

BUILDING INCLUSIVE AGRICULTURE TECHNOLOGIES

A Collaborative Approach between **Industry and Academia** for empowering Smallholder Farmers

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This article encapsulates a talk delivered by Kirti Mishra at GIET University, Odisha, which delved into the realm of inclusive technologies within the agriculture sector. The discourse combined theoretical underpinnings of inclusive technologies with a real-world case of AgroNXT a prominent agtech enterprise. By intertwining academic concepts with practical applications, the talk aimed to provide a holistic understanding of the subject matter.

It's an honour to be here today to discuss the critical role of inclusive technologies in addressing India's pressing agricultural challenges. My talk will focus on three key areas:

1. **Defining Inclusive Technologies:**
I will provide a clear understanding of what constitutes an inclusive technology and its importance in the Indian context.
2. **Academia-Industry Collaboration:**
I will explore how partnerships between academia and industry can accelerate the development and adoption of inclusive technologies.
3. **Integrated Solutions for Farmers:**
I will present a vision for a holistic approach to technology adoption, emphasizing the need for integrated solutions that address farmers' multiple challenges.

Defining Inclusive Technologies

Let's begin by understanding what constitutes an inclusive technology. Essentially, it's a technological innovation designed to benefit the masses, particularly those at the bottom of the pyramid. To qualify as inclusive, a technology must exhibit seven key characteristics:

1. **Mass applicability:** An inclusive technology should be accessible to a large population, especially in rural areas. It must address the specific needs of these communities, being affordable, easy to use, and relevant to their challenges. Ultimately, the technology should improve the lives of many, bridging the digital divide.
2. **Low cost:** For a technology to truly be inclusive, it must be accessible to a broad spectrum of users, particularly those in economically disadvantaged communities. This necessitates a low cost structure. Affordability is paramount for widespread adoption as it ensures that the technology can be integrated into the daily lives of those it aims to serve without imposing a significant financial burden. A technology that is too expensive will inevitably limit its impact and reach, defeating the purpose of inclusivity.
3. **Ease of operation:** Inclusive technologies must be user-friendly. Simple interfaces, minimal training, and error tolerance are crucial for broad accessibility.

4. **Robustness:** Inclusive technologies must be rugged and durable to withstand harsh conditions. They should resist extreme weather, rough handling, power fluctuations, and be made from high-quality materials. A long lifespan minimizes maintenance and environmental impact.
5. **Women-friendly:** Inclusive technologies should be designed with women's specific needs in mind. Key considerations include addressing the gender digital divide, incorporating women's perspectives, prioritizing safety and security, ensuring accessibility, supporting economic empowerment, and creating time-saving solutions. By focusing on these areas, technology can be a powerful tool for women's empowerment.
6. **Eco-friendly:** Sustainability is crucial for inclusive agtech. It safeguards the environment, conserves resources, mitigates climate change, protects biodiversity, and prioritizes social responsibility.
7. **Solving a societal problem:** Inclusive agri-tech should tackle specific societal challenges like food security, farmer livelihoods, environmental sustainability, rural development, and gender equality. By focusing on these issues, agri-tech can create a tangible impact on society, going beyond technological advancement.

Inclusive technologies must not only address the needs of underserved communities but also demonstrate scalability and market viability to ensure sustained impact. To achieve this, industries must focus on:

8. **Scalability:** Developing business models that enable rapid expansion and replication of successful interventions. This involves identifying cost-effective production methods, efficient distribution channels, and adaptable technologies.
9. **Market Creation:** Conducting thorough market research to understand the needs and preferences of target customers. Building strong distribution networks and creating effective marketing strategies to reach a wider audience.

AgroNxt:

An emerging case on developing inclusive innovation through a collaborative approach



PART A

Rajat Vardhan's journey with AgroNxt exemplifies the power of academia-industry collaboration in driving inclusive technological solutions for agriculture. Recognizing the critical role of soil health in sustainable agriculture, Rajat identified a significant gap in the market: the inaccessibility of affordable soil testing services to smallholder farmers.



India boasts millions of farmers cultivating millions of hectares of land, yet the country possesses only around 3,800 soil testing labs. This stark disparity, coupled with the high cost of soil testing, severely limits farmers' ability to make informed decisions about their crops.

With a strong foundation in agriculture from GB Pant University of Agriculture and Technology, Pantnagar and a decade of corporate experience, Rajat established AgroNxt to address this challenge. His goal was to develop a user-friendly, affordable, and robust soil testing solution that is both gender-inclusive and environmentally friendly. AgroNxt's innovation lies in creating a machine that can be operated by individuals with basic literacy skills, making soil testing accessible to a wider audience, including women farmers. The machine's rugged design ensures its durability in challenging rural environments.

Furthermore, AgroNxt has prioritized gender inclusivity by designing the machine to be physically manageable by women farmers. The company has also incorporated features to address the specific needs of women, such as ergonomic

By prioritizing scalability and market viability, industries can contribute to the widespread adoption of inclusive technologies and create a sustainable ecosystem for innovation and social impact.

Now, let's delve into the pressing issues facing Indian agriculture, which underscores the urgent need for inclusive technologies.

- **Small and Marginal Holdings:** An overwhelming 85% of our farmers own less than two hectares of land, making them particularly vulnerable to economic shocks and climate change.
- **Soil Degradation:** Decades of intensive agriculture have led to severe soil health issues, reducing yields and farmer incomes.
- **Water Scarcity:** The increasing demand for water coupled with erratic rainfall patterns has put immense pressure on our water resources.
- **Climate Change:** Unpredictable weather patterns, including extreme events like droughts and floods, pose significant risks to agricultural livelihoods.

Inclusive technologies can revolutionize agriculture by enhancing efficiency, expanding market access, promoting sustainability, and empowering farmers, inclusive technologies can create a more productive, sustainable, and profitable agricultural sector. Precision agriculture, mechanization, and early warning systems boost productivity, while e-commerce, supply chain management, and value-added products expand market opportunities. Soil health monitoring, water management, and renewable energy foster sustainability, and financial inclusion, knowledge sharing, and risk management empower farmers.

Ultimately, these technologies can create a more productive, sustainable, and profitable agricultural sector, supporting land-based agriculture, livestock, aquaculture, and other sub-sectors with tailored solutions.

design and safety considerations. The machine's operation is simple and requires minimal training, making it accessible to women with limited technical skills.

In addition to being user-friendly and accessible, the AgroNxt machine is designed with environmental sustainability in mind. The machine is energy-efficient and minimizes waste generation. The machine is developed on NIR Spectroscopy & AI/ML, a patented technology that doesn't require chemical reagents in the testing process. By incorporating eco-friendly practices into its operations, AgroNxt contributes to sustainable agriculture.

By pricing soil tests below INR 100, AgroNxt has made this essential service affordable for smallholder farmers. The machine's cost-effectiveness ensures rapid breakeven, making the business model financially viable. AgroNxt's business model is further strengthened by its potential to be replicated through a network of rural entrepreneurs, who can offer soil testing services using the AgroNxt machine while earning their livelihood thus ceasing the rural migration.

■ FOSTERING INNOVATION: The Academia-Industry Partnership

To truly harness the potential of inclusive technologies, we must consider a broader ecosystem encompassing academia, industry (including startups), investors, and policymakers. While investors and policymakers are crucial, the core engine driving innovation lies in the strategic partnership between academia and industry.

This collaboration can be structured around seven key areas:

1. **Deepening Understanding of Farmer Needs:** By combining academia's rigorous research methodologies with industry's deep-rooted connections to farmers, we can gain invaluable insights into the challenges and aspirations of end-users. This shared understanding will inform the development of technologies that are truly relevant and impactful.
2. **Co-Creating Innovative Solutions:** Academia's expertise in fundamental research can be complemented by industry's focus on product development and commercialization. By working together, we can accelerate the process of bringing innovative solutions to market.

3. **Addressing Affordability and Acceptability:** Academia can contribute to cost-reduction strategies through research into low-cost materials and processes, while industry can focus on making technologies accessible and user-friendly. Together, we can ensure that inclusive technologies are both affordable and desirable for farmers.
4. **Building Capacity:** Academia can play a vital role in educating the next generation of innovators, while industry can provide practical training and skill development opportunities. By collaborating on capacity building initiatives, we can create a robust talent pipeline for the agritech sector.
5. **Influencing Policy:** Academia and industry can work together to advocate for policies that support the development and adoption of inclusive technologies. By sharing data, research findings, and industry perspectives, we can shape a regulatory environment that fosters innovation.
6. **Sharing Risks and Rewards:** Academia can contribute to de-risking technology development through proof-of-concept studies and early-stage validation. Industry can invest in commercialization and market expansion. By sharing risks and rewards, we can create a more sustainable and equitable innovation ecosystem.

By forging strong partnerships between academia and industry, we can create a virtuous cycle of innovation, leading to improved livelihoods for farmers and a more sustainable future for agriculture.

PART B

A crucial factor in AgroNxt's success has been its collaboration with IIT Kanpur. Over the past six years, the incubation center at IIT Kanpur has played a pivotal role in understanding farmer needs, iteratively developing the technology, and providing financial support. This partnership has been instrumental in transforming the initial concept into a commercially viable product. Started in 2016, AgroNxt got deep support by IIT Kanpur which has been instrumental in their success. IIT Kanpur not only provided financial support, they also extended laboratory support, access to faculty members, innovation showcase opportunities, connection with other Research and commercial institutions along with access to pool of IIT Kanpur students willing to work on deep research-based technologies contributing to making India a Product nation.

They have a team size of 24 members, with 16 members full time and 8 members in training roles. They plan to be 50-100 members team in next 6-12 months of time.

The ICAR validation and the IIT Kanpur support as shareholder have significantly enhanced AgroNxt's credibility, attracting investors and international recognition. The company has been acknowledged by UNESCAP for its inclusive business model and has received funding from the BMGF to expand its operations to Africa.

AgroNxt's success story underscores the importance of academia-industry collaboration in developing and scaling inclusive technologies. By addressing a critical need in the agricultural sector and creating a sustainable business model, AgroNxt has demonstrated the potential for significant social and economic impact.

They are now poised to launch more inclusive eco friendly and cutting edge research based technologies to contribute towards sustainable technology driven Agriculture.

Now I would like to offer a situation and challenge for the academician to think and build a larger solution. The proposition is described below.

Building Integrated Solutions in Agriculture – a partnership between academia and industry

Unlike other businesses, farming is a complex, multifaceted operation that demands constant adaptation. Farmers function as micro-entrepreneurs, juggling a myriad of challenges across the value chain, from season to season. Their success hinges on their ability to optimize a diverse set of inputs and outputs.

Traditionally, agtech startups have often focused on developing standalone solutions without considering the broader agricultural ecosystem. This approach overlooks the reality that farmers require integrated solutions that seamlessly fit into their existing operations. A farmer's decision to adopt a new technology is influenced by its compatibility with their current practices and its ability to address multiple challenges simultaneously.

Therefore, successful agtech solutions must be designed with a holistic perspective, considering how they interact with other farm inputs and outputs. This integrated approach will increase adoption rates and deliver greater value to farmers.

To address this gap, academic institutions can play a pivotal role in fostering collaboration among innovators. By working with a diverse group of technology developers, academic centres can create an ecosystem where individual solutions are developed with the ultimate goal of integration. This approach will enable the creation of comprehensive technology packages that cater to the diverse needs of farmers.

Key benefits of integrated solutions:

By providing a comprehensive suite of technologies, farmers can achieve greater efficiency, higher yields, and improved incomes, leading to a significant improvement in their overall quality of life. These integrated packages can accelerate adoption by offering a one-stop solution to multiple challenges. Furthermore, they can reduce the risk associated with relying on a single technology, enhancing farmers' resilience. By fostering collaboration among innovators, integrated solutions can drive innovation, leading to more effective and sustainable agricultural practices.

Academic institutions can facilitate this process by:

Identifying complementary technologies, fostering partnerships, conducting field trials, and building capacity are crucial steps in creating integrated solutions. By analyzing the agricultural landscape, universities can identify technologies that can be combined to create synergistic solutions. Fostering partnerships between innovators enables the sharing of knowledge and resources, leading to the development of more effective and efficient technologies. Conducting field trials allows for the evaluation of integrated technology packages in real-world conditions, providing valuable insights into their performance and impact. Building capacity through training and education programs ensures that farmers and extension workers have the skills and knowledge to effectively utilize and benefit from these integrated solutions.

By taking a systems-level approach to technology development and deployment, academic institutions can significantly contribute to the transformation of agriculture and the improvement of farmers' livelihoods.

Thank you all!

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