. New Airport Road, Farmgate Dhaka-1215.

Bokhtiar, S. and S. Samsuzzaman (2023). *A Development Trajectory of Bangladesh Agriculture: From Food Deficit to Surplus.* Bangladesh Agricultural Research Council. New Airport Road, Farmgate Dhaka-1215.

BRRI (2022). Bangladesh Rice Research Institute (BRRI) website: *www.brri.gov.bd*

BTRI (2022). Bangladesh Tea Research Institute (BTRI) website: *www.btri.gov.bd*

BWMRI (2022). Bangladesh Wheat and Maize Research Institute (BWMRI) website: *www.bwmri.gov.bd*

CDB (2022). Cotton Development Board (CDB) website: *www.cdb.gov.bd*

Giley, J.W. and S.A. Eggland (1989). *Principles of Human Resource Development.* Reading, Mass: Addison-Wesley in association with University Associates.

GoB (2018). *Bangladesh Delta Plan 2100: Bangladesh in the 21st Century.* General Economic Division (GED). Ministry of Planning, Government of the People's Republic of Bangladesh.

GoB (2020). *Perspective Plan of Bangladesh 2021 – 2041.* General Economic Division (GED). Ministry of Planning, Government of the People's Republic of Bangladesh.

Hussain, Sk., G, and A. Iqbal (2011). *Agricultural Research Vision 2030 and Beyond: Research Priorities in Bangladesh Agriculture.* FINAL DRAFT. PIU-BARC. Bangladesh Agricultural Research Council. New Airport Road, Farmgate Dhaka-1215.

ICAR (2015). *Vision 2050.* Indian Council of Agricultural Research (ICAR). Dr. Rajendra Prasad Road. Krishi Bhaban. New Delhi 110 001, India.

ICAR (2022). Indian Council of Agricultural Research (ICAR) website: *www.icar.gov.in*

Mahmud, H. M. (2022). *Personal Communication.* Capacity Development Associate. PIU-BARC, NATP-2, Bangladesh Agricultural Research Council, Farmgate, Dhaka-1215.

NAP (2018). National Agricultural Policy 2018. Dhaka: Ministry of Agriculture. Government of the People's Republic of Bangladesh.

NATP (2015). *Project Implementation Manual (PIM), DRAFT.* National Agricultural Technology Program, Phase II Project (NATP-2), Project Management Unit (PMU), BARC Complex, Farmgate, Dhaka. Ministry of Agriculture, Govt. of the People's Republic of Bangladesh.

Rahija, M., S.M.M. Hossain, M. M. Rahman and G. Stads (2011). *Bangladesh: Recent Developments in Public Agricultural Research.* Agricultural Science and Technology Indicators. Country Note: December 2011.

Rahman (2017). Role of Agriculture in Bangladesh Economy. International Journal of Business and Management Invention; 6(7):36-46.

Rahman, M. (2022). *Personal communication.* Consultant (Training and Communication). PIU-BARC, NATP-2, Bangladesh Agricultural Research Council, Farmgate, Dhaka-1215.

Stads, G., M.M. Rahman, A. Nin-Pratt and L. Gao (2019). *Bangladesh: Agricultural Science and Technology Country Brief.* July 2019.

Siddique, M. A., M. A. Kashem, P.C. Golder and W. Kabir (2013). *Implementation of NARS Human Resource Development Programme (September 2008 – December 2013).* Project Implementation Init (PIU), National Agricultural Technology Project (NATO): Phase-1. Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215.

Stads, G., M. M. Rahman & L. Gao (2014). *Bangladesh: Key Indicators, 2000 – 2012.* Agricultural R&D Factsheet, December 2014. Agricultural Science and Technology Indicators (ASTI).

Swanson, R.A. and E.F. Holton (2001). *Foundations of Human Resource Development.* San Francisco: Berret-Koehler.

UGC (2020). *46th Annual Report (Executive Summary).* University Grants Commission of Bangladesh (UGC). UGC Building, Plot # E-18/A, Agargaon Administrative Area, Sher-e-Bangla Nagar, Dhaka-1207.

UNDP (2022). *World Population Data Sheet -2022.* New York: United Nations Development Program (UNDP). United Nations Building, USA.

World Bank (2022). The World Bank Website: *https://tradingeconomics.com>bangladesh> landarea-sq.km*

World Bank (2022). The World Bank. *https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=BD*

Appendix-I
NARS Scientists' Personal Data Form
HRD Plan in the NARS Institutes for 2023-2041
(To be filled in by individual scientists)

1. Name of Institute :
2. Name of Scientist :
3. Mother's Name   :
4. Father's Name   :
5. Sex   :

Male		Female	

6. Date of Birth   :

D	D	M	M	Y	E	A	R

7. Permanent Address

Village   :

Upazila   :

District   :

8. Educational Qualification (Start from last) :

Name of institutions	Degree/Certificate	Division/Class/Grade	Year	Major Subjects

Note: PhD to Bachelor's including Diploma

9. a. Designation   :
  b. Date of First Joining in Service :

D	D	M	M	Y	E	A	R

  c. Pay Scale   :
  d. Basic Salary   :
  e. Job Descriptions   :

I. _____
II. _____
III. _____
IV. _____
V. _____

10.   Length of Service   :   Year(s) [   ]

11.   Service Record(s) [Start from last position]
      Month(s)   [   ]

Designation	From	To	Place of posting	Organization	Discipline

A.   Journal publication: National: [   ]   International:

B.   Other publication: Books: [   ]   Bulletin/Proceeding

[   ]   12.   Number of

C.   Patent registered   [   ]   Publications:

13.   Training Information: [   ]
A.   Local Training:

Title	Day(s) /Month(s)	Training venue	Sponsoring Agency	Remarks

B.   Local Seminar/Workshop:

Title	Day(s) /Month(s)	Venue	Sponsoring Agency	Remarks

C.   Foreign Training:

Title	Day(s) /Month(s)	Venue	Country	Sponsoring Agency	Remarks

D.   Foreign Seminar/Workshop/Study visit:

Title	Day(s) /Month(s)	Venue	Country	Sponsoring Agency	Remarks

14.   Field of Specialization:

15.   Experience   :   a.   Research:(List of research program/project developed, research program/ project executed as Program Leader/ Project Investigator/Co-Project Investigator/Team Member)

Number of research programs developed	Number of research programs executed	Number of research projects developed	Number of research projects executed	Remarks

b.   Management of Training

Number of training programs developed	Number of training executed	Number of training programs acted as resource person	Number of impact study of training conducted	Number of publications on training impact study	Remarks

16.   Other relevant experience(s):

17.   Research Achievements (List of technology developed/patent registered and disseminated):

Number of technology/ methodology developed	Number of Technology/ methodology disseminated	Number of patents registered	Number of patents disseminated	Remarks

18.   Academic/research award if any:

19.   Membership of Professional Societies:

_____
_____
_____

20.   Future training needs (Post Doc/PhD/MS/Short-term training etc.):

Field of Training	Up to 2025				Upto2030				Upto2025				Up to 2041			
	LT (MS, PhD)	ST	P	OS	LT (MS, PhD)	ST	P	OS	LT (MS, PhD)	ST	P	OS	LT (MS, PhD)	ST	P	OS

* LT= Long Term, ST= Short Term, OS=Others (specify), P=Professional

Signature of the Scientist

Date:

<u>*Appendix-II*</u>
Questionnaire for the NARS Institutes
HRD Plan for 2023- 2041

Please provide the following data and information of your organization for preparing a Dynamic HRD Plan for NARS institutes 2023-2041 aligned with National Agricultural Policy 2018:

1. Management structure of (Name of organization)…………..

Director General	Director	Chief Scientific Officer (CSO)	Principal Scientific Officer (PSO)	Senior Scientific Officer (SSO)	Scientific Officer (SO)	Total	Total No. of PhDs (with %)

2. Major research achievements (Name of organization) …………

Crops*	Variety released	Crops	Variety released	Crops	Variety released

*add crops as required

Non-commodity technology generated:

Research Fields*	No. of technologies
1. Crop Management	
2. Insect Pest Management	
3. Farm Machinery	
4. Irrigation and Water Management	
5. Post-harvest Technology	
6. Farming Systems and Socio-Economics	
Total	

*add/delete the research fields as required

Grand Total Variety Technology; = Management Technology=

3. Discipline-wise scientific manpower provision, existing and vacant posts into (Name of organization)............as of June 2022

Type of posts / Discipline*	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Exis.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Scientists:																			
Agronomy																			
Agricultural Economics																			
Entomology																			
Pathology																			
Plant Breeding																			
Horticulture																			
Soil Science																			
Agricultural Engineering																			
Postharvest Technology																			
Statistics																			
Open scientists																			
Sub-total																			
Management/discipline																			
Administratio																			
Finance																			
Procurement																			
Sub-total																			
Total																			

* Pl add or delete discipline(s) as required

HRD plan for national agricultural research system 2023-2041

4. Discipline wise scientific manpower with MS and PhD positions in (name of organization)……..in June 2022

Posts \ Discipline*	Chief Scientific Officer (CSO)		Principal Scientific Officer (PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total		Status of Retirement							
											2023-2025		2026-2030		2031-2035		2036-2041	
	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD
Agronomy																		
Agricultural Economics																		
Entomology																		
Pathology																		
Plant Breeding																		
Horticulture																		
Soil Science																		
Agricultural Engineering																		
Post Harvest Technology																		
Agricultural Statistics																		
Open Scientists																		
Total																		

- Please add/delete disciplines as required

5. Scientific manpower development plan and enhancement of PhD level from 40% to 70% during the period of 2023-2041.

Year \ Discipline*	2023-2025(PhD level 40%)				2026-2030(PhD level 50%)				2031-2035(PhD level 60%)				2036-2041(PhD level 70%)				Total			
	PhD	Post Doc	Short T.	Sty/S/W	PhD	Post Doc	Short T.	Sty/S/W	PhD	Post Doc	Short T.	Sty/S/W	PhD	Post Doc	Shor t T	Sty/S/W	PhD	Post Doc	Short T.	Sty/S/W
Agronomy																				
Agricultural Economics																				
Entomology																				
Pathology																				

HRD plan for national agricultural research system 2023-2041

Discipline* \ Year	2023-2025(PhD level 40%)				2026-2030(PhD level 50%)				2031-2035(PhD level 60%)				2036-2041(PhD level 70%)				Total			
	PhD	Post Doc	Short T.	Sty/S/W	PhD	Post Doc	Short T.	Sty/S/W	PhD	Post Doc	Short t T.	Sty/S/W	PhD	Post Doc	Short t T	Sty/S/W	PhD	Post Doc	Short T.	Sty/S/W
Plant Breeding																				
Horticulture																				

* Please add/delete the disciplines as required

6. Suggest, if any new disciplines/areas that have to be opened by 2041 in your institute with skilled manpower requirement:

(a) Suggested disciplines/areas and manpower required

Sl. No.	Suggested Disciplines/Areas	Number of manpower required by 2030				Number of manpower required by 2035				Number of manpower required by 2041			
		SO	SSO	PSO	CSO	SO	SSO	PSO	CSO	SO	SSO	PSO	CSO
1.													
2.													
3.													

(b) Suggested disciplines/areas and training required

Sl. No.	Suggested Disciplines/Areas	Number training required by 2030					Number of training required by 2035					Number of training required by 2041				
		Professional ST	MS	PhD	Post Doc		Professional ST	MS	PhD	Post Doc		Professional ST	MS	PhD	Post Doc	
1.																
2.																
3.																

Signature:

Date:

Appendix-III:
Questionnaire for the BARC Scientists
HRD Plan for 2023-2041

Please provide the following data and information of BARC for preparing a Dynamic HRD Plan for 2023-2041 aligned with National Agricultural Policy 2018:

1. Major manpower development achievements of BARC under various projects from 1976-2022

Field of Training	Foreign				Local			
	PhD	MS	S.T.	S.W.T.	PhD	MS	S.T.	S.W.
Agronomy								
Plant Breeding								
Entomology								
Plant Pathology								
Horticulture								
AERS								
Farming System Research								
Soils								
Agricultural Engineering								
Irrigation								
Library & Document								
Training & Comm.								
Planning & Res. Mgt.								
Livestock								
Fisheries								
Forestry								
Jute Technology								
Computer								
Agricultural Extension								
Nutrition								
Others								
Total								

PhD=Doctor of Philosophy, MS=Master of Science, S.T.=Short-term Training, S.W.T.= Seminar/ Workshop/Study tour, S.W.= Seminar/Workshop

2. Institute-wise manpower development under various projects of BARC 1976-2022

Organization	Foreign				Local			
	PhD	MS	S.T.	S.W.T.	PhD	MS	S.T.	S.W.
1. BARI								
2. BRRI								
3. BJRI								
4. BINA								
5. BSRI								
6. BWMRI								
7. SRDI								
8. BTRI								
9. BFRI								
10. CDB								

11. BSRTI								
12. BFIRI								
13. BLRI								
14. BARC								
Total								

3.   Institute-wise manpower development under Foreign Scholarships1997-2022

Organization	Foreign					Local			
	PhD	Post Doc.	MS	S.T.	S.W.T.	PhD	MS	S.T.	S.W.
1. BARI									
2. BRRI									
3. BJRI									
4. BINA									
5. BSRI									
6. BWMRI									
7. SRDI									
8. BTRI									
9. BFRI									
10. CDB									
11. BSRTI									
12. BFiRI									
13. BLRI									
14. BARC									
Total									

4. Discipline wise scientific manpower provision, exiting and vacant post of BARC as of June 2022

Type of posts / Discipline	Chief Scientific Officer (CSO)/Director			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status by the year			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
Crops																			
TTMU																			
Agril. Engineering																			
Soil																			
Forestry																			
Planning and Evaluation																			
Agril. Econ. and Rural Sociology																			
Fisheries																			
Nutrition																			
Livestock																			
Training																			
Computer																			
AIC																			
Sub-total																			
Administration																			
Finance																			
Sub-total																			
Total																			

NB: Prov.=Provision, Ext.=Existing, Vac.=Vacant

5. Discipline-wise present scientific manpower rand PhD positions in BARC as of June 2022

Type of posts / Discipline	Director/ Chief Scientific Officer (CSO)		Principal Scientific Officer(PSO)		Senior Scientific Officer (SSO)		Scientific Officer (SO)		Total	Status of Retirement during					
										2025-2030		2031-2035		2036-2041	
	Ext.	PhD	Ext.	PhD	Ext.	PhD	Ext.	PhD		PhD	MS	PhD	MS	PhD	MS
Crops															
TTMU															
Agril. Engineering															
Soil															
Forestry															
Planning& Evaluation															
Agril. Econ .& RS															
Fisheries															
Nutrition															
Livestock															
Training															
Computer, ICT, MIS															
AIC															
Sub-total															
Finance															
Administration															
Sub-total															
Total															

6. Manpower development plan of BARC f or the period of 2023-2041

Discipline* / Year	2023-2025				2026-2030				2031-2035				2036-2041				Total			
	PhD Doc.	Post Doc.	Short T.	Sty/ S/W	PhD Doc.	Post Doc.	Short T.	Sty/ S/W	PhD Doc.	Post Doc.	Short T.	Sty/S /W	PhD Doc.	Post Doc.	Short T.	Sty/S /W	PhD Doc.	Post Doc.	Short T.	Sty/S /W
Crops																				
TTMU																				
Agri. Engineering																				
Soil																				
Forestry																				
Planning & Evaluation																				
Agri. Econ. & RS																				

Fisheries								
Nutrition								
Livestock								
Training								
Computer, ICT, MIS								
AIC								
Sub-total								
Administration								
Finance								
Sub-total								
Total								

*add/delete as required

7. Provision of scientific manpower in NARS institutes (post-wise)

Organization	EC/DG/ED	MD/Director	CSO	PSO	SSO	SO	Total	No. & % of PhD
1. BARI								
2. BRRI								
3. BJRI								
4. BINA								
5. BSRI								
6. BWMRI								
7. SRDI								
8. BTRI								
9. BFRI								
10. CDB								
11. BSRTI								
12. BFRI*								
13. BLRI								
14. BARC								
Total:								

* Bangladesh Fisheries Research Institute

NB:EC=Executive Chairman, DG=Director General, MD=Member Director, CSO=Chief Scientific Officer, PSO= Principal Scientific Officer, SSO= Senior Scientific Officer and SO= Scientific Officer.

8. Provision of existing and vacant positions of scientific manpower in NARS (post-wise) in June, 2022

Organization	Chief Scientific Officer (CSO)			Principal Scientific Officer (PSO)			Senior Scientific Officer (SSO)			Scientific Officer (SO)			Total			Retirement Status			
	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	Prov.	Ext.	Vac.	2025	2030	2035	2041
1. BARI																			
2. BRRI																			
3. BJRI																			
4. BINA																			
5. BSRI																			
6. BWMRI																			
7. SRDI																			
8. BTRI																			
9. BFRI																			
10. CDB																			
11. BSRTI																			
12. BFRI																			
13. BLRI																			
14. BARC																			
Grand Total																			

9. Discipline-wise present scientific manpower (CSO to SO) at the NARS institutes with their status (PhD and MS) in June, 2022

Institute / Discipline	BARI		BRRI		BJRI		BINA		BSRI		BFRI		BTRI		BFRI		BLRI		SRDI		BARC		Total		Grand Total
	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	PhD	MS	
Genetic& Breeding																									
Bio-technology																									
Genetic Resources																									
Agronomy																									
Plant Physiology																									
Soil Science																									

Plant Pathology																						
Entomology																						
Horticulture																						
Agril. Engineering																						
Agril. Econ. SS.																						
Agril. Statis.																						
Plan, Train. & Co.																						
Adapt & Farming Sys.																						
Jute Fiber Quality																						
Pilot Plant & Processing																						
Mechanical Processing																						
Chemistry, Microbi. & Biochemistry																						
Textile Physics																						
Silviculture																						
Seed Orchard																						
Minor Forest Production																						
Forest Processing																						
Technology																						
Fish Nutrition																						
Fish Breeding																						
Fish Health Management																						
Fisheries																						
Toxicology																						
Aquaculture																						
Animal Production																						
Animal Health																						
Poultry & Goat Production																						
System Research																						

Soil Classification										
Soil Physics & Micro-Bio										
Research Management										
Total										

10. NARS institutes' scientific manpower, retirement, and HRD plan for the year 2023-2041

Organization	Scientific Manpower Provision (June2022)	PhD in position with percent (June 2022)	Status of Retirement (2023-2041)			PhD Needed (2023-2041)	Post-Doc. Needed (2023-2041)	Short-term Training Needed (2023-2041)	Study Tour/ Workshops/ Seminars Needed (2023-2041)
			PhD	MS	Total				
1. BARI									
2. BRRI									
3. BJRI									
4. BINA									
5. BSRI									
6. BWMRI									
7. SRDI									
8. BTRI									
9. BFRI									
10. CDB									
11. BSRTI									
12. BFRI									
13. BLRI									
14. BARC									
Total									

11. Scientific manpower in the NARS institutes, scientists' retirement, and HRD plan for the year 2023-2030

Organization		Scientific Manpower Provision (2022)	PhD (present +ongoing) (2022)	Status of Retirement (2023-2025)			Total PhD Needed (2023-2030)	Post-Doc Needed (2023-2030)	Short-term Training Needed (2023-2030)	Study Tour/ Workshops/ Seminar Needed (2023-2030)
				PhD	MS	Total				
1.	BARI									
2.	BRRI									
3.	BJRI									
4.	BINA									
5.	BSRI									
6.	BWMRI									
7.	SRDI									
8.	BTRI									
9.	BFRI									
10.	CDB									
11.	BSRTI									
12.	BFRI									
13.	BLRI									
14.	BARC									
Total										

HRD plan for national agricultural research system 2023-2041

12. Summary of total NARS institute scientific manpower development plan for the year 2023-2041

Organization	Total PhD needed (2023-2041)	Total Post-Doc needed (2023-2041)	Total Short-term training needed (2023-2041)	Total Study tour/seminar/workshop needed (2023-2041)	Grand Total (2023-2041)
1. BARI					
2. BRRI					
3. BJRI					
4. BINA					
5. BSRI					
6. BWMRI					
7. SRDI					
8. BTRI					
9. BFRI					
10. CDB					
11. BSRTI					
12. BFRI					
13. BLRI					
14. BARC					
Total					

13. Summary of NARS Institutes' Scientific manpower development plan for the years 2025,2030, 2035 & 2041

Organ-ization	Scientific Manpower Provision (2022)	PhD Needed (2023-2025)	Post-Doc. Needed (2023-2025)	Short-term Training Needed (2023-2025)	Study Tour/ Workshops /Seminars Needed (2023-2025)	Total PhD Needed (2026-2030)	Post-Doc Needed (2026-2030)	Short-term Training Needed (2026-2030)	Study Tour/Works hops/ Seminar Needed (2026-2030)	PhD Needed (2031-2041)	Post-Doc Needed (2031-2041)	Short-term Training Needed (2031-2041)	Study Tour/ Workshops /Seminar Needed (2031-2041)
BARI													
BRRI													
BJRI													
BINA													
BSRI													
BWMRI													
SRDI													

HRD plan for national agricultural research system 2023-2041

Organization	Scientific Manpower Provision (2022)	PhD Needed (2023-2025)	Post-Doc. Needed (2023-2025)	Short-term Training Needed (2023-2025)	Study Tour/Workshops/Seminars Needed (2023-2025)	Total PhD Needed (2026-2030)	Post-Doc Needed (2026-2030)	Short-term Training Needed (2026-2030)	Study Tour/Workshops/Seminar Needed (2026-2030)	PhD Needed (2031-2041)	Post-Doc Needed (2031-2041)	Short-term Training Needed (2031-2041)	Study Tour/Workshops/Seminar Needed (2031-2041)
BTRI													
BFRI													
CDB													
BSRTI													
BFiRI													
BLRI													
BARC													
Total													

14. Summary of total NARS Institutes' scientific manpower development plan for the year 2023-2041

Organization	Total PhD needed (2023-2041)	Total Post-Doc. Needed (2023-2041)	Total Short-term training Needed (2023-2041)	Total Study tour/ seminar/ workshop needed (2023-2041)	Grand Total (2023-2041)
1. BARI					
2. BRRI					
3. BJRI					
4. BINA					
5. BSRI					
6. BWMRI					
7. SRDI					
8. BTRI					
9. BFRI					
10. CDB					
11. BSRTI					
12. BFRI					
13. BLRI					
14. BARC					
Total:					

15. BARC's local manpower development plan for NARS personnel for the year 2023-2041

HRD plan for national agricultural research system 2023-2041

Sl. No.	Type of training / Training course	PhD (2023-2025)	Short-term training / (2023-2025)	Seminar/ workshop/ meeting (2023-2025)	PhD (2026-2030)	Short-term training needed (2026-2030)	Seminar/ workshop/ meeting (2026-2030)	PhD needed (2031-2041)	Short-term training / (2031-2041)	Seminar/ workshop/ meeting (2031-2041)	Total PhD (2023-2041)	Total Short-term training (2023-2041)	Total Seminar/ workshop/ meeting (2023-2041)
1.	PhD												
2.	Foundation Training												
3.	Research Methodology												
4.	Administration and financial management												
5.	Procurement												
6.	Financial management												
7.	Monitoring and evaluation												
8.	Research management												
9.	Personnel management												
10.	ICT/MIS												
11.	Local Seminar, Workshop, Seminar, Meeting, Field days, etc												
	Total												

16. Others: Provide any other information which you might feel important for preparing a Dynamic Human Resources Development Plan for the scientists of NARS institute for 2023-2041:

Signature:
Date:

Appendix-IV:
Semi-Structured Questionnaire for FGDs
HRD Plan in the NARIs for 2023-2041

Due to worldwide climatic changes as well as other environmental and socio-economic changes, it is indeed the need of the time to conduct need-based research by the NARS institutes and generate more productive and sustainable agricultural technologies. However, there are no other alternatives than to develop skilled manpower to combat the changing situations. To this end, the NATP-2, BARC has taken a pragmatic initiative to prepare a Dynamic HRD Plan for the NARS institutes2023-2041 aligning with National Agricultural Policy 2018 and other related policy documents with input from stakeholders at bottom level.

1. Do you think that human resources at present in the NARS institutes in Bangladesh sufficient enough to address the changing situations? If not, why? Do you use the existing HRD plan? If no, why?

2. What types of new areas of research should be initiated by the NARS institutes?

3. What are new and forthcoming challenges in agricultural research to increase productivity in Bangladesh?

4. What would be possible threats to address the challenging of agricultural research?

5. Do you thing that preparing a dynamic HRD plan would be useful to address the challenges in agricultural research in Bangladesh?

6. Can you please indicate how a dynamic HRD plan for 2023 to 2041 can be made for developing Bangladesh?

7. What are areas of expertise that should be prioritized for HRD plan for 2023-2041?

8. Do you think only short-term training cane be enough for HRD plan? Justify, if you agree or disagree.

9. Higher training (especially MS and PhD) from the universities in Bangladesh would be enough for HRD plan?

10. What can be the probable universities from where the scientists can get higher degrees to increase their desired skills to contribute to the advanced agricultural research in Bangladesh?

11. Which areas are to be applied/adaptive research?

Appendix-V
Tools for conducting TNA (Training Need Assessment) in the NARS Institutes

Job Analysis Worksheet					
Job: SO/SSO/PSO/CSO/CSO & Head					
Activity Area (tasks)	Frequency Performed a	Importance b	Learning Difficulty c	Total score	Focus (9-12)
1.					
2.					
3.					
A: 1= Seldom 2= Occasionally 3= Weekly to monthly 4= Daily to weekly 5= Daily		b: 1= Marginally important 2= Moderately important 3= Extremely important		c: 1= Easy 2= Moderately difficult 3= Very difficult 4= Extremely difficult	

Task Analysis Worksheet					
Job: SO/SSO/PSO/CSO/CSO & Head					
Tasks:					
Components/Steps	**Frequency Performed a**	**Importance b**	**Learning Difficulty c**	**Total score**	Focus **(9-12)**
1.					
2.					
3.					
4.					
5.					
a: 1= Seldom 2= Occasionally 3= Weekly to monthly 4= Daily to weekly 5= Daily		b: 1= Marginally important 2= Moderately important 3= Extremely important		c: 1= Easy 2= Moderately difficult 3= Very difficult 4= Extremely difficult	

Skill-Gap Analysis Worksheet				
Job: SO/SSO/PSO/CSO/CSO & Head				
Sl. No.	(Scores) Tasks	Level of Proficiency (1 2 3 4 5)*	Is proficiency a problem? [Y /N]	Can the problem be solved by training? [Y/N]
1.			[ ]	[ ]
2.			[ ]	[ ]
3.			[ ]	[ ]
4.			[ ]	[ ]
…				
* 1 = Cannot do at all 2 = Can do less than half of the task 3 = Can do more than half but less than total 4 = Can do total but cannot maintain time schedule 5 = Can do within time schedule				

Appendix-VI

a) **Checklists for collecting information from the Key Informants on Dynamic Human Resource Development (HRD) Plan for the NARS Institutes from 2023-2041**

Having wide experience in the field of agricultural research in Bangladesh, your views and opinions in respect of preparing a dynamic Human Resource Development (HRD) plan for the NARS Institutes 2023-2041 is indeed very important. Please provide your valuable views and opinions on the following points:

Demographic Questions:

- Name:
- Occupation:
- Age:

Need for HRD Plan:

1. Do you think that it is necessary to prepare a dynamic HRD plan for the NARS institutes for increasing research productivity and output? If yes, please explain.
2. Can you please explain how HRD plans at the NARS institutes would be able to contribute towards increasing efficiency and effectiveness of the scientists of NARS?

Research Priorities:

3. Due to climatic, environmental, agro-ecological and socio-economic and other changes around the globe, what areas should be prioritized in conducting research by the NARS institutes in Bangladesh?
4. What components of agriculture (crops, livestock, fisheries, forestry etc.) should get more priority in setting research programs at the NARS institutes?

Challenges and Threats:

5. What are the current challenges in agricultural research in Bangladesh to address the climatic as well as other changes?
6. What can be the possible threats in conducting and running smooth functioning agricultural research in Bangladesh?

Preparation of a Dynamic HRD Plan for 2041:

7. Can you please explain the parameters to be considered in preparing a dynamic HRD plan for NARS Institutes of Bangladesh for 2023-2041?
8. In your judgment, what criteria should get priority in preparing the HRD plan up to 2041 for the NARS Institutes?

Implementation of HRD Plan:

9. How the HRD plan can be effectively implemented by the NARS Institutes to increase agricultural productivity to make Bangladesh as a developed nation?
10. What types of training, e.g. short (professional, certificate course), medium (diploma, MS) and long (PhD, Post-doc), would be required to make a dynamic HRD plan for 2023-2041 in the NARS Institutes?
11. Any other pertinent comments on the HRD plan in the NARS institutes for 2023-2041:

b) **Excerpts of Key Informant Interview (KII)**

Key Informant Interviews (KIIs) were conducted to get information regarding HRD plan 2023-2041 for the NARS institutes from the very learned and experienced persons in the field of agricultural research in Bangladesh. Four Key Informant Interviews (KIIs) were conducted. The excerpts of interviews are given below:

Key Informant Interview No. 1: Overall agricultural scenario

Name: Dr. Kazi M. Badruddoza
Occupation: National Emeritus Scientist
Bangladesh Agricultural Research Council (BARC)
Farmgate, Dhaka-1215
Age: 98 years

Please provide your valuable views and opinions on the following points:

Need for HRD Plan for NARS 2023-2041:
1. Do you think that it is necessary to prepare a dynamic HRD plan for the NARS institutes for increasing research productivity and output? If yes, please explain.
2. Can you please explain how HRD plan in the NARS institutes would be able to contribute towards increasing efficiency and effectiveness of their scientists?

Dr. Kazi M. Badruddoza:
Human Resource Development plan for NARS institutes to be prepared by BARC would definitely help the institutes in achieving research and development activities. Of course, each NARS institute should have their own human resource development plan apart from the HRD plan prepared by the BARC. It is to be noted that at the beginning when all the agricultural research institutes brought under the umbrella of NARS, due initiatives were undertaken to provide training to the scientists of NARS institutes, both home and abroad. Special emphasis was given for higher degrees like MS and PhDs from the recognized and prominent universities.

Research Priorities:
3. Due to climatic, environmental, agro-ecological and socio-economic and other changes around the globe, what areas should be prioritized in conducting research by the NARS institutes in Bangladesh?
4. What components of agricultural sector (crops, livestock, fisheries, forestry etc.) should get more priority in setting research programs in the NARS institutes?

Dr. Kazi M. Badruddoza:
Lots of research studies are going on in the NARS institutes. However, no research studies are observed now on the management and development of the institutes. This is very important and need of time. Many research organizations are suffering from managerial and development problems. So these things should get priority in conducting research by the NARS institutes. Providing training to support staff is also equally important like the scientific staff. Without their efficiency, scientists would not be able to conduct research studies as desired.

Challenges and Threats
5. What are the current challenges in agricultural research in Bangladesh to address the climatic as well as other changes?
6. What can be the possible threats in conducting and running smooth functioning agricultural research in Bangladesh?

Dr. Kazi M. Badruddoza:
To increase the performance and efficiency in research activities, facilities should also be increased simultaneously. Without such an effort, it would be difficult for the institutes to acquire success. For example, the scientists, officers and other support staff need residential accommodation. Necessary lands for construction of residences are available. Now the authority may take initiatives and expedite the process for its implementation. Without congenial living and accommodation facilities, the working environment may suffer accordingly.

Preparation of a Dynamic HRD Plan for 2023-2041
7. Can you please explain the parameters to be considered in preparing a dynamic HRD plan for NARS Institutes in Bangladesh for 2023-2041?

8. In your judgment, what criteria should get priority in preparing the HRD plan up to 2041 for the NARS Institutes?
9. How the HRD plan can be effectively implemented by the NARS Institutes to increase agricultural productivity to make Bangladesh a developed nation?

Dr. Kazi M. Badruddoza:

Research institutes are now self-centered which is not a good sign. More and more cooperation, coordination and integration are needed to make the national progress and prosperity in the field of agricultural research arena. All NARS institutes need to work together in harmony under the same ministry. Research, education and extension should have more effective linkages than what does exist now. In setting research priority and national research agenda, scientists of NARS institutes and competent representatives from the universities and extension organizations should have an open dialogue and come to a consensus to proceed in doing need-based and timely research studies.

Types of Training Required for HRD Plan

10. What types of training, e.g. short (professional, certificate course), medium (diploma, MS) and long (PhD, Post-doc) would be required to make a dynamic HRD plan for 2023-2041 for the NARS Institutes?

Dr. Kazi M. Badruddoza:

Both the short term and long-term training (MS and PhD) is required to for human resource development. In addition, need-based and job oriented professional training help the scientists to be efficient in performing the research activities better. The training may be within the country or outside the country depending on the availability of fund, facilities and expertise.

Overall comments on the HRD plan at the NARS for 2023-2041:

Dr. Kazi M. Badruddoza:

Management facilities and managerial capacities are not adequate now in the NARS institutes. Hence, leadership and managerial capacities need to be improved along with increasing research capacities.
A photograph of KI with Dr. Kazi M. Badruddoza has been shown in *Appendix-IX.* The interview was ended with thanks.

Key Informant Interview No. 2: Fisheries discipline

- Name: **Dr. Md. Gulam Hussain**
- Occupation: Consultancy services with USAID Feed the Future Innovation Lab for Fish (FIL). Currently serving as Asian Regional Coordinator and former Director General of Bangladesh Fisheries Research Institute (BFRI), Mymensingh.
- Age: 68 years

Please provide your valuable views and opinions on the following points:

Need for HRD Plan:
1. Do you think that it is necessary to prepare a dynamic HRD plan for the NARS institutes for increasing research productivity and output? If yes, please explain.

Dr. Md. GulamHussain:

Yes, preparing a dynamic HRD plan is essential for the NARS institutes to conduct smart and demand driven research following the set national mandates and guidelines to achieve the targeted goals of research and innovation of novel technologies. This indeed will provide synergy to enhance overall productivity and output of agricultural sectors.
2. Can you please explain how HRD plans in the NARS institutes would be able to contribute towards increasing efficiency and effectiveness of their scientists?

Dr. Md. Gulam Hussain:

Most of the NARS institutes in Bangladesh have no specific plans of human capacity development, therefore, due to lack of qualified, skilled and specialized scientists all these institutes could not contribute well to all the sectors of agriculture, viz. crop, fisheries, livestock etc. compared to developed countries.

Frontier technologies are rarely fostered by these institutes in the field of bio-resources, genetics and biotechnology, tissue culture, molecular based disease diagnosis, control and health management particularly for farmed fishes and animals. As a result, huge loss of produce is occurred every year due to catastrophic diseases of those fishes (tilapias and shrimps), animals (domestic goats, buffalos and cattle) and crops. - Genetically improved strains/varieties of fish, animal species, and crops etc. could not be generated to support increased production in all the agricultural sectors. So, a well-defined HRD plan must be developed in all these institute to train up the young scientists on the set disciplines home and abroad to obtain their higher degrees (PhD and MS) and high skilled short and medium-term specialized training programs. Therefore, scientists would be able to build up their efficiencies and skills to contribute to the respective fields of modern science in NARS institutes.

Research Priorities:
3. Due to climatic, environmental, agro-ecological and socio-economic and other changes around the globe, what areas should be prioritized in conducting research by the NARS institutes in Bangladesh?

Dr. Md. Gulam Hussain:
In considering the overall global and country's climatic, environmental, agro-ecological and socio-economic situation, meanwhile, the 8th Five Year Plan 2021 – 2025 of the Government of Peoples of Bangladesh has been initiated, where sectoral strategies and priorities for fisheries have been identified. NARS institution (s) related to fisheries should conduct research in the following areas:
- Open water fisheries management
- Inland aquaculture
- Shrimp and coastal aquaculture
- Harnessing marine aquaculture and fisheries through **blue economy development**
- Projected fish production target (2024 – 2025): 4.9 million tons

Government of Bangladesh has also prepared Bangladesh Delta Plan (BDP) 2100, where the major emphasis have been given as follows:
- The BDP 2100 develops an adaptive, holistic and long-term strategic plan for overall aquaculture and fisheries sector.
- Undertaking Perspective Plan (PP): 2021- 2041.
- The PP2041 strategy includes the development of a sound policy framework for harnessing the potential of the blue economy development including marine aquaculture and fisheries sector.
1. What components of agriculture (crops, livestock, fisheries, forestry etc.) should get more priority in setting research programs in the NARS institutes?

Dr. Md. Gulam Hussain:
In the national 8th Five Year Plan and all other aforementioned strategy and policy documents, Inland Aquaculture, Open water Fisheries Management and Blue Economy Development have been given major emphasis on R & D. Therefore, NARS institute(s) of fisheries should provide much priority in research programs in the following disciplines:
  A. Inland Aquaculture
  a. R&D priorities for fish biotechnology areas:
- Biotechnology for genetic stock improvement of commercially important fish
- Biotechnology for characterization and conservation of fish genetic resources
- Biotechnology for fish health management and quality control
- Biotechnology for improved fish nutrition

  B. Open water Fisheries Management
  a. Hilsa fisheries resources management
  b. Inland open water genetic resources conservation
  c. Floodplain fisheries management to protect and restore the natural breeding grounds of open water freshwater fish species

  C. Blue Economy Development
  a. Marine capture fisheries
  b. Marine aquaculture

    c.   Seaweed and other non-traditional marine species culture
    d.   Marine biotechnology

Challenges and Threats

2. What are the current challenges in agricultural research in Bangladesh to address the climatic as well as other changes?

<u>Dr. Md. Gulam Hussain</u>
Major challenges in fisheries research are as follows:
    a.   Habitat degradation
    b.   Silting of river basins
    c.   Industrial pollution
    d.   Salinity intrusion
    e.   Climate change and interim storms and cyclones

3. What can be the possible threats in conducting and running smooth functioning agricultural research in Bangladesh?

<u>Dr. Md. Gulam Hussain:</u>
Major threats for fisheries research are as follows:
    a.   Lack of research facilities and infrastructure
    b.   Lack of skilled and well-trained human resources
    c.   Lack of sufficient funds for research
    d.   Lack of international institutional linkage

Preparation of a Dynamic HRD Plan for 2023-2041

4. Please explain the parameters to be considered in preparing a dynamic HRD plan for NARS Institutes of Bangladesh for 2023-2041.

<u>Dr. Md. Gulam Hussain:</u>
To prepare a dynamic HRD plan for NARS institutes, following parameters could be considered:
    a.   Sitting with all NARS institutions' authorities to identify and pin-point the need of HRD disciplines for the scientists.
    b.   Prioritize the short, medium and long-term programs for HRD in each NARS institute.
    c.   Identify the institutions and countries for trans-boundary collaboration of HRD programs.

5. In your judgment, what criteria should get priority in preparing the HRD plan up to 2041 for the NARS Institutes?

<u>Dr. Md. Gulam Hussain:</u>
For preparing a long term HRD plan, criteria need to be considered as follows:
    a.   Design a perspective plan to implement short, medium and long-term basis.
    b.   Estimate and allocate adequate budget (either donor funded or revenue) for HRD program implementation.
    c.   Selection of category candidates viz. scientists, lab/field technicians
    d.   Prioritize the need-based disciplines.
    e.   Capacity development of NARS institutes i.e. development of infrastructures, well-equipped labs/experimental fields etc. where the trained scientists and technicians will work for innovative research.

6. How the HRD plan can be effectively implemented by the NARS Institutes to increase agricultural productivity to make Bangladesh a developed nation?

<u>Dr. Md. Gulam Hussain</u>
For HRD plan, the effective strategies should be as follows:
    a)   All the NARS institutes' authorities need to give much attention to implement HRD plans phase wise.

b) They should prioritize the frontier subjects/disciplines where the scientists/technicians need to be trained at home and abroad

c) Arrange adequate budget for phase wise materialization of the plan

d) After attending and completing short, medium and long-term training programs from home and abroad, the scientists and technicians must be engaged in their respective field and disciplines to conduct research for their better contribution

Types of Training Required for HRD Plan for NARS institutes from 2023-2041

7. What types of training, e.g. short (professional, certificate course), medium (diploma, MS) and long (PhD, Post-doc), would be required to make a dynamic HRD plan for 2023-2041 in the NARS Institutes?

<u>Dr. Md. Gulam Hussain:</u>

In overall Aquaculture and Fisheries Sector, the following training: short, medium and long-term programs and courses need to be considered for future implementation:

a. **Freshwater Aquaculture**
   - Fish breeding and quality mass seed production in the hatcheries
   - Fish nutrition and feed formulation
   - Fish disease and heath management
   - Pearly mussel breeding and culture
   - Freshwater Pear culture
   - RAS system development and operation

b. **Open Inland water Fisheries**
   - Hilsa fish sanctuary and management
   - Biodiversity and conservation of open freshwater fish species and their habitats
   - Floodplain fisheries and implementation of best open water practices
   - Control measures for riverine and industrial pollution

c. **Aquaculture Genetics and Biotechnology**
   - Selective breeding and genetically improved strain development
   - Development of Quantitative Trait Loci Specific (QTLs) molecular marker and marker-assisted selection for all major cultivated species
   - Characterization of all the important fish and shrimp species using suitable molecular markers and karyotyping
   - Gene mapping of commercially important fish species using microsatellite markers
   - Development of cryogenic gene banking for conservation of improved strains and threatened species
   - Development of PCR based molecular technique for rapid and effective diagnosis of infectious diseases
   - Development of genetically engineered vaccines for protecting devastating pathogens
   - Development of molecular techniques for quality assessment of fish and fish products

d. **Fish Processing**
   - Fish preservation and processing techniques
   - Fish filleting and chilling process for packing
   - Value added product development and marketing

e. **Blue Economy Development**
   - Marine fish breeding and mass seed production
   - Marine fish farming and culture
   - Seaweed, macro/micro algae culture and product development for export
   - Muscle, oyster and other shellfish culture
   - Marine pearl culture
   - Culture of sea cucumber and sea urchins
   - Techniques for development of IMTA
   - Trawling and small-scale fishing techniques in the sea
   - Marine pelagic fish harvesting, marketing and export
   - Mariner fish stock assessment

- Post-harvest quality assessment
- Processing and product development of marine fish, shrimp and crabs
- Marine biotechnology application, implementation and product development for human food, cosmetics and pharmaceutical drugs etc.
- Marine bio-resources and their application

8. Any other comments on the HRD plan in the NARS institutes for 2041: None

Key Informant Interview No. 3: Livestock discipline

Name: Dr. Kazi M. Kamaruddin
▪ **Occupation:**
Former Member Director (Livestock Division), Bangladesh Agricultural Research Council (BARC) and Director, Poultry Research and Training Centre (PRTC), Chattogram Veterinary and Animal Sciences University (CVASU),
Presently working as the Animal Health Sector Laboratory Capacity Specialist under the Fleming Fund Country Grant to Bangladesh (FFCGB), an UK based donor agency.
▪ **Age:** 68 years
Please provide your valuable views and opinions on the following points:

Need for HRD Plan:
1. Do you think that it is necessary to prepare a dynamic HRD plan for the NARS institutes for increasing research productivity and output? If yes, please explain.
Comments:
Bangladesh has only one research institute, the Bangladesh Livestock Research Institute (BLRI), to cater the research needs in the livestock sector of the country. Considering the importance of livestock in supplying the high-quality animal protein for building a prosperous nation, the present infrastructure and manpower of BLRI (with only two to three poorly equipped and staffed sub-stations for research) is very minimum. Increasing the number of research institutes based on geographic/climatic zones or production types like, Hill livestock research, "Barind" livestock research, Coastal belt/ "Char land" livestock research, etc. and Dairy research, Sheep and Goat research, Poultry research, etc. is needed. To take care of the health problems of the highly productive animals, ah specialized genetic characters establishment of animal health research institute is also very important. To increase the efficiency of BLRI in relation to quality research output, along with establishing above mentioned specialized research centers, a dynamic HRD plan is needed for the institute.

2. Can you please explain how HRD plans in the NARS institutes would be able to contribute towards increasing efficiency and effectiveness of their scientists?
Comments:
For solving the problems of farmers in relation to development of climate resilient breeds of animals and fodders for feeding animals, there is a need for long-term research. Long-term research is also needed for production of vaccines and therapeutics for preventing animal diseases. BLRI is supposed to conduct these types of long-term researche but, due to manpower shortage the institute is unable to handle the problems in a proper way. Due to lack of proper HRD plan there is limited scope of promotions in the institute resulting in drainage of experienced scientist from BLRI to other institute or even to the foreign countries. Frustration also leads the scientists to become unproductive therefore, proper HRD plan is needed for creating better opportunities for those who have dedicated their life in research. Thus, a good HRD plan would help reduce drain-out of scientists from mother institute and increasing promotion facilities through better HRD plan will help reduce frustration that in-turn will increase the efficiency and productivity of the scientists.

Research Priorities:
3. Due to climatic, environmental, agro-ecological and socio-economic and other changes around the globe, what areas should be prioritized in conducting research by the NARS institutes in Bangladesh?

Comments:
The following areas should be prioritized:
i)   Climate resilient animal breed development,
ii) development of climate resilient fodder varieties,
iii) development of environment friendly animal production and disease prevention system,
iv) development of agro-ecological region based feeding and disease control program for the different production types of livestock,
v)   value added environment friendly (low carbon producing) and safe food (meat, milk and eggs) production,
vi) determination of economic burden of different diseases of livestock and poultry, socio-economics of smallholder livestock production and marketing, economics of technology transfer process of commercially important technologies through public-private (commercial organizations) partnership.

4. What components of agriculture (crops, livestock, fisheries, forestry etc.) should get more priority in setting research programs in the NARS institutes?
Comments:
All the components of agriculture have their own priority research themes and programs however, livestock sector, being lagging behind of other sectors in relation to research infrastructure and human resources, may be given more priority in setting research programs.

Challenges and Threats
5. What are the current challenges in agricultural research in Bangladesh to address the climatic as well as other changes?
Comments:
For livestock sector, as far as the climatic research is concerned, lack of trained/experienced manpower along with the institutional and/or infrastructural deficiency and lack of relevant equipment are the major challenges.
1. What can be the possible threat in conducting and running smooth functioning agricultural research in Bangladesh?
Comments:
BLRI, the only institute to take care of all the research needs of livestock sector in Bangladesh, is constrained with shortage of manpower which is the major threat in smooth running of research projects. Shortage of regional stations also poses threats in conducting research on regional problems.

Preparation of a Dynamic HRD Plan for 2023-2041

7. Can you please explain the parameters to be considered in preparing a dynamic HRD plan for NARS Institutes of Bangladesh for 2023-2041?

Comments:

Organization development (Institutional expansion, creation of regional stations), dynamic organogram, recruitment and promotion policy, on the job/refresher/special training and higher training, carrier development, carrier opportunity, etc. should be considered.

Types of Training Required for HRD Plan for NARS institutes from 2023-2041

8. What types of training, e.g., short (professional, certificate course), medium (diploma, MS) and long (PhD, Post-doc) would be required to make a dynamic HRD plan for 2023-2041 in the NARS Institutes?

Comments:
MS, PhD, Post-doc training etc, should be given priority in the HRD plan. Emphasis should be given for the training on climate change effect on livestock production, environment friendly animal production, economics of animal diseases in Bangladesh, socioeconomics of smallholder livestock production, etc.
8. Any other comments on the HRD plan in the NARS for 2041:

Antimicrobial resistance (AMR) is emerging as a silent pandemic throughout the world including Bangladesh. Research in relation to combating AMR like farming practices that require no/minimum antibiotics, development of feed additives/growth promoters to replace antibiotics in the feeds, development of disease resistant birds and animals requiring less antibiotics in the production cycle, development of bacterial vaccines, etc. is neddedz.

Key Informant Interview No. 4: Agricultural Engineering and Natural Resources

▪ Name: Dr. Wais Kabir
▪ Occupation: Former Executive Chairman, BARC
▪ Age: 67

Need for HRD Plan:

1. Do you think that it is necessary to prepare a dynamic HRD plan for the NARS institutes for increasing research productivity and output? If yes, please explain.

Yes, I think a dynamic HRD plan is essential to reshape NARS. Under increasing demand for food of diversified commodities and other factors of challenges, it is necessary to upgrade the skill through training and practices

2. Can you please explain how HRD plans in the NARS institutes would be able to contribute towards increasing efficiency and effectiveness of their scientists?

Firstly, the HRD planning process should analyze the existing scientific capacity, future need in identified areas of expertise, and capabiity of addressing challenges. As agriculture is widening and getting complex, there is a need for skill development with multiple disciplines, the pool should be equally widened in response to research need.

Research Priorities:

3. Due to climatic, environmental, agro-ecological and socio-economic and other changes around the globe, what areas should be prioritized in conducting research by the NARS institutes in Bangladesh?

Areas could cover core disciplines of agriculture, there is a further need to develop skill in monitoring, evaluation, planning, project management, leadership, communication, behavioural science, translating climate change into agricultural commodities including prediction, policy analysis etc.

4. What components of agriculture (crops, livestock, fisheries, forestry etc.) should get more priority in setting research programs in the NARS institutes?

Crops may continue to get priority but fisheries has better growth potential. Livestock has opportunities in women empowerment and higher return. Considering all sub-sectors, these should be equally given importance. Research in value added products should be enhanced in the expert service development.

Challenges and Threats:

5. What are the current challenges in agricultural research in Bangladesh to address the climatic as well as other changes?

Scientists should be aware of global negotiations on climate change, equally simulation studies of individual commodities need attention under climate change situation. Productivity alone may not do unless it considers farm profitability involving market signal. Nutrition should be in the forefront in research. Scientists must be equipped with regulatory framework of safe food. Agro- processing is getting out of focus, it needs linking with regulators and private sector.

6. What can be the possible threat in conducting and running smooth functioning agricultural research in Bangladesh?

There are many threats including institutional weakness, retention of merit, erratic funding, incentive and recognition. Politicizing in the research system is also considered as threat for the development of research.

Preparation of a Dynamic HRD Plan for 2023-2041:

7. Can you please explain the parameters to be considered in preparing a dynamic HRD plan for NARS Institutes of Bangladesh for 2023-2041?

Degree level of the scientific capacity, research output, drawbacks of organogram of the institutions, support to HRD by project or core funding, quality monitoring of short and long-term training etc, are needed,

8. In your judgment, what criteria should get priority in preparing the HRD plan up to 2041 for the NARS institutes?

Identify gap analysis in skill, future need to address, compare capacity of agricultural research institutes in South Asian countries.

Implementation of HRD Plan:

9. How the HRD plan can be effectively implemented by the NARS Institutes to increase agricultural productivity to make Bangladesh a developed nation?

Teamwork with international partnership, private sector participation and collaborative research with international centers should be taken into consideration..

10. Any other pertinent comments on the HRD plan in the NARS for 2023-2041:

Nothing more.

Date and time of conducting the TNAs and FGDs in the NARS institutes

Sl No.	Name of the institute	Conducting TNAs and FGDs		No. of scientists participated
		Date	Time	
1.	Soil Resources Development Institute (SRDI), Farmgate, Dhaka	25/09/2022	10.00 AM – 12.30 PM	30
2.	Cotton Development Board (CDB), Farmgate, Dhaka	26/09/2022	2.00 PM – 4.00 PM	08
3.	Bangladesh Jute Research Institute (BJRI), Manik Mia Avenue, Dhaka	27/09/2022	10.00 AM – 12.30 PM	35
4.	Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh	29/09/2022	8.30 AM – 10.,30 AM	39
5.	Bangladesh Fisheries Research Institute (BFRI), Mymensingh	29/09/2022	11.30 AM – 1.30 PM	30
6.	Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka	04/10/2022	9.30 AM – 11.30 AM	28
7.	Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur	06/10/2022	9.30 AM – 11.30 AM	36
8.	Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur	06/10/2022	11.45 AM – 1.45 PM	33
9.	Bangladesh Wheat and Maize Research Institute (BWMRI), Noshipur, Dinajpur	16/10/2022	10.00 AM – 12.30 PM	26
10.	Bangladesh Sericulture Research and Training Institute (BSMRTI), Rajshahi	17/10/2022	10.00 AM – 1.00 PM	06
11.	Bangladesh Sugarcrop Research Institute (BSRI), Ishurdi, Pabna	18/10/2022	10.00 AM – 12.30 PM	34
12.	Bangladesh Tea Research Institute (BTRI), Sreemangal, Mouluvibazar	20/10/2022	10.00 AM – 1.00 PM	09
13.	Bangladesh Forest Research Institute (BFRI), Soloshahar, Chattogram	24/10/2022	10.00 AM – 1.30 PM	32
14.	Bangladesh Agricultural Council (BARC), Farmgate, Dhaka	01/11/2022	11.30 AM – 1.00 PM	26

<u>*Appendix- VIII*</u>
Photographs of TNAs and FGDs

Photograph 1: TNA and FGD in SRDI, Farmgate, Dhaka on 25 September 2022

Photograph 2: TNA and FGD in CDB, Farmgate, Dhaka on 26 September 2022

Photograph 3: TNA and FGD in BJRI, Manik Miah A venue, Dhaka on 27 September 2022

Photograph 4: TNA and FGD in BINA, Mymensingh on 29 September 2022

Photograph 5: TNA and FGD in BFRI- Fisheries, Mymensingh on 29 September 2022

Photograph 6: TNA and FGD in BLRI, Savar, Dhaka on 04 October 2022

Photograph 7: TNA and FGD in BARI, Joydebpur, Gazipur on 06 October 2022

Photograph 8: TNA and FGD in BRRI, Joydebpur, Gazipur on 06 October 2022

Photograph 9: TNA and FGD in BWMRI, Noshipur, Dinajpur on 16 October 2022

Photograph 10: TNA and FGD in BSRTI, Rajshahi on 17 October 2022

Photograph 11: TNA and FGD in BSRI, Ishurdi, Pabna on 18 October 2022

Photograph 12: TNA and FGD in BTRI, Sreemangal, Mouluvibazar on 20 October 2022

Photograph 13: TNA and FGD in BFRI, Soloshahar, Chattagram on 24 October 2022

Photograph 14: TNA and FGD in BARC, Farmgate, Dhaka on 01 November 2022

Photograph 15: Discussion meeting with Expert Members, NARS Review Team on 03 November 2022

Photograph 16: Validation workshop on HRD plan   at BARC auditorium on 14 December 2022

Photograph 17: Presentation of draft HRD report at the validation workshop by the consultant on 14/12/22

Photograph 18: HRD Validation workshop participants on 14 December 2022

Appendix-IX
Date and time of conducting the KIIs (Key Informant Interviews)

Sl Nr.	Name of the Key Person	Conducting the KIs	
		Date	Time
1.	Dr. Kazi M. Badruddoza National Emeritus Scientist Bangladesh Agricultural Research Council (BARC) Farmgate, Dhaka-1215	08/11/2022	11.00 AM – 12.00 PM
2.	Dr. Md. Gulam Hussain Consultant USAID Feed the Future Innovation Lab for Fish (FIL). Currently serving as **Asian Regional Coordinator** and former **Director General** of Bangladesh Fisheries Research Institute (BFRI)	10/11/2022	3.00 PM -5.00 PM
3.	Dr. Kazi M. Kamaruddin Former Member Director (Livestock Division) Bangladesh Agricultural Research Council Farmgate, Dhaka-1215	13/11/2022	4.00 PM to 5.00 PM
4.	Dr. Wais Kabir Former Executive Chairman Bangladesh Agricultural Research Council Farmgate, Dhaka-1215	20/11/2022	12.00 Noon – 1.00 PM

Appendix-X

Photographs showing the Key Informant Interview session.

Interview with Dr. Kazi M. Badruddoza, National Emeritus Scientist on
08 November 2022 regarding HRD plan for the NARS 2023-2041

Interview with Dr. Wais Kabir, former Executive Chairman, BARC on 20 November 2022 regarding HRD plan for the NARS 2023-2041

Discussion with Dr. Shaikh Mohammad Bokhtiar, Executive Chairman, BARC on 21 November 2022 regarding HRD plan for the NARS 2023-2041

Appendix- XI:Tables

Appendix-X, Table 1. Institute-wise manpower development under various projects of BARC 1976-1997

Organization	Foreign				Local			
	PhD	**MS**	**S.T.T.**	**S.W.ST.**	**PhD**	**MS**	**S.T.**	**S.W.**
BARI	43	30	122	127	24	25	3305	675
BRRI	6	4	16	15	5	4	305	36
BJRI	1	0	8	6	5	6	123	350
BINA	5	0	15	12	3	1	35	0
BSRI	4	0	11	5	3	7	0	0
BFRI -Forest	5	1	8	6	2	0	0	0
BTRI	0	0	1	0	0	0	0	0
BFRI -Fisheries	4	3	7	7	3	5	160	15
BLRI	8	3	12	8	1	0	384	0
SRDI	0	0	2	2	1	0	0	0
BARC	15	2	46	87	6	0	491	1713
BAU	10	0	30	45	10	11	421	15 (1)
DAE	0	0	3	019	1	3	308	0
Others	2	0	34	65	4	11	335	0
Total	**103**	**43**	**315**	**404**	**68**	**73**	**5867 (212)**	**2804 (46)**

Appendix-X, Table 2. Institute-wise manpower development under IDA Credit 2815 BD, 1997-2001

Organization	Foreign					Local			
	PhD	Post Doc.	MS	S.T.T.	S.W.ST.	PhD	MS	S.T.T.	S.W.
BARI	8	0	0	59	49	30	0	0	0
BRRI	20	0	12	54	18	10	0	0	0
BJRI	3	0	0	41	4	0	0	0	0
BINA	0	0	0	0	0	0	0	0	0
BSRI	5	3	0	10	16	4	10	0	0
BFRI -Forest	2	3 Dip.	2	10	31	0	0	0	0
BTRI	0	0	0	0	0	0	0	0	0
BFRI -Fisheries	10	0	2	17	7	5	0	0	0
BLRI	8	4	1	24	21	3	0	0	0
SRDI	0	0	0	0	0	0	0	0	0
BARC	3	10	0	85	176	3	0	1034	2,998
Total	**59**	**20**	**17**	**300**	**322**	**55**	**10**	**1034 (30)**	**2,998 (30)**

Appendix-X, Table 3. Institute-wise manpower development under NATP Phase-1 2009-2014

Organization	Foreign					Local			
	PhD	Post Doc.	MS	S.T.T.	S.W.ST.	PhD	MS	S.T.T.	S.W.
BARI	12	2	0	67	69	35	0	1412	2245
BRRI	5	1	0	23	12	15	0	443	860
BJRI	3	1	0	12	13	8	0	247	413
BINA	0	1	0	9	5	3	0	195	316
BSRI	3	1	0	9	26	6	0	178	318
BFRI -Forest	1	0	0	0	6	0	0	58	192
BTRI	1	0	0	0	1	1	0	32	79
BFRI -Fisheries	1	0	0	1	1	5	0	102	213
BLRI	1	0	0	2	4	0	0	108	293
SRDI	1	0	0	3	4	5	0	131	199
BARC	1	4	0	31	38	0	0	342	793
CDB	0	0	0	1	3	0	0	141	92
BSRTI	0	0	0	0	0	0	0	61	0
MoA	1	0	0	9	23	1	0	0	32
Others	0	0	0	0	2	0	0	1059	151
Total	**30**	**10**	**0**	**167**	**207**	**79**	**0**	**4,509 (150)**	**6,196 (103)**

Appendix-X, Table 4. Institute-wise manpower development under NATP Phase-2, 2017-2022

Organization	Foreign				Local			
	PhD	MS	S.T.T.	S.W.ST.	PhD	MS	S.T.T.	S.W.ST
1. BARI	19	0	17	7	21	0	932	1278
2. BRRI	10	0	4	9	6	0	434	872
3. BJRI	04	0	2	0	5	0	408	352
4. BSRI	04	0	4	0	5	0	281	367
5. BINA	05	0	5	2	4	0	416	781
6. BFRI -Fisheries	05	0	0	0	6	0	289	489
7. SRDI	03	0	2	1	4	0	146	213
8. BLRI	04	0	0	2	2	0	261	374
9. BTRI	01	0	1	0	1	0	135	87
10. BFRI -Forestry	02	0	0	0	2	0	143	189
11. CDB	01	0	1	1	1	0	136	156
12. BSRTI	0	0	0	0	3	0	0	37
13. BWMRI	0	0	0	0	0	0	08	53
14. BARC	0	0	11	18	0	0	37	1292
15. BAU	0	0	0	0	0	0	0	47
16. DAE	0	0	0	2	10	0	205	459
17. DLS	0	0	0	0	5	0	122	197
18. DoF	0	0	0	0	5	0	88	205
19. MoA	02	0	5	15	0	0	0	0
20. Others	0	0	0	2	0	0	120	1953
Total	**60**	**0**	**52**	**59**	**80**	**0**	**4,161 (138)**	**9,401 (155)**

Appendix-XII Training needs as identified by the individual scientists of NARS institutes

a) **Discipline and area-wise training needs of the NARS scientists as identified through TNAs** (Training Need Assessments) (score range: 9-12 indicating low to high priority of training needs)

1. Bangladesh Agricultural Research Institute (BARI)				
a) Biotechnology				
Score	**Areas**		**Score**	**Areas**
12	Sanger Sequencing and Analysis		11	Confined Field Trial Biosafety
12	Gene Cloning		11	DNA/RNA/Protein extraction and quantification
11	Genetic Transformation and Gene editing		12	Polymerase Chain Reaction (PCR)
10	Biosafety and Steward ship of Transgenic crop		12	Crop bioinformatics and genomics
9	Research Report writing (Paper/leaflet/booklet)		11	Next Generation sequencing and computational (Genetics and Bioinformatics data analysis)
10	Human Resource Management		10	Molecular Marker design and Marker assisted selection
9	Data collection, Analysis and Report writing		11	Molecular Data analysis
10	Contain Trial Biosafety		11	Gene Mapping/Genomic Prediction
11	Gene Identification and Characterization		12	Hybrid research
c) Agricultural Economics			**b) Plant Pathology**	
10	Software based Analysis (4IR)		12	Molecular characterization of pathogens
10	Projection of Demand Supply Analysis		11	Morphological, bio-chemical and serological study of pathogens
10	Value Chain Analysis		9	Machine maintenance
9	Impact Analysis		**d) Post Harvest Technology**	
e) Vertebrate Pest			10	Sample Preparation
11	Captive animal management		10	Chemical Analysis of sample
10	Rodent capture		11	Food and nutrition based biological research using mammals
9	Machine maintenance			
f) ASICT			12	Climate smart and nutrition sensitive agriculture
11	GIS, remote sensing and crop modeling		11	Integrated water, nutrient, pest and disease management
12	Artificial intelligence & IoT		12	Agro-processing, value chain and marketing
11	Cloud computing		11	Stress management in major crops
			11	Integrated farming system
2. Bangladesh Rice Research Institute (BRRI)				
a) Plant Breeding				
10	Genomic analysis of abiotic and biotic stress tolerance		10	Breeding value estimation for Rice, SNP marker design, high throughput DNA, RNA or protein sequence analysis
11	Application of cutting-edge techniques in breeding like bioinformatics		10	Application of Bioinformatics tools (e.g. R, Python, Big data management, Linux based operating system)
b) Genetic Resources and Seed			**c) Grain Quality and Nutrition**	
9	Collection of rice germplasm		10	Physico-chemical analysis of rice sample
9	Storage/conservation of rice germplasm		12	Biofortification in rice

9	Regeneration/multiplication of rice germplasm	11	Quality of chemicals
9	Morphological and molecular characterization of rice germplasm	10	Machine maintenance
9	Evaluation of rice germplasm	**d) Hybrid Rice**	
e) Soil Science		10	Genomic analysis of abiotic stresses (QTL mapping, GWAS and genomic prediction)
10	Soil and plant sample analysis	9	Application of cutting-edge techniques in breeding like bioinformatics
9	Experimental design and layout	**f) Plant Physiology**	
10	Treatments selection	10	Data collection by sample analysis in machine
11	Efficient nutrient, water and energy management	10	Data analysis for interpretation
10	Data interpretation and report writing	9	Sample preparation
g) Entomology			
11	Surveying insect pest incidence	10	Prepare tentative budget
10	Scoring of the damage	9	Financial management/ budget distribution
10	Fixing of the dose of insecticide	9	Monitoring and execution
9	Data analysis	9	Verify supporting documents
11	Sample preparation	9	Ensure accountability for the actions
10	Chemical analysis	9	Set divisional rules and regulation
9	Maintenance of the machine (LC-MS)	11	Managing laborers in experimental farms
h) Plant Pathology			
10	Sample isolation, preservation & inoculation	10	Collect supporting documents
10	Microscopic work	10	Equipment operation
11	Molecular work		
i) Post-harvest			
11	Rice based machinery design and development	10	Research on renewable energy
9	Development of postharvest processing and grain storage technology	11	Modification of developed machinery
j) Adaptive Research			
10	Advanced line Adaptive Research Trial (ALART)	11	Integrated farming
11	Seed production and dissemination program	11	Farming in meta verse
k) Training Division			
9	Manner and etiquette	11	Research methodology
10	Behaving with junior staff	11	Scientific report writing
3. Bangladesh Jute Research Institute (BJRI)			
9	Conventional breeding	10	Experimental design
11	Data management	9	Physical analysis of raw materials
9	Report writing	10	Chemical analysis of raw materials
9	Market research	11	Production of nucleolus & breeder seed of JAF crops

11	Project development and management		11	Blending technology for natural and synthetic fiber like acrylic, rayon, wool, viscose, coir, banana, pineapple etc. by using Hopper Feeder machine.
10	Office administration		10	Development and modifications of machinery and equipment for jute and jute products.
12	Computer, router, switch, access switch and network equipment maintenance		10	Adopting and implementing programs for manufacturing jute fabrics of various weave design.
12	Data Management		12	Environmental impact assessment
12	E-filing		10	Automatic data monitoring
10	DPP formulation		9	Sample preparation technique
9	Identification of microorganism		10	Composite fabrication technique
10	Assay/activity test of the enzymes		9	Robotic management
11	Improvement of jute cuttings and low-grade jutes through microbial process		11	Sample characterization technique
12	Production of bio-plastic, paper and pulp from jute fiber		9	Improvement of jute fiber, yarn and fabric through biochemical modification
11	Determination and improvement of jute and allied fiber quality (physical and chemical) properties		10	Collection, characterization, evaluation, documentation and conservation of jute and allied fiber germplasm
10	Isolation and identification of effective jute retting bacteria		11	Regeneration and viability assessment of jute and allied fiber germplasm
10	Molecular characterization of jute retting bacteria		10	Breeder seed production and distribution to different seed producing agencies
11	Formulation of GRS work plan to mitigate the problems of BJRI personnel		11	Nucleus seed production and maintenance
10	Formulation of delta plan work plan		11	Molecular analysis of jute and allied fiber germplasm
9	Evaluate project progress and identify the problem during Project implementation		10	Bio-informatics analysis of two jute species
10	Project formulation to achieve the target of SDG by 2030		9	Molecular characterization of jute germplasm through DNA finger printing
9	Adjustment and adaptation with 4IR		9	Optimization of plant regeneration system for *C. olitorius* for establishing tissue culture plants into the field
11	National Social Safety Strategy work plan formulation		9	Drought management

4. Bangladesh Institute of Nuclear Agriculture (BINA)
(training needs identified based on the level and categories of officers from senior to junior)

a) Chief Scientific Officers (CSOs) & Head of all Divisions

12	Research project development, execution and management		11	Future research strategies development for sustainable crop production & food security
9	Leadership development			

b) Chief Scientific Officers (CSOs) / **c) Principal Scientific Officers (PSOs)**

12	Need based knowledge for 4IR based Agricultural research		10	Knowledge for Preparation of Draft Project Proposal (DPP)
11	National policy- based knowledge - such as SDGs, NIS, Perspective Plan-2041, Delta Plan-2100 etc.		10	Knowledge & techniques for baseline study for Project Initiation

9	Knowledge for qualitative advance scientific paper or article reviewer		10	Knowledge of PCR (Project Completion Report)
10	Knowledge for qualitative evaluation and monitoring of research work / team		12	Need based knowledge for 4IR based Agricultural research
11	Qualitative criteria for evaluation & proper judgment of scientific personnel		9	Knowledge of IoT (Internet of Things)
9	Knowledge of quality project management with a team sprit		11	National policy based knowledge - such as SDGs, NIS, Perspective Plan-2041, Delta Plan-2100 etc.
9	How to build up or trained up a junior scientist		9	Knowledge for qualitative advance scientific paper or article reviewer
10	Advance financial management practices		9	Knowledge for qualitative evaluation and monitoring of research work / team
11	Good administrative management procedure & protocol		9	Knowledge of quality scientific paper presentation
9	TOT :Training for Trainers			
d) Senior Scientific Officers (SSOs)			**e) Scientific Officers (SOs)**	
10	Advance Data Analysis for quality presentation		12	Basic foundation training for new scientists (General)
9	Scientific paper /report writing		12	Nuclear foundation training (BINA scientist)
11	Knowledge of quality research laboratory analysis (molecular, analytical, biochemical)		11	Statistical Data analysis
9	Research laboratory equipment maintenance		12	Scientific report writing
10	Use of nuclear techniques		10	Research result / data interpretation and management
11	Use of gene editing tool: CRISPR/cas-9		12	Research methodology
12	Gene sequencing		12	Mutation breeding (basic experimental procedures and methods specially in radiation and chemical mutation, mutation mapping, tilling)
12	Use of Nanotechnology		10	Molecular technology (MAS, MABC, Mapping, QTL and gene identification)
12	Estimate nutrient use efficiency using ^{15}N isotope		11	Biochemical (protein, micronutrients, ROS, hormone) analysis of crop/plant
11	C- sequestration studies using ^{13}C and ^{15}N isotope		10	Abiotic stress breeding (screening protocol/methods)
10	Water hydrology studies using ^{18}O and ^{2}H isotope		11	Hybrid breeding (basic methodology) techniques for cereal and horticultural crop.
11	Measurement of critical limit using ^{65}Zn and ^{35}S		11	Bioinformatics (SNP to GWS)
9	Use of different modeling for scientific research result		12	Crop improvement through genome sequencing
9	Quality of Scientific paper presentation		12	Speed breeding
5. Bangladesh Sugarcrop Research Institute (BSRI)				
12	Data Management		9	Android App Development
10	Policy Analysis		10	Research Proposal Formulation
12	4IR		10	Scientific report writing
11	GIS		11	Procurement management
12	Precision Agriculture		12	Supply chain development

12	DPP/TAPP Formulation		12	Genomics, QTL mapping and CRISPR-Cas9 based genome editing
6. Bangladesh Wheat and Maize Research Institute (BWMRI)				
10	Manpower management		12	Collection of DNA samples for DNA isolation
11	Administration and supervision		11	Maintenance of varietal purity
12	e-file management		10	Fingerprinting of BWMRI released varieties
11	Financial management		12	Genome editing for targeted gene
10	Nutrient management		9	Seed production, processing and storage
9	Conservation agricultural practices		10	Maintenance of parental lines
11	Wheat genomics, phenomics and transcriptomics		9	Production of hybrids
12	Germplasm screening		9	Inoculation
12	Molecular identification		10	Greenhouse management operation
9	Procurement process		11	Pricing of produce
10	Maintenance of varietal purity		10	Office management
7. Soil Resources Development Institute (SRDI)				
12	Chemical, physical & biological parameter of soil/fertilizer/ water/ plant analysis		10	Field survey
12	Instrument maintenance & trouble shooting		10	Soil map preparation
12	Quality control of chemical analysis		10	Preparation of Upazila Nirdeshika
11	Data interpretation		9	Technical report writing
11	Lab management		11	Office management
11	Problem soil management		9	Data interpretation
9	Project formulation		11	Heavy metal analysis
8. Bangladesh Tea Research Institute (BTRI)				
11	Research methodology		11	Pesticide residue in tea
9	Project management		10	Determination of BCR in different methods
12	Procurement work with PPR law		10	Development of mass rearing technique
11	Labor management		12	Development of high yielding clone
9	Pests and diseases control measures		11	Crop loss assessment of the new insect pest species
9	Irrigation and drainage management		10	Preparation of extracts
10	Crop (leaf) harvesting		10	Identification of pesticidal components
11	Labor payment management			Determination of ETL of insect pests before pesticide application
11	Farm/campus security management		9	Data collection, compilation and analysis
10	Labor management in the factory		12	Quantification of different components through HPLC/ UV-VIS spectrophotometer
11	Safe tea production and processing		9	Controlling the night guards for campus security
10	Factory machineries maintenance and troubleshooting		10	Preliminary selection process for promising vegetative clones
11	Field machineries maintenance and troubleshooting		11	Breeding for selecting suitable parent line
9. Bangladesh Forest Research Institute (BFRI)				
10	Research planning		12	Meta data analysis, bioacoustics, biotechnology and genetic analysis
9	Research coordination		11	Budget execution and monitoring
10	Field data collection		12	Identification of DNA/RNA

11	Data analysis and report writing	11	Gene detection, expression and exploitation
10	Report writing	11	DNA/RNA extraction and quantification
11	Forest pathology	10	DNA sequencing
10	Microbiology	11	Mapping climate change and biodiversity conservation
12	e-filing and management	9	Media preparation and inoculation

10. Cotton Development Board (CDB)

10	Crop physiology	11	Transgenic cotton development
11	Cotton based farming	11	Pathological identification and monitoring
9	Pathogenic analysis in lab	10	Pest identification and management
9	Biotechnology	10	Herbicide effect
9	Chemical analysis	11	Stress tolerant hybrid cotton development
9	Fiber analysis	9	Policy analysis
10	Field inspection	10	Farmers motivation

11. Bangladesh Sericulture Research and Training Institute (BSTRI)

11	Silkworm disease management	9	Independent research studies
11	Production management of mulberry plant	10	Office administration
11	Scientific report writing	11	Improve mulberry and silkworm
9	Conducting training	11	Research methodology

12. Bangladesh Fisheries Research Institute (BFRI)

11	Climate smart aquaculture and mericulture	11	Fish stock assessment/population dynamics/ remote sensing
11	Bio-flock technology in fish and shrimp culture	10	Mapping pollution, heavy metal toxicity and food safety
10	Domestication of wild fish	10	Tagging in aquaculture
11	Non-conventional fisheries	11	Fish health management
11	Pearl culture	12	Bivalves ecology, breeding, culture
12	Fish geonomics, phenomics and improvement	11	Bioinformatics, Data management and machine learning
11	Marine aquaculture and breeding	10	AMR and climate change
09	Data analysis	09	Training co-ordination

13. Bangladesh Livestock Research Institute (BLRI)

11	Blood/tissue/samer sample analysis	10	Pollution and waste management
10	Scientific report writing	9	Administration
9	Software handling	9	Office management
11	Genomics, phenomics and bioinformatics	11	Molecular biology
11	Livestock product processing, value chain analysis and marketing	11	AMR and Vaccine development
10	Climate smart fodder and cost effective feed production	10	Research methodology
11	Climate smart livestock development	11	Precision animal farming

14. Bangladesh Agricultural Research Council (BARC)

a) Chief Scientific Officers (CSOs)

10	Office management	11	Research activities of NARS institutes
9	Formulating recommendation	11	Genomics & bioinformatics
12	Use of feedback for implementation	10	Preparation of draft MoU
11	Monitoring research activities	11	Project Management
10	Evaluation of technologies	11	Trainee selection for national & international training programs
11	Evaluation of projects	12	Good governance in agriculture

10	Policy support preparation		10	Policy support recommendation
11	Key gap identification		11	Preparation of annual report, & journal article
11	Research management		11	Priority based topic selection for research
11	DPP preparation		9	Policy updating
9	Budget preparation and allocation		10	Selection of resource person for training
11	PCR preparation		10	Action plan preparation
b) Principal Scientific Officers (PSOs)				
11	Research gap identification		9	Recommendation for implementation of suggestion of ATECC meeting
9	Selection of priority area		9	Preparation of module
10	Research methodology		10	Impact analysis of transferred technology
10	Concept note preparation		10	Knowledge management
9	Activity and timeframe		11	Climate smart agriculture
9	Budgeting and distribution		9	Sample analysis, field trial and letter preparation
10	DPP preparation		10	Module preparation
9	Coordination		10	Project implementation
10	Preparation of policy support		10	Writing recommendation
10	MoU preparation		11	Preparation of national policy
10	Input for foreign policy		10	Conduction of meeting/seminar/ workshop for policy formulation
10	Bilateral meeting conduction and input support		9	Coordination of Sample analysis and field trial.
10	Consulting support to service provider		9	Meeting arrangement
11	Modern biotechnological techniques in crops, livestock and fisheries		10	Opinion and feedback collection
c) Officers				
12	Foundation Training		11	Policy Support
10	Information delivery services		11	Organizing policy dialogue/meeting/ workshop
11	Scientific report writing		11	HRD planning
9	Communication skill development		11	Training module development
10	Library management		11	Training budget management
11	Graphic design and audio-visual creation		12	Office management
10	Network operations & management		9	Input/opinion giving on bilateral international issues
9	Server operations & management		10	Cartography (ArcGIS)
11	GIS and crop modeling		9	Organizing international events
11	Remote sensing activities		9	MoU preparation & signing
11	ICT in agriculture		9	Human resource development (4IR, Innovation, SPS, Online Applications)

b) Period and area-wise training needs of the NARS scientists as identified through TNAs (Training Need Assessment)

Bangladesh Agricultural Research Institute (BARI)

Up to 2025 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Molecular and marker assisted breeding				1		Capacity building				1		Computer & software skill development	1					Carbon sequestration & adaptation		1			
Data management			1			GIS & remote sensing		1		1		Crop weed management		1				Artificial intelligence & IoT		1			
Soil microbiology			1			Soil microbiology		1				Cloud computing	1					Soil microbiology				1	
						Big data analytics		1										Artificial intelligence					1
						Gender & nutrition			1									Protocol development		1			
Crop bioinformatics & Genomics	1					Crop bioinformatics & Genomics		2						1						3				

Bangladesh Rice Research Institute (BRRI)

Field of Training	Up to 2025 MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 MS	PhD	Short Term	Professional	Post-doc
Statistical Analysis	1																			
Hands on training for handling and analysis of lab equipment like LCMS, LCMS -MS,				1					1											

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025 — Long Term MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 — Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 — Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 — Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Entomology and rice related training																							
Python, Machine learning, GIS		1																					
Agricultural Economics (Post Doc)			1																				
Entomology	1					Entomology		1															
Agricultural Water Management					1																		
Cereal grains/Rice based technology	PhD	1	1	1		AI/Biotechnological approach			1	1		Digital Agriculture /Modern Farming			1	1		Farming in Metaverse			1	1	
Greenhouse gas emission, soil health			1								1												
Conformation of rice blast resistance genes in rice germplasm					1	Rice blast resistance gene incorporation in elite Indica lines			1			Gene bank management				1							
Post-Doc on Farm Mechanization			1			Farm Machinery				1		Robotic engineering				1							
Farm mechanization			2									Farm Machinery and ICT				1		Image Processing & Precession Agriculture				1	
												Machinery and ICT				1		Image Processing				1	
Financial management			1																				
Crop Modelling, Precision Agriculture, Conservation agriculture																							

HRD plan for national agricultural research system 2023-2041

Bangladesh Jute Research Institute (BJRI)

Field of Training	Up to 2025					Field of Training	From 2026 to 2030					Field of Training	From 2031 to 2035					Field of Training	From 2036 to 2041				
	Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc
	MS	PhD					MS	PhD					MS	PhD					MS	PhD			
Molecular Biology, Plant Breeding and Genetics			1	1								Precision Agriculture				1		GIS and Remote sensing				1	
Molecular Breeding		1				Biotechnology		1				Bioinformatics			1	1							
Molecular Breeding			1	1		Genetic Engineering		1	1	1		Data analysis	1		1	1		Research Methods	1		1	11	
Molecular Breeding Research			1	1		Office management	1		1	1		4th IR	-		1	1		4th IR	-		1	1	
Data analysis			1	1	1	Report Preparation			1	1	1	Hydroponic culture			1								
Research Methodology						Soil Microbiology			1	1													
Soil Fertility related, E-filing, Research Methodology		1	1	1		Plant Tissue culture	1		1	1	1												
Modification of genes and cambium cell regulation			1	1	1																		
Plant biotechnology / molecular plant biology		1	-	-	-	Genetic engineering, crispr cas9 technology and bioinformatics			1	1	1	Plant biotechnology, molecular plant breeding and bioinformatics			1	1		Plant biotechnology, molecular plant breeding and bioinformatics			1	1	

Bangladesh Institute of Nuclear Agriculture (BINA)

Up to 2025 Field of Training	MS	PhD	Short Term	Professional	Post-doc	2026 to 2030 Field of Training	MS	PhD	Short Term	Professional	Post-doc	2031 to 2035 Field of Training	MS	PhD	Short Term	Professional	Post-doc	2036 to 2041 Field of Training	MS	PhD	Short Term	Professional	Post-doc
Stress Physiology		1	6	4		Nuclear Techniques Application			4	4		Molecular Screening			3	3		Research in Plant Physiology			10	10	
Advanced Plant Breeding		3	1																				
Varietal improvement of Teasel gourd			1	1		varietal improvement of tomato & chilli	-	1	1			varietal improvement of pointed gourd			1			varietal improvement of sweet gourd			1		
Mutation breeding				1		Molecular biotechnology			1														
Mutation breeding, Molecular Breeding, Research Methodology	-		1	1		Advanced Breeding Technique		1	1			Genome editing	.	1	1	1	1	Advanced genome editing		1			
primer designing, map-based cloning, and genome editing, mutation breeding, speed breeding		1	1	1	1	Mutmap, Genome sequencing, 4IR, Speed Breeding			1	1		Speed Breeding, Mutation breeding, 4IR, Bioinformatics			1	1							
Varietal development through genetic transformation				1	1							Transcriptome analysis			1	1		Genome editing			1		
Irrigation and Water Management		1				Irrigation and Water Management					1												
Data analysis, Report writing, Molecular techniques,		1				4IR, Remote sensing, Big data analysis,																	

HRD plan for national agricultural research system 2023-2041

Up to 2025						From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Microbiology related training					1	Artificial intelligence																	
Fallout Radionuclides						Compound Specific Stable Isotope																	
Breeding of Horticultural crops		1		1		Molecular Breeding					1	Transformation and Transgenic Breeding				1							
Crop nutritional quality analysis and improvement		1	1	1		CRISPR/Cas 9 Genome Editing Technology	1		1	1		Speed breeding			1	1							
Genetic Engineering			1			Bioinformatics			1														
CRISPR Cas9			1	1		Genetic Transformation			1			Meta genomics			1			Machine learning					
Molecular Markers and Genetic Polymorphism			1	1		Metagenomics, Molecular Markers and Genetic Polymorphism	1		1			Nanotechnology in plant protection						Machine learning	1				
Molecular plant pathology			1			Nanotechnology in plant protection			1									Machine learning			1		
Long time PhD																							
Basic nuclear techniques related training		1	1	1		Isotop aided Nuclear Training		1				Nuclear Lab placement			1								
Advance Nuclear Technique, Automation, GIS, Machinery Design	1		1																				

HRD plan for national agricultural research system 2023-2041

Up to 2025

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Stable isotope in ET studies, Isotope hydrology		1	1	1	
Nuclear based training		1			
Nuclear based training/lab visit				1	

From 2026 to 2030

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Research methodology			1		
Soil water conservation		1			

From 2031 to 2035

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Use of atomic energy in agriculture				1	

From 2036 to 2041

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc

Bangladesh Sugarcrop Research Institute (BSRI)

Up to 2025

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Agronomy		1			
Sugarcrops Breeding		1	1		
Entomology, Biotechnology	1		1	-	-
Soil Microbiology, Biological Nitrogen Fixation, Bio-Fertilizer Technology, Soil Fertility Management			5	2	1
Training on beekeeping	-				1
Agroclimatology	1		1	1	1

From 2026 to 2030

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Agronomy			1	1	1
Sugarcrop Breeding	1	1	1		
Entomology, Biotechnology	1		1		
Insect biotechnology	-		1	-	-
Adoption to Climate Change	1		1	1	1

From 2031 to 2035

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Crop Modeling	1		1	1	1
Sugarcrops Breeding	1		1		
Entomology, Biotechnology			1		1
Environmental Modeling and Management	1		1	1	1

From 2036 to 2041

Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Modeling and Precision Agriculture			1		
Sugarcrops Breeding	1		1		
Data Science			1	1	1

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025					Field of Training	From 2026 to 2030					Field of Training	From 2031 to 2035					Field of Training	From 2036 to 2041				
	Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc		Long Term		Short Term	Professional	Post-doc
	MS	PhD					MS	PhD					MS	PhD					MS	PhD			
Production Economics	1		1	2	1	Environmental Economics	1		1	1		Agribusiness and Marketing	1				1	Agricultural Resource Management	1		1	2	1
Plant Breeding	1					Sugarcane Breeding		1				Secured Food Production	1		1		1	Nano Technology		1	1	1	
Horticulture	1	1	1	1		Presision Agriculture	1		1	2	1	Machine learning, ICT in agriculture	1	1	1		1	Robotic, GPS GIS mapping		1	1	1	
Agronomy	2	2	2	2		Agronomy	2					Sugarcane Breeding					1	Molecular Breeding and Bioinformatics		1	1	1	1
Farm Power and Machinery, Irrigation and water management.	1	1	1	1	1	Computer aided design	1		1	1	1	Molecular Breeding and Bioinformatics			1		1	Priority based Plant breeding Research Supervision		1	1	1	
Plant Breeding	1		1			Sugarcane Breeding		1			1	Germplasm management, Breeding, Molecular Breeding, Molecular Charactization ,Administrative			1	1		Plant breeding, genetics and genomics		1	1	1	1
Genetics and Plant Breeding	1	1	1			Genetics and Plant Breeding		1	3		1	Plant breeding, genetics and genomics		1	1	1	1	Climate change related study	1		1		
Plant Breeding, Molecular breeding, Tissue culture	1	1	1	1	1	Molecular breeding	1		1	1		International collaboration	1		1		1						
Plant breeding, genetics and genomics	1	1	1	1		Plant breeding, genetics and genomics	1		1	1	1												
Plant Pathology	1	1	1	1		International Seminar			1		1												
Econometric Models		1	1	1																			
Genotyping and Association Mapping, Date Palm Breeding, Molecular Palm Breeding, Molecular Characterization of Sugarcrop	-	1	1	-	-	QTL mapping	-	-	1	-	-												
Date palm weevil management and			1	1	1	Mass rearing of Bio-agent and	-	1	1	1	1												

Field of Training	Up to 2025					From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
	MS	PhD	Short Term	Professional	Post-doc	Field of Training	MS	PhD	Short Term	Professional	Post-doc	Field of Training	MS	PhD	Short Term	Professional	Post-doc	Field of Training	MS	PhD	Short Term	Professional	Post-doc
Honey insect pest management						rearing larvae of sugarcane stem borer to develop male moth																	
Soil microbiology, Biological Nitrogen Fixation and biofertilizer technology, Soil fertility			5	2	1																		
Soil Fertility, Micronutrient, Soil Physics and Soil Microbiology			2	2	3	Soil Fertility, Micronutrient, Soil Physics and Soil Microbiology			1	2	2												
Soil Fertility, micronutrient, problem soil management.			2	2	4	Soil Fertility, micronutrient.			3	3	3	Soil Fertility, micronutrient, problem soil management.			2	2	2						
Breeding of allied sugarcrop			1		1																		
Agricultural Extension Management, Extension Systems Management, Agricultural Knowledge management.	1		1	1		Socio economic impact Analysis, Extension models for rural and agricultural development..			1	1	1	Good Governance, Farm Management, Disaster Management, Value Chain Management, Financial Management.			1	1,	1	Organizational Management, Administrative Management,			1	1	
Biotechnology	1		1	1	1	Biotechnology			1	1	1	Biotechnology			1	1		Biotechnology	1		1		
CRISPR/dCAS9 Based Genome Editing and Genomics				1		Bioinformatics and System Biology				1		Proteoomics and Cellular Biology				1		Multiomics				1	
Abiotic stress/ Plant			1		1	Plant physiology/ Plant science			1	1	1	Advance research in biotechnology			1	1	1	Office management			1	1	

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025 Long Term MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Abiotic stress/Plant Physiology	1		1	1	1	Plant Science	1		1	1	1	Advance Research in Biotechnology		1	1	1	1	Office Management	1		1	1	1
Abiotic Stress / Plant Physiology	1		1	1	1	plant science			1	1	1	Office Management			1	1	1				1	1	1

Bangladesh Wheat and Maize Research Institute (BWMRI)

Field of Training	Up to 2025 MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Wheat breeding	1		1	1		Wheat & Maize Pathology			1	1	1												
-																							
Plant Pathology, Molecular Plant Pathology, Plant Genomics, Plant-Pathogen interactions, QTL Mapping, Genome Editing, Resistance Breeding, Biological Control of Pathogen,	1		6	5		Plant Pathology, Resistance Breeding, Molecular Plant Pathology,	1		5	10		Plant Pathology, Resistance Breeding, Molecular Plant Pathology,			10	10		Plant Pathology, Resistance Breeding, Molecular Plant Pathology, Plant Genomics, Plant-Pathogen interactions, QTL Mapping, Genome Editing,			10	15	
Wheat Genomics and Phenomics			1			Advance molecular tools for crop improvement			1														
Molecular Genetics	1		1	1.		Molecular Genetics			1														
Farm Management			1			Phytopathology	1																
Genetics and Plant Breeding	1		1			Genetics and Plant Breeding	1											Genetics and Plant Breeding					1
Farm management	1		1			Farm Management	1																

172

Discipline (Up to 2025)	Up to 2025			Subject (Up to 2025)	From 2026 to 2030			Post Doc	Subject (2026-2030)	From 2031 to 2035			Subject (2031-2035)	From 2036 to 2041			Subject (2036-2041)
Molecular analysis, Genomics, Fungicide resistance, Resistance Breeding, Biological control, Gene editing, SNP Analysis	1	6	3	Molecular analysis, Genomics, Fungicide resistance, Resistance Breeding, Biological control, Gene editing, SNP Analysis	3	2		Post Doc	Molecular analysis, Genomics, Fungicide resistance, Resistance Breeding, Biological control, Gene editing, SNP Analysis	3	3		Molecular analysis, Genomics, Fungicide resistance, Resistance Breeding, Biological control, Gene editing, SNP Analysis	2	2	2	Molecular analysis, Genomics, Fungicide resistance, Resistance Breeding, Biological control, Gene editing, SNP Analysis
Genetics and Plant Breeding	-	1	1	-														
Crop and Soil Management	1	1	1	-	-	-	-	-		-	-	-		-	-	-	-	
Genetics and plant Breeding, Tissue culture, Molecular based research, gene editing etc	1	1	1	Genetics and plant Breeding, Tissue culture, Molecular based research, gene editing etc	1	1	1		Genetics and plant Breeding, Tissue culture, Molecular based research, gene editing etc	1	1						
Wheat Breeding		1	1	Wheat Breeding	1	1	1	1									
Irrigation and Water Management, Conservation Agriculture and Resource Conservation Technology, Agricultural Mechanization, Farm Machinery and Post-Harvest Processing Technology, Crop Production and Climate Changes	1	1	1	Irrigation and Water Management, Conservation Agriculture and Resource Conservation Technology, Agricultural Mechanization, Farm Machinery and Post-Harvest Processing Technology, Crop Production and	1	1	1	1	Irrigation and Water Management, Conservation Agriculture and Resource Conservation Technology, Agricultural Mechanization, Farm Machinery and Post-Harvest Processing Technology, Crop Production	Training	Agricultural Engineering		Irrigation and Water Management, Conservation Agriculture and Resource Conservation Technology, Agricultural Mechanization, Farm Machinery and Post-Harvest Processing Technology, Crop Production and Climate Changes	1	1	1	Irrigation and Water Management, Conservation Agriculture and Resource Conservation Technology, Agricultural Mechanization, Farm Machinery and Post-Harvest Processing Technology, Crop Production and Climate Changes

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025					From 2026 to 2030					From 2031 to 2035					From 2036 to 2041				
	Long Term (MS, PhD) MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term	Short Term	Professional	Post-doc	Field of Training	Long Term MS PhD		Short Term	Professional	Post-doc	Field of Training	Long Term MS PhD		Short Term	Professional
						Climate Changes														
Genetic engineering in abiotic stress tolerant wheat variety	Bioinformatics, Genomics, Proteomics 1	1			1	and Climate Changes	1	1	1		Transcriptomics	1		1							
Genomics	1				1																
Administration, Fund management		Yes																			
Molecular Breeding	Wheat Breeding	3	2			Molecular Wheat Breeding	2	2		2	Wheat Genetics	2	2					2	2		
MAS, QTLs	salinity Stress Strategies In Improvement of Wheat Variety 1	1	1				1	1													
Wheat Improvement and Biotechnology	Advance Wheat Improvement and Biotechnology 1	3	1				2	1													

Bangladesh Tea Research Institute (BTRI)

Field of Training	Up to 2025					From 2026 - 2030						From 2031 - 2035						From 2036 - 2041				
	Long Term (MS, PhD) MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS PhD		Short Term	Professional	Post-doc	Field of Training	Long Term MS PhD		Short Term	Professional	Post-doc	Field of Training	Long Term MS PhD		Short Term	Professional	Post-doc
Drought management	1	1				Irrigation management		1		2		Plucking standard of oolong tea		2			1					
			1	3		Tea cutting methods			1	3												

Bangladesh Sericulture Research and Training Institute (BSRTI)

Field of Training	Up to 2025 MS	PhD	Short Term	Professional	Post-doc	From 2026 - 2030 MS	PhD	Short Term	Professional	Post-doc	From 2031 - 2035 MS	PhD	Short Term	Professional	Post-doc	From 2036 - 2041 MS	PhD	Short Term	Professional	Post-doc
Sericultural Related (Specialization on Mulberry)			1	1	1			1		1			1		1			1		1
Sericulture related (Silkworm &Pathology)	1		1	1	1	1		1		1			1					1		
Sericulture related (specialization of post cocoon technology)			1					1					1					1		

Bangladesh Forest Research Institute (BFRI)

Field of Training	Up to 2025 MS	PhD	Short Term	Professional	Post-doc	From 2026 to 2030 MS	PhD	Short Term	Professional	Post-doc	From 2031 to 2035 MS	PhD	Short Term	Professional	Post-doc	From 2036 to 2041 MS	PhD	Short Term	Professional	Post-doc
Plant Breeding and Genetics	1	1																		
Genome sequencing, PCR, & Bioinformatics				1																
data analysis program, species conservation,			1						1											
Bio-diversity conservation, climate change mitigation				1																

Note: In the "From 2026 to 2030" block the "data analysis program, species conservation" row lists the Field of Training as "project proposal writing, Coastal forest related" with a value of 1 in the Professional column.

175

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025 — Long Term MS	PhD	Short Term	Professional	Post doc	Field of Training (From 2026 to 2030)	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training (From 2031 to 2035)	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training (From 2036 to 2041)	Long Term MS	PhD	Short Term	Professional	Post-doc
Biomaterial Science, Wood Products, Agar oil Research	1			1																			
Data Science Training, Use of R-studio and ArcGIS			1	1	1																		
Data analysis through software	1					Climate change adaptation and mitigation		1			1	Delta plan	1										
Paper Science	1		1	1		Pulp and Paper Technology	1		1	1		Bleaching and Effluent Management Technology			1	1							
						Bamboo composite Lumber		1															
Modern wood technology	1					Modern wood technology Post Doc						Various physical utilization of wood			1		1	Advanced physical utilization of different wood			1	1	
Agroforestry/Plant Science	1					Agroforestry/Plant Science	1					Plant Science/Agroforestry			1		1	Non Timber Forest Products			1		
Environmental Science					1																		
Pulp & Paper	1		3		1	Pulp & Paper	1		3	1		Pulp & Paper Science	.		2	1	1						
Forest policy & land use management	1																						
Forestry	1		1	1		Project Development			1			Project Management			1								
Silvicultural management	1																						
Genetic Engineering and Biotechnology			1	1		Gene editing and DNA barcoding		1	1	1	1	Bioinformatics and computational biology			1	1	1	Somatic hybridization, mutation breeding, polyploidization			1	1	1

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025 — Long Term (MS, PhD): MS	PhD	Short Term	Professional	Post-doc	Field of Training	2026 to 2030 — Long Term: MS	PhD	Short Term	Professional	Post-doc	Field of Training	2031 to 2035 — Long Term: MS	PhD	Short Term	Professional	Post-doc	Field of Training	2036 to 2041 — Long Term: MS	PhD	Short Term	Professional	Post-doc
Nanotechnology; Natural fiber; Polymer technology; Pulp and paper; Wood science and technology; Composite products	-		1	1		Nanotechnology; Natural fiber; Polymer technology; Pulp and paper; Wood science and technology; Composite products			1	1	1	Nanotechnology; Natural fiber; Polymer technology; Pulp and paper; Wood science and technology; Composite products	Post Doc		Yes	Yes	Post Doctorate	Nanotechnology; Natural fiber; Polymer technology; Pulp and paper; Wood science and technology; Composite products			1	1	1
Soil conservation		1			1																		
Plant Taxonomy		1	1			Wild Fodder		1															
GIS and Remote Sensing			1	1		Meta data analysis, Bioaccoustic, Biotechnology and Genetic analysis			1	1	1	Meta data analysis, Bioaccoustic, Biotechnology and Genetic analysis			1	1	1				1	1	1
"Boot Camp" in wildlife study design and data analysis			1	1	1	MSc in Statistical Ecology			1	1	1	Advanced Wildlife Management	1				1						1

Bangladesh Fisheries Research Institute (BFRI)

Field of Training	By 2025 — Long Term: MS	PhD	Short Term	Professional	Post-doc	Field of Training	2026 to 2030 — Long Term: MS	PhD	Short Term	Professional	Post-doc	Field of Training	2031 to 2035 — Long Term: MS	PhD	Short Term	Professional	Post-doc	Field of Training	2036 to 2041 — Long Term: MS	PhD	Short Term	Professional	Post-doc
Fish/Shrimp Health Management, Nutrition, Breeding and Culture	2					Fish/Shrimp Health Management, Nutrition, Breeding and Culture			3	4		Aquaculture			5	3	1						
Live Feed			2	3		Fish Breeding	2		3	2													

HRD plan for national agricultural research system 2023-2041

Field of Training (By 2025)	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training (From 2026 to 2030)	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training (From 2031 to 2035)	Long Term MS	PhD	Short Term	Professional	Post-doc Training	Field of Training (From 2036 to 2041)	Long Term MS	PhD	Short Term	Professional (Post-doc)
Data Analysis, Scientific Report Writing			2	4		Paper Reviewing, Project proposal writing					1											
Heavy Metal Toxicology and Food Safety			4			Microplastic Toxicology and Food Safety			5													
Fish/Shrimp Health Management	2	1	4	6		Aquaculture/Fish Health Management	1		-	-		Aquatic Environment/Shrimp or Fish Health Management			-	-	1					
Aquaculture/Aquatic Environment/Fish and Shrimp Health Management	1	1	2									Fish and Shrimp Health Management					1					
Seaweed Biotechnology	1		3	5	-	Marine Fish Production		1	3	-		Non-conventional Marine Resources	1		3	2						
Research methodology	1																					
GIS on Aquaculture	1					Tagging in Aquaculture			3			Use of Drone on Coastal Aquaculture	1	1				Use of AI in Aquaculture	1		2	1
In depth training on HPLC			2			PhD		1														
Fish Breeding, Algae			3	3		Fish Breeding		1	1													
Aquaculture/Quality Control/Fish and Shrimp Health Management	1											Quality control					1					
Aquaculture/Aquatic Environment/Fish and Shrimp Health Management	1	1										Fish and Shrimp Health Management					1					
Domestication of wild fish, Habitat restoration			1	2		Domestication of wild fish, Habitat restoration, mariculture			3			Domestication of wild fish, Habitat restoration, mariculture			2			Domestication of wild fish, Habitat			3	

HRD plan for national agricultural research system 2023-2041

Field of Training	By 2025					From 2026 to 2030					From 2031 to 2035					From 2036 to 2041				
	Long Term MS	PhD	Short Term Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term Professional	Post-doc	Field of Training
																				restoration, mariculture
Fish breeding and health management		1																		
Fish breeding and Aquaculture		1																		
AMR			2				1			AMR and Climate change				1	AMR, Climate change and Blue Planet					
Database management, Barcoding, Sequencing, Fish disease, Breeding, Hatchery management			1																	
Biofloc technology in Fish and srimp culture				1					1											
Fish stock assessment/ Population dynamics / Remote Sensing	1		1			1			1	Remote sensing lab development				1	Bilateral training with other nations				1	Training with advaced end users of Fisheries sector
Crab breeding, nursery, grow-out management, Horse shoe crab breeding, nursery and grow out management, Shark management	1		1			1				PCR, Genome sequencing		1			PCR, Genome sequencing					
HPLC Machine training	1																			
Mussel breeding and pearl culture	1								1	Mussel breeding and pearl culture										
Pearl culture			2				1			Pearl culture				1	Pearl culture					

Field of Training	By 2025					From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Stock Assessment, Reduction of Post Harvest Loss, Fish Nutrition	1					Fish nutrition, Fish Feed Formulation, Value added products production					1												
Stock assessment of fishes, Training on R software,	1					Stock assessment of Fishes	1					Stock assessment of Marine Fishes	1					Stock assessment of Marine Fishes		1			
Bivalves Ecology, Breeding, Culture			1	2		Bivalves Ecology, Breeding, Culture	1																
Marine Aquaculture and breeding			2	2		Marine Aquaculture and breeding	1					Marine Aquaculture and breeding			1	2		Marine Aquaculture and breeding			1	1	
GIS, Bioinformatics, NGS, Statistical Course	1		2	1		Bioinformatics					1	Data Science, Machine Learning	1				1						
Maricultre	1																						

Bangladesh Livestock Research Institute (BLRI)

Field of Training	Up to 2025					From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	PhD	Short Term	Professional	Post-doc
Molecular biology	1		1			Animal breeding & Genetics		2			1	Bioinformatics	1	1		1							
Nutritional biotechnology		1																					
Data analysis	1				3																		

Bangladesh Agricultural Research Council (BARC)

Field of Training	Up to 2025					From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc)	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc	Field of Training	Long Term MS	Long Term PhD	Short Term	Professional	Post-doc
Agriculture policy, planning and strategy	3	2	1	1	3	Agriculture policy, planning			2	2								Gene editing	1	1		2	
Animal Molecular Biotechnology				1	1	Project Planning and Implementation on Livestock			1	1								Biotechnology		2		1	2
physiological and molecular mechanism of crops under stress condition			1		1	Yield gap analysis		1				Good Agric. Practices					1	Climate resilient technologies	1	1	2		
Project planning & implementation			1		1																		
Integrated farming system					1																		
Research Management			1	5	2																		
Conservation agriculture			1	2	1																		
Plant Genomics & Biotechnology			2	2	2	Plant Genomics & Biotechnology			2	2		ICT, 4IR, bioinformatics	2	2	2		1	Econometrics	1	1		2	1
Plant Breeding & Genetics			2	2	1						1							Policy support	1		1		
Agric. Policy planning & Strategy	1	1				Agric. Policy planning & Strategy					1												
Animal molecular biology					1	Extension Management		1			1	HRD & ICT in Dev.		1			1	4IR, food & nutritional security	1	1			
GIS	1	2				Big Data	1	1			1							Agro Geo Spatial technology, IoT		1		1	
Image processing, 4IR technology				2		Stress management	1		1			Knowledge management			1	1		Communication,		2		2	1

HRD plan for national agricultural research system 2023-2041

Field of Training	Up to 2025					From 2026 to 2030						From 2031 to 2035						From 2036 to 2041					
	Long Term		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc
	MS	PhD					MS	PhD					MS	PhD					MS	PhD			
												nt ant copy right						leadership development					

Cotton Development Board (CDB)

Field of Training	Up to 2025					From 2026 - 2030						From 2031 - 2035						From 2036 - 2041					
	Long Term (MS, PhD)		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc	Field of Training	Long Term		Short Term	Professional	Post-doc
	MS	PhD					MS	PhD					MS	PhD					MS	PhD			
4IR in cotton	1		2	2			MS	PhD															
HDPS, Harvest Aid	1		2	2		Relay cropping	1	1	2			Cropping pattern	1		2	2							