The SatSure Newsletter

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FOREWORD

Dear Readers,

Welcome back to another edition of The SatSure Newsletter, which everyone likes to call TSNL. We are still in the middle of a pandemic, and over the months, we have learned to live with it and manage our lives around it. We now need to look ahead and plan. What does the post-COVID-19 world look like? Will life get back to normal, and will we see large scale digital transformation and hyper-automation (machines) taking over the world?

In this edition of TSNL, we have kept the focus on the impact of technologies such as Remote Sensing, Artificial Intelligence (AI) and data analytics, and Quantum Computing, with special focus on Agri-finance and how technology is playing a role in the post-COVID-19 world.

Dr Vinay Kumar Dadhwal, Director of Indian Institute of Space Science & Technology (IIST), in an interview with Prateep Basu, CEO, SatSure, has identified the trends in Remote Sensing and recent developments in geospatial technologies as well as the role of policies and industry standards in enabling startups to work in this field.

Dr Prasun Das, Secretary-General, Asia Pacific Rural and Agricultural Credit Association (APRACA) has spoken about the unique challenges experienced by their partner lenders in the agriculture sector in a post COVID-19 world, especially about the impact on rural market places in South-east Asian countries, and how new technologies is enabling effective reporting by these financial institutions.

Besides COVID-19, natural calamities like floods and landslides have continued to impact farmers and agri-supply chains. Inefficiencies of scale are observed when it comes to crop loans

and recoveries that depend on the vagaries of nature. However, the advent of applying AI to satellite remote sensing and making it an integral part of the digital transformation efforts on financial institutions has provided effective levers to support banks, farmers and insurers. A panel of four eminent authors talk about this in detail in the article "Scope for Process Re-engineering of Indian Crop Loan Management – Intervention of Satellite Imagery Analytics".

While AI technology has been around for quite a while now, enterprises are still grappling with how to use it for creating a strategic business advantage. And then we have technologies like Quantum computing, which are still under research globally, but have the potential to completely disrupt the way we process data today. The article "Quantum Computing and its Economic Impact: Why You Should Care" by Jason Necaise and Nancy Xia from qBraid, MIT describes vividly the emergence of quantum computing and how they are different from everything we know about computers today.

Finally, we have the key takeaways from a webinar held on 20th August where the Villgro Innovations Foundation partnered with SatSure and brought together financial institutions, agtech enterprises and impact-led organisations to discuss the challenges of innovation in agriculture and potential solutions to this.

I hope you enjoy reading these insightful articles and interviews. Stay safe!

Abhishek Raju
Co-Founder and Global MD
SatSure

Remote Sensing Technology: The Past, The Present & The Future

A Conversation with
Dr Vinay Kumar Dadhwal,
Director, Indian Institute of Space
Science & Technology (IIST)

Prateep Basu

Hello, and thank you for doing this interview with us. Let us begin with the story of how you got into Remote Sensing, specifically Agricultural Remote Sensing?

It is indeed, a story! I had done my Bachelors in Botany from Hansraj College Delhi University. There used to be a competitive examination known as the "ICAR Fellowship". Here you wrote a national exam in one of the agriculture subjects and being from a Botany background, and I had appeared for 'Plant Physiology'. In 1976, the fellowship holders were invited by the Indian Agricultural

Research Institute (IARI) for an interview to join the master's program. That is how I joined the M.Sc. in Plant Physiology at IARI in 1976.

After completing my M.Sc. in 1978, I took up a PhD. My research covered "A study of phenology, growth and yield in Wheat concerning environmental factors, especially photoperiod and temperature." During this period, the only remote sensing topic I came across was LACIE – Large Area Crop Inventory Experiment of USDA, NASA & NOAA.

In January 1983, the Space Application Centre (SAC) visited IARI and held in-campus interviews. They were looking for Agriculture or Agronomy students to do wheat yield modelling. I had appeared for the interview, and so without a formal remote sensing education, I joined the Space Application Centre on 30th June 1983 as Scientist SC. The division that I worked in was called Aerial Surveys Ground Truth and Photo Interpretation Division (AGPD) and was headed by Dr Baldev Sahai.

The first job that was assigned to me was to demonstrate a procedure for groundnut forecasting. In September of 1983, ISRO formally started a programme called "IRS Utilization Program" which had 16 projects. There were four operational projects and four quasi operational projects which were assigned to the National Remote Sensing Agency (NRSA) in Hyderabad. There were four experimental and four technique development projects which were to be carried out at SAC. One of the experimental application projects was crop production forecasting. So along with Mr Jai Singh Parihar, M.H. Kalubarme, Dr M.V. Potdar and myself – we formed the first satellite-based crop production forecasting team.

Over the next 21 years, I developed many procedures. These were for a village level to national level satellite-based crop forecasting and included crop discrimination, assessment, yield forecasting and crop biophysical parameters.
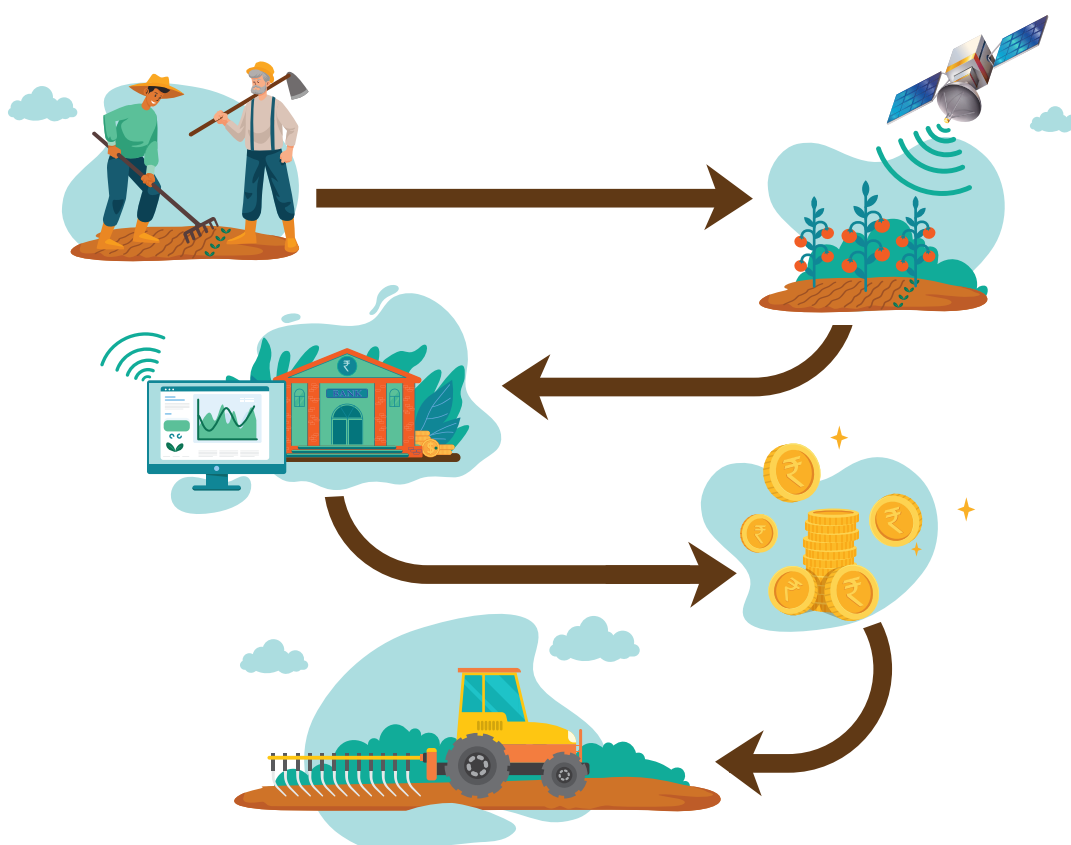
That's very interesting, sir! You have come from a botany background to a remote sensing background so seamlessly the way you have explained it.

Yes, none of the research work that I have done has been repetitive; they are linked but still dissimilar. Same plants, same crops and same objective but the tools and processing changed continuously. We were educating ourselves on the new tools, along with the regular forecasts the team was carrying out.

True! An interesting observation that our readers would have is you were part of this crop forecasting team way back in the early '80s, and today we are in 2020 and are we still speaking of the same thing?

We are attempting the same objective with new data, approach and an entirely new system design. If you look at the Mahalanobis National Crop Forecasting Centre (MNCFC) website, currently for nine crops and 14 states, they are doing multiple operational forecasting.

So the Remote Sensing based assessments are slightly different from how we generate bottom-up traditional crop statistics. In that approach, village enumerations are added to create the estimates for blocks and districts. The average yields of districts based on crop cutting are used to get the state and national level crop estimates.

There are many industrial applications of crop yield forecasting – and the current shift we are seeing is to go from district level forecasts which MNCFC was doing to GP level yield forecasting which is currently being piloted by them. The next step that would be to do farm-level crop yield forecasts. What do you think needs to be done from data acquisition, remote sensing, and crop modelling innovation to get to farm-level yield forecast? Or is it a pipe dream, in your opinion?

Firstly, there has to be a purpose to do a farm-level yield forecast. Secondly, one of the early lessons we learnt was that the cost of making a forecast must be less than the benefit which will come from the estimates. If the cost-benefit ratio does not support a projection, then it will die.

The third important point to remember is that a forecast is temporary – it will die when another late-stage estimate or the actual result is found. Fourth – the forecast's accuracy will be a function of how early/late one is making it. The best forecasts are those which are taken in a later stage, and also accounting for what is likely to happen from the date of the forecast to the actual harvest.

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Second is, assimilating the satellite-based biophysical parameters (Leaf Area Index, phenology and biomass) then run simulations with multiple downscaled weather forecast.

So, if you are making a forecast 60 days before the actual yield, it will have more considerable uncertainty. If it is 30 days, the risk is less; and if you're making 15 days before then, it is quite likely to be entirely accurate.

Now let us talk about a spatial scale – farm or district. So, when you are standing in the field, you can use biometric and some local input like weather to make a forecast. You are seeing the number of stems bearing grains, length and other such biophysical parameters. Nowadays, you can use a mobile phone to capture the information to be analysed by machine learning. Suppose the aim is to do a GP level or a village level forecast, the sampling points matter – how they account for soil and plant variability. **The moment you go to a district-level, you have two challenges.**
One is choosing the areas where you would do stratification and where you would do the complete enumeration. But data such as soil type, date of irrigation or application of fertiliser, would be available on a nominal basis. So, you have to start making intelligent solutions. This way, you can either end up in an empirical statistical model or an advanced model if you bring in crop simulation models. When you have, for example, a better medium-range weather prediction, you can bring in the forecasted weather also – and then you have a much higher version of a forecast.

Further on assimilating the satellite-based biophysical parameters (Leaf Area Index, phenology and biomass) then run simulations with multiple downscaled weather forecast. An empirical model can only be applied to the similar data set and the same location, the same set of observations. But advanced models can be easily transferred across spatial and temporal domains.

Just out of curiosity, I would like to understand what kind of time scale that should be targeted for doing the appropriate model based on phenology. The reason why I'm asking is that during Kharif season we have to do a gap fill – we have long durations of no data. So phenological detection can also give inaccuracies. So, in your career as a practising remote sensing scientist, how can one achieve the best temporal resolution to achieve good forecast?

Even if one goes to the field and makes a phenology observation for an area, the uncertainty would be +/- 1 to 2 days; this sets an upper limit of the accuracy required. With Earth Observation (EO) data which is available weekly is a full corrected time series that can be interpolated, then it could allow phenological estimation with +/- 2 to 3 days.
The challenge of a scientist is using multiple pieces of evidence because actual sowing day will not come from remote sensing, but you will get spectral emergence. So, you will get a profile of growth, which is every week or every 2 or 3 days. If you can convert spectral emergence into an expected sowing date and also parallelly do thermal imaging, then you can use this convergence of evidence to get +/- 2 days. This should solve most of the challenges.

I would like to go one step back to where you were talking about your journey. You have had a long career path where you have worked in SAC, and then NRSC to heading IIRS and today you're in IIST. How and why did you go from NRSC's industry-focussed application approach tomore of training the next generation of remote sensing experts and scientists at IIRS and now at IIST?

Let me confess that I haven't consciously done anything. Whenever anything that posed a challenge has come my way, I have taken it up readily! So, while I was in SAC and was heading the crop modelling division, Dr Navalgund, then Director of NRSA asked me one day if I would like to go to Indian Institute of Remote Sensing (IIRS) in Dehradun. He explained that as I am research-minded, the place will suit me and so, I decided to go.

So, I did more than agricultural remote sensing in IIRS until I was advised by Dr Radhakrishnan to go to the National Remote Sensing Centre (NRSC) in Hyderabad and take up a different responsibility. In 2010 I came to NRSC to be the Associate Director and oversaw many of their duties until 2016. In the year 2016, I came across this advertisement put out by IIST for a similar post. I was initially hesitant to take it up initially as it was engineering. However, people advised me as I'm interested in research, and education and I know so much about space and remote sensing – I should take it up. So, I went ahead and applied for the position on their advice and got it.

So that is how you became a part of IIST! Us alumni are very thankful that you're there as a director leading the institution. There has been a lot of changes and growth during your time, especially with the moves to open up to industry, setting up a placement cell, and the courses undergoing modifications.

We at SatSure have hired many IIST graduates as well since 2017, and quite a few of them are at leadership roles currently. How do you see IIST playing a role in bridging the industry talent gap, especially with geospatial technology becoming more integrated with traditional software products and applications?

Frankly speaking, a Director has specific roles. He has to ensure that the faculty teach, the students learn, and he facilitates the work of every individual.

A challenge that I have seen is that this domain of geoinformatics where the industry-academia gap is ever-widening. Earlier it was just surveying or satellite data interpretation. Now the areas of navigation and positioning are becoming critical. When you study engineering with a strong foundation of physics and mathematics, you can apply your mind to any tool. You are ready to assimilate the information from different domains and solve a problem. So, at IIST, we emphasise on problem-solving skills rather than knowing a software. Knowing a software implies that you are a technician and IIST doesn't produce technicians, **it creates engineers who possess problem-solving abilities in mathematics, programming and interdisciplinary areas.** Through their internships which begins from their 2nd year, they come across innovative ideas in their field.

What we have also done to our engineering students is to provide more options through a choice-based credit system. We have also recently started the industry partnership program for them to collaborate with companies from an early stage in their curriculum while also being

mentored academically by a professor at IIST. The industry partnership program is a step towards making IIST an attractive place for companies to recruit.

That is a fantastic initiative, and I am sure it will benefit both the students and the industry collaborators.
In the geospatial industry, what kind of innovative applications would you say could be developed with the introduction of new technologies like high-frequency satellite data, cloud computing, and AI?

In the industry, the individuals would get segregated into traditional RS/EO analysis and those who would do LiDAR/mobile vehicle survey. These come under the domain of photogrammetry and information extraction and merging with geospatial datasets. The latter category's skills are becoming more critical as a part of extensive infrastructure monitoring like buildings, roads, and bridges. So, we would see a high amount of collaboration between the engineering and architecture teams with the use of geospatial technologies.

On the other hand, smart cities will be coming up, and they would be linked by sensors, decisions and SCADA (Supervisory Control and Data Acquisition) or IoT (Internet of Things) and real-time data. The third domain will be citizens and NGOs who would use one's phone to take a picture and acquire some information. The information obtained

can be used for providing the community information, for example on underdeveloped areas and places which aren't safe for women.

The fourth category is the application of geospatial technologies in water resource management, irrigation, the distribution and use of pesticides, protecting the forests and preventing fires. Finally, we have an application in global-scale problems from monitoring greenhouse gases, the size of the poles and protecting the oceans. One wouldn't be able to do all this daily without the widespread use of geospatial technologies.

Correct, like the use of Google Maps on one's phone where one doesn't realise that their location is the result of triangulation of four GPS satellites.

Yes, everyone uses Uber and Ola; they don't realise that they're using geospatial technology. They only ask the driver to come to their location! There are even algorithms for taking the shortest route from your location to the next.

I agree. India is doing well in the geospatial domain but not at the same level as other developed countries. So, many people blame the non-predictability and the non-transparency of the regulatory framework around it.
In your opinion, especially with the establishment of IN-SPACe, which has led to both positive and negative vibes everywhere, what role do you see the government playing in shaping the convergence of geospatial technologies into mainstream software platforms like mobile phones.

Let us look at the answer in this manner – you would agree that there are successful

geospatial companies in India? There exist technically competent geospatial organisations who carry out projects for global users. We also see other successful organisations who own the content, like MapMyIndia. We also see implementations done in-house like electric utilities and the construction of Lavasa, to name a few. Either one owns the content or has the expertise or they should build up a customisable solution. I have come across many individuals who say that interpreting the scene or acquiring high-resolution data is their biggest challenge! I would say that it's the least of the problems, especially if you want to be a top-notch commercially successful organisation. **The critical question is – what are the skills necessary to do this?** The policies and the government are looking from the perspective of security and marketing their data. There are ways to go around these challenges – which are both successful and financially viable.

Yes, that's true, at SatSure we have also been able to work around these challenges and create a sustainable business!

The actual business acumen, the technologies and solutions one brings to solve people's problems and to make money simultaneously – that is the essential skill needed in the industry. They need to create their own markets!

What will change post this pandemic is that it will become effortless to access and market high-resolution satellite data. For example, the locust attack on India has shown that agencies can simply hire drones and spray insecticides; even the Survey of India plans to use drones to do cadastral and field mappings.

An entity's commercial success will be based on the software they use; the content they deliver; and the service the end-user subscribes to. **An organisation needs to answer three essential questions –** what are they bringing to the table, where do they fit in and what can they uniquely sell to users and ultimately make money.

In my opinion, the policies are nice to have, although they can only do so much. The actual business acumen, the technologies and solutions one brings to solve people's problems and to make money simultaneously – that is the essential skill needed in the industry. They need to create their own markets!

I agree! We are seeing that the usage of open-source data and satellite data from the European Space Agency and USGS has played a significant role in making the focus more on creating market demand. However,

what many people don't understand is how the interpretation of the information that they are getting could convert into final insights.

If you could provide, based on your experience, what are the key pitfalls that start-ups operating in the remote sensing & analytics space should take care of in their technology development plans.
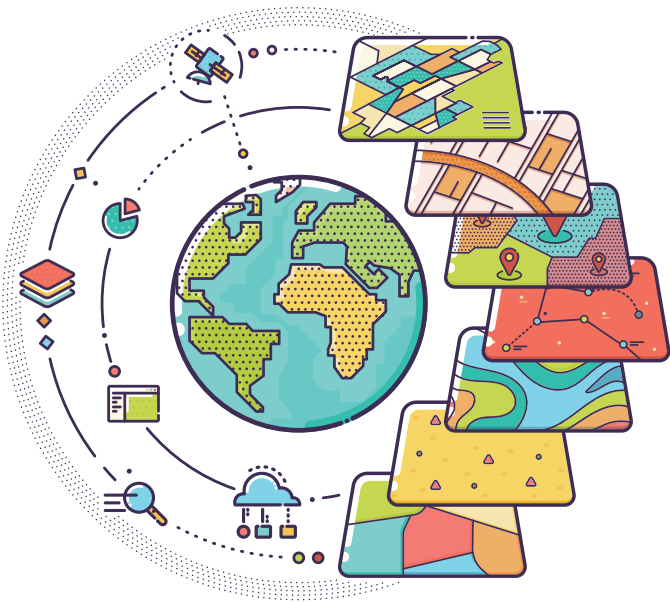
> **The supplier and end-user must answer three crucial questions: what exactly is the information needed, when is it required and what would be the format for assimilation.**

The supplier and end-user must answer three crucial questions: what exactly is the information needed, when is it required and what would be the format for assimilation. When I was the at NRSC lot of people would question the absence of high-resolution data. They miss the point of the resolution required for their application and the limitations of large area coverage at such a high resolution (in that time frame). Also, USGS and ESA opened their data, and commercially available data

remained at a substantial cost.

The second issue is that most of these applications create legacy data. So even a new map may still have 80-85% accuracy. However, if we assimilate past maps and field information in the next cycle of assessment with appropriate logic, a better output could be generated. Thus, legacy data availability and use must be encouraged.

You mentioned an interesting point that many people don't get. Two out of the four founders at SatSure did not have a remote sensing background, so we started with wanting to understand the customer problems and then work backwards to create the most optimal solution. A satellite image may not be the only way of solving that problem. Over time we arrived at something through a rigorous process of customer discovery.

So according to you, what are some of the more significant problems today which could make use of such kind of a service-driven by remote sensing data and also has a nationwide impact? Could it be better yield prediction, could it be creating better models for monitoring infrastructure construction, or something related to supporting sustainability initiatives of the government?

In my opinion, if you want to address a problem like making a national level forecast or a state-level forecast, you will have limited users. But suppose you want to make an impact; it is always good to have a product which one can modify at two or three spatial scales. It can be tweaked at the farmer/village level or the local supplier level, depending on the kind of problem you want to solve. **Such a person who can do this successfully will become a node, and you can have hundreds of such nodes.**

One should look at the user interfaces and then design their products and services. With such an approach, multiple users will benefit – like an insurance agency or a lending organisation or industry supply chain actors as well. **The idea is to be aware of the bigger picture and create customisable solutions.**

So, it is essential to have that user focus; and the user and the entire market has to be big enough for you to sustain your business. But the education level on utilising analytics derived from remote sensing data varies across the industry value chain, and most of the users are unsure of how to trust the results since they aren't party to the modelling and assumptions that have gone behind it.

The final question is that once we cross this hurdle, what is the usability of these geospatial insights for extracting value for the business? Do you think that the lack of industry standards around the data quality and modelling processes could help address such challenges? Would it help open new markets and allow the users to differentiate between companies' basis the quality of work, rather than be confused by marketing jargons?

A challenge which I faced was when targeting an output which was already being produced by a non-Remote Sensing approach. We spent a decade in arguing and making comparisons, and then there would be turf wars like why should the space guys do forecasting. The argument is still the same, but the actors have changed. Now, these commercial companies and youngsters should not get into these turf wars. So if you find or develop a new market, just move into it and do not wait for the government to establish standards and certifications.

There are other challenges which are in the heart of the system – it can either be related to making an observation, creating a crop model with an additional layer or any other extracted parameter. You can then add the application-specific information, based on the type of user.

Unfortunately, many people don't think that way and consider it more like a pipeline with fixed sequence. So, if tomorrow the Sentinel satellite fails, you can replace it with Landsat or an alternate source. Unfortunately, many players have not been able to get this in place in their system design. Several problems arise which could be difficult for users to overcome. The question of acceptance by user will always be there in the remote sensing industry, and it's within the acumen of the entrepreneur to overcome them.

About Dr Vinay Kumar Dadhwal

Dr Vinay Kumar Dadhwal is Director of the Indian Institute of Space Science & Technology (IIST) since July 2016. He has more than 37 years of research experience in developing applications of earth observation data for agriculture, hydrology, land transformation and deforestation and disaster management support. His earlier leadership positions include Director, National Remote Sensing Centre, Dean of the Indian Institute of Remote Sensing (IISR) and Head, Crop Inventory & Modelling Division (CMD) in the Space Applications Centre (SAC/ISRO) during 1998-2004. He is a recipient of many awards from ISRO, Indian Society of Remote Sensing, Indian Meteorological Society as well as young scientist awards of Indian National Science Academy (1989) and Indian Science Congress Association (1986).

The Paradigm of Rural Agricultural Finance in Asia Pacific

An interview with

Dr Prasun Kumar Das, Secretary-General, Asia Pacific Rural and Agricultural Credit Association (APRACA)

Prateep Basu:

I would like to start this conversation by requesting you to kindly brief our readers about APRACA and the work that it is doing in improving rural credit in the Asia Pacific region.

Prasun Das:

APRACA was established by the Food and Agricultural Organization (FAO) of the United Nations (UN) in 1977. The basic idea of this organisation was to have a regional member-based association of financial service providers.

During the 1970s, countries in the Asia Pacific and in other parts of the world were facing a significant challenge of "food security" where there was an ongoing food crisis. All the developmental organisations realised the importance of providing investment and capital for developing agriculture. For that purpose, FAO established three regional associations – one here in Bangkok which is APRACA, one based in Nairobi, Kenya which is called I and one more based in Aman, Jordan which is called NENARACA. Established in 1977, these three associations were the associate agencies of the UN. They aimed to provide an impetus to agricultural finance and to support agricultural development in the regions.

The mandates were mostly regional, but with a global outlook to work with communities. With the start of the new millennium, these regional associations along with two more agencies namely, ALIDE, based in Lima, Peru and CICA based out of Zurich, Switzerland, joined in

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organising the global community with the introduction of World Congress on Rural and Agricultural Finance which are hosted in different continents.

The 43 years journey of APRACA has been extremely fruitful. If you look at the significant developments across the region in agricultural finance and policy, APRACA drove them through its initiatives. We have received much support from the FAO, along with organizations like The International Fund for Agricultural Development (IFAD), GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH), Syria Populate and the World Bank, and several international agriculture research institutes under the CG system, have supported us thus far.

You might be aware that the APRACA membership ranges from the government agencies, line departments specifically the agricultural departments, central banks, national development banks, commercial banks, the rural banks to the APEX level financial co-operatives and their associations. During the '90s, APRACA started extending its membership to MFIs keeping in view the important role being played by these institutions. Although we didn't reach out to the smaller MFIs, we did reach out to the smaller organisations by providing membership to the national level microfinance associations, like those based in Pakistan, Myanmar and Cambodia. In a nutshell, we kept APRACA's membership open for the institutions that were working for the development of agricultural and rural finance and MSMEs in the region.

As APRACA has a very niche area of work, it takes up the membership with three primary objectives:

1. We work with the policymakers, the government and the central banks so that we can have a rounded agriculture finance policy. We do this by generating evidence-based research in different countries, and the results of these are taken to the government.

2. We try to document the best practices by the member institutions and then disseminate it to the broader knowledge portals which exist in FAO,
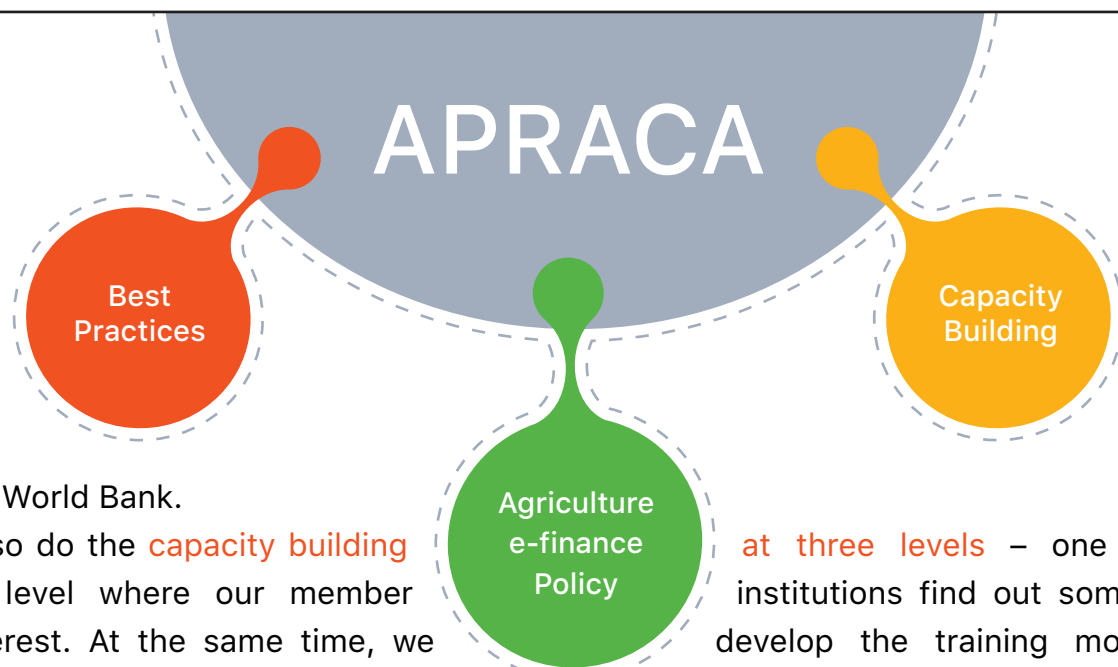
ADB and World Bank.

3. We also do the capacity building ... at three levels – one is at the national level where our member ... institutions find out some areas of their interest. At the same time, we ... develop the training modules and delivery, through our technical experts ... drawn from the member institutions. Second is the regional level which is more thematic in nature. For example, we are currently working on the green finance, SMEs and digital finance initiatives in specific regions. The last level is, of course, the global one.

For a public organisation, we are an incredibly open one! While our secretariat is in Bangkok, but we have our arms spread all over the region. For example, our regional training centre is in Manila, our consultancy service is in Jakarta, our Centre of Excellence in Beijing, the publication office in Mumbai and the Women Empowerment Centre of Excellence in Iran. We are also developing a centre in Nepal on Digital Finance and one in Thailand on Value Chain Financing. The secretariat's job is to establish the relationships, maintain the network of partners and conduct their training need analysis. That's my summary of the 43-year journey of APRACA!

Prateep Basu:

Thank you, sir, for the elaborate explanation of the origin of APRACA and its functioning. As a follow up to this question, could you mention a couple of remarkably successful initiatives that APRACA has led over the years? I'm sure there are many, but maybe the one's you have been involved in person.

Prasun Das:

We have many of them indeed, and I can give you a couple of cases as examples. The Self Help Group (SHG) movement in India, which was started by NABARD (National Bank for Agriculture and Rural Development) is an example of this. It was initiated by APRACA in five countries, with India being one of them. We received a GIZ fund in 1983, and we started working in Thailand, India, Philippines, Vietnam and Indonesia. The most success that we got was in India, and it is now a movement, like in Thailand, where it is called JLG (Joint Liability Group). In these two countries, our mission was successful in engaging with the national developmental institutions to work with the local institutions.

The second example that I can tell you about took place during my tenure. We had a long

engagement with the government of Nepal for three years. We were able to develop a policy in Nepal in financing the smallholder farming and allied activities, where they receive an interest rate subsidy of up to 5%, depending on the risk they were facing. For example, a farmer in Nepal who was in the mountainous areas had a higher risk, so his subsidy rate was more than that of a farmer in the plains. We developed such categories to determine what are the indicators of risk which would be accepted by the central bank, and now it has become a norm. The banks financing to the farmers under this scheme are receiving the difference through Nepal Rashtra Bank (the Central Bank of Nepal).

The third one, which is also a significant example, is where we worked closely with the Philippines government, along with the support of Agriculture Credit Policy Council (ACPC) and the Land Bank of the Philippines. Here, we supported the development of the terminal market, which is in Baguio City, for farmers. This market is now covering three provinces in the mountain region of the Philippines, where the highland farmers produce vegetables and bring them to the terminal market through the producer's co-operatives. So they get a price which is better and higher than what they used to receive before!

Prateep Basu:
That's excellent! Since you work with partners across the region, could you elaborate for our readers on some of the challenges that organisations into rural financial services face?

Prasun Das:
The key challenges that I see from APRACA's point of view – has three parts to it. One is the Rural Finance Market Framework. The diversity in the Asian countries created a rural finance market which hadn't grown and was ripe for disruption. For example, in India's case, the agricultural finance market was deployed during the 1970s and 80s, and more emphasis was given in the 1990s when the new industrial policies came in. Other countries, like China, changed their policies in rural finance in the latter part of the 1980s, wherein they allowed the rural co-operatives to become commercial banks. The Agriculture Bank of China, which is one of the first members of APRACA, happened to be a co-operative bank and now they're the second-largest bank in the world!

There is much diversity which is a real challenge to the whole agricultural finance market in South Asia and Asia Pacific region. Within the rural finance markets, we have issues like the development of differential products. We have several financial products to support agriculture; however, if you go deeper into those products, you will see that they are mostly general and not customised, which is what the agricultural sub-sector requires. To address these challenges, APRACA is developing tailor-made products for the fisheries sector along with FAO. If you go to the banks in India, Cambodia or the Philippines, they don't have any particular product for the fisheries sector. So now we're trying to develop such a product for the industry. As you know, insurance is an essential component in the agriculture financing sector, and only in some of the countries like China and India, do we have insurance-linked loan products. So we are trying to build a similar product to develop for our fisheries sector - an insurance-linked fisheries lending

product.

We have also seen significant issues related to KYC (Know Your Customer). On the one hand, you have some countries with strict KYC norms due to the terrorism-related threats, and on the other, there are countries with no rules at all! Another challenge is the limited financial access issues like in Nepal, which is mountainous, and the banks have their branches in city areas. These are some examples of the challenges we have to address with the use of technology, favourable policies and regulatory reforms.

Rural Financing regulatory framework is another area of challenge that organisations in this sector have to face. Some of our central banks are very developed, and they want to move forward quickly. An example is the Bangladesh Bank which has made changes in the last ten years to enable agriculture and rural finance, and their progress is impressive. Even bigger countries have not been able to achieve this level of success. Another example is from Cambodia, where the Central Bank there has developed a cryptocurrency.

The government and the Asian countries are intervening in the finance market vastly because most of them have policies of their own. Some of these are demand-led, while some are subsidy led.

These rural market regulations have always been an issue for us and a large amount of APRACA's time goes in engaging with central banks for enabling such policies. Even if the challenges of the rural finance market and regulatory

frameworks are addressed, one will would still need to innovate mainly at a product and services level.

To elaborate a bit more on this aspect, let me share the learnings from a project that we did for four years with IFAD on documenting best practices of rural financing in different countries like India, China, Indonesia, Philippines and Thailand. What we found is that one state may follow excellent practices in agricultural finance and outreach, but it does not suit other countries. The issue of innovation comes in here – how does one innovate to add features in the product of one country and implement it in another?

Although there are issues of innovation, lately there have been good signs of exciting products being developed such as the micro agricultural loans in the Philippines. The rural banks there have designed micro agriculture loans for amounts as low as $ 150 - $ 200 and these may last for a period of 7 to 10 days so that one can come back and repay it comfortably. This is an important innovation as the bank can immediately serve the customer with the requirement. Even micro-insurance as a product didn't receive recognition until 2010-11, and APRACA took many efforts to engage with the banks and insurance companies to develop these products and deliver them to their borrowers.

We recently carried out a study for green finance in the region to understand how "green" it is and whether these new products are serving the agriculture sector or not. We found that these weren't directly serving agriculture. However, indirectly they did, and we have to understand the reality – which is that the agriculture sector produces greenhouse gases. We need to develop a product to curtail this aspect. Hence such innovation is essential, and now we are looking to work with CGIAR and the Stockholm Environment Institute for developing a green finance product for our members.

Agriculture inputs

Farming

Aggregation storage/logistics

Processing & ancillary service

Consumption

Prateep Basu:

Can you also throw some light on the challenges faced by the rural financing sector due to COVID lockdowns? And how do you see the current situation evolving moving forward?

Prasun Das:

Recently we surveyed our member institutions and came across some key issues. One of them is servicing the smallholder farmers for providing them with necessary inputs, provisioning of markets and including procurement, and insurance. Due to the markets getting disrupted, smallholder farmers across countries faced the maximum brunt of it. Hence, it's clear that we need to find ways to provide them with digital agricultural technologies. We also found that the livestock market was more affected than the agriculture market, and I believe that we need to ensure that we stabilise their demands, as it was highly unorganised.

It was apparent to us that we needed to provide a significant amount of financing facilities to the value chain actors, who are in turn providing services to the smallholder farmers (SHF) by buying back produce or providing them inputs. These are the small agribusinesses and even AgTech startups who are serving SHFs. Hence, our primary activities during the COVID-19 time was providing tailor-made solutions to the SHF's so that they can avail the required money to pay for the labour. These agricultural labourers were in distress and weren't getting their farm job back, while they aren't supposed to keep their produce in the field for a long time either. Hence enabling financing to them is essential so that they can have a linkage with the buyer at a village level, which supports the local food system. APRACA is working on initiatives to unlock financing for these small groups who are taking care of the products from the field.

We also supported the small businesses so that they could link up with the larger stores and so that they can get a more extended period of cash credit from the financial institutions. Most of the cash credit these groups were getting was for two or three cycles, which has now increased to five to eight cycles. There is a requirement of huge investments, but our financial institutions are facing considerable challenges currently with assets and liabilities because the asset sizes that they have created is no longer working, due to rising delinquencies as an after-effect of COVID-19.

During this lockdown and due to restricted movements, the savings chart which the Asian Development Bank has published recently

shows that the propensity to save has been reduced, with rural markets being drastically affected. This is a particular area of concern from a financing point of view, and most rural banks would suffer as well for the near term at least due to these cash crunches.

At APRACA, we tried to negotiate with the central banks to support MFIs or NBFCs in Cambodia, for example, by conducting webinars with all of them and guiding them on how to deal with this pandemic situation. In Bangladesh, a small fund for these NBFCs and MFIs was created so that they can get funds from the central bank at a low interest and for a more extended period. These are some of the things we are doing to support our member institutions so that they, in turn, can help the farming community and the rural population in their countries, with the outlook that such downturn will be the new normal for the next couple of quarters.

Prateep Basu:

Regarding the challenges that you mentioned, there are so many different aspects around. You also spoke about linking insurance to credit which is somewhat done here in India, although the current insurance scheme is now voluntary. Another major challenge that we have seen in India is the absence of digital land records; it is so challenging to create a customised product because of this. We have to go to the lowest administrative region – that is the village boundary. Is that something prevalent across the broader Asia Pacific regions as well?

Prasun Das:

You have brought up a fundamental issue, and we have been grappling with this over the last five-six years. What we have found that is, even countries like India and China face such problems. Smaller countries like Thailand have, however, digitised their land records, which are an asset for them today.

We suggested to the Ministry of Agriculture, Government of India in a recent meeting that we not only need to record the land size but also the record the other assets in a registry. Having such a log at a national level for the farmers, where they can register their land, all their assets like how many cows they have, how many cycles and their updated value will prove to be vital in unlocking more finance in this sector. This would help to finalise what is the worth of a particular farmer. If the value is estimated basis just the land, then that is not reflecting the real worth of the farmer. We have seen some countries are trying to do it – though not in the Asia Pacific region.

Our counter agency in Africa created such a national registry where they had registered all the farmers. They then categorised them based on the asset's quality, size and worth. This would help any financial institution, including an insurance agency, at any point of time to understand the value of this particular farmer.

A new workaround on the challenge of missing digital land records was seen in China. They developed loan insurance a kind of guarantee, as digitising every farm is a mammoth task which may not provide the right benefit even for the cost needed to achieve it. Today, loan insurance is a particularly important market in China, and it isn't insurance like what we see in India or the Philippines. One doesn't have to go to the farmer; instead, companies providing these loan

insurances have to do the due diligence on the bank and the portfolio of the bank.

Several innovative ideas are coming up. But the collective agreement is that a digitised system to show the worth of the farmer is the most important activity that needs to be achieved for the insurance companies and banks servicing the agriculture sector to survive.

Prateep Basu:

You mentioned about evidence-based reporting, which is something that APRACA does. How do you see the use of alternate data like weather proxies or satellite imagery for doing this kind of reporting, especially in the context of a post-COVID world where travel restrictions will be there?

Prasun Das:

We all have seen that the banking infrastructure is changing rapidly today, with more and more penetration of digital technologies. About ten years back, we were thinking of the national ID, which is very important in many countries, like India and China. The national ID was essential to identify the borrower, but what we have found is that even if a national identity exists, it is not enough to push for enhancing finance in the agriculture sector. A deeper dive into this was taken by us to look at the elements needed for a financial institution to identify when they want to finance agricultural development or projects. We found that it isn't the national ID or KYC but the changing environmental situation.

There are three challenges in this respect. The first is that agriculture in several countries is dependent on the weather. The second is regarding the off-takers of these agricultural commodities which the farmers have produced. And the third issue is that it is not just the off-takers information that we need but also that of the whole value chain ecosystem. All these three things need data. Without useful data, it is not possible to address these gaps.

Now agriculture is a technology-driven sector, and

all of our member banks understand this. Unless you consider data as necessary, it will be a precarious affair to finance SHFs, who constitute the majority of the farming community in Asia. But if we have accurate data, for example, the information regarding the crop and weather patterns from the past ten years, we can start predicting on what might happen to the crop of the farmer who is borrowing.

It is a known fact that data will play a significant role in the next five years. We at APRACA are trying our level best to include all our financial institutions, including the banks, to provide guidelines to our member institutions so that there will be a considerable usage of the data – both traditional and alternative ones. There is a large amount of data available, but in a lot of the cases, it is not centrally stored and may not be readily available to the banks. But private-sector banks can get the data from various organisations like SatSure, for example, and use it for their work. Data will be the next level of change in the banking system, especially for rural banks and agricultural finance.

There has also been considerable talk about ESG (Environment Social Governance), where we are telling our banks to consider this in their risk mitigation process. For ESG, we need data and how this data is generated and used should be decided at a national level, which we are facilitating. What we have found is that if obtaining the information is expensive, then our smaller institutions like financial co-operatives and MFIs or NBFCs – they would not be interested in using it. But if the data is available at a commonplace, at a national level where they can access it easily, then it will be easier for such institutions to involve themselves in this system to get the data and make informed decisions.

Prateep Basu:

What we have seen in India is that NBFCs and MFIs, even though their loan sizes are small, are keener to adopt technology than the large public sector banks. Is that something you see in the Asia Pacific region as well, where most large central or public banks are slightly more risk-averse in trying out new technologies?

Prasun Das:

You are right. Most of the large banks in this region are government banks. Till they don't receive directives from the government, they won't take up any new ventures. However, NBFCs are talking about it. For example, in India, one of the NBFCs is Samunnati; they are taking up a lot of these new initiatives. They are considering the data as a significant driver for their financing to the value chain. The data is not just for providing funding to the farmers, but also for making decisions about other actors in the ecosystem.

Back to your question, yes, most of the large banks in the Asia Pacific region are minimal adopters of such technology, but when they do adopt it, they do it in a big way. We need just to wait and keep providing them with more data or feedback or evidence so that they will adopt it, and when they do, it will be huge!

Prateep Basu:

This brings me to the last question, which is related to the role of developmental agencies like IFAD, FAO, ADB in these testing times for supporting agricultural finance in the region. You mentioned that the delinquencies have been high, and the asset quality has overall reduced for lenders in the area. How do you see developmental agencies playing a pivotal role both from a policy perspective and technology guidance? As you know, the developmental agencies are the ones exposed to all kinds of technology and policy reforms that are provided as a consultancy to the members. How do you see these entire dynamics evolving?

Prasun Das:

You have raised an important question! However, what I would like to flag here is that majority of these developmental agencies work with the government and not the lenders. For example, the multilateral agencies, work with the government while bi-lateral agencies sometimes work with the private sector. These agencies have two powers – one, as you said, is the development aspect, the other is their businesses.

When we talk about this post-COVID-19 situation, what we have found is that in most of the Asian countries, agriculture faced a formidable challenge to grow. Asia has the highest population growth rate, and interestingly the highest growth rate of agriculture as well. The Asia Pacific region is the largest exporter of different food items across the globe, so we need to be more focussed on developing our agriculture to be at the same point as we were before COVID-19 happened.

A harsh lesson that we've learnt is the challenge of technology in infrastructure, especially that of warehouses, and cold chains. Farmers will continue to produce, but the prices of their commodities are reducing each day. At the same time, the people at the end of the value chain are getting the product at a rate higher rate. Why is there such a big difference?

We did a study in where we saw that a farmer who produces the same product that he was in January, is selling it in June, at a 66% higher rate than what he was selling in January. There is such a big dichotomy here, and we need to help the farmers to get the right balance. So with this problem identified, here comes the role of the developmental

institutions.

These agencies can provide technical assistance where they can support the farmers to become significantly more competitive in the current scenario and assist them in linking it with the market. Also, developmental financial institutions like ADB need to develop agricultural infrastructure to support the farming community so that SHFs can get the right kind of a price through such infrastructure development. By infrastructure, I mean not only physical ones but also the technological ones where they can get information about the market, about the weather, the prices of the inputs and outputs. We've been trying this for some time. If one does a check today, you'll see that farmers haven't been able to reap the benefits of technology as you would expect.

So, what should be the mechanism to execute this? For example, in Vietnam, the women's co-operatives are a significant force in the whole Vietnamese agricultural export system. Vietnam is now exporting the highest amount of agrarian commodity in SE Asia. How did they do this?

We need to draw lessons from such kind of models and put it forward to those development agencies so that they can support other countries. What I have seen is that the development agencies are doing much work in this COVID situation. For example, IFAD created a separate fund for less developed countries to build their agricultural value chains, so that the local market doesn't get disrupted. But there is still a lot more to do, especially working closely with the government. We have discovered a ground reality, and all of us need to watch closely and work from there.

ABOUT DR PRASUN KUMAR DAS

Dr Prasun Kumar Das is currently serving as the Secretary-General of APRACA based in Bangkok where he is leading the Secretariat function of the 86 member institutions spread over 24 countries in the Asia-Pacific region. Before this assignment, he completed his term as the Project Manager in implementing IFAD (International Fund for Agricultural Development) regional project on 'Documenting and Piloting Rural Finance Best Practices'.

Dr Das received his PhD in Agricultural Sciences (Agronomy) with specialisation in Post-harvest Management and also held a Master's in Business Administration (MBA) with specialisation in Financial Management.

The main areas of work and Dr Das are synergising agriculture and farming system with the value chains and access to finance for enhanced productivity and efficiency of the smallholder farmers. He is a recognised leader in the areas of value chain development and finance, agriculture for nutrition and linking farmers with the support systems in South Asia, South-East Asia and Sub-Saharan Africa and published more than 20 international papers on the area of his specialisation.

Scope for Process Re-engineering of Indian Crop Loan Management –
Intervention of Satellite Imagery Analytics

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About Crop Loan

From ancient times, Indian farmers practised subsistence farming (i.e., farmers produced what was needed for their immediate family, but not to sell in the market). This is the foremost reason why farmers from ancient times couldn't accumulate large amounts of wealth. Slowly as the British and globalisation took over, the Indian farmers were forced to produce a marketable surplus. However, the repeated famines, non-remunerative prices, miscalculated policy actions, and many political agendas ensured farmers remained hand to mouth. Various reports have pointed out that the farmers' average annual income hovered around Rs.70,000 to Rs.80,000 during 2012-13 .

Further, the income levels increased with growth in acreage. The average Indian farmer holds small or marginal landholding. All this points out that one of the major threats to the Indian farmer is the lack of investment for farming activities. Despite this constraining situation, the farmers have continued to invest in their farms by borrowing from various lending parties. Until today, informal money lending remains a widespread means of agriculture finance. However, it is steadily being replaced by formal lending institutions like banks and NBFC's. Despite the new age policies taken to push farmers into taking credit from formal institutions, the method of assessing creditworthiness is still archaic.

Existing Process

The farmers would need the crop loan before the beginning of the crop season. The farmer could approach the banker either for a loan renewal or a new loan. When the farmer approaches for a new loan, he would have to submit documents to prove that his land is non- encumbered and a no dues clearance certificate from all the banks in the service area. If a farmer attempts to obtain renewal for the crop loan, then he would have to submit a document confirming his ownership of the land and fill up the application form. The application form contains details related to acreage, type of crop, farmers' capabilities, etc. With these documents in hand, the banker proceeds to determine the creditworthiness (CW) of a farmer.

The three main components in deciding the CW of a farmer are his CIBIL score (also known as CIR – Credit Information Report, issued by Credit Information Bureau India Ltd, referred to as CIBIL), past performance on loan repayment and the inputs received from the informal network. Using the above factors, farmers CW is determined and combined with the 'Scale of Finance' to arrive at each farmers' loan eligibility. The scale of finance (SOF) is a document prepared by NABARD's (National Bank for Agriculture and Rural Development) State Level Banking Committee (SLBC), determining the rules and limits of agriculture lending.

In addition to this, it has been observed that farmers' relationship with the bank managers might determine loan eligibility. Upon completion of all these intricate procedures, the bank communicates its loan acceptance decision to either accept or reject a crop loan application. At this stage, the banks' field level officers are expected to step in and do the groundwork. This involves verifying the farmers' details based on the field visits and also discussions with village-level informal networks.

The loan is then disbursed to eligible candidates, and the bank is supposed to monitor now and then. They accordingly provide interest rebates under government regulations. The Interest subvention (IS) and the Prompt Repayment Initiative (PRI) for the short-term crop loans determined by RBI (Reserve Bank of India) are 2% and 3% respectively for loans up to 3 lakhs . This implies that if a bank charges interest for crop loan at 7%, then the effective interest rate for a farmer who borrows less than three lakhs would be 2% (i.e., 7% - (2%+3%)). The 5%, which includes the IS and PRI component, would be remitted by the government, and the bank would need to collect only the remaining 2% interest from the farmer.

In this stage, the role of field officer is again crucial when they perform post disbursal inspection. They would need to conduct field visits and also monitor the usage of crop loans in accordance with the loan application. The farmers, on the other hand, would receive the loan amount and are supposed to use it for their farming activities. Making timely repayments would also be necessary to improve their creditworthiness for being able to renew their subsequent credit. We have captured this whole process diagrammatically in Figure 1 below.
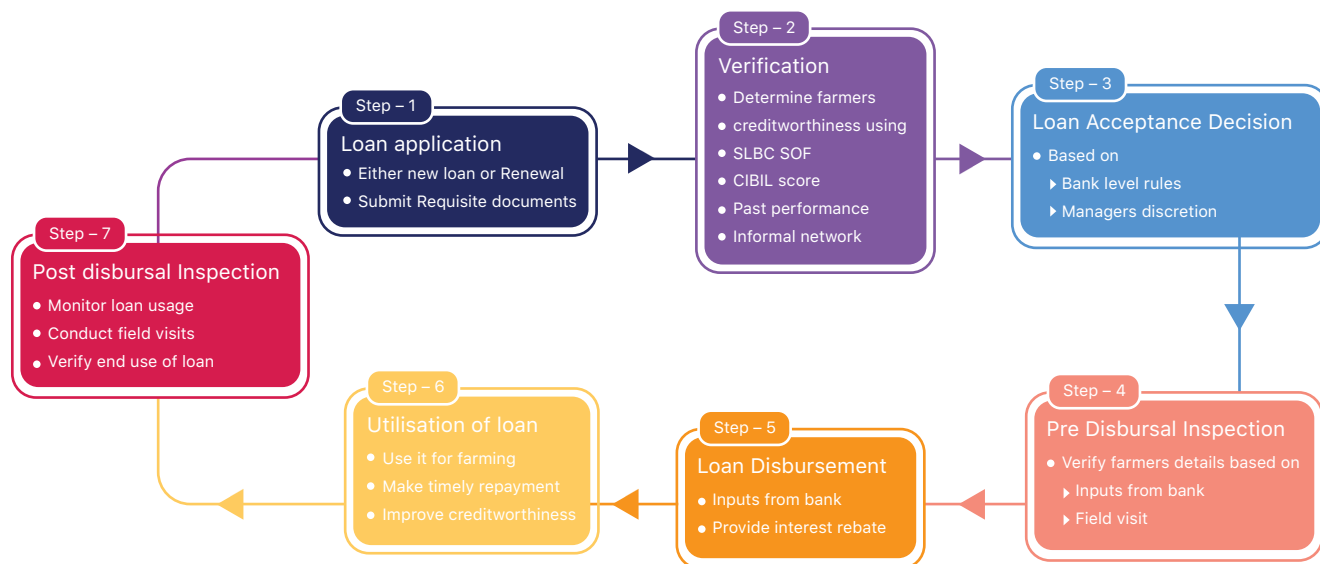
Inefficiencies/Limitations of the Existing Process

After discussing with various stakeholders, we understood that the above process has serious inefficiencies. Every bank has priority sector lending targets, and they would want to attend to them. Quality is compromised in the process of increasing the number of loans. Our observation reveals the following:

1. Substandard way of determining creditworthiness (Step -2)

In Step 2, the banker would have to verify the application and documents submitted by the farmers and determine their creditworthiness. Although the bankers are guided by Scale of Finance and CIBIL score, the bankers do not take into account more efficient micro-level farmer data which could help them better understand the farmers' repayment capability. For instance, data on farmers' past performance or the existing/forecasted market conditions for the crop in question are not being considered. These two pieces of information are very crucial and hence if missing, would lead to a substandard determination of the farmers' creditworthiness.

2. Manual discretion coming into the picture (Step – 3)

After getting a reasonable idea on the farmers' creditworthiness, the final call of whether to give a loan or not is still dependant on the bank manager. Many studies have vouched for the prevalence of discrimination in rural India. In these lines, if a bank manager discriminates based on gender or caste, then even an eligible farmer could be deprived of loan. Although eliminating manual discrimination in these decisions is currently farfetched, at least amending the manual component with objective evidence would help in tackling such discrimination.

3. Pre disbursal inspection being overlooked (Step – 4)

The official norms of the banks require the field officer to visit every farm before loan disbursal to check upon the farmers' whereabouts, the land, and other information contained in the loan application form. However, we observed that field officers rarely perform this job. Especially in the cases of loan renewal, the loan is granted merely after the farmers visit the bank and fill

in the application form. The reason for this could either be the laxity of the bankers and the lack of adequate staff. Given the limited workforce available and wide range of farmers (and their acreage) to be covered, strict and wholesome background checks become close to impossible.

4.   Post disbursal inspection being given a miss (Step – 6)

This is another area of grave concern. Several farmers divert the proceeds of loan several times for non-farming purposes. They would mostly use it for purposes such as the marriage of their children, education, constructing a house, etc. Some have reported that they would use this money to lend to other villagers informally and earn interest from it. This diversion happens because the field officers give the post disbursal inspection a miss. There have been cases where the banker is aware of such diversion but tend to overlook it as long as they receive the payment within time. However, this has the potential to defeat the real purpose of crop loans. This also provides an implication to the policymakers to introduce other convenient credit options for farmers' purposes and ensure strict guidelines for crop loans.

Owing to this inefficiency, farmers who are looking to expand their activities to higher acreage would not obtain higher crop loans. Almost all farmers we interviewed made use of crop loans, but many of them still depended on informal money lending because the crop loans had an upper limit. Hence, with proper monitoring, more crop loans can be given to deserving farmers, which in turn would help them increase their income.

Intervention - Satellite Imagery Analytics

The formal lending is expected to increase in the coming years. The lending institutions would slowly start recognising agriculture lending, not as a compulsion but a viable business vertical. For that to happen, the creditworthiness assessment and credit collection have to improve. At this stage, satellite imagery analytics has a crucial role to play.

Satellite imagery analytics can map the entire loan life cycle across the crop life cycle by monitoring crop health, soil moisture using satellites, and weather data. This helps the bankers to determine and analyse cropped acreage, yield predictions, availability of ground and surface water and price movements.

Re-engineered Process

We estimate that the satellite-based data analysis can cut short the existing crop loan process and also drastically improve its overall efficiency. In the revised procedure, the farmers submit their application for crop loan to the bank. At the stage of verification, in addition to using CIBIL score, past performance and informal networks, the banker can rely on the insights from satellite imagery analytics to extract detailed information on the past performance of the farm and thereby understand farmers' prowess. This would aid the bank manager in step 3 to take a more informed and objective decision. This input, to some extent, will also help in tackling the discrimination existing in the loan disbursement process.

In step 4, the field officer would still need to visit the farm but will be able to make better decisions with satellite imagery analytics aided tools. Currently, the role of a field officer, although necessary, is being side-lined.

This inherent limitation in the current process will give rise to severe inefficiencies. Once the loan is processed with inputs from satellite imagery analytics, the post disbursal inspection could be ultimately taken over by satellite and drone technology. Satellite imagery analytics can regularly monitor the performance of the farm. This would reduce the requirement of regular field visits, hence decreasing the loan life cycle management cost to the bank, which can potentially be passed on to the farmers. This in turn will also help the banker to assess if the loan proceeds are only being used for farming.

Further, due to constant monitoring, the bankers could well understand the trend of the market price. This information helps in loan recovery. As satellite gives a clear and accurate picture of what happened in a given land, the loan recovery officers could argue with facts and achieve higher recollection. In case of loss at the farm due to environmental factors, the banker being equipped with a better understanding of the reality, can be more empathetic to the situation and find a better solution that involves cooperation on both sides. Figure 2 presents the re-engineered crop loan management process after the intervention of satellite imagery analytics.

Satellite analytics can also help in sourcing of farm loans more transparently. It can help a banker to expand his portfolio while reducing risk by lending in areas that have shown improved performance in the recent past. This process would reward those farmers who have been working hard and applying better land management practices that lead to better utilisation of the land. This also gives confidence to the banker to expand his loan portfolio in a way that does not lead to increased risk.
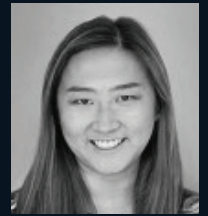
Takeaways

Satellite imagery analytics has the potential to provide a universe of information to the bankers regarding crop loan. This can potentially reduce the significant overload on field officers. On the long term, there would be increased discipline among farmers and bankers would be able to provide higher loans, thereby easing the access to credit for farming. This would also reduce the dependence on informal money sources. Going forward, this can be a significant step in bridging farmers and bankers to achieve the intended objective of instituting low-interest crop loans for farmers.

Step
01
Loan application
➤ Either new loan or Renewal
➤ Submit Requisite documents

Step
02
Verification
➤ Determine farmers creditworthiness using
➤ SLBC SOF
➤ CIBIL score
➤ Past performance using satellite imagery analytics

Step
03
Loan Acceptance Decision
➤ Based on
 • Bank level rules
 • Insights from multiple data sources

Step
04
Pre Disbursal Inspection
➤ Verify farmers details based on
 • Inputs from bank
 • Field visit
 • Insights from satellite imagery analytics

Step
05
Loan Disbursement
➤ Inputs from bank
➤ Provide interest rebate

Step
06
Utilisation of loan
➤ Use it for farming (confirmed using satellite imagery)
➤ Make timely repayment
➤ Improve creditworthiness

Quantum Computing and its Economic Impact: Why You Should Care

Jason Necaise,
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Quantum computers represent one of the most promising emerging technologies of our time. These devices rely on the laws of quantum mechanics to store and process information in a fundamentally different way than is possible using ordinary computation. This allows them to unlock significant computational advantages in many tasks. In some cases, these advantages are so dramatic that quantum computers can efficiently solve otherwise intractable problems. Some notable examples include **modelling protein folding for biochemistry, and cracking encrypted personal or government data.** The economic implications of devices capable of performing these tasks, as well as the security concerns that they bring, have motivated efforts in both academia and industry towards this technology, which is still in its infancy.

In 2019, tech giant Google announced their achievement of demonstrable "quantum supremacy" - the milestone in which a real quantum computer successfully computed something that would be realistically infeasible on traditional computers. The calculation in question was not any useful algorithm and was explicitly designed to be easy for a small quantum computer and difficult for traditional computers. However, for each milestone that quantum computing hardware companies reach as they improve their fabrication and design, the world gains incremental access to the eventual promise of the technology, as each milestone will enable increasingly complicated tasks.
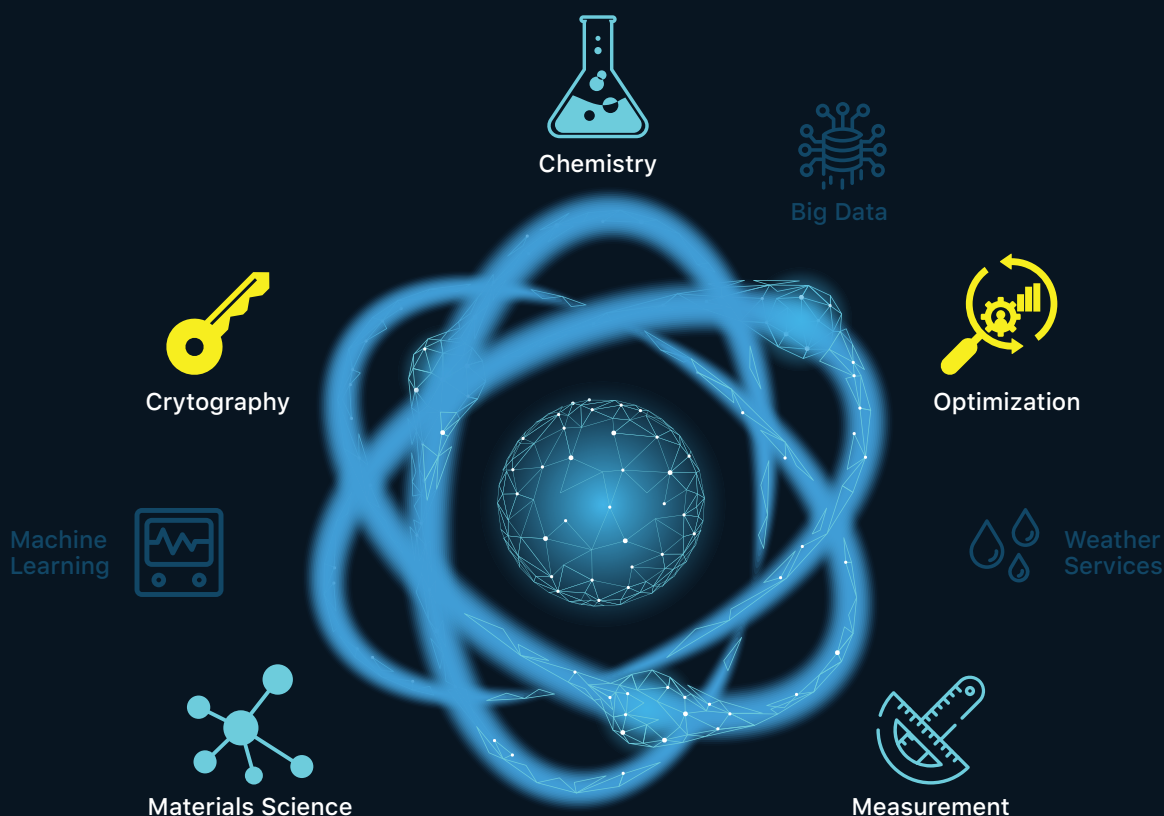
Researchers are also working to improve the quantum algorithms relevant to each industry application, which could make them calculable on smaller quantum computers.

As time goes on, we can expect to see industry segments become take place as the state of quantum hardware, and algorithms reach commercial viability for tasks critical to their businesses; this is reflected like the forecasted economic impact of quantum computing. Upon entering the ultimate milestone of "fault-tolerance," which is incredibly unlikely at least in the coming decade, nearly every business will see some commercial and competitive advantage in having access to a quantum computer. Quantum computers today are not yet general-use computers; they are accelerators that can process a limited number of algorithms at speeds impossible for today's computers. This feature will soon transform specific industries, namely sectors that leverage artificial intelligence and pattern recognition, molecular chemistry,

Quantum Computing's Impact and Applications in Different Industries

Chemistry

Big Data

Crytography

Optimization

Machine Learning

Weather Services

Materials Science

Measurement

Goverment
e.g. Support deep cryptoanalysis of critical data

Pharmaceutical
e.g. Develop new drugs and treatment

Manufacturing & Industrial
e.g. Develop materials and processes

Telecommunication
e.g. Enable secure communications across network

Travel & Transportation
e.g. Design new vehicles and transport system

Financial Services
e.g. Predict market trends and risks

and encryption. For example, quantum computers can simulate the chemical composition of materials and pharmaceutical compounds, leading to faster discoveries of new materials and personalized medicine. Companies in any computationally and algorithmically heavy industries should invest in quantum computing research and development, as the first to license and patent discoveries will hold significant future market power. Gartner estimates that by 2023, 20% of all companies will be budgeting for quantum computing projects.

Despite this, the market of developing and utilizing quantum computers today is led by research groups at universities funded by the world's governments, while the private sector is just beginning to catch up. In 2020, BCC Research estimates that the market for quantum computing-related services and products is provided almost entirely by research labs, totalling USD 50 million. By 2030, the same report predicts the total market size of quantum computing to be over USD 3.2 billion, with industry customers growing to make up over two-thirds of the market. Established tech giants like IBM, Microsoft, and Google have already made significant investments in developing proprietary quantum technology. Numerous quantum computing hardware startups, such as Rigetti and IonQ, have commanded hundreds of millions of dollars of collective investor attention. The governments of Japan, Israel, and South Korea, among others, have all made multimillion-dollar

commitments to the field. In January 2020 the Government of India announced it would spend over USD 1 billion on quantum computing research over the next five years; this rivals the roughly USD 1.2 billion that the United States and China have each committed over the same period.

The Difference

Understanding why there is so much interest in quantum computing requires a brief understanding of how quantum computers differ from today's computers and what their consequential impact is. Computers today process information using units of information, bits, which are expressed in binary: 0 or 1. While quantum computers also use bits, quantum bits (qubits) can express not only 0 or 1, but also any particular combination of 0 and 1 simultaneously by using unique properties of quantum mechanics. Putting multiple qubits together in a computation further enables combinations of expressions unachievable by classical computers. This is known as superposition and allows a single qubit to encode significantly more information than the binary bit. This, together with the more complicated phenomena of interference and state entanglement, allows quantum computers to encode and process information in ways that fundamentally change the nature of algorithms. They are not devices that compute the same steps of our classical computers but faster somehow: quantum computers compute results in vastly fewer steps, to begin with.

Gartner Research reports strongly

> This feature will soon transform specific industries, namely sectors that leverage artificial intelligence and pattern recognition, molecular chemistry, and encryption.

recommend that businesses begin identifying applications of quantum computers within their own business and supply chains. Unfortunately, creating an entirely in-house quantum computing research team is impractical for most companies given the necessary quantum computing hardware and PhD-level staffing needed. Therefore, the few experts in the domain are increasingly recruited into non-research positions to seed efforts that will take years to develop. One of these reports predicts that 90% of organizations will seek some consulting regarding quantum computing by the end of 2023. There are workshops aimed at helping executives prepare and know more about the various technical and business implications of quantum computing.

The authors of this article are representatives of qBraid, a cloud platform which provides an end-to-end solution for learning, building, and deploying quantum algorithms for research and commercial applications. qBraid will be hosting a 3-day executive workshop in September to help you learn how quantum computing will transform your industry and provide consultation on what you can do to stay ahead of the market. You can learn more about their work and a team of experts at qbraid by visiting this link.
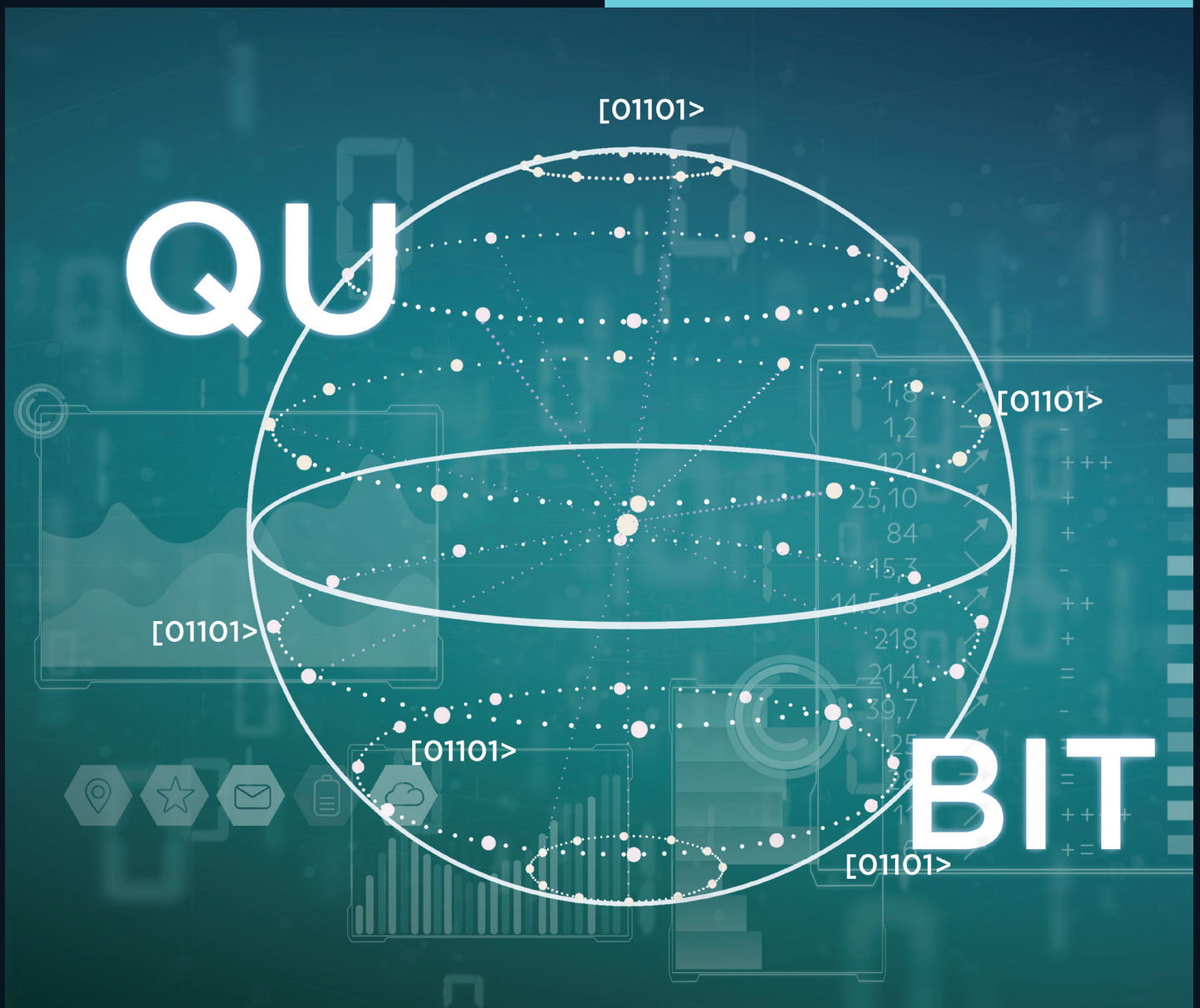
AgriStack: Powering Indian Agriculture Through a Digital Data Commons

Indian Agriculture has seen a technology transformation since 2014, led by 450+ agtech start-ups. Several promising solutions on Agri inputs, farmer financing, market linkages and Agri intelligence have come up. However, these enterprises face two key challenges - quick adoption of their technology at scale, and access to data that will make their solutions more accurate and relevant. *Villgro, together with SatSure held a webinar on August 20th, bringing together financial institutions, agtech enterprises and impact-led organisations to discuss these problems and potential solutions.*

Panellists: Purushottam Kaushik (Head, Center for the Fourth Industrial Revolution India), Harrie Vollaard (Head, Rabo Frontier Ventures), Ritu Verma (Co-Founder, ThinkAg/Ankur Capital), Arjun Ahluwalia (Founder, Jai Kisan), Purvi Mehta (Asia Lead, Agriculture, Bill & Melinda Gates Foundation) and Prateep Basu (CEO, SatSure Switzerland & India)

Moderator: Srinivas Ramanujam (CEO, Villgro Innovations Foundation)

Collaboration is Key

The Indian farmer's willingness and ability to adopt tech has been grossly underestimated. If the technology is easy to use and affordable, they will use it. According to Harrie Vollaard, the focus should be to enable "farmers to have better control over their business, and this is where data comes in". Today there are multiple technologies, working in silos, making it inconvenient for the farmer to adopt them. Dr. Purvi Mehta stressed on why agro-dealers attract farmers, "the biggest thing they offer is the packaged service". The panellists discussed the possibility of collaboration amongst various players in the ag-tech ecosystem to bring together a single comprehensive solution to the farmer – inputs, advisory, farm gate processing, credit and market linkages. They agreed unanimously that the start-up which, in a Darwinian sense could adapt best, in this case, collaborate most effectively, would be the winner. "Entrepreneurs need to see that the whole is greater than the sum of the parts" emphasised Ritu Verma.

Regarding access to data, Prateep Basu said "there is no framework for people to share data" because of which "analytics built on data is inefficient". Today start-ups are spending disproportionately on collecting data themselves through satellite and IoT sensors. Similar collaboration on the data sharing front, like the creation of a data commons, would expedite

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tech development, allowing start-ups to focus their resources on analytics, AI and transformational innovation instead.

Infrastructure for Trust

Now, this leads us to the key question - How do we collaborate? Or rather, how do we trust each other?

Here, an architecture for agricultural data will be immensely helpful, similar to IndiaStack and the Health Stack that is in development. This infrastructure will facilitate aggregation of data and make it usable by instituting standards and security protocols that will support interoperability and APIs that the ecosystem, including agtech enterprises, can then build on top of. This structure will also build trust, encouraging start-ups and other ecosystem players to share their data more freely. Dr Purvi Mehta rightly cautioned, "it's not just data collection, but data utilization and sharing that is important. This is where a public-private partnership is critical".

The Need of the Hour

"Indian agriculture is not data-starved. We need to keep an eye on the value and connect the right pieces" suggested Srinivas Ramanujam. Most states have disaggregated data over 40-50 years, and data dashboards. The Centre for Fourth Industrial Revolution is working with the Ministry of Agriculture and Govt. of Telangana to build digital infrastructure and datastack for agriculture. Purushottam Kaushik emphasised their work to "make this data dynamic and secure while making it available".

Some avant-garde start-ups have also joined this journey. SatSure has been engaging with ecosystem players to promote the idea of a data highway that enables interoperability between datasets and an open API on which analytics, apps and more can be built. On Jai Kisan's financing solutions for farmers, Arjun Ahluwalia said "we have been able to bring the entire value chain to the farmer", both buyers and sellers of credit.

There is great potential for the Government to play the role of catalyst here. As the EU did with banks, they can push large players to open their data to the public. Alternatively, the Government could bring together a consortium to lead and fast-track this process. This would require the participation of the entire ecosystem and lead by an organisation seen as credible to all players.

The hope is that the current initiatives build the momentum for a vibrant Agri ecosystem powered by an AgriStack - a digital data commons for ready and almost instant access to farmers.

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