Project Completion Report

Inventorization of Agriculturally Important Microorganisms for Catalyzing Agri-Prenurship

Implemented by

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DST Project No: DST/NSTMIS/05/315/2017-18

Study Sponsored by

National Science and Technology Management Information System (NSTMIS)
Department of Science & Technology Government of India

(October, 2021)

Preface

Since the commercialization of inoculants in India during late seventies, microbial inoculants popularly known as biofertilizers and biopesticides have come a long way. The journey that started with Rhizobium has now been diversified and various types of microorganisms have joined the race and are not only being exploited for nutrient mobilization or plant growth promotion but also playing a key role in plant protection. But, in spite of good going, the actual utilization is nowhere near the potential. Majority of the research work done in the field was on development of strains, their mode of action and on explaining the science behind their potentiality. Very little work has been done to convert the science into technology. Basic information related to available technological options, cost of production, quality control, turnkey solution and IP protection are lacking. Further, no information is available on how many industries are currently engaged in producing these organic inputs and what kind of microbial technologies are developed and transferred by which research institutions. Such knowledge gaps are big hurdle in starting new project initiatives. In the present context, inventorozation has to play a more serious role to its stakeholders in times to come. It is high time to get rid of knowledge gap beyond the conditions for which they were developed. There is an urgent need to communicate the overall status, recommendations and finally findings need to be translated into economic terms so that farmers and policy-makers can work with them.

Amitava Rakshit

B.K. Sarma

S.P. Singh

Acknowledgements

An exhaustive project of this vastness does not become possible without contribution of several prepared souls. We have been fortunate that several colleagues and representatives from government organization, private industries helped us in our endeavor bring this report to light. We are grateful to **Prof. H.S. Gupta**, formerly Director General, Borlaug Institute for South Asia & Director, IARI for his enormous impact, guidance, unflinching encouragement and support.

We would like to express our gratitude to **Dr. P. Arora**, Head, CHORD (NSTMIS) Division and **Dr. P.K. Arya**, Scientist 'C', PCPM (NSTMIS) Division who saw us through this journey, provided support, talked things over, offered comments and assisted us to do our work efficiently.

Finally the production team members, project staffs Chinmay and Ambuj deserve special appreciation for helping us through the process of publishing this huge volume. We would like to thank **Mr. Sumit Verma** for enabling us to publish this on the web. Last but not the least we would thank our family for their absolute support, persistent love in putting everything together.

Amitava Rakshit

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Executive Summary

It is increasingly felt that although the use of the agrochemicals helped a lot in increasing agricultural productivity but they have caused adverse effects on soil health, water quality, produce quality and developed problems like insect resistance, genetic variation in plants, toxic residues food and feed. There is a rising demand and justifications for intervention of ecologically safe and sound, environmentally compatible techniques in crop production which will provide global food security and improved agricultural produces. To accomplish this goal, application of agriculturally beneficial microorganisms is a potential, viable alternative to traditional agricultural techniques based on fossil fuel supported options.

Constantly increasing demand of biopesticides and biofertilizers offers exciting career for science graduates with a special reference to agri-graduates and scholars. Entrepreneurships based on production of biopesticides and biofertilizers have potential to generate large employment and income. However, in spite of fascinating and vast opportunities in this sector, growth and development of the same is not encouraging.

In order to process the idea of new start up and entrepreneurship, information is very essential factor. Based on the available information one can formulate and execute his idea of entrepreneuring. Similarly the start-up plan for setting a biopesticides and biofertilizers based industry need basic information for troubleshooting various problems. However, information regarding requirement for establishing a biopesticides and biofertilizers industry are lacking. Basic information related to available technological options, cost of production, quality control, turnkey solution and IP protection are lacking. Further, no information is available on how many industries are currently engaged in producing these organic inputs and what kind of microbial technologies are developed and transferred by which research institutions. Such knowledge gaps are big hurdle in starting new project initiatives.

Based on existing knowledge gaps and scattered partial information on available technologies, their cost, inventor details and guidelines, the proposed project was conceptualized for providing all information on single portal.

A team of experts collected data from primary and secondary sources for the reference period 2018-2020 covering three hundred nineteen public, private and cooperative enterprises engaged in development of microbial technologies. Apart from this seventy five SAU's and ICAR institutes and four CSIR institutes involved in bioinoculant production have also been covered during the study. Secondary data was collected from Ministry of Agriculture and Farmers welfare, Central Insecticide Board and Registration Committee, National Centre for Organic farming, Department of Fertilizer, Ministry of Chemicals and Fertilizer, Government of India's web page and personal contact.

From the extensive survey conducted during 2019 to 2021 eighty commercialized bioinoculant technologies and fourty three cost effective and efficient green technologies involving AIMs from ICAR,CSIR and SAU systems is identified and enrichidion was prepared .Further details pertaining to three hundred nineteen public, private and cooperative enterprises, twenty seven start ups involved in commercial production units for biological inputs was formulated in a structured format to help guide the users to relevant useful information.

In the present project, we have compiled an informative user friendly compendium on biopesticides and biofertilizers commercialization available green technologies for public use on single platform.

This project is mainly focused on the gathering of the information and presents them at single platform. This project will strengthen the idea of 'Skill India' which conceptualizes on providing a collaboration platform to help empower the all stakeholders to freely connect with each other. The overall focus of this initiative is to help provide an engaging ecosystem to cater to skilling needs of citizens by publishing and sharing relevant information.

The outcome of this initiative likely to direct inclusive growth especially for the budding entrepreneurships. The portal attempts to disseminate reliable information and by providing an interface to enquire, explore, and access and engage with various affiliated and accredited institutions, infrastructure providers, understand skill options, opportunities, information on various providers, reliable and credible digital content. It will also help in achieving the goals of Digital India scheme which is a flagship programme run by Government of India with a vision to transform India into a digitally empowered society and knowledge economy and by providing universally accessible digital resources and services in Indian languages. Widening demand – supply gap of food crops, increasing demand of organic food and the government focus on conserving the environment is expected to drive the growth of biofertilizers and biopesticides industry in India, who will be the major beneficiary of this outcome.

Chapter 1

Introduction

It is increasingly felt that although the use of the agrochemicals helped a lot in increasing agricultural productivity but they have caused adverse effects on soil health, water quality, produce quality and developed problems like insect resistance, genetic variation in plants, toxic residues food and feed. There is a rising demand and justifications for intervention of ecologically safe and sound, environmentally compatible techniques in crop production which will provide global food security and improved agricultural produces. To accomplish this goal, application of agriculturally beneficial microorganisms is a potential, viable alternative to traditional agricultural techniques based on fossil fuel supported options. Beneficial microorganisms including biological control agents (BCAs), plant growth promoting rhizobacteria (PGPRs) and fungi (PGPFs) and endophytes play a crucial role in sustainable crop production. Biopesticides and biofertilizers are naturally occurring formulations made from the substances that control pests by non toxic mechanisms and in eco-friendly manner. Biopesticides being a living organisms (natural enemies) or products there of pose less threat to the environment and to human health, hence can be used for the management of pests.

Since past decade use of biopesticides and biofertilizers are growing rapidly. Commercial production of organic inputs for sustainable agriculture is also increasing. Around 170 organizations in 24 countries are engaged in commercial production of biofertilizers. In India total production of carrier base and liquid biofertilizers was 88029.30 and 6240.92 MT in 2015-16 and experienced manifold increase from previous financial years. Indian biofertilizer market had grown rapidly in the period FY09 to FY15, the production of biofertilizers in India had more than tripled during FY09- 15. The growth is expected to continue in future owing to the strong push by the Government of India to promote sustainable agriculture. The Indian biopesticide market stands at over US$127 million (7-8% of the global market) and is expected to triple by FY20. Over 970 Indian Private

Companies are listed with registered products. In India, biopesticide production and registration regulation is made by Central insecticide Board and registration Committee, Government of India. Under section 9(3B) and 9(3) of the Insecticides Act, 1968, Government of India has allowed 34 microorganisms for registration as biopesticide.

Constantly increasing demand of biopesticides and biofertilizers offers exciting career for science graduates with a special reference to agri-graduates and scholars. Entrepreneurships based on production of biopesticides and biofertilizers have potential to generate large employment and income. However, in spite of fascinating and vast opportunities in this sector, growth and development of the same is not encouraging.

In order to process the idea of new start up and entrepreneurship, information is very essential factor. Based on the available information one can formulate and execute his idea of entrepreneuring. Similarly the start-up plan for setting a biopesticides and biofertilizers based industry need basic information for troubleshooting various problems. However, information regarding requirement for establishing a biopesticides and biofertilizers industry are lacking. Basic information related to available technological options, cost of production, quality control, turnkey solution and IP protection are lacking. Further, no information is available on how many industries are currently engaged in producing these organic inputs and what kind of microbial technologies are developed and transferred by which research institutions. Such knowledge gaps are big hurdle in starting new project initiatives.

This project is mainly focused on the gathering of the information and presents them at single platform. This project will strengthen the idea of 'Skill India' which conceptualizes on providing a collaboration platform to help empower the all stakeholders to freely connect with each other. The overall focus of this initiative is to help provide an engaging ecosystem to cater to skilling needs of citizens by publishing and sharing relevant information. The outcome of this initiative should ideally lead to inclusive growth especially for the budding entrepreneurships. The portal attempts to disseminate reliable information and by providing an interface to enquire, explore, and access and engage with various affiliated and accredited institutions, infrastructure providers, understand skill options, opportunities, information on various providers, reliable and credible digital content. It will also help in achieving the goals of Digital India scheme which is a flagship programme run by Government of India with a vision to transform India into a

digitally empowered society and knowledge economy and by providing universally accessible digital resources and services in Indian languages.

In the present project, we propose to undertake this work to have an informative database for accumulating more essential information on biopesticides and biofertilizers commercialization on single platform.

Objectives

- To identify and segregate the various Governmental, private industries and State and Central Universities/Research Institutes based on the types of AIMs produced and commercialized.
- To study various cost effective and efficient green technologies involving AIMs available with ICAR, CSIR, DBT, DST, State and Central Universities and private research institutes.
- To generate a user friendly web portal (compendium) for broadcasting available green technologies for public use.

Limitations

- Secondary data may not be complete and readily available with any department.
- States/UTs may not be comfortable to share secondary data.
- States/UTs may not cooperate in collection of primary data.
- Limited availability of resources in this area.
- Project limited cost and duration.

Chapter 2

Review of Literature

Rhizosphere biology is approaching a century of investigations wherein PGPR have attracted special attention for their beneficial skills. Considering the priorities of food security and enhancing the productivity, profitability and sustainable rural livelihoods at farm level, developing new order of farm inputs has become imperative. In this perspective, bio-inputs either directly in the form of microbes or their by-products are gaining tremendous momentum. Sustainable crop production depends largely on soil conditions. Optimum combination of both organic and inorganic components in the soil is imperative for maintaining good soil health. Post green revolution; the dependence on chemical pesticides and fertilizers application in Indian agriculture has increased manifold. Constant and excessive use of chemical fertilizers leads to devastation of soil biota. In Uttar Pradesh, Punjab and Haryana, it has reached alarming levels, risking human health and ecological balance. It has therefore become imperative to look for some alternatives which are not only eco-friendly and efficient in enhancing soil fertility but also effective in management of pests and diseases. Agriculturally important microorganisms (AIMs) have an important role to play in the promotion sustainable agriculture. However, despite all these efforts, the acceptance and diffusion of green inputs in India agricultural market is limited.

At global scale, AIMs comprises only 4 % of the plant protectants; however, the last two decades has seen a steady increase in its growth rate. Worldwide production and distribution of AIMs has increased manifold. The global market for AIMs was valued at $1,796.56 million in 2013 and is expected to reach $4,369.88 million by 2019, growing at a CAGR of 16.0% from 2013 to 2019. Globally, approximately 1,400 biopesticide products are available in market and the major producers and consumer of biopesticides are the North American Free Trade Agreement (NAFTA) countries. A market study reported that USA, Mexico and Canada consume about 47 % of the biopesticides sold globally, while Asia with mere 5 % consumption is lagging behind. The positive impacts of biopesticides have failed to diffuse into

the Indian biopesticide market and consequently it is lagging behind, growing at a slow pace. According to a study, India's share of the global biopesticides market was approximately 2.89 % during 2005, which gradually increased to 4.5 % by 2012. Currently, over 970 Indian private companies are listed with registered AIMs products.

Around 170 organizations in 24 countries are engaged in commercial production of biofertilizers. In India total production of carrier base and liquid biofertilizers was 88029.30 and 6240.92 MT in 2015-16 and experienced manifold increase from last many financial years. Indian biofertilizer market had grown rapidly in the period FY09 to FY15, the production of biofertilizers in India had more than tripled during FY09- 15.

After numerous group discussions with different stakeholders of organic inputs (farmers, traders, Government officials, agricultural scientists, extension officers and NGO's) and taking into consideration their varied perspectives, few general recommendations or guidelines to enhance promotion and acceptance of green agriculture in India are suggested. In addition, to facilitate the diffusion of biopesticides and biofertilizers in Indian agricultural scenario, various national strategies have to be formulated with the foremost step being creation of extensive national database for agriculturally important microorganisms for empowering Agri-Graduates for Entrepreneurship development.

Chapter 3

Methodology

Data was collected from primary and secondary sources as per the proforma attached in annexure.

1. Target population and sample size to be covered

   The biopesticides and biofertilizers producing Government and private industry

   State and Central Universities/Research Institutes

2. Method of data collection

   Secondary data will be collected from Ministry of Agriculture and

   Universities/research institutes web page

   A team of experts which included PI and project staffs collected primary data from Agricultural Universities, CSIR Labs, ICAR Labs and other private and public sector organization engage in development of microbial technologies.

3. Sources of the data

   Central Insecticide Board and Registration Committee, Ministry of Agriculture, National Centre for Organic farming, Department of Fertilizer, Ministry of Chemicals and Fertilizer, GoI, Agricultural Universities, CSIR Labs, ICAR Labs.

4. Reference period of the data to be covered

   2018-20

5. Method of processing and analysing

The following parameters was analysed based on extensive survey:

- Salient features
- Performance results
- Impacts and benefits
- Cost
- Manufacturers
- Contact details (Inventor)
- IP details (if any)

Chapter 4

Detailed analysis of data

Private, public and cooperative units engaged for producing bioinoculants

As we know that the Indian government has drawn its considerations lately in comparison of developed country but had put big initiatives in collaboration with national institutes to look forth and contributes enhancement of biofertilizer productions. Indian biofertilizer market had grown rapidly in the recent past. The growth is expected to continue in future owing to the strong push by the Government of India (GoI) to promote bio-agriculture. Maharashtra is having highest no. of companies (64) followed by Gujarat (56) and lowest in Tripura (01) as shown in Fig. 1.

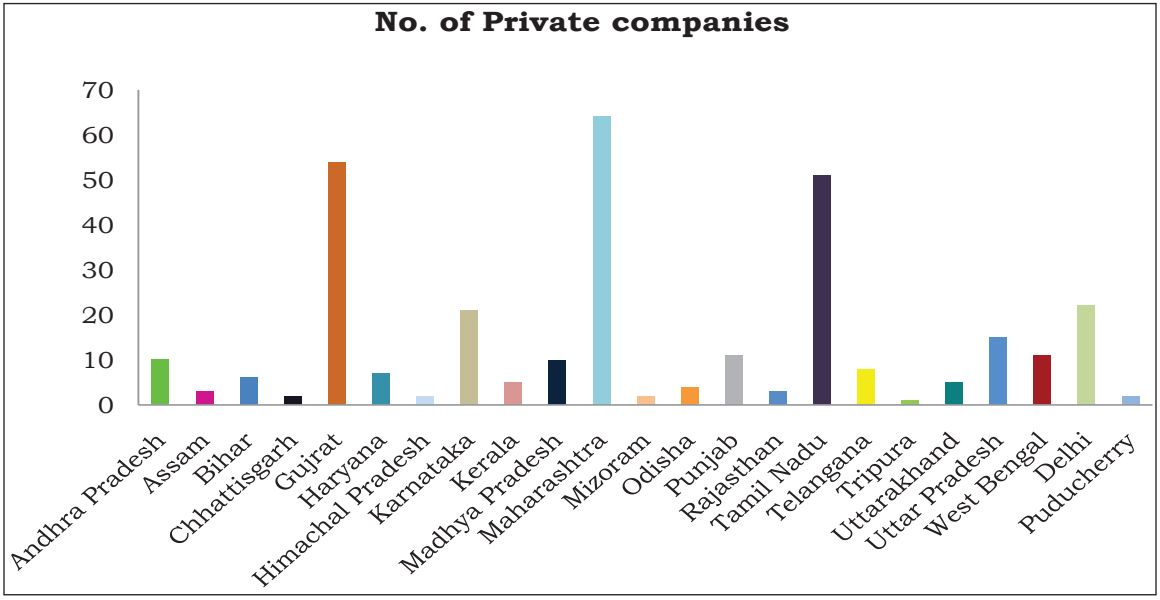

Fig. 1: Number of Private companies engaged for producing bioinoculants in different states of India

Number of private companies engaged for producing bio fertilizers in different states of India revealed that Tamil Nadu have the highest number of public sector companies (7) and Delhi is having largest number of co-operative units (3) as indicated in Fig. 2. Information with reference to establishment year, founder, commercial production and formulations, products, number of employee, address, market chain and turn over of each units have been presented in a separate enchiridion (Appendix 1).

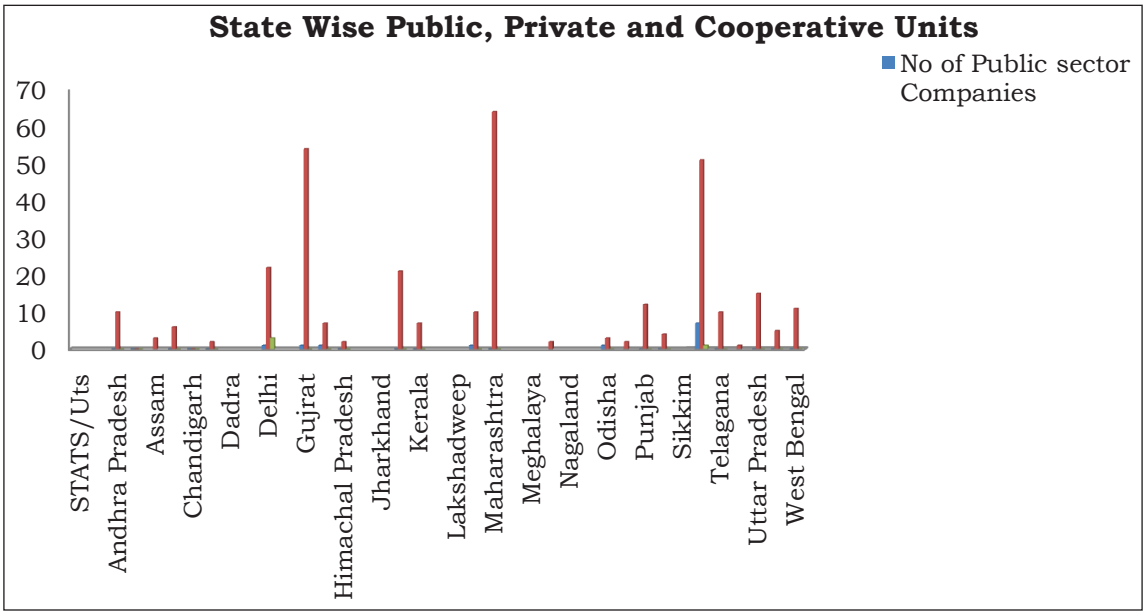

Fig. 2: State wise public, private cooperative bioinoculants units in India

Bioinoculant production

Inoculant wise biofertilizer production (carrier base) (MT) in different State/UT of India have been presented in Table 1 and Fig 3. The total production of solid formulation estimated to be 1,19,156 MT where as the use of liquid formulation estimated to 1433.92 lac liter per annum. The graph represents the highest production of Bio-fertilizer in Delhi (Liquid-588.21 Lakh Liter/year, Solid-77846.5 tonn/year), lowest was observed in Tripura (Liquid-0.2 Lakh Liter/year, solid-28 tonn/year). Total outlay of the business is estimated to be around 32,481.1 crores. From the Table 1 and Fig 3 it is evident that total number of technical persons involved in the business estimated to be around 12,074.

Table 1: Estimated production, turnover and number of personnel involved in bioinoculant industry

Sl. No.	States	Turnover (Crore)	Number of Employers	Production (Powder) Tonne/year	Production (Liquid) Lakh Lts/year
1	Bihar	33	177	372	5.553
2	Assam	7.25	60	41	0.06525
3	Puducherry	8	36	50	0.085
4	Tripura	2	11	28	0.022
5	Rajasthan	80	126	574	11.276
6	Delhi	16397.29	753	77846.5	588.2102
7	Haryana	1188.5	1258	792.5	121.09
8	Punjab	616.05	302	606.5	38.106
9	Tamil Nadu	6591.97	775	6519	129.267
10	Gujarat	1422.25	2371	17339.5	142.783
11	West Bengal	54.4	222	386	4.734
12	Odisha	11.25	44	45.5	0.1605
13	Telangana	1043.85	1289	1490.7	37.716
14	Andhra Pradesh	1017.25	281	912.5	20.93
15	Karnataka	111	469	1185.5	24.2895
16	Uttar Pradesh	645.25	855	1153	22.3887
17	Chhattisgarh	35	151	200	2.75
18	Madhya Pradesh	67.5	255	308	2.44
19	Uttarakhand	107	170	204	3.319
20	Himachal Pradesh	1.25	20	18	0.032
21	Kerala	32	156	151.5	1.587
22	Maharashtra	3009	2293	8932	277.1175
23	Total	32481.1	12074	119156	1433.92

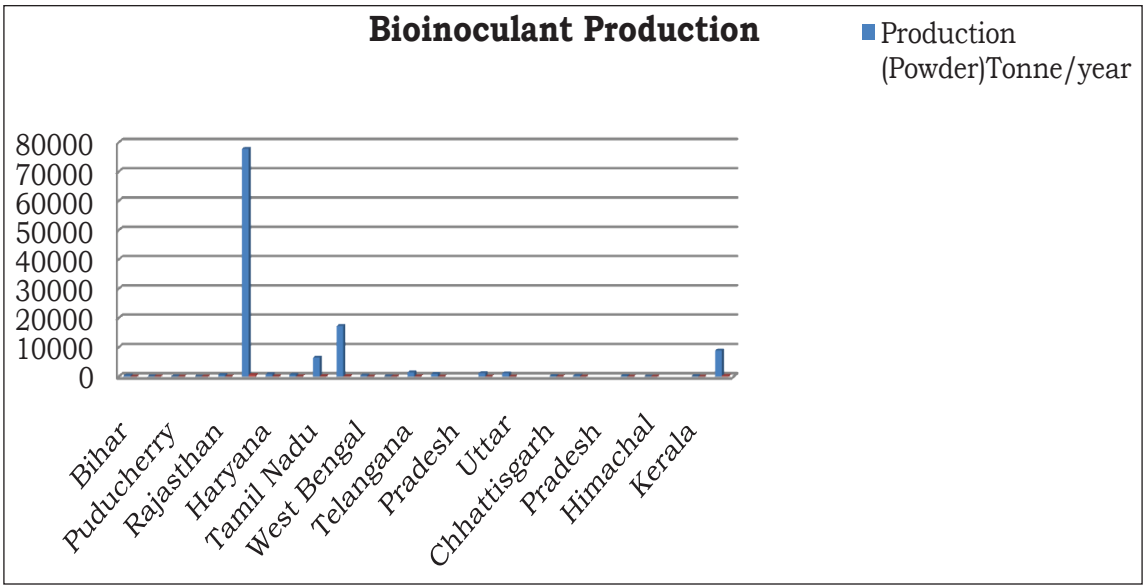

Fig. 3: Bioinoculant production in India

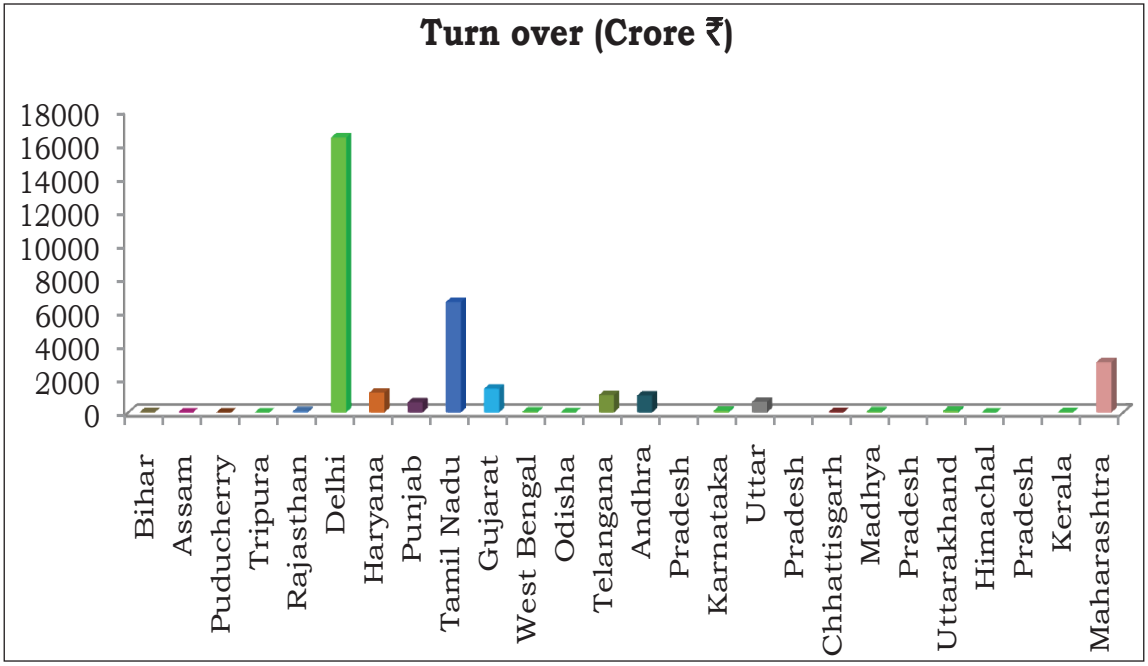

Fig. 4: Turn over with regards Bioinoculants production in India

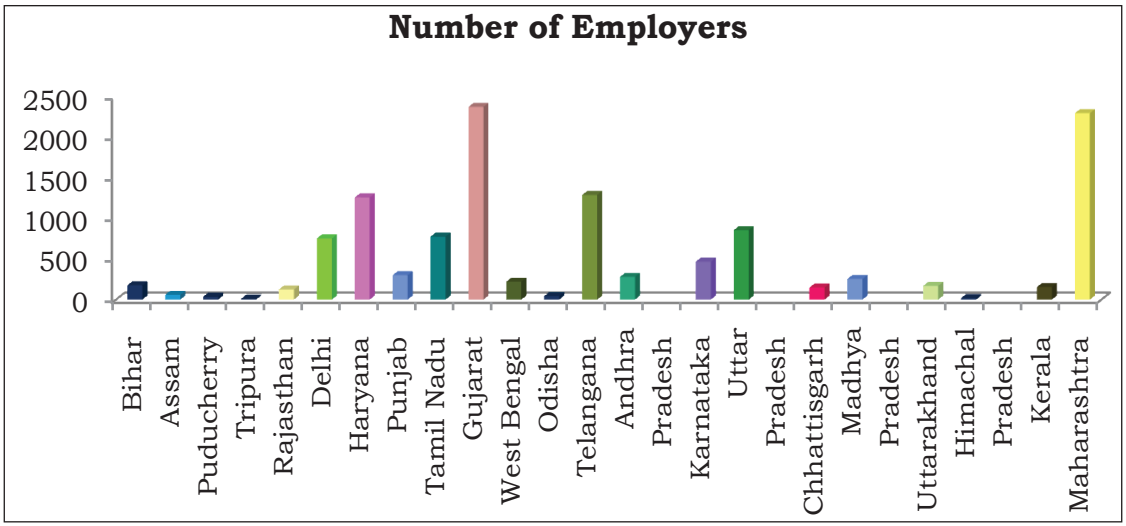

Fig. 5: Number of Employers associated with Bioinoculants production in India

Bioinoculants Commercialized

The government of India is very proactive in cause of taking actions against the miserable conditions of agriculture sector. It has been always in the attention of the government officials to look after the fertility of soil and its health. Government of India has been implementing the scheme for the promotion of biofertilizers since 7th Five Year Plan. Under this scheme, one national centre - NCOF and six regional centres RCOFs have been established. In 1988, under full grant-in-aid of Govt. of India OAIC (Odisha Agro Industries Corporation Limited) a Govt. of Odisha undertaking set up a bio-fertilizer production unit at Laxmisagar, Bhubaneswar. Since then the unit has been processing quality bio-fertilizers namely Rhizobium Culture, P.S.B., Azotobactor, Azospirrilum, Potash Mobilizing Bacteria (KMB) Trichoderma for compost production.

From the survey pertaining to technology commercialization process of different bioinoculants have also been studied through in-depth interviews with senior management of the organization. Factors influencing technology commercialization process are also namely customized infrastructure, infrastructure accessibility, and government intervention. This information will help organizations, entrepreneurs, and policy makers to devise strategies and policies respectively to enhance bio-fertilizer commercialization in India. The Fig. 6 shows that the

highest number of bioinoculants commercialized was observed in PSB fallowed by Azotobacter, Rhizobium etc., lowest was the Pseudomonas.

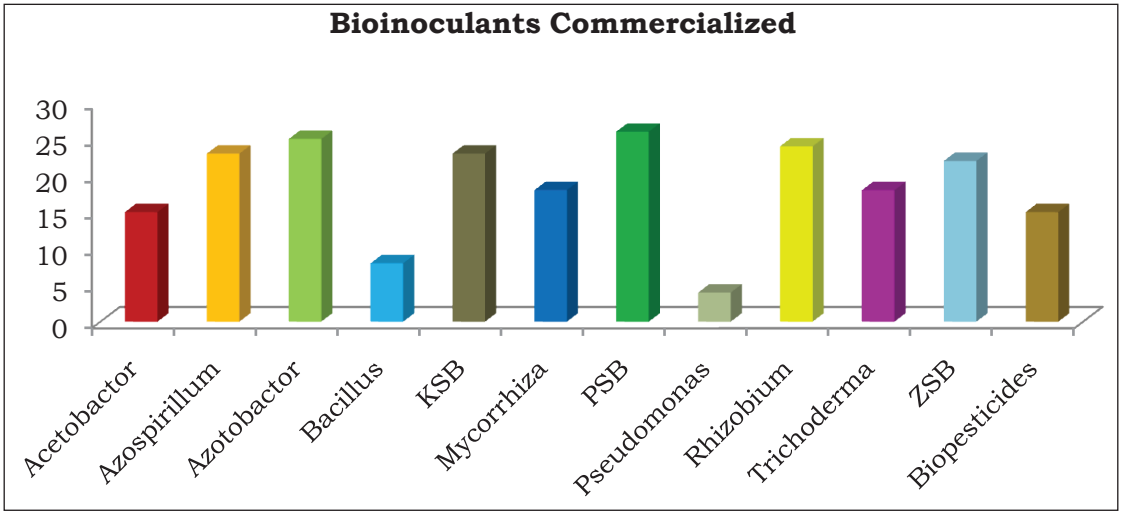

Fig. 6: Bio-inoculants commercialized in India

Incubation Centers related to bioinoculant

Looking at the present perspective and growing awareness for organic farming initiative for restoring natural resource base authenticated inventorisation is key. The total number of units involved in technology making and its legitimations, their product's, productions and productivity, their demand in present and need in future, development of initiatives, startups and entrepreneurships their availability of resources as well-warrant digitization. Although efforts have been started from seventh five year plan but taking advantage of proactive government set up it has been observed that there is a steady revival and fresh initiative in this sector with reference to incubation centres. The Fig. 7 represents the highest number of incubation centers observed in Telangana and then followed by Tamil Nadu, Gujarat etc., lowest was observed in North eastern states of India. An enchiridion has been prepared (Appendix 2) for the startups in bioinoculant sector with a special emphasis on establishment year, founder, commercial production and formulations, products, number of employee, address, mentoring institute ,market chain and turn over. A total of twenty seven active startups has been created across the country with maximum number in Karnataka.

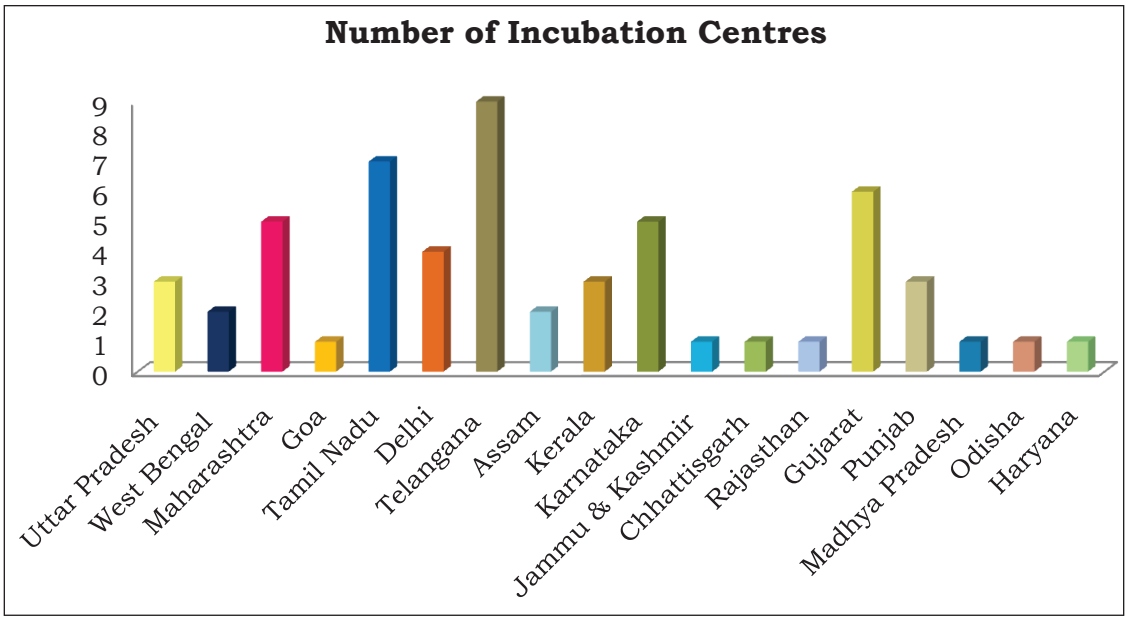

Fig. 7: Number of incubation centers in India

Popular green technologies

Green technology is an approach to agricultural development that aims to increase agricultural productivity, improve resilience and reduce vulnerability to climate change and reduce green house gas emissions. Green technology basically helps to manage and recycle waste material. A lot of recyclable material has allowed individuals to create biofertiliser, biopesticide, compost and growth regulators in different agro ecologies based on the locally available resources. An enchiridion has been prepared (Appendix 3) for available and feasible popular green technologies in different agro ecologies of the country with reference to innovator, technology, protocol and outcome.

Web Portal (Compendium) Development

The web portal development has been initiated from June 2020. It is an info graphic presentation in the form of a compendium. It has been designed and generated in a user friendly texture to significantly display the goal of making availability of information about agri-prenurship of agriculturally important microorganisms. Further, the web portal has been developed in .Net framework

which consists of #C coding and the design has been programmed under HTML, CSS and JS. The web portal has been named as Green Microbial Technology for Agriculture: Novel bioinoculant solutions which also contains a sub-heading as Bioinoculant use in Agriculture: Taking India towards evergreen revolution. The domain name is proposed as www.agrigreentech.in.

Stages in Development Process

1. Sitemap, Wireframe and Content Creation

The portal comprises of six tabs namely Home, Aboutus, Bio Inventory, Green Technology, Multilingual Bioresources and Schemes. These tabs or pages have their own menus likewise:

1. Home page consists of upper navigation menu which shows home icon, contact, gallery etc., banner, portal name, quick links like green technology invention videos and footer containing location, feedback option, visitor counts etc.
2. About u1. Commercialized Bioinoculant Technologies consist of the introductory information about the web portal.
3. Bio Inventory have menu which comprises of six different detailed bioinoculant related inventories named as Commercialized Bioinoculant Technologies, Manufacturing Units, start-ups and lists of universities and institutes of ICAR and Incubation centres.
4. Green Technology comprises of Popular Green technology in different agroecology and green technology invention videos.
5. Multilingual Bioresources contains bioinoculant's informationsin different aspects in eleven different languages of India.
6. Schemes provides the links for different governmental schemes for bioinoculants running in India.

2. Testing and Finalizing of Contents

After content creation combine manual browsing of the site on devices like computers, mobiles etc. has been done for testing to identify everything from user experience issues to simple broken links. It is performed with automated site crawler.

3. Launch: Once everything's has been found working perfectly, launching has done keeping in mind about planning both launch timing and communication strategies.

Chapter 5

Results and Discussion

Based on the extensive survey through personal visit/electronic follow up / telephonic query an exhaustive list was prepared for private industries, State and Central Universities/Research Institutes engaged in producing biofertilizers in different states of India with reference to attributes like establishment details, production technology, specifications, quality control measures, IP protection and marketing channels.

The analysis of the national scenario shows that the biofertiliser sector in agriculture has the potential to propel economic growth and accelerates socio-economic development in an economy. Biofertiliser sector is important for various spheres of economy such as skill development, innovations and technology transfer, promotion of entrepreneurship and start-ups, among others.

Biofertiliser industry is at a very nascent stage, though some improvement has been observed of late, one of the biggest bottleneck in the country has been the absence of vibrant quality control monitoring.

The analysis reveal that the industries entering into strategic alliances (linkages) and collaborations with the universities and research institute in few states (Karnataka, Maharashtra, Tamil Nadu, Gujarat) at an accelerating rate compared to rest of India to sustain in the market as per the changing needs at ground level.

It is observed from the study that there is a large number public owned (fifty five) of incubation centres across the states but their research activities are not associated with industrial clusters *vis-à-vis* non availability of industrial cluster to conduct research in the respective biofertiliser sectors.

We looked into emerging green technologies and up-and-coming startups working on solutions for the agriculture sector. As there is a large number of startups working on a wide variety of solutions including promising biofertilizer solutions.

The present study focuses on studying the fourty three cost effective and efficient green technologies involving AIMs in all States of India based on parameters such as availability of raw material, economic feasibility, crop coverage, environmental perspective, patents gained and continuity of research activities in that technology.

The present study focuses on studying the various cost effective and efficient green technologies involving AIMs in all States of India based on parameters such as availability of raw material, economic feasibility, crop coverage, environmental perspective, patents gained and continuity of research activities in that technology. The objective of the study is to entail competitiveness of the technology showcased by different players. This study will be useful to enhance the growth and competitiveness of our industries. This will facilitate Make in India programme of the Government to provide fruitful results as well as create synergies between Industry and Academia/research institutes to create more and more employment opportunities in the economy.

Further analysis is conducted on biofertiliser industry to employment scenario in the country through variables such as involvement of technical and nontechnical personnel, working on gaining patents, students' internship, providing specific solutions to Government to know if it influences level of placement as well as employment generation. The results indicate that few industries (around 8%) that are in consultation in setting pedagogy; gaining patents have significant impact on placement level.

A web portal i.e., Green microbial technology for agriculture (www.agrigreentech.in) has been completed and launched.

Chapter 6

Findings/Summary and Recommendations

The analysis of the national scenario shows that the biofertiliser sector in agriculture has the potential to propel economic growth and accelerates socio-economic development in an economy. Biofertiliser sector is important for various spheres of economy such as skill development, innovations and technology transfer, promotion of entrepreneurship and start-ups, among others.

In the present project, we have identified region specific relevant solutions and were chosen based on a data-driven startup scouting approach, taking into account factors such as location, founding year, and technology among others.

An informative database compiled for accumulating more essential information on biopesticides and biofertilizers commercialization on single platform. It will also help in achieving the goals of Digital India scheme which is a flagship programme run by Government of India with a vision to transform India into a digitally empowered society and knowledge economy and by providing universally accessible digital resources and services in Indian languages.

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Research Summary

Inventorization of Agriculturally Important Microorganisms for Catalyzing Agri-Prenurship. 2019-2021, by Amitava Rakshit. Banaras Hindu University, Varanasi. 2021

This work provides an inventorization and progress of bioinoculant industry using AIMs through quantitative and qualitative analysis. The study also brings out strong and weak areas of research, quantity and quality of output, and dynamics of agriculturally important microorganism across public, private and cooperative institutions, geographical regions covering diversified agro ecological regions of India. This project is mainly focused on the gathering of the information and presents them at single platform. This project will strengthen the idea of 'Skill India' which conceptualizes on providing a collaboration platform to help empower the all stakeholders to freely connect with each other. The overall focus of this initiative is to help provide an engaging ecosystem to cater to skilling needs of citizens by publishing and sharing relevant information. The outcome of this initiative will lead to inclusive growth especially for the budding entrepreneurships. The portal attempts to disseminate reliable information and by providing an interface to enquire, explore, and access and engage with various affiliated and accredited institutions, infrastructure providers, understand skill options, opportunities, information on various providers, reliable and credible digital content. It will also help in achieving the goals of Digital India scheme which is a flagship programme run by Government of India with a vision to transform India into a digitally empowered society and knowledge economy and by providing universally accessible digital resources and services in Indian languages. The study also includes analysis on biofertiliser industry to employment scenario in the country through variables such as involvement of technical and nontechnical personnel, working on gaining patents, students' internship, providing specific solutions to Government to know if it influences level of placement as well as employment generation. The results indicate that few industries (around 8%) that are in consultation in setting pedagogy; gaining patents have significant impact on placement level.

End project deliverables

- Identification of eighty commercialized bioinoculant technologies from ICAR,CSIR and SAU systems.
- Identification of three hundred nineteen public, private and cooperative enterprises involved in bioinoculant production.
- Identification of twenty seven start ups involved in bioinoculant production. Identification and inventorisation of fourty three cost effective and efficient green technologies involving AIMs.
- Compiled more than one hundred fifty multilingual bio resources in eleven languages and seventy three green technology related videos in ten national languages.
- A web portal i.e., Green microbial technology for agriculture (www.agrigreentech.in).

How the outcome of this project will be beneficial to various stakeholders

The outcome of this initiative will ideally lead to inclusive growth especially for the budding entrepreneurships. The portal has attempted to disseminate reliable information and by providing an interface to enquire, explore, and access and engage with various affiliated and accredited institutions, infrastructure providers, understand skill options, opportunities, information on various providers, reliable and credible digital content. It will also help in achieving the goals of Digital India scheme which is a flagship programme run by Government of India with a vision to transform India into a digitally empowered society and knowledge economy and by providing universally accessible digital resources and services in Indian languages.

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Annexure

काशी हिन्दू विश्वविद्यालय

BANARAS HINDU UNIVERSITY

सत्यमेव जयते
Department of Science and Technology
Ministry of Science and Technology
Government of India

PROFORMA I

PART A

Project title: "**Inventorization of Agriculturally Important Microorganisms for Catalyzing Agri-Prenurship**"

Principle Investigator: **Dr. Amitava Rakshit (M-21/201)**

Name of Company	
Year of establishment	
Head/Contact Person	
Contact Number	
Address	
Web address	
Email address	

PART B

Name Bioinoculant	Name of Strain	Name of product	Technology/ Protocol used	Production of Formulations	
				Solid (MT)	Liquid (KL)

काशी हिन्दू विश्वविद्यालय

BANARAS HINDU UNIVERSITY

सत्यमेव जयते
Department of Science and Technology
Ministry of Science and Technology
Government of India

PROFORMA II

PART A

Project title:" **Inventorization of Agriculturally Important Microorganisms for Catalyzing Agri-Prenurship**"

Principle Investigator: **Dr. Amitava Rakshit (M-21/201)**

Name of Company	
Year of establishment	
Head/Contact Person	
Contact Number	
Address	
Web address	
Email address	
Number of employees	Technical
	Non-technical
Technology received from	CSIR/ ICAR/Central University/State Agriculture University/Any other
Marketing channels	Northern India/Southern India/Eastern India/ Western India/Central India/SAARC

PART B

Name Bioinoculant	**Name of Strain**	**Name of product**	**Technology/Protocol use**	**Production of Formulations**	
				Solid (MT)	**Liquid (KL)**

NSTMIS Division

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About NSTMIS

The National Science and Technology Management Information System (NSTMIS), a division of Department of Science and Technology (DST) has been entrusted with the task of building the information base on a continuous basis on resources devoted to scientific and technological activities for policy planning in the country.

Citation:

The report may be cited as DST (2021): Report on Inventorization of Agriculturally Important Microorganisms for Catalyzing Agri-Prenurship; PI Amitava Rakshit, Department of Soil Science & Agricultural Chemistry, Institute of Agricultural Science, Banaras Hindu University, Varanasi, UP-221005.

Disclaimer:

Every care has been taken to provide the authenticated information. However, the onus of authenticity of data rests with the PI of the project.