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Approaches for New Product Development in Biotechnology: An Empirical Study on Problem Inventory Analysis

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ABSTRACT:

In biotechnology, Problem Inventory Analysis (PIA) is an essential tool for New Product Development (NPD), particularly in India's dynamic market. This method entails methodically recognising and classifying consumer problems in order to generate creative solutions. India's heterogeneous population and different geographical demands need for customised biotech solutions. In order to comprehend customer pain concerns across many industries, including agriculture, healthcare, and environmental biotechnology, PIA starts with comprehensive market research. Genetically engineered crops or environmentally friendly pesticides can be developed as a result of PIA highlighting problems in agriculture, such as decreased agricultural yields brought on by pests or illnesses. In the medical field, it can reveal gaps in accessible treatment options, spurring the development of more economical diagnostic instruments or vaccinations. By tackling pollution control and waste management concerns, environmental biotechnology can help spur the development of sustainable bioremediation approaches. It is imperative to focus on scalable, sustainable solutions, collaborate with regional research institutes, and take use of government programmes like Made in India.

Keywords: Problem Inventory Analysis (PIA), New Product Development (NPD), Biotechnology, Market research, Agriculture and healthcare, Environmental biotechnology.

1. Introduction

The utilisation of Problem Inventory Analysis (PIA) is a crucial strategy for biotechnology new product creation, especially in the diversified and rapidly evolving Indian market. Gupta et al. (2017) claim that because biotechnology has many uses, it is important to pinpoint the particular issues that various industries are facing. By methodically recognising and classifying these issues, PIA makes it easier to build focused solutions. PIA assists biotech businesses in developing products that effectively address local difficulties in India, a country where regional needs and challenges differ greatly. In order to identify customer pain concerns in industries including environmental biotechnology, healthcare, and agriculture, this approach starts with comprehensive market research. PIA can identify problems in agriculture, like as low crop yields brought on by pests or illnesses, which can lead to innovations like genetically modified crops or environmentally friendly pesticides.

Applications in healthcare may highlight gaps in accessible treatment alternatives, which could spur the creation of more cheap diagnostics or vaccines. In order to guarantee that novel solutions adhere to industry norms and legal requirements, Lorenz et al. (2019) claim that standardisation is essential at the nexus of product and process development in biotechnology. Sustainable bioremediation solutions can be developed through environmental biotechnology by tackling problems related to waste management and pollution control.

Another field in which PIA can have a big influence is environmental biotechnology. India has a lot of environmental issues to deal with, like waste management and pollution control. Biotech businesses can offer unique solutions such as sustainable bioremediation techniques and other creative alternatives to solve specific challenges identified by PIA. These solutions can be made even more successful through cooperation with regional research centres and the utilisation of government programmes like "Make in India." The significance of biotechnology literacy and stakeholder participation in the development process was underscored by Fırat et al. (2021). Biotech businesses may foster an innovation-friendly ecosystem by enhancing biotechnology literacy and engaging several stakeholders, such as government agencies, academic institutions, and industry partners. The Indian biotechnology industry will grow and flourish sustainably as a result of this collaborative strategy, which guarantees that the solutions generated are not only technically solid but also socially and economically viable.

2. Literature Review

Biotechnology companies use intricate methods and approaches to develop new products that produce inventive and sustainable results. Identifying and addressing possible problems early in the development process is made easier using the systematic procedure known as "Problem Inventory Analysis," which is one of the main approaches. In the Indian biotechnology industry, where innovation happens at a breakneck speed and strong risk management and product viability methods are essential, this approach helps. Sustainability in the advancement of biotechnology depends on "collaborating constructively" across many stakeholders, as stated by Matthews et al. (2019). India may make use of group knowledge to negotiate the challenging terrain of biotechnology product creation by encouraging collaboration between scientists, developers, and legislators.

Additionally, a key component of guaranteeing sustainability is including "Life Cycle Assessment" (LCA) into the framework for product creation. According to Frohling and Hiete (2020), thorough life cycle assessment (LCA) methods are required to assess the environmental

effects of biotechnological products from the point of manufacture to the point of disposal. LCA can assist in identifying and mitigating unfavourable ecological effects early in the development process, particularly in India, where environmental concerns are becoming more and more vital. By enabling businesses to produce goods that both satisfy consumer desires and environmental regulations, this strategy contributes to the larger objective of advancing sustainable industrial biotechnology.

One additional crucial component of biotechnology new product development is effective "Inventory Management for Consumable Materials". In order to save resources and cut expenses, Kadian and Jain (2016) emphasised the significance of effective consumable material management. Strong inventory management techniques can greatly improve the productivity of biotechnological processes, especially in the Indian environment where resource optimisation is essential. Companies may focus on innovation and quality while streamlining their processes by minimising surplus and guaranteeing materials are available when needed. Problem Inventory Analysis" is an essential method in the field of biotechnology, especially when devising new products for the Indian market, for spotting any problems. By using this approach, developers can proactively solve potential issues by methodically examining them as they may arise. Managing the "Microbial products supply chain," which is crucial for guaranteeing the availability of raw materials, is something Kumara Behera and Varma (2017) address about. To mitigate the impact of supply chain interruptions on production in India, a thorough "Problem Inventory Analysis" should be put in place to detect weak points and ensure a steady flow of microbial products required for biotechnological breakthroughs.

Utilising "Life-Cycle Analysis" (LCA) to evaluate a product's environmental impact is a crucial component of biotechnology's new product development process. Integrated biorefineries that produce both biofuels and bio-based chemicals should be evaluated for sustainability using Life Cycle Assessment (LCA), as noted by Cai et al. (2018). LCA can be used to identify potential environmental consequences early in the development process in India, where environmental sustainability is becoming a more important concern. This can be achieved by including LCA into the "Problem Inventory Analysis" framework. This strategy improves the marketability of biotechnology goods by decreasing harmful ecological effects and adhering to international sustainability requirements.

Furthermore, for biotechnology to optimise new product development, "Bioprocess Development-Based Modelling and Simulation" is a must. For the purpose of developing sustainable bioprocesses, Satish Kumar et al. (2022) stress the importance of modelling and simulation. These technologies allow Indian biotechnology businesses to anticipate possible production problems and adjust procedures by integrating them into the "Problem Inventory Analysis." Product development is made efficient and economical by this method, which allows problems to be identified and resolved before they become more serious. Innovation is crucial in a field that is changing quickly, like biotechnology, thus taking preemptive steps is essential to preserving competitive advantage.

Biotechnology approaches to the development of new products entail a variety of techniques and approaches, especially when it comes to "Problem Inventory Analysis" in India. The creation of comprehensive policies and the proactive involvement of "cluster agencies" are two essential strategies. In order to promote cooperation and invention, these laws and organisations, according to Vlaisavljevic et al. (2020), greatly aid in the growth of biotech open innovation ecosystems. The dynamics of "knowledge sharing" are another important factor.

Joshi (2018) underlined how crucial it is for stakeholders in the Indian biotechnology sector to collaborate and communicate effectively. Effective problem-solving and identification are crucial for accelerating the creation of novel biotechnological products. This can be achieved through the sharing of ideas and best practices.

Biotechnology development and policy must adopt an entrepreneurial mindset. To successfully negotiate the complicated biotechnology ecosystem, Baporikar (2017) emphasised the importance of entrepreneurial tactics. Companies may increase India's competitive edge by embracing an entrepreneurial attitude, which helps them spot rare opportunities, reduce risks, and create creative solutions to urgent issues. "Plant biotechnology" advancements provide insightful information about developing new products. The significance of incorporating state-of-the-art research into the product development process was underlined by Gahlawat et al. (2017) assessed the current advancements in plant biotechnology. A new product's innovativeness and relevance to the unique needs and issues of the Indian market are guaranteed when it adopts these improvements.

An extensive "problem inventory analysis" is the cornerstone of this process, according to Lokko et al. (2018), who emphasised the importance of inclusive and sustainable industrial growth. A thorough grasp of the environment in which they operate can be attained by stakeholders by methodically identifying opportunities and problems. Structured procedures are much more essential, as Khan's (2018) insights into biotechnology product development methodologies highlight. In defining the parameters and scope of innovation activities, "problem inventory analysis" is a crucial step. Researchers and business owners can identify areas ready for investigation and improvement by using this systematic review. Using the field of bio-entrepreneurship in the context of medical biotechnology, Sharma (2021) assessed on the discussion. It promotes a sophisticated awareness of market demands and technology gaps while highlighting the importance of "problem inventory analysis" in the starting, managing, and leading of innovative technologies. Bio entrepreneurs can successfully negotiate the challenging terrain of biotechnology product creation by carefully evaluating the problems at hand. This allows them to ensure that the solutions they provide are both novel and critically needed by society.

Objective

1.To know different Approaches for New Product Development through Biotechnology in medical field, healthcare, environment and agriculture sector.

2. Methodology

226 people from production division in biotechnology sector to know the Approaches for New Product Development in Biotechnology. “Random sampling method” and “Factor Analysis” were used to collect and analyze the data.

Findings

Total 226 people were surveyed in which male are 39.4% and 60.6% are female. Among them 31.4% are below 35 years of age, 41.1% are between 35-45 years of age and rest 27.4% are above 45 years of age. 31.0% are having the work experience of less than 5 years, 42.9% are working in their field from last 5-10 years and rest 26.1% are having the work experience of more than 10 years.

Table 1 General Details

"Variables"	**"Respondents"**	**"Percentage"**
Gender		
Male	89	39.4
Female	137	60.6
Total	**226**	**100**
Age (years)		
Below 35	71	31.4
35-45	93	41.1
Above 45	62	27.4
Total	**226**	**100**
Work experience (Years)		
Less than 5	70	31.0
5-10	97	42.9
More than 10	59	26.1
Total	**226**	**100**

Table 2 "KMO and Bartlett's Test"

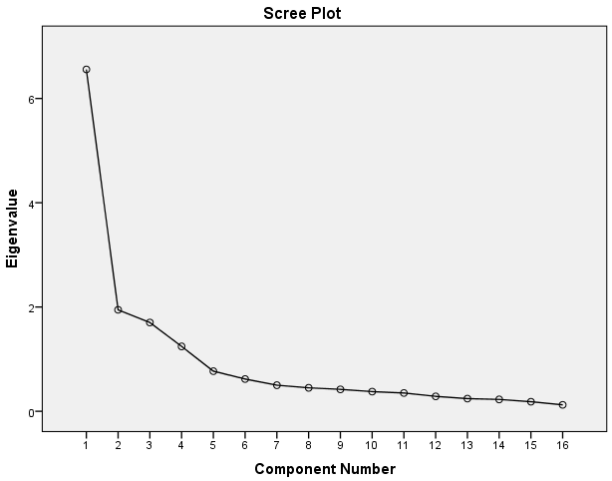
"Kaiser-Meyer-Olkin Measure of Sampling Adequacy"		.855
"Bartlett's Test of Sphericity"	Approx. Chi-Square	2135.670
	df	120
	Sig.	.000

In the table above KMO value is 0.855 and the "Barlett's Test of Sphericity" is significant.

"Table 3 Total Variance Explained"

"Component"	**"Initial Eigen values"**			**"Rotation Sums of Squared Loadings"**		
	"Total"	**"% of Variance"**	**"Cumulative %"**	**"Total"**	**"% of Variance"**	**"Cumulative %"**
1	6.557	40.983	40.983	3.218	**20.111**	20.111
2	1.946	12.162	53.145	2.843	**17.768**	37.878
3	1.703	10.642	63.787	2.817	**17.606**	55.484
4	1.244	7.775	71.562	2.572	**16.077**	**71.562**
5	.769	4.807	76.369			
6	.618	3.865	80.233			
7	.500	3.127	83.360			
8	.450	2.812	86.173			
9	.420	2.628	88.801			
10	.377	2.357	91.158			
11	.350	2.189	93.347			
12	.287	1.791	95.138			
13	.244	1.522	96.660			
14	.228	1.423	98.083			
15	.183	1.147	99.230			
16	.123	.770	100.000			

The "principal component analysis" method was applied to extract the factors and it was found that 16 variables form 4 Factors. The factors explained the variance of 20.111%, 17.768%, 17.606% and 16.077% respectively. The total variance explained is 71.562%.



"Table 4 Rotated Component Matrix"

"S. No."	**"Statements"**	**"Factor Loading"**	**"Factor Reliability"**
	Medical field		**.881**
1	Encourage the development of more economical diagnostic instruments or vaccinations	.859	
2	Identify gaps in existing medical treatments, devices, and technologies	.835	
3	Incorporate user-centered design principles	.794	
4	Continuously improve the product based on real-world data and feedback	.786	
	Environment		**.831**
5	Develop biological solutions for cleaning up pollutants in air, water, and soil using microorganisms	.870	
6	Sustainable bioremediation techniques and other creative alternatives to solve specific challenges	.819	
7	Identify resource depletion, and climate change impacts	.779	
8	Engineer microbes to break down organic pollutants or plastics into harmless by-products	.581	
	Healthcare sector		**.869**
9	Utilize biological insights and advancements like genomics, proteomics, cellular therapies	.836	
10	Facilitate brainstorming sessions with interdisciplinary teams like scientists, clinicians, engineers	.810	
11	Adhere to Good Clinical Practice (GCP) guidelines and regulatory standards	.774	
12	Form strategic partnerships with biotechnology companies, pharmaceutical firms, and healthcare providers	.763	
	Agriculture		**.809**

13	Identify key challenges like pest and disease management, drought tolerance, nutrient efficiency	.769	
14	Engage with farmers, agricultural experts, policymakers, and environmental organizations	.763	
15	Utilize genetic engineering techniques to introduce desirable traits into crops	.720	
16	Scale up seed production of genetically engineered crops	.690	

Table 4 is showing different approaches for New Product Development in Biotechnology. In medical field it is important Encourage the development of more economical diagnostic instruments or vaccinations, identify gaps in existing medical treatments, devices, and technologies, incorporate user-centered design principles and continuously improve the product based on real-world data and feedback. For Environment, it is important to develop biological solutions for cleaning up pollutants in air, water, and soil using microorganisms, Sustainable bioremediation techniques and other creative alternatives to solve specific challenges, identify resource depletion, and climate change impacts and Engineer microbes to break down organic pollutants or plastics into harmless by-products. In Healthcare sector, it is good to utilize biological insights and advancements like genomics, proteomics, cellular therapies, facilitate brainstorming sessions with interdisciplinary teams like scientists, clinicians, engineers, adhere to Good Clinical Practice (GCP) guidelines and regulatory standards and form strategic partnerships with biotechnology companies, pharmaceutical firms, and healthcare providers. In Agriculture sector, identify key challenges like pest and disease management, drought tolerance, nutrient efficiency, engage with farmers, agricultural experts, policymakers, and environmental organizations, utilize genetic engineering techniques to introduce desirable traits into crops and scale up seed production of genetically engineered crops.

“Table 5 Reliability Statistics”

“Cronbach's Alpha”	“N of Items”
.900	16

The reliability for 4 constructs with total of sixteen elements is 0.900.

3. Conclusion

In summary, a critical phase in the New Product Development (NPD) process for the biotechnology industry in India is the completion of a Problem Inventory Analysis (PIA). With this method, opportunities and obstacles related to the creation and marketing of novel biotechnological products can be systematically identified, categorised, and prioritised. By means of PIA, interested parties acquire significant understanding regarding the current state of the industry, regulatory framework, technological constraints, and customer requirements unique to the biotechnology sector in India. Biotechnology companies can increase their chances of success by tailoring their new product development (NPD) strategies to the specific needs of the Indian market by knowing these elements in-depth. Beyond that, PIA makes it easier to find unmet requirements and niches in the biotechnology environment, which allows companies to concentrate their resources and efforts on creating solutions that close important gaps in the market. This focused strategy boosts innovation and differentiation in a market that is changing quickly, as well as the competitiveness and relevance of new biotechnology products. Problem Inventory Analysis is fundamental to the successful implementation of New

Product Development (NPD) in the Indian biotechnology industry. It helps companies to manage risks, take advantage of opportunities, and negotiate difficult situations in a competitive and ever-changing market. Adopting this strategy encourages sustainable growth driven by innovation, which eventually produces favourable results for companies and society as a whole.

The study was conducted to know different Approaches for New Product Development through Biotechnology in medical field, healthcare, environment and agriculture sector and found that in medical field it is important Encourage the development of more economical diagnostic instruments or vaccinations, for Environment, it is important to develop biological solutions for cleaning up pollutants in air, water, and soil using microorganisms. In Healthcare sector, it is good to utilize biological insights and advancements like genomics, proteomics, cellular therapies and in Agriculture sector, identify key challenges like pest and disease management, drought tolerance, nutrient efficiency,

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