

The SatSure Newsletter

November - December 2020


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Examining the Agriculture Financing Sector in India

Arindom Datta

Strengthening an Innovation Agenda Through an Ecosystem Approach

Saswati Bora

The Explainability of Artificial Intelligence

Sanjutha Indrajit

Chinmay Shah

Smallsat and the Downstream Sector- a Volatile Relationship

Krishna Reddy

FOREWORD

The year 2020 will be remembered by our generation for a long, long time! Amidst personal losses and an unprecedented phase of lockdown, the world around us changed suddenly and then gradually - the exact opposite of how it would otherwise happen. As a bootstrapped startup, we had our challenges as well but emerged stronger than ever by the end of the year with 40% more workforce than pre-COVID times, two patents, one new product launch and market entry in three new international geographies. And while all of this was happening, the SatSure Newsletter (TSNL) continued being the independent platform it was envisioned. It continued to disseminate knowledge and opinions of experienced industry professionals on topics varying from the impact of COVID on various sectors, the small success stories of entrepreneurs, and the larger questions on climate impact, technology evolution, and financial inclusion.

This edition has four articles focussing on diverse topics such as agriculture financing, food ecosystem innovations, explainability of Artificial Intelligence (AI), and the evolution of the space industry value chain. The first article is an interview with Arindom Datta, Executive Director and Head of Rural & Development Banking/Advisory at Rabobank, the largest food and agriculture bank globally. He brings in his deep experience in the agriculture financial services sector to provide insights on how banks and other lending institutions responded post-COVID. He also talks about the paradigm of broken crop insurance products in India and south-east Asia that are failing farmers as climate change-related events become more frequent.

The second article is an interview with Saswati Bora, Head of Food Systems Innovation at the World Economic Forum (WEF). She shares about the work that the Forum is doing in building innovation ecosystems globally, the technologies that are being



piloted for addressing various challenges in the food chain, and the challenges faced in executing these pilot projects in a public-private partnership model. The third article in this year-end edition is written by two young individuals at SatSure, Sanjutha Indrajit and Chinmay Shah, on the explainability of AI and why it should matter to us. I feel very strongly on this subject as the term AI is being abused by everyone today. AI's expectations are inflated to such an extent that we are not willing to slow down to dig deep into it to evaluate the larger socio-economic impact it has.

The last article is written by Krishna Reddy, who is a space industry analyst and currently Innovation Officer at the Consulate General of the Kingdom of The Netherlands. He focuses on the volatile relationship between analytics companies that uses data from space and emerging startups that are developing small satellites to generate data from space cheaply. The wild card here, in my opinion, is AI. It bridges the supply-demand gap of a rapid Earth observation data thirsty market, fueled by post-COVID, and sluggish manufacturing and launch industry growth that is grappling with limited availability of high-risk capital and quick industry consolidation.

As an ending note, I would like to thank all our readers on behalf of SatSure, for the continued support. We are immensely proud of TSNL, and it indeed has emerged as an industry thought leadership content platform. In the year 2020, we all have gained some, lost some, and learnt a lot! I wish all our readers a happy and prosperous year ahead on behalf of Team SatSure and hope to continue providing exciting and unique content through TSNL in the new decade.

Prateep Basu

Prateep Basu
Founder, CEO
SatSure



Page 4

Examining the Agriculture Financing Sector in India

Arindom Datta

Page 16

Strengthening an Innovation Agenda Through an Ecosystem Approach

Saswati Bora

Page 25

The Explainability of Artificial Intelligence

Sanjutha Indrajit
Chinmay Shah

Page 31

Smallsat and the Downstream Sector- a Volatile Relationship

Krishna Reddy

Examining the Agriculture Financing Sector in India



A Conversation with Arindom Datta

Executive Director and Head of Rural & Development Banking/Advisory, Rabobank

Would like to start this conversation by understanding your views on how COVID-19 and the lockdowns in India have had an impact on the agriculture financing sector.

One of the winners, among various sectors, in terms of recovery post-COVID, is the agriculture sector. It has overall fared better than the other sectors – even if you look at the gross level. If you see it in terms of GDP, while in the last quarter, India's GDP went down by 24%, which is a record low, agriculture showed a 3% increase. It needs to do well because irrespective of what kind of disruption you have, the food needs to move and people need to eat. Farmers have grown their crops, and the product needs to move to the market. Despite this, we all know that there was

much disruption during the lockdown because goods and people could not move. So obviously there was a hit, especially at the micro-level and in specific sub-sectors in agriculture. The most significant impact was in the HoReCa (hotel, restaurant and catering) segment where the food supply chains were geared up differently and, there was more institutional buying of food. With the lockdown, suddenly the HoReCa segment came to an abrupt standstill, and there was a significant disruption.

Second disruption and impact were in the non-food agricultural produce like cotton. If you look at the end-users of cotton, i.e. the garment manufacturers primarily, the demand for this has changed drastically. Suddenly it wasn't essential any more, as there was a large stock existing in the market.



Could you share your perspective on the global as well as Asia Pacific region faring in terms of the agriculture financing sector, in terms of recovering post-COVID?

So far as financing is concerned, I believe overall India has done a great job. **A reason for this is because agriculture is a priority sector lending requirement, which is unique to India.** As it is a massive chunk of the balance sheet of any bank, whether you are a Public or Private sector bank, it needs

to go towards agriculture, and this has made financing stable in the Indian ecosystem.

Another reason is the pressure that is always there on policymakers, especially the government of India, to ensure that financing reaches out to the farmers. This pressure still exists and increases during a crisis. There were a series of meetings where the banks were coached that funding to the agriculture sector needs to continue. Many COVID schemes which came up were targeted towards SMEs, rural institutions,

MFIs, NBFCs and other segments which provide a huge chunk of capital to the agriculture sector.

This scale of disruption was something we had never seen earlier. There was uncertainty about the existing moratorium once the crisis period was over – in both the microfinance and agriculture sectors. Collections are still taking place, and we're unsure of how it is going, even though some institutions have done well.

Overall, so far, I believe we haven't seen any red flags, but I think we need to wait till the end of this year or the beginning of 2021 to see how collections have stabilized.

I can say that, overall, agriculture financing hasn't been a big problem in the Indian agriculture sector. **But on the flip side, the general appetite of the banking sector to finance came down drastically because of the uncertainties caused by COVID.** Banks weren't sure how COVID would impact individual sectors, and so, initially, a lot of financial institutions had clammed up. Most of the financial institutions limited their financing to existing customers, i.e. the ones who they were familiar and comfortable with. They were not willing to take on new customers.

As per the statistics coming in, there was a bumper sowing during the Kharif season. The farmers benefitted from the financing received from different institutions which led to such bumper sowing. Overall, the jury is still out! We will have to wait till March-April of next year to see how the agriculture sector and the portfolios have been impacted and how.

You mentioned that the general appetite of the banking sector came down initially post the lockdown - but based on the

Kharif sowing – it indicates that both formal and informal financing has reached out. Assuming that the formal sector was initially hesitant to lend to farmers, does it mean the funding took place from traditional sectors? If yes, then how do we understand the efforts taken by institutional financing sectors, like banks, in building trust with farmers?

We have to wait for the granular data to come out to see how much of financing has happened during the first phase of COVID-19, one, vis-à-vis the previous years and two, vis-à-vis the amount of sowing that happened – we still don't have those numbers. It is a little early to comment, but the general feeling is that a lesser amount of financing would have occurred because banks had lost their appetite.

With regards to the different initiatives by banks to build and ramp up their agricultural financing portfolio – I don't see a significant challenge there. Agriculture, as we all know, is a large sector with 51% of the population involved directly or indirectly in it along with 135 million farmers. There is a temporary disruption for banks that are looking at growth in the agriculture sector. No bank has changed their agricultural financing policy so far. This is a seasonal blitz, and I would expect all banks and other NBFCs and MFIs to come back to their financing levels very soon. However, the challenge that we have before us is how do we make such institutions more resilient? How do we know that the shock experienced this year will not happen again?

I believe that technology will make the farmer more resilient by providing information about market access, location of the product and other logistics.

Digitization and digital solutions have got a significant tailwind during the COVID period because, without them, the information asymmetry is too high for businesses to be resilient during a crisis period.

In the future, we would see considerable interest in making businesses more resilient, both from the financing as well as the market viewpoint. Technology will continue to play a significant role in the next few years, and businesses will adopt new methodologies to make their systems and their business more resilient.

Resiliency is an important aspect but is still a big challenge, at least for farmers. I say this because, despite a bumper Kharif sowing, we had very unseasonal heavy rains in Karnataka, Telangana, Maharashtra. This damaged crops substantially. Despite all the efforts made by the entire sector to bounce back, it seems a lot of it gets eroded. In the future, do you see financial products – both loans and insurance – being diversified and contextualized enough to address these kinds of challenges that we see because of climate change?

It's a little disappointing that climate risk hasn't been incorporated by the financing systems in India so far. **The question is then how do we protect our client from the climate risk – whether they are farmers or small businesses in the Agri sector or any sector. How do we, as a financing institution, protect our portfolio from climate risk?**

The immediate need is in the financial products, as you mentioned. The lending product is probably the only financial product in India that is doing better than the

other emerging economies. This is because of policy interventions in institutions from the regional rural banks to public and private sector banks, and the MFIs. **However, it is the insurance product that I would say is extremely weak in the Indian market.**

Historically there has been no insurance product that has worked well in India. Our focus needs to be on integrating the weather risk, pest attacks and any other risks that a farmer might face and use it to build a product which would be viable from his/ her perspective as well as the insurance company's perspective. I believe this would be possible with the intervention of technology.

If you see any insurance product, there are two overall costs – the granularity of the risk model, and the insurance premium payout. The insurance company has to understand how granular they need to get in understanding the risk of the product – where the higher the granularity in the risk



model, the higher is the cost. There is also an inverse relationship between the premium payout and the risks involved. The less you spend on understanding what your chances are; you'll land up paying more premium. But the more you spend on really understanding the risk, the less premium you will payout because you have covered your bases through the initial premium charged. However, doing this manually in a country as complex and diverse as India is incredibly challenging. That's where technology has to come in.

We need to leverage the potential of technology to be able to do the granular number-crunching in a very cost-effective and detailed manner. We need to build up the knowledge through AI and Machine Learning mechanisms and come out with insurance credit modelling, and price modelling in a way that is more efficient.

As an agriculture banker, I am not happy or satisfied with the kind of efforts that have come out on the insurance product, even know private entities are making

developments. There is potential for a lot more work, and I believe that without technology we will be back to square one. The technology practices we need to adopt will have to make sense of all the diverse information available. This will help to make very credible bet-taking on insurance products in different agro-climatic zones across parts of the world and India and for various commodities as well.

There is a significant lacuna in the Indian bouquet of financial services in the agriculture sector. It is a global issue as well in countries like Africa, South-East Asia or Latin America. But in India, because of the existing scale of fragmentation – we have to come up with a better solution, and if required, provide subsidy efficiently to mitigate risk at the farmer's level.

A major challenge that I see looming ahead is the climate risk. It all starts with our ability to understand and work on two initiatives – one, where Indian farmers need to adapt to the changing weather patterns; and two, making the agricultural practice cleaner so that the



THE GREATEST VULNERABILITIES

are in sub-Saharan African and South and South-east Asia



THE MOST EXPOSED

are millions of low-income smallholder producers in developing countries



PRODUCTIVITY OF CROPS, LIVESTOCK, FISHERIES AND FORESTRY

are seriously threatened



DROUGHT, FLOOD AND OTHER EXTREME WEATHER EVENTS

impact every dimension of food security



UNDERNUTRITION IS A SERIOUS THREAT IN POOR REGIONS

where productivity has been affected

mitigation strategies are in place. **How does agriculture as a sector evolve so that it becomes as less of a polluter towards the climate?**

There is a large bank of information out there, especially with the research institutions/academia doing specific studies like "climate-smart soya bean in Madhya Pradesh", or "climate-smart practices during different sowing seasons". Whether we are agricultural companies or sizeable corporate financing institutions, we are still learning how do we adapt and make our practice cleaner. I want to reiterate my point here that without a robust technology, this is just not possible.

A point that I would like to highlight here is - even though India is in a race to address climate risk concerns, I have a hope in India because of the number of small farmers we have. I believe that we can make small farmers change their agricultural practices quickly compared to the 100,000-hectare single commodity growing large farmer in the US, Brazil or Australia. But for a smallholder farmer, if they have the right knowledge, advisory, inputs and access to the markets, then they can easily switch from one crop to another depending on the climate factors - like soil and water availability.

If one tries to do this physically, it is going to be a nightmare with the knowledge getting lost in translation, from the research institution to the millions of farmers. It will not be sufficient unless we have the right kind of technology platform.

Farmers can use this platform to tap into the right advise of what to grow and how to access the market and income opportunities, and where to get the required raw material. Many technology players are

working towards this and researching into climate-smart agriculture. Without technology to enable this in a country like India, we can't do it!

How do you define the policy-making complexities or dichotomy, when it comes to the credit and insurance piece in the farm sector?

In India, we have seen that the government's busy rolling out an insurance product which they are doing independently. The private sector players are building and rolling out their own products in the market - but it's a very distorted market out there.

The two most significant issues in India still are - first, the interest rates where lending is concerned and second, the premium where insurance is concerned. Who is going to pay the premium - the farmer, or should it be subsidized? If we want to subsidize it, do we have an efficient manner of doing this? Would the government also fund the private sector schemes?

I believe that for different commodities in different agro-climatic zones, the actuarial studies should reflect what premium would make it a viable business for insurance providers. This, matched with the interest cost, will make the lenders build a profitable portfolio, and then also look at the farmer who pays a certain insurance percentage. Would such a cost-loaded model make sense for the farmer at the end of the day? It requires a comprehensive approach where all stakeholders need to get together and look at the entire ecosystem of cost and benefits - otherwise, it's not going to work. To answer your question - it is a distorted market as far as insurance is concerned. The government schemes are not working too

well, and most of the farmers don't seem to be too happy with it. Many cases have been reported where farmers have suffered a loss but haven't got a compensation; and vice versa where farmers have been compensated even though they haven't incurred a loss. A lot more work needs to be done there and again, and we need technology for all this!

The biggest bane for the financial sector – whether it's insurance, transactions or financing or any other product – is the transaction and risk cost. How do we handle the transaction cost, and how do we control the risk cost? Both of them are immense when you're dealing with a very dispersed and fragmented farmer base, and that's where we need technology. The earlier we adopt it, the faster we can scale up, and the sooner the digitization of farmers can be taken care of – this is a complex issue at the

moment. The good news is that with the existing technology, organizations are making small developments and are succeeding!

COVID is a new

challenge; it's happening today. But 25 to 30 years back, when I was starting my career – the same issues were being discussed. **To ensure that 20 years later, we aren't discussing the same problems, we need to ensure that they are taken care of by the adoption of technology.**

It's interesting as the emphasis on technology is very important, and the impact isn't felt in the diversification of financial products. For example, – you take traditional agri-credit products which have a limited effect on climate resilience. It doesn't insulate the farmers from the vagaries of climate change; nor does it reduce the probability of repayment failure, thus making it highly risky. Do you think that there is a re-alignment of farm-credit risk beyond the insurance?

Absolutely! If you look at the way financing is done in the more matured markets, they are working directly with the customers. These are the large farmers with whom they are working on addressing climate risk – both from the bank and client's side and protecting the portfolio. The banks will get hit if a farmer gets hit. Hence, they have to protect the farmers and help them on the sustainability journey by making them aware



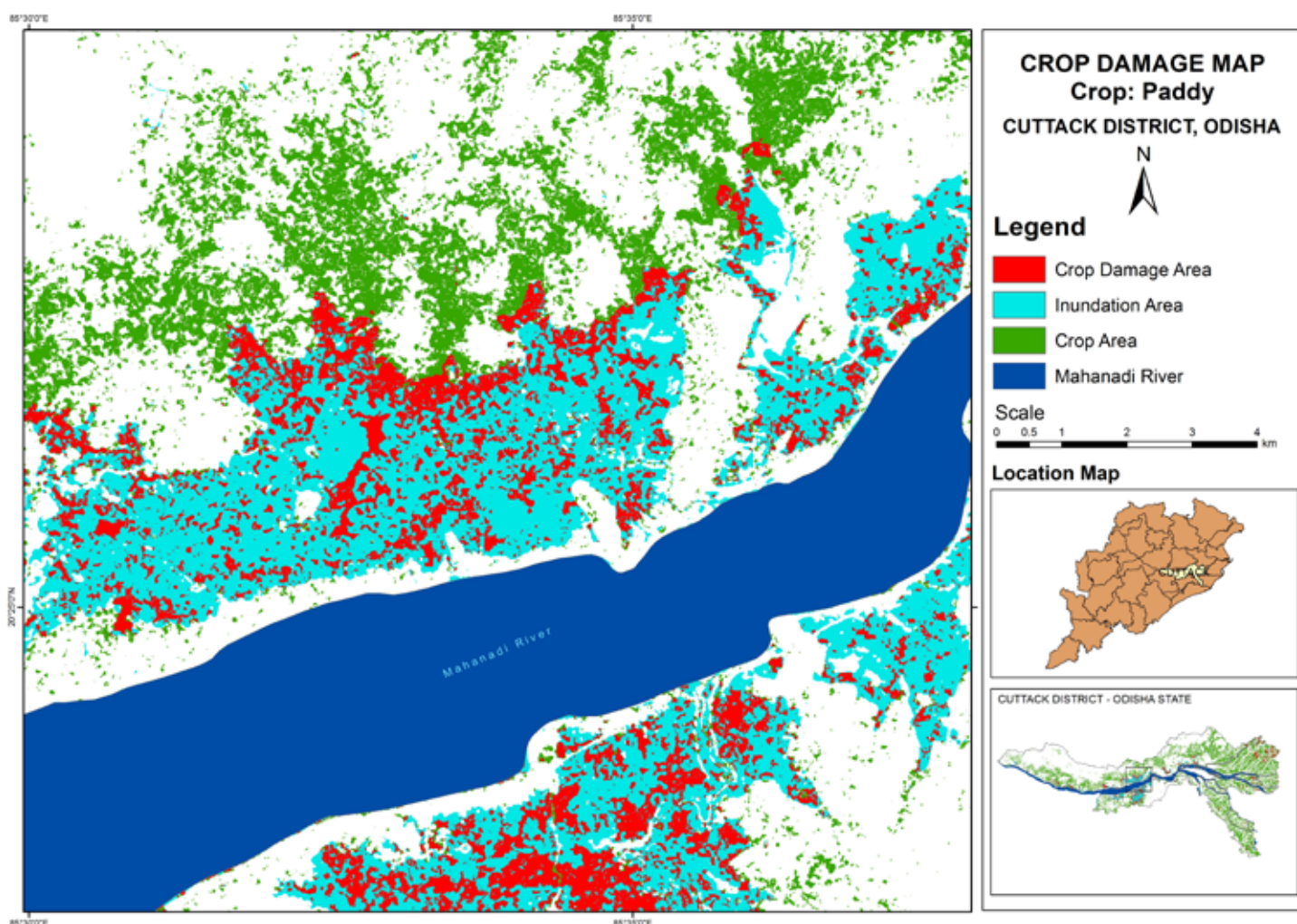
of the existing risks, the mitigants available and what they need to do to adapt.

In India, so far, climate risk has still not been incorporated in the financing decisions in the agriculture sector, as well as other sectors. However, in the Agri sector, banks must start incorporating and investing in people who have the knowledge and products which are climate-friendly, investing in clients to make business more robust and resilient. **I believe that with the kind of danger we are seeing for farmers and production and 'nutrition security' of the country – it is a matter of time before these practices are incorporated.** There exists a vast amount of knowledge, and we need to keep building this with customized data for different regions. Diverse conditions

mean the existence of various factors, and the technology solutions need to address this.

It is a big challenge! Despite having technology, there are banks which are still struggling to mitigate the risk on the portfolio because it's not being utilized at a loan product level yet. They are using it to optimize their processes and reduce transaction costs. However, they're not using this data to create new loan products in a manner that can cushion them from this risk or create new business models using the same technology to ensure them of this risk.

This issue that you have brought up hasn't



Using Sentinel-1 SAR data, SatSure has analysed the agri-flood damage in Cuttack district (Odisha), India (September, 2020)

been seen in India alone, but also in regions like Latin America, Africa, South-East Asia. Let's look at it from the perspective of any business – once you become a large organization – for you to become more agile and adopt technology for your benefit – becomes extremely difficult. We are seeing that across sectors, many big players are not embracing technology to sharpen their product, their businesses, their client base and services – and because of this, they lose out.

If you look at the agriculture or agriculture financing sector – there will be institutions which will do what you have stated. They will use all that knowledge, not only to build key products and services to make themselves better but to also adopt relevant risk mitigation measures.

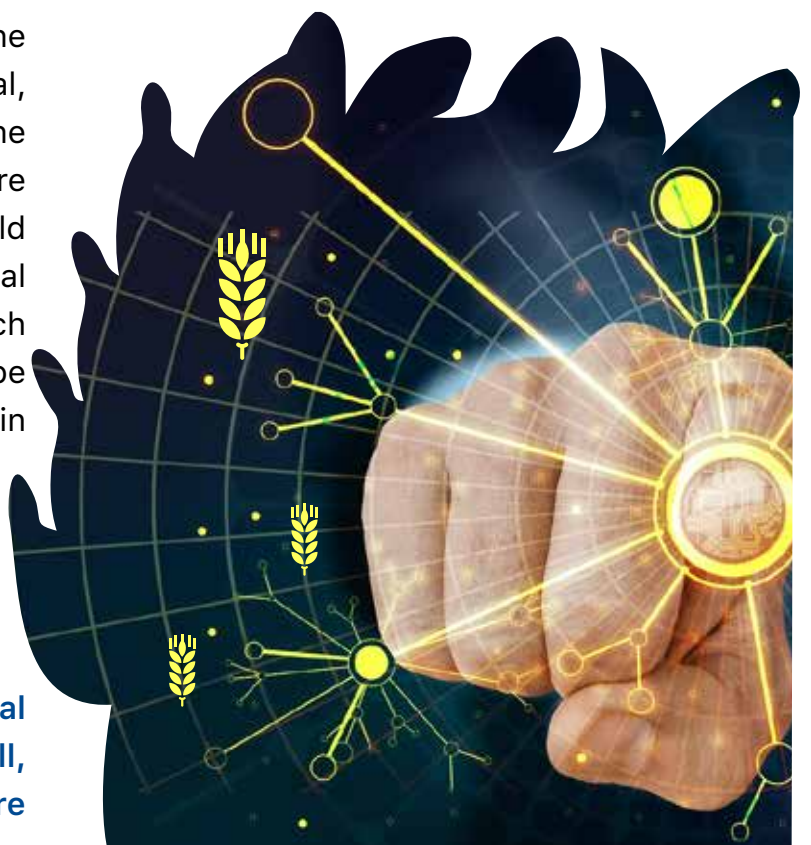
Several banks, including some traditional ones, have started adopting technology for financing decisions. There is a shift taking place with new-age players like the AgFinTech companies who are leveraging their agility and broad knowledge base. With the help of advanced technologies at the back-end, they are building practical, efficient solutions which are better than the traditional ones. Such organizations are going to become critical players in the field of agriculture financing. If conventional banks don't respond to the solutions which are out there by adopting them – they will be risking a lot and will not be able to sustain financially. **The winners will be the ones who embrace technology, and through this, sharpen their products, especially with a focus on climate risk.**

I agree. There are, however, several challenges with such technology as well, which one needs to be aware of. There are

different categories of technology solutions which focus on credit access, advisories or providing a risk-management overview. This fundamental aspect of digitization in the farm sector is receiving a lot more optimism than pessimism. My question here is on the pessimism side.

What do you think is the moral and ethical canvas around which the technology adoption should happen because as a technology of this kind seeps into critical sectors of finance and agriculture – it is going to impact the lives of people. If today we're making a credit decision based on trust and tomorrow it's through a model, what mitigation steps should the banks and insurance sectors look at to avoid biases in the model that could be due to the data on which it is built?

While technology is set to be the next key enabler for addressing the opportunities and risks in the sector, there still are issues



that we need to discuss. **One is, as you mentioned – there will be haves and have nots.** 30% of farmers have access to the most refined products and are categorized by the model as 'good farmers'. There will be another 30% who will be excluded entirely from this model, and they may not even find out the reason for this. That's where the question of the ethicality and universality of our technology comes up. **Are you challenging it to be more inclusive by reaching out to all the potentials from a gender and region perspective?** You would need to use the right kind of data points to build up an inclusive technology ecosystem. Policy frameworks at both the national and institutional level have to be worked on. How many of the banks' sustainable initiatives lead to ESG goals (Environmental, Social and Governance) especially on the social front, of being more inclusive so far as the vast majority of the population is concerned?

The second biggest challenge is about data protection. How do we protect and manage all this data, who does it, what are the norms, the best practices and who supervises this entire sector? There are zillions of sensitive data points out there, and we need to protect them!

The third is about the redressal mechanism when something goes wrong. When you interface with technology and not a person, and something goes wrong, like a failure of the system - who will address it? In a physical system, you're so used to walking into a branch and telling the branch manager that I have this problem and he'll advise you on the path to take and to some extent that works. But let's say I am a farmer in the future, and I have this gadget through which I am getting advice on transactions,

and I encountered an error. Do I have a redressal mechanism out there which works instead of always saying "we'll get back to you" and no one gets back!

These are the three broad areas where we need to work a lot and make changes. You will agree with me as a technology player that not everything is optimistic and right; there are issues which we need to tackle soon!

These are very pertinent points, and the reason why I asked this question is that there aren't enough people thinking this way or even how to address these issues. Strangely enough, there aren't any policies or an RBI directive on how to efficiently move from a physical system to a digital one in agriculture.

You're right. We have also observed that the European regulators and the Dutch Regulators, are coming out with robust requirements for climate and technology reporting. Like what data are you using, your model, how accurate is it and how customer friendly is it? These regulators are pushing very hard for such reporting to take place because it's complicated to supervise technologies as they can be very disruptive for the existing system. So such regulators always need to be one step ahead, and this isn't easy!

How does one regulate it in a manner that it is equitable, fair and incredibly customer-friendly? These are questions that regulators are raising – be it from the insurance, banking or other financial services sectors.

My last question to you would be as a summary of the year 2020, through your

lenses, what is some insight and overview you could provide of how you see us moving into the next decade, especially in comparison to the last decade and the last one year.



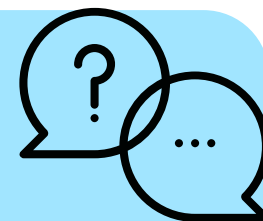
First, I would like to highlight that there have been significant developments of niche products which are **'agri-smart' and 'climate-smart'** to support the agriculture sector in the years to come. Second is the presence of blended finance transactions in the industry. Blended finance will be using non-commercial and commercial capital to come up with a product which can take the necessary risks which need to be taken when trying to address a climate issue. These are on the rise – like, for example, in the education and health sector. Rabobank has launched a slew of blended finance products for FPOs, climate-smart agriculture and AgFinTech companies.

The third is about **"green financing" or "sustainability linked loans" or "ESG compliant loans"**. We see an increasing number of such loans globally including in

Asia, where many banks are focusing on stepping up their sustainability compliance and performance. In a broad sense, we will see increased Green Financing not only in sectors like construction, transportation and housing but also increasingly in agriculture. We need to build such products or face a disaster in the future. We need to "green" our portfolios not for the sake of just reporting and recognition, but real greening where every financing has a positive impact on the environment and people. This will happen significantly in the years ahead as we have regulators and the youth pushing for more environmentally friendly products.

I hope that in the year ahead, using technology as a wild card, we can move more towards sustainable related financing options, and this will take place across several sectors.

“Technology is an enabler in this journey of increasing efficiency and making businesses more resilient and robust in the years ahead. We need broad-based partnerships/collaboration as per SDG 17 to make technology not just an enabler but also a solution to increase sustainability in the years ahead.”



Profile of the Interviewee

Arindom Datta

Arindom Datta has been working for Rabobank for the last 14 years and has over 28 years of experience in Rural Finance, Cooperative, Microfinance and Agribusiness banking. He is responsible for the sustainability banking initiatives on knowledge, risk management and business development. He also oversees the Rabo Foundation projects in blended finance, technology/innovation and access to finance in the agriculture sector. Arindom is further passionate about following the Agtech developments and its significance for small holder farmers. He previously worked with National Bank for Agriculture and Rural Development, IDBI Bank and CARE. Arindom's work is recognized and he has been honoured with the 'India Sustainable Leadership' award at the India Sustainability Leadership Summit in 2017.

His other affiliations include Independent Director of NABKISAN Finance Limited; Observer on the Board of Agrostar; Advisory member of Climate Smart Agri 100 of the World Business Council for Sustainable Development; Member of the FICCI Task force on Agtech; Member of the National Advisory Committee on the PRODUCE Fund for FPOs set up by NABAR

Strengthening an Innovation Agenda Through an Ecosystem Approach



Could you kindly inform our readers about the World Economic Forum's Innovation with a Purpose platform, what are its objectives, and a few key projects that the platform is leading?

We started the Forum's 'Innovation with a Purpose' platform a few years back as a response to our partners who highlighted that the food and agriculture sector is behind other sectors in leveraging technology and broader innovations for food systems transformation. Unlike some other sectors, minimal investment was going into technology innovations to meet the challenges of the food and agriculture sector in spite of huge potential and opportunity.

An Interview with Saswati Bora

Head, Food Systems Innovation, World Economic Forum

So the Innovation with a Purpose platform was started and in the early years published several reports that provided thought leadership on the topic. For example, in 2018, we published a flagship report, in collaboration with McKinsey, that highlighted the technology innovations that could be transformational for the food and agriculture sector. We highlighted twelve technology applications from blockchain to big data to microbiome technology. Another report in 2019 looked at how IOT, blockchain and food sensing technologies can enable more traceability in food value chains.

But the main message was that even though these technologies can be transformational, they may not be scalable in the food and agriculture sector. This is

due to a variety of factors – as the industry is very fragmented, with small size farms in emerging economies, issues related to last-mile delivery and affordability, and policies not keeping up with technology innovations.

Hence, we focused on the concept of “innovation ecosystems” where we support an enabling environment which brings multiple diverse stakeholders to work together to develop ecosystems that can unlock investments, build capacity, lead to greater policy alignment and smart partnerships. **To build and strengthen such an innovation ecosystem approach, we need to bring in diverse stakeholders to work in a collaborative multistakeholder approach. As well as, look beyond the agriculture, food and beverage industries, we need to leverage innovations emerging out of adjacent sectors such as ICT, finance, health, among others.**

The “innovation ecosystem” approach has resonated with stakeholders, and earlier this year, we received the request from a diverse group of partners to look at supporting this at the country level. So the next phase of Innovation with a

Purpose is focused on catalysing and strengthening country-level **Food Innovation Hubs** with a focus on enabling country-specific approaches to address local challenges and opportunities. For example, the challenges and opportunities for the food and agriculture sector will be different in Kenya compared to Colombia or India and requires a region-specific approach.

We have been working with a multistakeholder group of partners on developing these Food Innovation Hubs in Colombia (Latin America), in several countries in Africa, and will soon start work in India. **These Hubs will focus on five key outcomes:**

- o **Equitable access to innovations for farmers and consumers.**
- o **Increased investments in inclusive and scalable technology solutions.**
- o **Support enabling policy incentives and improve the resiliency of food systems.**
- o **Mitigate unintended consequences of technology solutions.**
- o **Unlock institutional bottlenecks to scale in support of systemic change.**



The platform is very global, and you are engaging in several regions, including India, which have different challenges. How do you engage with stakeholders to create this kind of customized programs to develop or test out some of these technologies and their applicability to the regional context towards supporting food systems innovation?

At the global level, we are developing the framework, distilling learnings and bringing in the broader collaborations and networks, including linkages to major global initiatives and milestones. However, the work is all driven at the local level by local stakeholders through a country-owned and country-led approach. Each country or region will choose a bespoke model depending on their priorities and needs, and we are working with local stakeholders to dig deep into what are the problems we want to solve for in that particular context. It involves a lot of consultations and dialogues with local farmers, stakeholders, governments, private sector and SMEs to define what are the key challenges opportunities that could be leveraged. However, we don't want to be duplicative and crowd out existing initiatives; instead, our approach is to build on existing initiatives and partners and focus on building scale and impact through an ecosystem approach. That also means working with government partners, looking at policies and priorities in place and engaging with policymakers continuously through dialogues and consultations.

For example, in Zambia, through extensive consultations, we identified that one of the critical focus areas could be on providing incentives for smallholder farmers to move

towards more sustainable agriculture practices. And the mechanism could be by supporting the development of an interoperable data and analytics ecosystem that brings together multiple data platforms to provide financing, advisory, capacity building and other support to smallholder farmers to move towards more sustainable farming practices.

While having such extensive collaborative frameworks, what are some of the key challenges that you face in making sure that from the time to strategize the objectives to the time these are executed – they are all coherent. I believe the execution will be the main challenge, as the Forum is working in so many different countries. Could you list a few such challenges that you have faced?

The World Economic Forum is an international organization for public-private cooperation with a focus on supporting innovative approaches for public-private collaboration. We are a neutral organization and act as a catalyst where we facilitate, convene, co-create, and support local stakeholders in defining the vision and action plan. The Forum is not a funding or implementation agency. The success of our program depends mostly on the ownership and willingness of our partners to lean in.

But we have been lucky as there is strong ownership and championship from our public, private and social sector partners in building and supporting this work. That is why we also try to ensure that we are building on existing key initiatives and priorities as that would provide more ownership and action. If we try to put something new on their plate, there will be

less appetite to take this forward. But if it is aligned with a goal where there is already a commitment to deliver and the initiative is supporting this commitment, then it becomes easier.

However, there is always challenge when there is leadership transition in either government or private sector. A particular bureaucrat or senior executive may commit to an initiative, but once that person changes, there is a risk that the work may falter. So it's always best practice to institutionalize the approach within organizations to mitigate any risks related to leadership transition.

Based on your global experience with the platform, which all technologies have you seen showing the maximum promise or potential for transforming food systems, especially in developing countries?

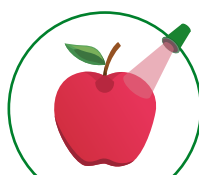
In 2018, Innovation with a Purpose, in collaboration with McKinsey, identified

around twelve technology applications that could be transformative for food systems. This was identified through a systematic scanning and landscape mapping process, through surveys, interviews and stakeholder consultations. These technology applications range from those that can change the shape of demand (example, alternative protein and food sensing technologies) to ones that promote value chain linkages (example, big data and blockchain) to those that create effective production systems (example, precision agriculture and microbiome technologies). Some of these technology applications are more prominent in certain regions than others. For example, alternative protein or food sensing technologies is more pronounced in the USA or Europe. For emerging economies, mobile service delivery, along with big data combined with advanced analytics, could provide huge benefits, especially in terms of financing, insurance and risk mitigation opportunities for farmers. IoT could also be a massive

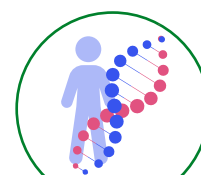
Changing the shape of demand



Alternative Proteins

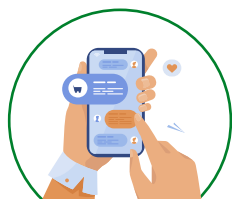


Food sensing technologies
for food safety, quality,
and traceability



Nutrigenetics for
personalized nutrition

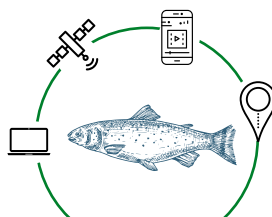
Promoting value-chain linkages



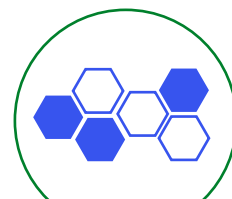
Mobile service delivery



Big data and advanced analytics for insurance



IOT for real-time supply chain transparency and traceability



Blockchain-enabled traceability

Creating effective production systems



Precision agriculture for input and water use optimization



Microbiome technologies to enhance crop resilience



Off-grid renewable energy generation and storage for access to electricity



Gene-editing for multi-trait seed improvements



Biological-based crop protection and micronutrients for soil management

The "Transformative Twelve" technologies impacting food systems.

Adapted from: "Innovation with a Purpose: The role of technology innovation in accelerating food systems transformation", World Economic Forum, January 2018

game-changer as it leads to more supply chain transparency and traceability. Precision agriculture could also be one of the big game-changers in the future, especially in developing countries.

However, we are not focusing on promoting any specific technology but are more focused on supporting a broader innovation agenda which can enable these technologies to meet its potential while

mitigating any unintended consequences. Many times, these technology applications do not create the desired impact for the food and agriculture sector as the broader ecosystem is not in place for the needed scale and effect. Hence, we need to not only focus on high-tech but also look at supporting innovations in business model, partnerships, grassroots and institutional innovations that can lead to scalable impact.

We were talking about technologies such as blockchain, IoT and AI that are showing much promise. Concerning these food innovation systems, which part of the value chain do you see these technologies contributing the most? Is it at the farm, is it post-harvest, or pre-harvest in the input side of the business?

At the World Economic Forum, we are working towards advancing a holistic food systems approach. Our focus is on reaching four goals for food systems transformation:

- **Sustainable** – minimizing negative environmental impacts, conserving scarce natural resources, saving biodiversity loss and strengthening resiliency against future shocks.
- **Nutritious and healthy** – providing and promoting the consumption of diverse nutritious and safe foods for a healthy diet.
- **Efficient** – producing adequate quantities of nutritious and healthy foods while minimizing loss and waste.
- **Inclusive** – ensuring economic and social inclusion for all food systems actors, including smallholder farms, women and youth.

We want to support these four goals through an integrated, holistic systems-based approach and the work of the Food Innovation Hubs is focused on leveraging innovations that help meet these aspirations through a multistakeholder, pre-competitive approach.

What we want is to enable innovations across the ecosystem and not just focus on one part of the value chain. For example, we might provide innovations to farmers to improve their productivity. However, if there is no market for the product or processing or cold storage to reduce food loss, it won't

lead to an increase in farmers' income. We need to look at the broader ecosystem of support for farmers, including financing, advisory and capacity building.

We have also found that there is a gap in demand-side innovations, and we are trying to enable more focus on consumer demand and sustainable consumption. The key questions we ask ourselves are - how do we incentivize consumers to shift their demand to more sustainably grown, nutritious and healthy food? What are the innovations that can enable this? For example, is it food sensing technology where you can use a mobile phone to see the nutrition profile or environmental footprint of the food you're buying that will enable you to make more informed buying decisions? Suppose you immediately see that it is a better product and are willing to pay a premium price as it meets your values. How do we ensure that this premium trickles down the value chain and reaches the farmers, so it rewards farmer for producing more nutritious food through better farming practices?



The goals of the World Economic Forum's Food systems initiative
Adapted from: "Innovation with a Purpose: The role of technology innovation in accelerating food systems transformation", World Economic Forum, January 2018

There is a lot of hue and cry about bringing in more sustainable practices in farming – like changing the behaviour of growers. When we are looking at the end-to-end traceability and improving the entire quality of the food that we eat, importance is given to how we grow our food, mainly since the agriculture sector contributes a lot to GHG emissions. In that context, are there any examples you have seen globally where a policy or key incentive is changing the behaviour of how we are growing food?

As I mentioned before, the food and agriculture sector has to meet a multitude of diverse aspirations – addressing malnutrition, sustainability and efficiency, improve farmers income for example. But many of the current incentives were put in place decades ago when much focus was on food security and self-sufficiency. But the focus has now expanded. For example, the kind of food people are eating – is it leading to obesity or diabetes? And also, how do we ensure farming practices do not lead to environmental degradation?

We need to realign our incentives to support an integrated approach to meeting these 21st-century priorities. The challenge is – how do we overcome the hurdles preventing stakeholders from making this change? How do we address the transition costs and costs of behaviour change? For example, why would farmers change their production patterns unless someone pays them to do it?

In a recent report published by the World Economic Forum, we identified four pathways to realigning incentives. The first is repurposing public investments and policies. The second is

private sector need to redesign their business models to prioritise environmental, social and financial outcomes. Third – institutional investors, like private equity funds, need to set higher standards on how companies approach environmental and social outcomes besides financial returns. Fourth, consumers need to demand more environmentally and socially responsible nutritious products. All these four pathways are interconnected, and we need progress on all four to realign incentives.

Regarding your question on policy incentives that has changed the behaviour of how we grow food, subsidies and public investments can be one of the most powerful drivers in the food and agriculture sector to stimulate widespread change. For example, the EU's Common Agricultural Policy through reforms over the last few decades has shifted from price guarantees to direct payments to farmers, decoupled from crop choice and input use. These changes increased the incentives to use fertilizers more efficiently. Studies have shown that these led to improved environmental outcomes while crop yields rose. Another example is Costa Rica which has pioneered the use of payment for environmental services (PES) that paid farmers and landowners to support ecological efforts.

There have been many projects in India where they want to move from paddy towards millets or maize. But all of them are failing even though the government is incentivising them with cash. Even there

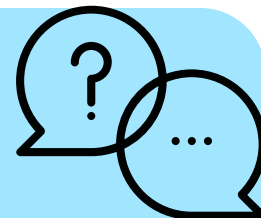
are funds now to curb crop burning by including financial incentives for the farmers. But still, these are not having the expected impact. What is your opinion on the critical success factors of such programs?

Providing financing is essential but not sufficient to induce behaviour change. We need to provide a full ecosystem of support that can incentivize farmers to diversify their crops, especially if they have been cultivating this crop over many generations. We need to provide them with the right inputs, education, training, advisory services, capacity building, as well as infrastructure support and access to markets. There needs to be risk mitigation measures in place like insurance mechanisms so that if crops fail, there is support available for farmers. We need to ensure there are buyers for the commodities that farmers produce who will provide a fair price and augment their income. So, the ecosystem needs to be put in place and not just targeted at one part of the value chain or one standalone intervention.

All the nations agreed that by 2030, we would meet the SDGs, and we are already at the end of 2020. As the head of food systems innovation at WEF, what do you think needs to be done to achieve those targets by 2030? What are the key steps to take in the next decade to achieve those targets?

That's a pertinent question on the need for urgency to meet the SDGs. Food systems cut across multiple SDGs so if we are to meet SDGs, then we need a renewed focus on the food and agriculture sector. We need to enable multistakeholder partnerships that

embrace multiple sectors and industries and bring learnings and innovations that can support a systems-based approach. We need to bring in innovations that are being developed by start-ups and scale them up for broad-based impact. We need to leverage partners from adjacent sectors like the IT and the financing industry – who were traditionally hesitant to work on the food and agriculture sector – and leverage their resources and knowledge. What we need is extensive engagement from multiple stakeholders and along with that, a focus on realigning incentives so we can enable a broader food systems transformation.



Profile of the Interviewee

Saswati Bora

Saswati Bora is the Head of Food Systems Innovation at the World Economic Forum (WEF) where she heads WEF's global initiatives on innovations and incentivizing food systems transformation as well as the food and agriculture work in India. She has almost two decades of experience in agriculture, food and nutrition security, innovation and rural development. Before WEF, Saswati worked in the agriculture and rural development department of the World Bank where she helped set up two key global initiatives - the Global Agriculture and Food Security Program (GAFSP) and the Global Food Crisis Program (GFRP). Saswati has worked previously as a researcher at the International Food Policy Research Institute (IFPRI) in Washington DC, UNDP offices in Nepal and New York, and as a journalist with a daily newspaper in Mumbai. She has a Masters in International Affairs from Columbia University, a Bachelors degree in Economics from Delhi University and a Post Graduate Diploma in Communications from Sophia Polytechnic in Mumbai.



The Explainability of Artificial Intelligence



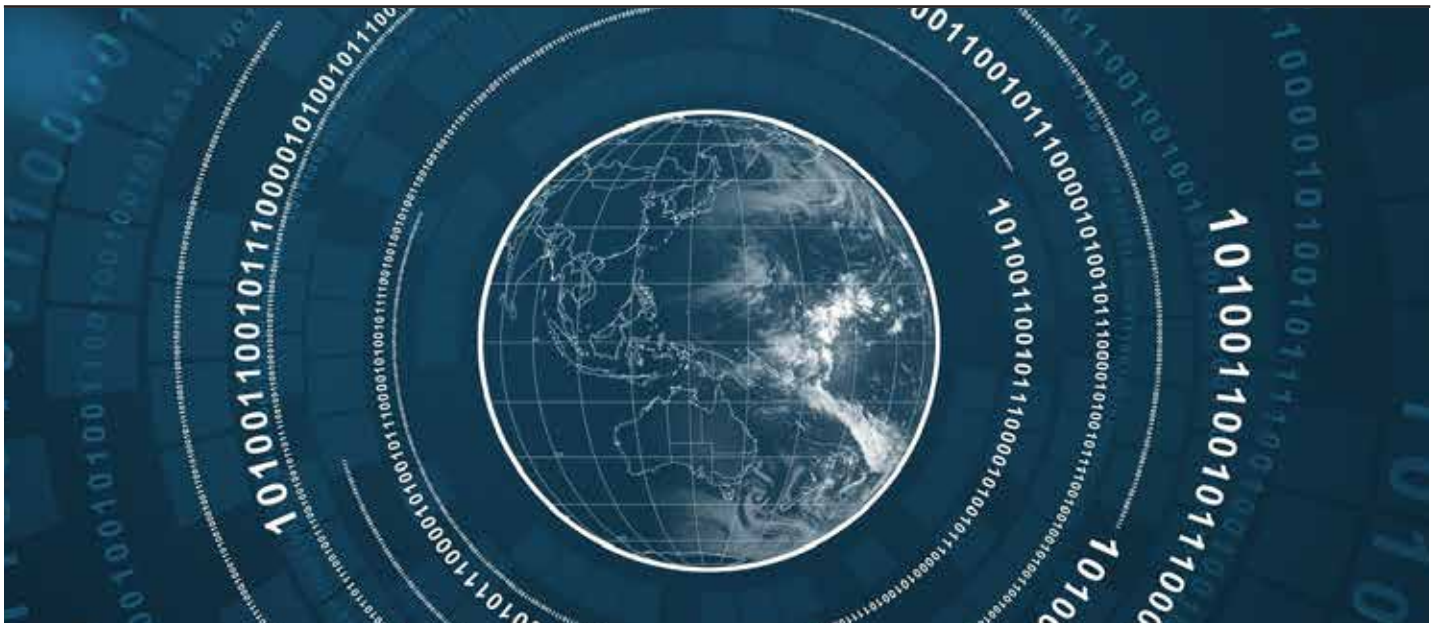
Sanjutha Indrajit,
Data Scientist,
SatSure



Chinmay Shah,
Junior Back-End
Developer, SatSure

May 6th 1949 is considered the birthday of modern computing as on this day, Maurice Wilkes and a team at Cambridge University executed the first stored-program on the EDSAC (Electronic Delay Storage Automatic Computer). Then on, scientists and engineers the world over made significant advances in the world of computing with the introduction of transistors, microprocessors and storage devices. However, computing large amounts of data was expensive and only prestigious universities, and big technology companies could afford to do so. **The proof of concept and advocacy needed to persuade that machine intelligence was worth pursuing came in 1956 at the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) hosted by John McCarthy and Marvin Minsky.**

From 1957 to 1974 AI flourished with computers becoming cheaper and more accessible and machine learning algorithms improved with a better understanding of where to apply them. From the 1980s onwards with significant funding, innovation and superior technology, Artificial Intelligence achieved many of its landmark goals and continues to do so. **In recent years, AI has made its way to practically every segment of human life, from marketing, banking, entertainment to healthcare and self-driving cars. It has saved countless human hours and increased human productivity.** For example, in healthcare AI has empowered doctors to make better decisions and also helped in reducing human errors resulting in saving human lives.



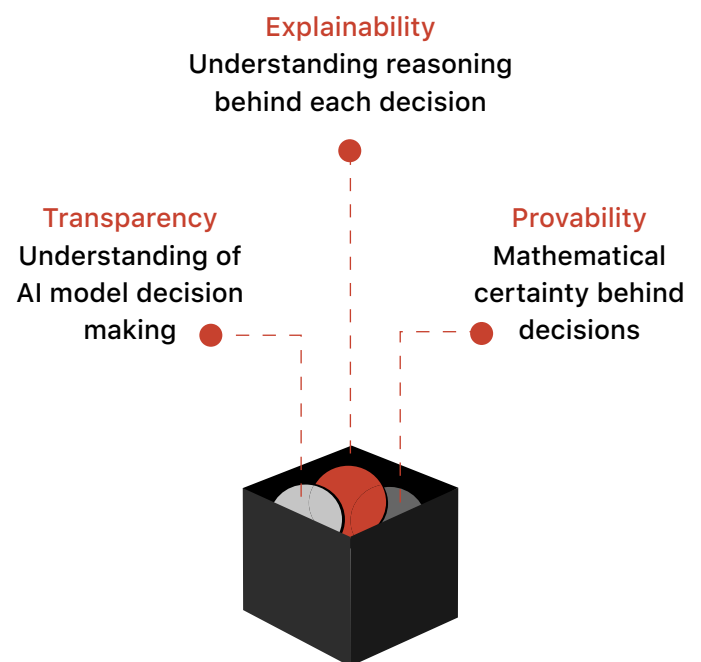
One of the successful use cases of AI is in cancer detection, where it is used to assist the radiologist in not only detecting the tumour but also to identify its type. For example, a tumour wrongly classified can not only increase the treatment time but may also result in death, if not corrected at the right time. AI is also being used to distinguish between a benign tumour and an actual tumour. This helps in reducing the psychological trauma the patient has to go through in case of false positives. Recently, AI was also used to detect SARS COVID-19 (coronavirus) using CT scan with a 90.8% accuracy, which again is a noble example of how we can use AI-assisted healthcare to provide better health outcomes.

Although AI algorithms are becoming increasingly adept at producing results that are acceptable to humans, we have not, as of yet, been able to convincingly explain the inner workings of the model which lead to the desired results. Unlike conventional software algorithms which are mostly rule-based, AI algorithms are learning-based. This means humans have a control on what the input is and how the output should be. But since the algorithm

itself is a set of probabilities and real numbers of features, it is nothing less than an opaque system whose working is not explainable in simple terms to an end-user. Hence AI models are increasingly being referred to as a "Black Box".

Black Box in AI implies a system whose inputs and operations are not visible to the

What it means to look inside AI's black box



Source: 2018 AI Predictions Report, PwC

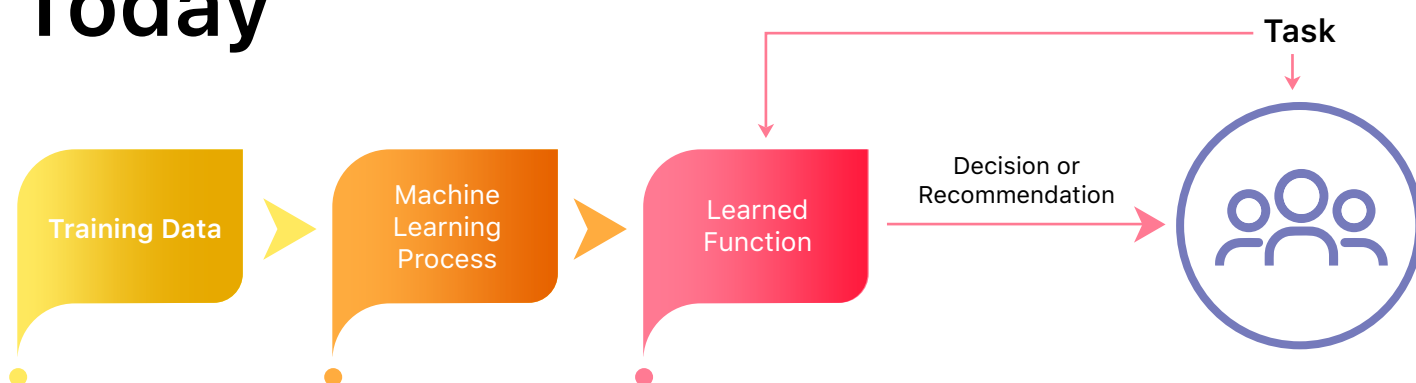
user or any party. Black Box models are created directly from data by an algorithm, and the people who design them mostly cannot understand how variables are being combined to make predictions. **Explainable AI models, on the other hand, provide a technically equivalent, but an interpretable alternative to black box models.** These models are constrained to give a better understanding of how predictions are made.

One reason why the black-box nature of the AI models is a critical point to be discussed is the Amazon recruitment example, where the AI unfairly discriminated against women as well as people of colour. And when things are serious, there is no way to know what did go wrong, and more importantly, what caused it to go wrong. In the US, risk assessment tools are designed to give every convict a recidivism score which is then used by a judge to decide whether a person

can be granted parole. The data used to train the models that give the recidivism score are trained on historical data, which often disproportionately targets people of lower socio-economic strata, furthering this class drift.

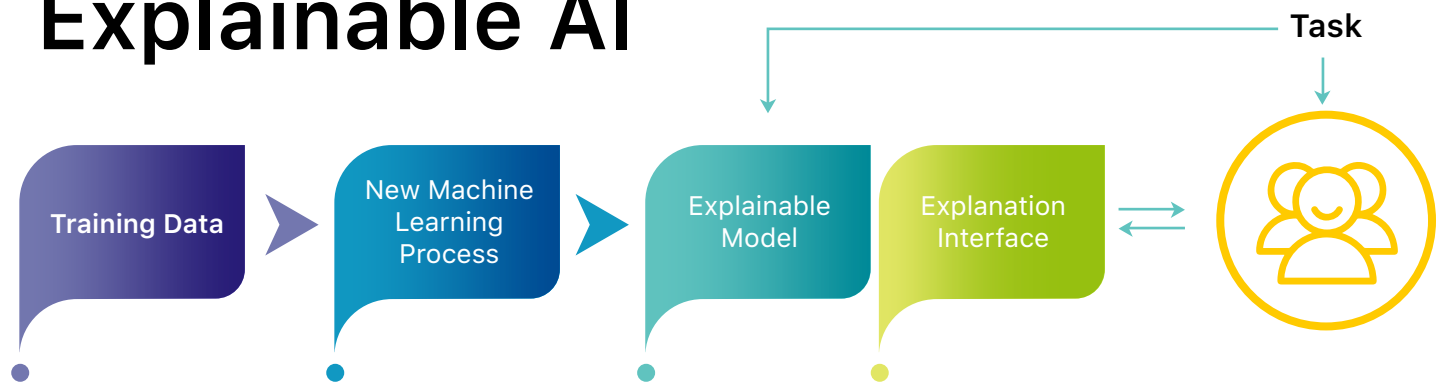
In the past few years, advances in deep learning for computer vision have led to a common belief that the solution to any given data science problem should be inherently uninterpretable and complicated for reaching high accuracy. This belief stems from the historical use of machine learning in society, which are low-stakes decisions such as online advertising and web search, where individual choices do not profoundly affect human lives. **But when AI enters a decisive part of human life, such as in healthcare or agriculture, we might ask how this decision came into being, which gives rise to the demand of Explainable AI.** As the

Today



- Why did this happen?
- Why not the alternative?
- When will it succeed?
- When will it fail?
- When can it be trusted?
- How do we correct an error?

Explainable AI



- We know why this happened
- We know why not
- We know when it will succeed
- We know when it will fail
- We know when it can be trusted
- We know why this error happened

The concept of Explainable AI

Adapted from: <https://www.darpa.mil/program/explainable-artificial-intelligence>

noise around AI applications in agriculture increases, probably faster than the models themselves, there are groups already working on building AI ethics frameworks.

But in our opinion, the AI explainability paradigm needs to be overcome before venturing into making the ethics part of it for farmers.

In the context of the work we do at SatSure, AI methods provide many new and exciting research avenues to analyse petabytes of satellite imagery and derive meaningful insights from them. But it also requires us to reflect on when and how these methods should be used because using such methods without careful consideration can lead to bad science. We have found that integrating scientific knowledge into AI

methods and the use of visualisation tools are two most hopeful safeguards against such potential for bad science when applying AI to earth imaging datasets.

The societal implications of applying AI models for farmer and food quality related applications made us look into three different schools of thought emerging on how we can approach the problem of black box AI.

1. PRE-MODELLING EXPLAINABILITY

The explainability at this stage is based on the knowledge of the data scientist. The assumption is that the data scientist understands the problem statement completely and will select a model that best

suits the problem. Exploratory data analysis is used to understand the data and data distribution, which helps weed out any skew in the distribution, which often leads to a biased AI model. It is also at this stage that a walk-through of all the available methodologies to approach the given problem statement is done to explain which model understands the data characteristics better keeping in mind the 'No Free Lunch' theorem. The selection of the model should be based on domain knowledge with a consideration of each distinct feature representation.

2.MODELLING EXPLAINABILITY

During the modelling phase, explainability can be achieved in two ways.

First, we could use inherently explainable models, which often come at the cost of the model's performance.

Secondly, we could develop models by considering a trade-off between explainability and performance and

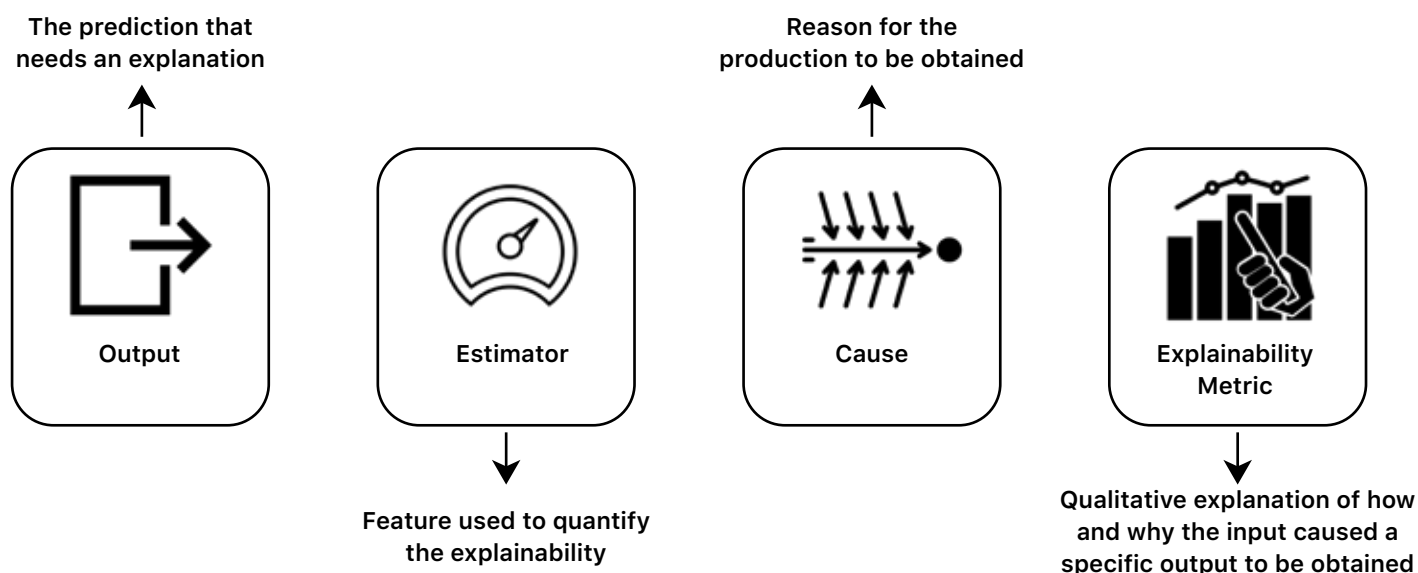
optimising these in an acceptable way, using hybrid models. In this approach, models consisting of robust and explainable features are used during the training phase, followed by high-performance features during the validation phase.

A comprehensive way to evaluate model explainability is using a 'human-in-the-loop' approach. Here, the explainability is reviewed by a human and based on the decision, an explanation is either rewarded or penalised (reinforced). The limitation here is the human bias and consistency in their line of thought, which can often be visible in the input data itself; hence a board of reviewers is recommended.

3.POST-MODELLING EXPLAINABILITY

Post modelling explainability is, by far the most explored and tested methodology. It gives the need for explainability but arose much later than the need for better performing models. This approach takes into account four key aspects of modelling: the

The four key aspects of modelling



output, estimator, cause and the explainability metric.

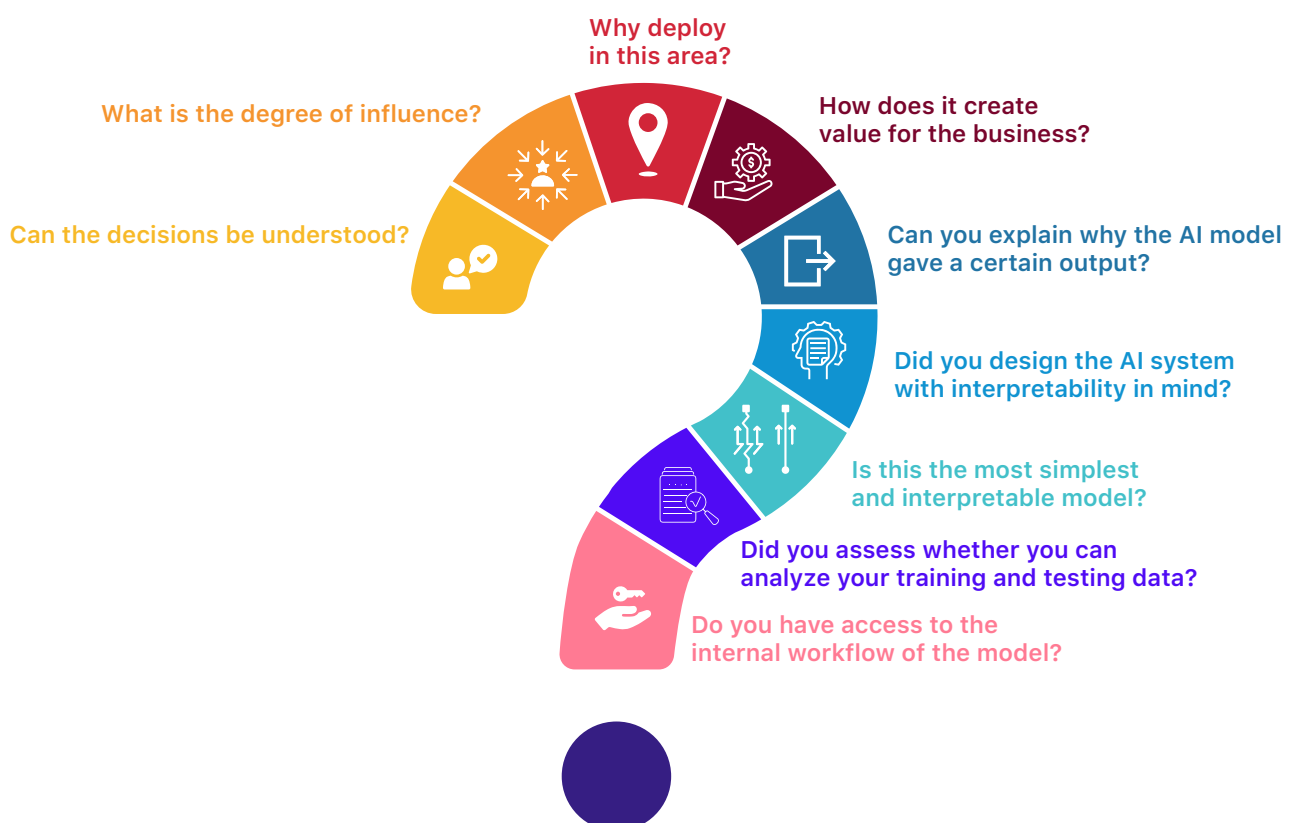
Although this is a more thorough method, it might affect the performance severely. This method can be seen as reactive, rather than proactive, which could add on to the model. Microsoft's FairLearn toolkit, Google's What-If and IBM's AIX360, are a few of the existing open-source toolkits that aim to increase the explainability of AI models by taking the post-modelling explainability route. They have, however, been able to reach the level of model transparency exploration and very little in terms of any tangible explainability.

The Road Ahead for Explainable AI

Over the past few years, several R&D tools around explainable AI has gained momentum. However, there is still a large amount of apathy towards accepting AI due

to the lack of convincing explainability. And before we indulge in the dream of AI replacing humans in sectors like agriculture and healthcare, our understanding of the models itself needs to develop to the extent where we can convince the consumer of the model's output. This, in turn, would require a framework to be put in place. The data scientists would list the features and quantitative explanations of the model along with human acceptability of the same from their side. Post which, the question of ethics arises as the output may be explainable but built on decades of biased data collection, and hence a similar framework is also to be agreed upon with the consumer whom the AI's decision would directly or indirectly affect. As we can see, this is going to be a long drawn process of individuals debating and discussing before reaching an apt conclusion!

QUESTIONS TO REVIEW THE EXPLAINABILITY OF YOUR AI SYSTEM





Smallsat and the Downstream Sector- a Volatile Relationship

Krishna Reddy
Innovation Officer, Consulate General of
the Kingdom of The Netherlands

With time, a certain product, or service tends to enter a threshold state, beyond which the only way to thrive is, innovation. Now, innovation need not be based on the scientific fundamentals but more of a hybrid version which is an appropriate mix of appealing technological innovation, led by a master business plan.

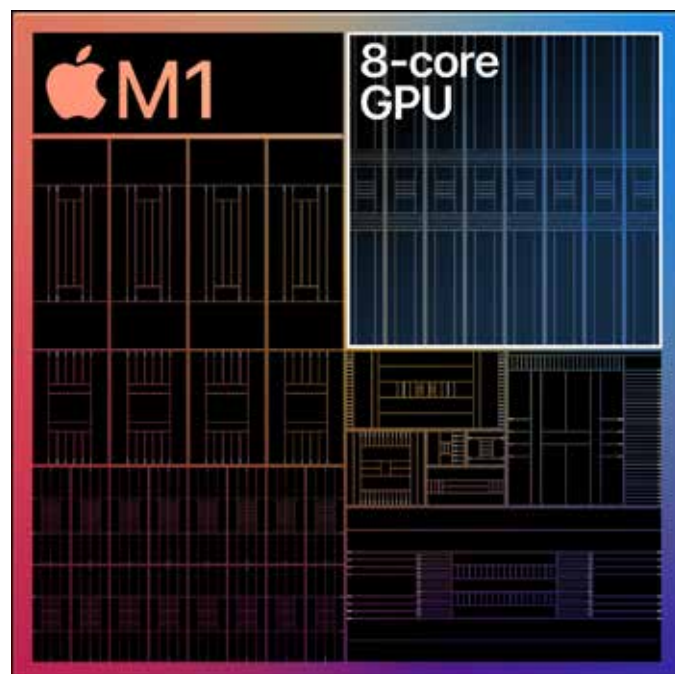
For example, look at the video rental market shift from Blockbuster to Netflix in the late 90s where Netflix's smart business plan and understanding of the market trends gave it the upper hand in this battle. Similarly, Apple Inc. and the recent technology development can be compared to the strong relationship between the small satellite industry and the downstream sector – satellite data analysts.

The Origin of the New Profound Trend

Before we dive deep into space, let us have a look at what's happening in another technology producing market: the smartphone industry. If you are a close follower of the technology market, you would have seen how Huawei is building everything on its own and within its facility, from hardware to the chipset (Kirin series) and now an entirely new operating system, Harmony.

Whereas, Apple Inc. decided to do away with the third-party manufacturers for semiconductors. As a result, we have the new M1 chip which has been integrated into its new MacBook range, unlike the older one with an Intel chipset. We thus have a blazing fast laptop, faster any other laptop in the market. Apple steadily entered all sectors of the market (excluding camera sensors and modems), with the launch of its products like the iPhone and the A-series Bionic chipsets.

Looking at these developments, what can we learn or see in a different yet naive market of space exploration?



Smallsat and Satellite Data Operators – The Fragmented State of the Sector

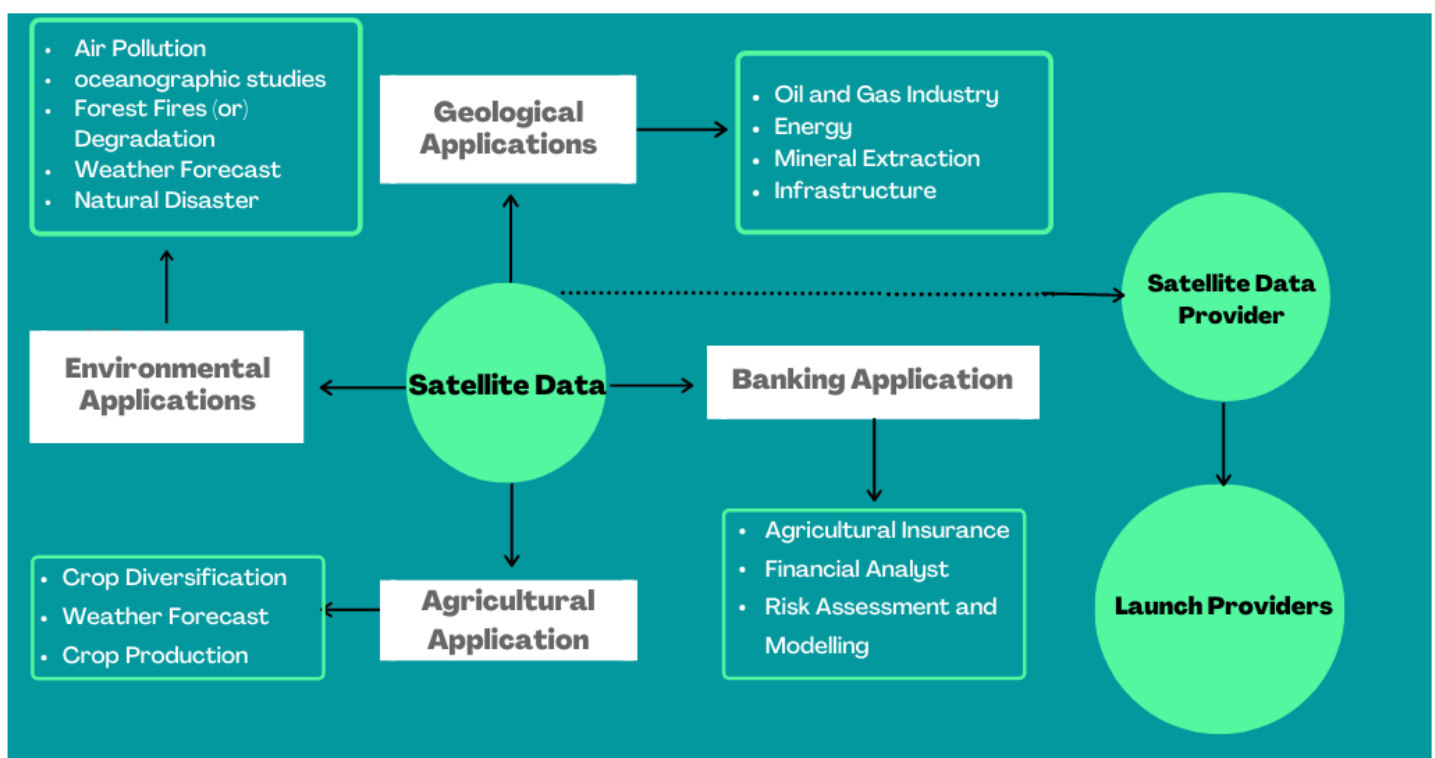
Why was the first satellite launched in space? Apart from cementing the Soviet's position in the technological front, it was also meant to identify the density of high atmospheric layers through measurement of its orbital change and provide data on radio-signal distribution in the ionosphere. With time, Earth Observation and Defence application came into play, and soon the former emerged as one of the key applicators in employing the smallsat into the Earth's orbit. Having multiple satellites in orbit (Low Earth Orbit specifically), the need to operate and filter the data of these satellites also came into existence and later transformed into a downstream market.

Satellites today, act as a data mine where information can be produced as per our requirement and demand. The satellite data is then filtered, analysed, and processed to

understand it's applications in segments, like the ocean, forest fire, minerals, air pollution, weather, and disaster management.

The young smallsat industry, which is yet to emerge, has a long way to go before making an impact. The reason it needs to prove itself and pass through the phases of TRL (Technology Readiness Level) to enter the commercial market, and then become commercially viable. Hence, the downstream sector has the lead, and this, in many ways, plays well for the existing smallsat industry operating as we speak. The sector's stakeholders are building several solutions to cater to the vast global commercial market by utilising the data from the existing smallsat in orbit. These satellites, however, don't have the latest hardware but can be classified as an almost outdated piece of technology.

The link between the commercial market and the stakeholders is not complete without a



Source: Author

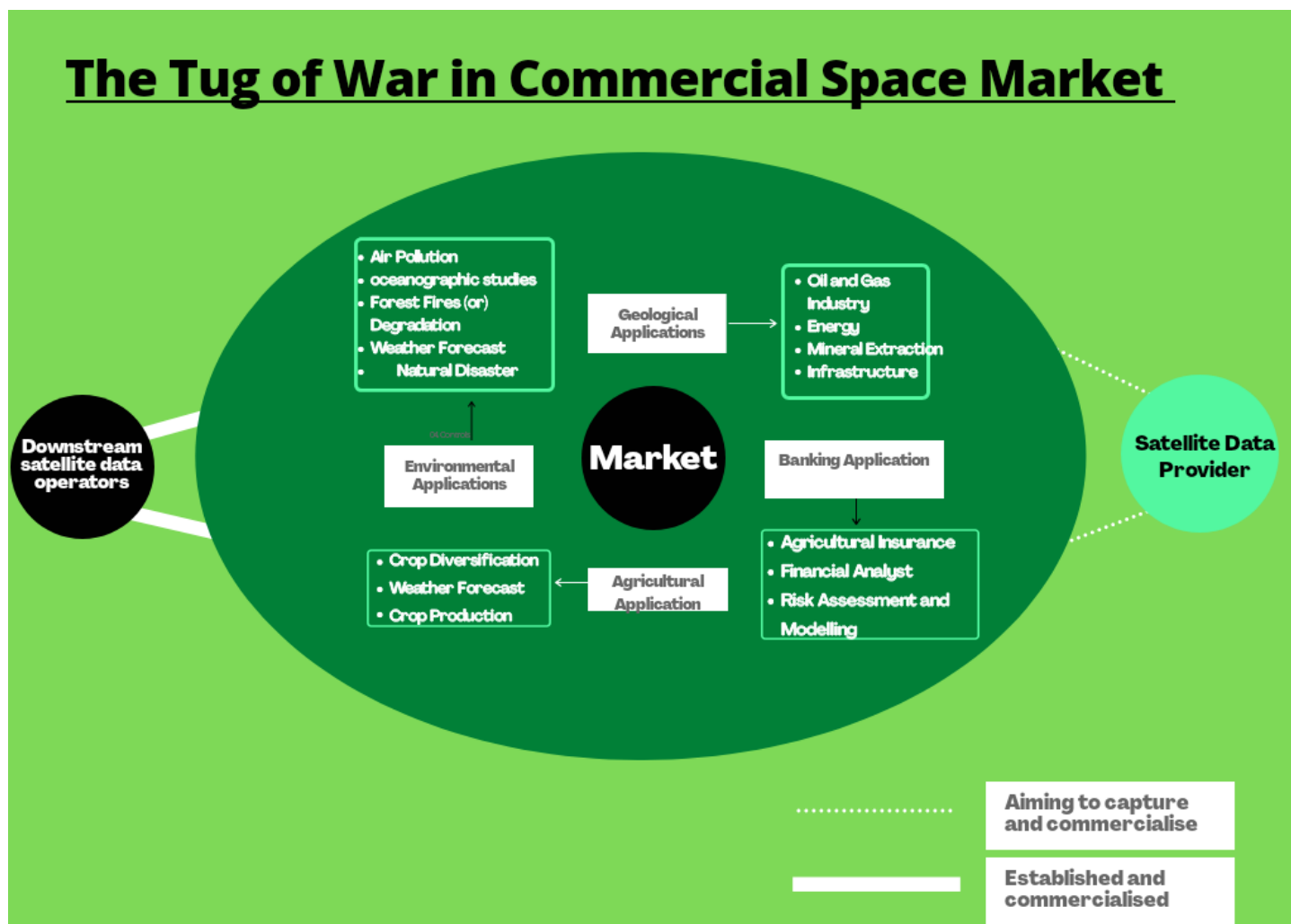
data processing unit, i.e. the satellite data analysing people. For instance, a banking industry would not process the satellite data on their own, even if they have access to the data directly. Data management and processing is an entirely different ball game, and it does require a mammoth amount of time and energy to get the desired results, which satellites aren't capable of doing on board today.

In a parallel sector, the data sets required by banks and government are similar to the byproducts of minerals we extract from the Earth. For instance, CNG, LPG, petrol, diesel, and other forms of fuels are just a byproduct of the fossil fuels extracted from the ocean

floor. The difference lies with the fragmented stakeholders in the space sector, unlike in the fossil fuel sector, where a specific company carries out extraction, filtration, processing, and sale of the byproducts.

The Gap of a Pendulum

The question that we have here is about why these downstream sector stakeholders aren't acquiring the data mines in orbit? The answer – they don't need to. The software development and the analytical tools used for extracting and processing satellite data are bound to outrace themselves in years to come. Hence, no matter how old a satellite or



Source: Author

how outdated it would be, the extraction and the quality of data-oriented solutions will only tend to enhance and grow over the years to come. But, with certain technological advancements in satellite design and manufacturing, specific innovators today are capable of accurate and precise data sets from orbit to their provider without the need for any downstream data analytical support.

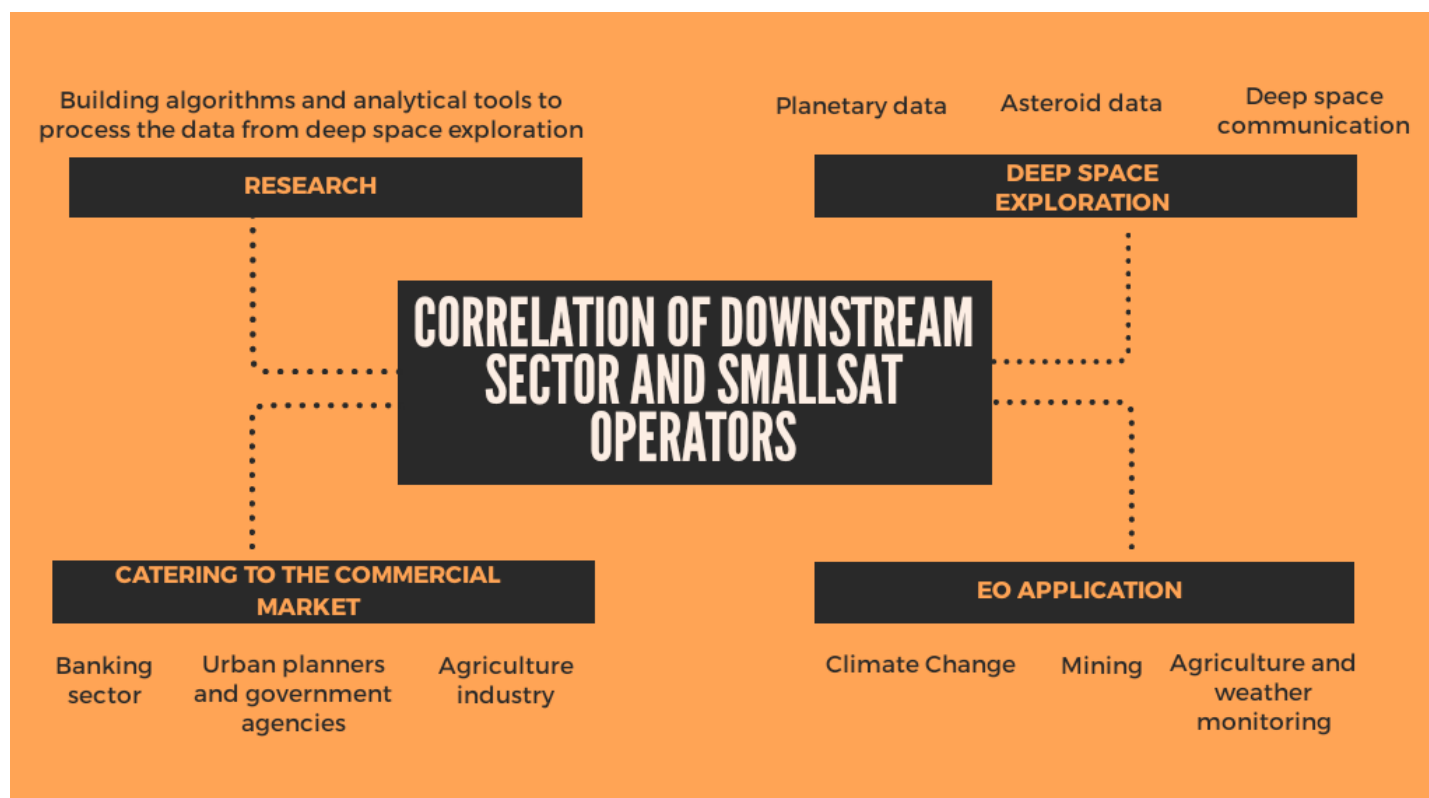
It is up to the stakeholders and their business plans on acquiring the satellite manufacturers. The shift in the market share between impact and market behaviour is like a pendulum, it won't remain stationary and will oscillate, which will again depend only upon a business strategy and not entirely on the technological front.

At present, the downstream sector stakeholders have the lead due to their focus and use of a software product, instead of hardware which is built by the upstream

sector. The rate at which solutions are churned out, and market share is acquired, is quite instant when compared to the upstream players. However, we do see some behavioural changes where some potential downstream market players have shown concern in collaborating with the satellite manufacturers. As we speak, such collaborations are taking place, which is like an alignment of bringing the data mine and data processing sector in one line.

Partners for Life

No matter how the markets mature in the years to come, the objective of the new emerging satellite market isn't limited to orbit, but beyond it. The technology to understand those data sets derived from deep space would need a whole new approach and possibly have some business potential in the coming days, which would make it immortal with the help of



Source: Author

downstream sectors.

The reason for this is because satellites are like an independent floating body with no manual control. Hence, the datasets it provides would eventually become a constant, serving a variable market. It's just like how we use our smartphones, having Android 11 is what everyone desires, but that's not enough. It would help if you had an updated or the latest hardware to make the best use of the Android 11 software update, and it's possible in this commercial market where manufacturing phones for a mass market is feasible. But this isn't possible with the smallsat industry. Hence, the investment and focus on building a better solution in the downstream segment are always on the rise. This means, extracting multiple information and answers out of a consistent quality dataset to meet the market demand.

In the end, what will accelerate the global space players will be the strategy devised solutions to capture the commercial segment. On the other hand, technological

advancement will always have government agencies at their behest to fuel their curiosity to study deep space.

I believe that in the future, neither the downstream sector nor the smallsat industry would exist without each other. What fascinates me, is that with every breakthrough, smallsat tends to outrace the downstream sector operators by providing processed and filtered data right from the orbit. On the other hand, downstream sector operators tend to outrace the new smallsat industry by developing and implementing new software solutions to extract and provide data-oriented solutions of a much higher quality than from an older satellite.

Among the experts and market analysts, it will be the launch vehicle industry, who would and will with time emerge as a market expert. After all, these launch vehicle industries are the link, to say the least, between the downstream sector and smallsat operators, if not now, then in a few years.

About the Author

Krishna Reddy is a mechanical engineer graduate with interest in niche technologies, especially the space tech sector. He has worked as a journalist where he reported and analysed the domestic space sector. Krishna is currently studying market behaviour, and it's possible impact on a global domestic stage. He also represents the Netherland space ecosystem to India, as an Innovation Officer, Innovation Attaché network, Netherlands.

Krishna is a budding space enthusiast, with a focus on the analysis of Upstream Market (Launch Vehicle and Satellite Manufacturing industry) and Downstream Market (Data analysis and Interpretation sector) and the relationship and impact of the two.

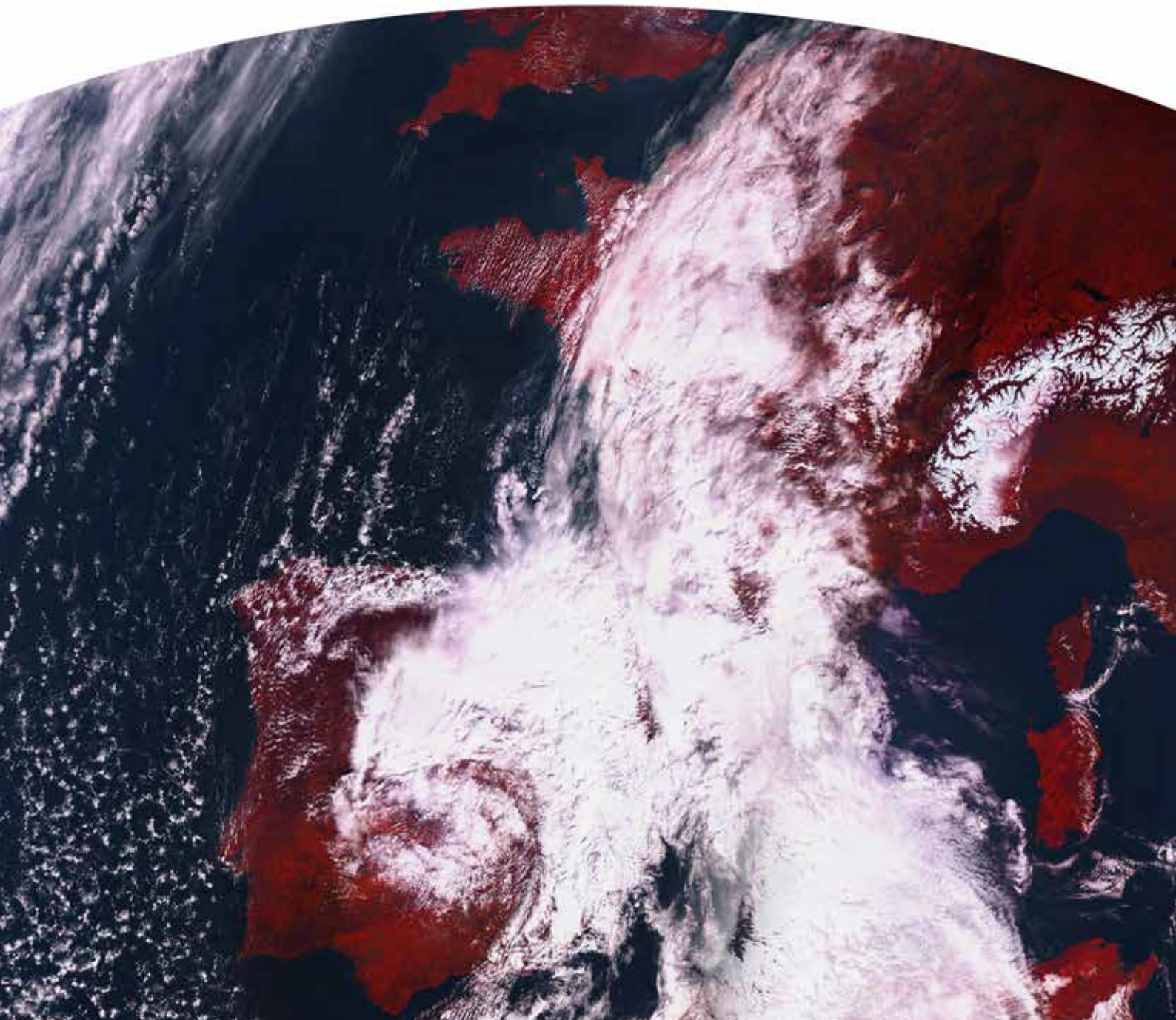


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Page 16

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Article 3: The Explainability of Artificial Intelligence

Page 25

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