Roundtable on Transformational Technologies for Agriculture in India

Saturday, March 18, 2023

Venue: Department of Computer Science and Automation (CSA), IISc, Bengaluru

8 AM – 2 PM

The objective of the Roundtable is to come up with focussed, concrete, recommendations that could be taken up for action through a lively partnership among academic institutions, R&D labs, industry, and startups, with the help of the Government.

1 Schedule

Part 1

09.00 – 09.30: Plenary Talk 1 – Ajay Malshe, Distinguished Professor of Mechanical Engineering and Agricultural and Biological Engineering, Purdue University, USA (online)

0935 – 10.05: Plenary Talk 2 - Rajeev Chawla, Strategic Advisor and Chief Knowledge Officer, Ministry of Agriculture and Farmers Welfare, Government of India (online)

10.15 – 11.15: Roundtable – 5 minute talks

1. T.N. Prakash Kammardi. Ensuring Minimum Support Price (MSP)
2. Jaywant Arakeri. Need for Deep Tech Solutions in Agriculture
3. Jose Joseph. Role of Sensors in Transforming Indian Agriculture
4. P. Rajalakshmi. Automated Pipeline for Stress Management – Drone Based Sensing
5. M.S. Bobji. Precision Agriculture
6. Satyam Sahay. ML Applications in Precision Agriculture
7. Siddharth Barman. Fairness in Algorithmic Decision Making.
8. Shankar Venugopal. Autonomous Tractors and Smart Agri Implements
9. Soma Dhavala. Solving Foundational Issues in Data Using AI/ML to Drive Applications
10. Ramana Tadepalli. Digitialisation and Antifragility
11. Gali Basavaraj. Capacity Building for Farmer Producer Organisations (FPOs)

Part 2

11.45 - 12.45: Breakout Sessions

Digital Agriculture including AIML and Digital Public Goods

1. Ravi Trivedi, Srijan Capital (Moderator)
2. Y. Narahari, IISc
3. Rajesh Sundaresan, IISc
4. Siddharth Barman, IISc
5. Rajul Patkar, IIT-Bombay
6. P. Rajalakshmi, IIT-Hyderabad
7. Sunitha Choudhary, ICRISAT, Hyderabad
8. Soma Dhavala, Wadhwani AI

9. Vineet Singh, Digital Green
10. Suresh Venkatesan, Samunnati
11. Sanjiv Jha, Amazon
12. Purushottam Kaushik, WE Forum

Regenerative Agriculture and Precision Agriculture

1. Jaywant Arakeri
2. Gali Basavaraj, CoE for FPOs, Karnataka State
3. G. Shobharani, BEL
4. M.S. Bobji, IISc
5. L Tulasi Gandikota, IISc
6. Rajul Patkar, IIT-Bombay
7. C.T. Ramachandra, UAS, Bangalore
8. K.B. Veda Murthy, Dairy Science College, Bengaluru, KVAFSU, Bidar
9. TK Prakash, UAS, Bangalore

Global Best Practices - Action Plan for India

1. G. Ananthasuresh, IISc
2. Nipun Mehrotra, Agri Collabaratory
3. V.K. Aatre, Former Secretary to Raksha Mantri and Former DRDO Chief
4. V.V.R. Sastry, Former MD, Bharat Electronics Limited
5. Puthra, Director, Department of Agriculture, Karnataka State
6. P.V. S. Surya Kumar, Deputy Managing Director, NABARD
7. SheshShayee, UAS, Bangalore
8. Lalith Achoth, UAS, Bangalore
9. Jose Joseph, IITBMK
10. Ramana Tadepalli, Entrepreneur
11. Venugopal Shankar, Mahindra
12. Manesh Jain, FloMobility
13. Abhay Pareekh, WE Forum
14. Satyam S. Sahay, John Deere
15. Ram Kaundinya, Advanta

2. Participants

1. Ajay Malshe, Purdue University
2. Rajeev Chawla, Strategic Advisor and Chief Knowledge Officer · Ministry of Agriculture & Farmers Welfare, Government of India
3. V.K. Aatre, Former Secretary to Raksha Mantri and Former DRDO Chief
4. V.V.R. Sastry, Former MD, Bharat Electronics Limited
5. G. Ananthasuresh, IISc
6. Y. Narahari, IISc
7. Nipun Mehrotra, Agri Collaboratory
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12. Jaywant Arakeri, IISc

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17. SheshShayee, UAS, Bangalore
18. C.T. Ramachandra, UAS, Bangalore
19. Lalith Achoth, UAS, Bangalore
20. Veda Murthy, UAS, Bangalore
21. Arun Kumar, UAS, Bangalore
22. TK Prakash, UAS, Bangalore
23. Rajul Patkar, IIT-Bombay
24. Jose Joseph, IITBMK
25. P. Rajalakshmi, IIT-Hyderabad
26. Sunitha Choudhary, ICRISAT, Hyderabad
27. Ramana Tadepalli, Entrepreneur
28. Venugopal Shankar, Mahindra
29. Soma Dhavala, Wadhwani AI
30. Manesh Jain, FloMobility
31. Vineet Singh, Digital Green
32. Suresh Venkatesan, Samunnati
33. Purushottam Kaushik, WE Forum
34. Abhay Pareekh, WE Forum prof.arun.kumar.55@gmail.com
35. Satyam S. Sahay, John Deere
36. Sanjiv Jha, Amazon

3. Keynote Talk by Ajay Malshe

- Four A's in food science - Acceptability, Availability, Accessibility, Affordability. These are the 4 things we try to achieve to produce and distribute nutritious food to everyone.
- Most of the time food is grown/produced in rural areas whereas the maximum consumption is in urban areas. The challenge is harmonizing the relationship between people and food producers. Production farms should be the nexus of farm-food-energy.
- The mission is to use data to analyse food insecurity and come up with resilient innovations for food equity and convergence of manufacturing to food production.
- The goals are to achieve precision and delivery at point of need, mass scale customization, resilient production and production processes, nutritious and safe produce.
- One needs the integration of domains such as life sciences, physical sciences, engineering, etc. to gain insights which would be otherwise inaccessible.
- The key question lies not with the production itself but to get it to the point of need.
- One of the solutions being worked on are large digitally connected manufacturing systems with drivers such as climate, food equity, jobs in community, manufacturing in the US, national security.
- Merge traditional ranches & cellular agriculture, traditional farms & cultivated food

- Food - as important as security
- His work:
  > 3D Printing food

  > Repurposing unused space for farming.

4. Keynote Talk by Rajeev Chawla

Agri-Stack is an ecosystem for facilitating the delivery of digital services to farmers by the government, by agri-startups, by FPOs, etc.

• An Aadhar for farmers.

> APIs to collect data

> farmer ID, land they own, crops sown, etc.

> There are registries such as a farmer registry with linkages to land owned and geo-referenced village maps, crop sown registry, etc.

> crop registry - needs people to go to the farms and take reports (*)

> Unified farmer Service Interface: UFSI is a set of APIs for exchanging various agri data

> Agri-Stack does not build use cases & services for farmers, benefit schemes, collect data from the ground, allow updates to data directly from the central registry.

• Next Goal - to make farmers access their data whenever needed

> Identity (ID) > Assets (crop, land)> Transactions

•Provides an interface / all data you need.

• Use case:

> Millet production: stack gives list of farmers producing them, govt gives benefits.

> Farmer digitally fills forms for insurance

• Catch those trying to cheat

> Improves transparency

• Use farmer IDs for loans, loan waivers. Helps farmers access markets for selling

• Questions / Problems:

> How to identify handless farmers

> Other methods for crop survey.

> Make all tech apps into one

5. Roundtable Talks

PVS Suryakumar: (NABARD)

The major issues that need attention are:

- Water management - 70% of irrigated land is using ground water.
- No farmer advisories since the green revolution.
- Credit, Insurance - use the efficient banking system that we have
- Market – how can farmers get appropriate price?

- NABARD deals with everyone related to agriculture.
- The current issues are:- production process(water is finite) - advisory to farmers is gone after the green revolution, farmers don't know whether products like pesticides are genuine - credit(banking systems are inefficient) - market(how do farmers get appropriate prices)
- What can NABARD do:- fund people who can add value - make rainfed farming system better - give space for researchers to work

Prakash Kammardi

• Farmers: Price Takers not Makers.

• Announce MSP and address/ implement MSP.

Jaywant Arakeri

- We need to develop an ecosystem where innovations can go into the market.
- Key areas that are worked on and need attention in the future:- protected agriculture - aeroponics, hydroponics, drones(imaging and interpreting images) - field robotics(mechanical deweeding) - space agriculture
- Interaction between engineers, economists and agricultural scientists is poor.
- Implementation side is still bad.
- Bottleneck:
    - Taking innovations from Product to Market
    - We need sustained funding for one or two decades for results to take shape, cannot expect results within 2-3 years.

Proposes the founding of a Centre for Innovative Agri. Tech. at IISc

Jose Joseph

• Sensors in Agricultures

• Cost-to-production:

> Reliable sensors at lower precisions that are more cost effective are more useful.

Sunitha Chaudhary (ICRISAT) and P. Rajalakshmi (IITH)

• Use drones.

> Crop survey.

> yield prediction

• CNN to identify drought stress level

M.S. Bobji

• Precision agriculture - providing right inputs, right quantity at the right time

• Improve the efficiency, reduce cost, increase numbers

• We need local solutions for local problems

• 3 things:

> Plant physiology

> Engineering solution

> how to make it bigger / scale up.

Satyam Sahay

• ML application in Precision Agriculture. Precision at plant level.

• Machinery that has cameras & selectively sprays herbicides & pesticides. (reduces consumption by 60%)

• Data, from GPS, Robotics, CV ML.

Siddharth Barman

• ML models: race to metrics.

• Shift views to - use them for decision making.

Shankar Venugopal

• There is a need for technology that is affordable and can work on small area farms

• Driverless tractor.

>auto steer.

> headland turning

> Obstacle detection>Geofence Lock

• Rotavator: smart agricultural machinery

• To get innovation to ground level

> customize to the customer's needs

- There is a need for technology that is affordable and can work on small area farms
- Tractors should be easy to use
- Developed driver-less tractors which perform tasks such as auto-steer, auto-headland turn and skip passing, obstacle detection and avoidance, geofence lock

Soma Dhavala

• Getting datasets directly from farmers. Use speech and language models

• Upload picture, use cv to get info about fertilizers, etc.

• Opensource models and data for students to use for their projects instead of MNIST, etc.

Ramana Tadepalli

• Agriculture: not a viable business

• How to reallocate subsidy properly

• look at risk in systems.

Gali Basavaraj

• Generation of FPOs

Ravi Trivedi

• Remove CO2 from air → get credit → get cash

• Natural farming: Reduce Tillage, manure, cover crop.

• 500-750rs /acre / year. (10 years contract), integrate with forest farming to get 5000/acre/year.

6. Breakout Session on Digital Agriculture (prepared by Ravi Trivedi and Nipun Mehrotra)

Digital Public Goods (DPGs)

DPGs are tiny atomic building blocks that can be used by various services in various scenarios to provide some solution to the public(eg., aadhaar).

- There are currently 22 ministries that impact agriculture. This creates a dis-aggregated environment with no unity and standardization.
- The American model follows the winner takes all policy and the European model is government led, both will not work in India and India has taken a balanced variation of both.
- AI models take time and hence we rely back on estimations and simulations.
- An example of a DPG is crop identification, it is very important that it has the ability to target single fields.
- Without talking to people, one should be able to pick up any DPG and use it.
- We need to develop an ontological framework that is uniform across the country.
- Another example of a DPG is a crowd sourcing platform for unstructured data collection

DPGs issues:

- Scale needs to be looked at
- Agri. is a disaggregated sector. (22 ministries effect agri) It has uncalibrated and distributed data.
- State-Centre friction
- India has many AES.

DPG ideas:

- History of a farm (crops grown, etc.) can be used to assess credit scores, etc.
- Can make a dictionary for uncalibrated data. It can mention the relations between different things in addition to mentioning which things (eg., which two pesticides) are the same. Note: A task force has already been created by the government (being done by EY) to create such an ontology.
- Another example of a DPG is a crowd sourcing platform for unstructured data collection

Can we use crowdsourcing for gathering data?
The problem is in incentivizing data collectors.
Suggestion: Use distributions (along with sampling)

Doubt: But that will leave out the farmers who are exceptions to the trend. So we will end up serving only some sections of the society.

1. Basic analysis of the problem reveals: The mechanism needs to incentivize reporting data and disincentivize misreporting. (eg., buy a fraction of the crop from the farmer to get his information - of course, this example has several loopholes). eg., Insurance companies, banks, etc. have incentive to help as it would help their bottom lines.

2. One solution is to have a central encrypted database where you pay a miniscule amount for running your code on the data, and you get paid proportional to the quality of data that you submit.

- Incentivizing truthful data collection and reporting is an issue, disincentives for misreporting data must also be considered. The fundamental issue in agriculture is trust, if too much money is provided as an incentive it will be misused.
- All startups are facing the same issue of unavailability, they keep trying to solve use cases and create pipelines for various things, these are not approaches that will work.
- When we speak about data in agriculture, is it that costly to have inaccurate data? Is a distribution good enough? To what degree do we need to be precise?
- Incentivizing truthful data collection and reporting is an issue, disincentives for misreporting data must also be considered. The fundamental issue in agriculture is trust, if too much money is provided as an incentive it will be misused.
- All startups are facing the same issue of unavailability, they keep trying to solve use cases and create pipelines for various things, these are not approaches that will work.

7. Breakout Session on Regenerative Agriculture including Precision Agriculture (Prepared by Jaywant Arakeri and M.S. Bobji, IISc)

7.1 Current Issues

- Soil health degradation is a major problem
    - Excessive fertilizer and pesticide use
    - Over tilling
    - Lack of scientific crop rotation
    - Increasing salinity of soil
- Poor usage of water resources
- Lack of diversity in crop varieties

7.2. Way Forward

- Identify the regions in the country which have very poor soil health
    - To take focused remediation measures
- Planned water-shed development
- Minimise soil disturbance
    - Study soil biome with minimal tilling or no tilling
- Develop technologies towards the precision application of fertilizers and pesticides
- Develop technologies for mechanical de-weeding
- Establish field facilities for research and testing of developed technologies
- “Center for innovative agriculture technologies” to be established at IISc in collaboration with Agriculture University and ICAR labs in Bangalore

8. Breakout Session on Global Best Practices and Action Plan for India (Prepared by G.K. Ananthasuresh, IISc)

The discussion on formulating an action plan for Indian agriculture based on current global best practices began with four imperatives in mind:

(i) economic viability
(ii) environmental suitability
(iii) social acceptability, and
(iv) food safety and quality.

Some of the challenges that Indian agriculture currently faces were also laid down based on the talks in the earlier session and common knowledge of all participants. They are:

- Highly unorganized and fragmented
- More traditional than modern
- Lack of affordability
- Water scarcity
- Soil degradation
- Natural calamities
- Distribution of produce
- Storage
- Residue management

The opportunities that are unique to the Indian context were also noted at the outset. These included: tapping ancient Indian agricultural wisdom, empowering farmers, and using modern technologies effectively.

The first point that was discussed was how effective modern best practices would be in the current Indian context. It was noted that agricultural practices in temperate climate are substantially different from those in tropical climate. So, what works well in the western countries might not necessarily work well in India. While it is a general statement, it does not mean that we should not consider best practices of the west. They should be experimented and studied to understand their efficacy for Indian agriculture. The socio-economic conditions of India also play a role in this.

Another important point that was raised was that the land in India is under large-scale cultivation for nearly 3000 y as opposed to about 300 y in the USA, for instance. So, the soil has undergone significant changes in India. This needs to be studied scientifically to gauge the degradation of the soil and consider ways to upgrade soil conditions for sustainable agriculture. Data is scarce and sparse on Indian soil conditions. This should be rectified through sensor technologies. Despite changes in soil characteristics, soil science is still taught from the same old textbooks. So, the same old practices are continuing. As noted earlier, the soil science books which we follow have come from the western world where there is temperate climate, but we have tropical climate. So, we need to study soil science for India from basics. Therefore, there is a need to write books and make them available in regional languages.

Action point 1
Study in Indian soil in depth in light of the age of cultivation, methods used, climatic conditions, water resources, etc., collect data using sensors and make up-to-date data accessible to farmers through books and other media.

The second point was that there should be a balance between empowering Indian farmers with modern technology and learning from their former best practices. Thus, there should be a two-way exchange of knowledge. Hence, it was suggested that gleaning the wisdom of the farmers should concurrently happen with advocating modern technologies. It was also suggested that there should be a convincing demonstration of the efficacy of the modern technologies in Indian farms. This can be done by adopting a farm and trying out modern best practices systematically.

Several companies and intuitions have developed technology to improve agricultural productivity and crop yield. But farmers are not aware of these techniques, as they are not demonstrated to the farmer near their farmland. It is a good practice to create model farms to demonstrate the advantages of technology to the farmers by deploying sensors and other advanced techniques. Sensors from different vendors can be deployed side-by-side to have a comparative study. And traditional methods should also be tried with the right blend of modern technologies to see if that works better. In this process, it will be possible to assess the practicality of modern technologies in Indian conditions. For example, the use of tractors, chemical fertilizers and pesticides, genetically modified seeds and crops, drip irrigation, etc., have definitely had positive impact on Indian agriculture. But there have also been deleterious effects. So, renewed studies on soil are useful with the aim of rejuvenating it.

Suggesting drastic steps to small farmers is not likely to be effective. Educating the farmers on modern technologies should be gradual through comparative demonstration, as stated earlier. Noting that younger generation in rural area is disillusioned with agriculture, it may be a good idea to expose rural children to benefits of modern agricultural practices in model farms in villages. It can be implemented like a midday meals scheme so that it becomes a part of school curriculum and hence compulsory.

Action point 2
Adopt a farm and demonstrate viability of modern technologies through comparison.

The third point discussed was water management. Indian traditional agricultural practices do not use water effectively. Furthermore, many of our farming practices depend on the availability of rain. This will restrict the farmers from growing different crops round the year and cultivate depending only on the rain calendar. It was mentioned that it has been well established that paddy need not be grown in knee-deep water. But it continues to be practised in India.

It was also noted that mega irrigation projects based on ground water are not sustainable in India. Alternatives to ground water should be investigated. This is a challenge in parts of the country that are dependent on rain and are far from rivers and reservoirs. Therefore, drip irrigation should be made more widespread. To promote drip irrigation, a policy can be brought in as follows: If you have a borewell, you will get electricity only if you use drip irrigation.

Action point 3
Improve and expand drip irrigation in parts of the country that are dependent on groundwater and rain.

The fourth point discussed was about logistics of harvesting and storage. It was felt that there is a need to reduce the time from harvesting to taking it to the market. Methods should also be devised to improve the marketability of the agricultural products. Storage facilities near the farms and villages are direly needed. Decreasing time to market will increase the longevity of agricultural produce, increasing the revenue of the farmers. Adequate storage mechanisms to store perishable items should be provided. Hierarchical storage will help prevent farmers from selling their crops forcibly at very low prices. It was also felt that imparting business skills to farmers is critical. Farmers should be savvy to navigate the refined urban market to get the best price for their produce.

Furthermore, farmers need to be educated in management of the residue and waste. Shredding of areca sheath and fronds was cited as an example of effective use of waste. It could serve as food for the livestock while reducing the waste accumulation. It has been observed that feeding shredded areca fronds to cows and buffaloes increased their milk yield.

Action point 4
Innovate on storage solutions that are affordable, and help farmers acquire business skills to get the best price and also manage agricultural waste without harming the environment and even valorize the waste.

It was noted that there is a need to promote agricultural tourism and agro-foresting among the urban elite and researchers. This will help increasing awareness of time-tested Indian agricultural practices among the urban population. Armed with that understanding and the knowledge of modern technologies, they might be able to think of sustainable and affordable ways of integrating modern methods with ancient practices. Another benefit of agri-tourism is that it will provide an alternate source of income to farmers. With regard to agro-foresting, a goal should be set that one third of India should be forest land.

Action point 5
Promote agri-tourism and agri-foresting.

A question was raised if big corporations would succeed in large-scale farming in India. It was answered that it is unlikely. Several corporates attempted community farming and large-scale farming in India. In most of these occasions, it proved that such large-scale farming is not effective in India. Farmers holding small agricultural lands always develop apprehension on large-scale farming. The challenges of Indian agriculture are so complex that corporate farming is not viable. Not only in India but also in many other countries, it is the government that subsidizes and helps farmers. So, corporates succeeding on their own without government help is improbable. This being the case, a question arose as to the use of modern farm equipment. Tractors have been undoubtedly helpful but modern farm mechanization equipment is too large for small Indian farms that are unevenly fragmented. So, it was felt that small mechanization equipment suitable for Indian farms is needed. It could be from sowing the seeds to weeding to harvesting. Precision spraying of pesticides and insecticides is also important. It will be effective if corporates in agriculture extend a helping hand to small-scale farmers by providing technology for rent or at a subsidized rate with mutually beneficial arrangements.

Action point 6
Develop small mechanization equipment suitable for Indian farming and make it available to small farmers.

Finally, it was felt that government subsidies should be given wisely so as not to make farmers complacent. Free electricity leads to wasteful use of water by farmers. On the other hand, subsidies on fertilizers do not go to the pockets of farmers but to industries. The distribution of subsidies should be streamlined.

National crop planning is essential. There should be some policies on it so that only relevant crops are grown in different parts of the country. Micro-entrepreneurship should be facilitated.

Action point 7
Formulate policies and enforce them for crop planning and efficient farming.

In summary, the general consensus was that global best practices cannot be used in Indian agriculture without scrutiny and demonstrated effectiveness notwithstanding the fact they have been effective in other socio-economic, climatic, and geo-political conditions. They should of course be studied, demonstrated for comparison, and then implemented wisely. Academicians, government, and industries should join hands to help the farmers adopt modern technologies through research, policies, and empowerment.

Members of the breakout session

1. G. K. Ananthasuresh, IISc (moderator)
2. Nipun Mehrotra, Agri Collabaratory
3. V. K. Aatre, Former Secretary to Raksha Mantri and Former DRDO Chief
4. V. V. R. Sastry, Former MD, Bharat Electronics Limited
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8. Jose Joseph, Digital University of Kerala
9. Ramana Tadepalli, Entrepreneur
10. Venugopal Shankar, Mahindra
11. Manesh Jain, FloMobility
12. Abhay Pareekh, WE Forum
13. Satyam S. Sahay, John Deere

9. Suggestions and Observations about Indian agriculture from Participants (through Google Form)

1. Data is scarce and sparse in agricultural field. There is need for data in universities to do research, planning and take actions. All data is 2-3 years old. We need government to find free lancer for data collection like population counting is done or farmers could be incentivised to give data via some app so that it could be used for planning and policy making for the farmers benefit
2. Government should provide educational institution what logic/model they are using for various agri planning. Like price prediction model, existing recommendation model, crop area reallocation model.
3. Arial images should be released with farm area marked. Releasing 1-1 areal images per quarter could also be very helpful in getting insight about how much area is used for each crop and their seasonality. Using areal images we can get acreage data for farm level granularity.
4. Create Special Interest Groups with clear mandate - one group picks one problem only.
5. Each should feed into Agri Stack. Develop open schema when they don't exist
6. A process to ideate, and vet the designs so that point solutions are compatible with others
7. Create a list of 100 problems with clear inputs and outputs defined. Release the problem statements with resources where possible.
8. Effort to identify the crops and allied enterprises suited for a district of agroclimatic regions by calculating the Nominal Protection Coefficient and Domestic Resource Cost.
9. Develop a mechanism to collect cost of cultivation data from farmers which is quick and accurate. A mechanism of crowd sourcing of data from 100 farmers each from about 300 talukas will go a long way in meaningful digitization of agriculture.
10. Customize crop advisory to the taluka level.
11. Development of sensitive, long lasting and economical Sensors for all the environment, crops . soil and nutrients parameters in precision farming system

12. Use of drones/ UAV (Unmanned Aerial Vehicle) for Mapping and image analysis for disease management, crop management and production and marketing management

13. Mechanization through custom hiring centres and subsidy to reduce input cost of production

14. Focus on developing affordable technology (especially sensors

15. Demonstrate technology on the field by creating model farms

16. Policy to bring all agri-startups together in one platform

17. Focused points and Short term goals can be defined to take quick action on prioritized action points

18. Develop a crowd sourcing platform for unstructured data collection as a DPG, incentivise truthful data collection, disincentives for misreporting data.

19. Crop identification as a DPG with the ability to target single fields.

20. Usage of excessive fertilizers is degrading our soil. I would like to suggest following points in this regard (a) Create awareness among farmers that how excessive usage of fertilizers, pesticides, water is degrading the soil. (b) Usage of technology is difficult as land holding of farmers is shrinking . So it will be good if a framework is created for community farming. (C) slowly we have to move towards organic farming. This can be done Phase wise by selecting a region supported by the govt .

21. Thematic areaa on (a) secondary agriculture, (b) sustainable agriculture, and (c) Integrated Farming System

22. Have regular round tables.

23. Follow-up meetings in smaller groups.

24. We should try some Generative AI use cases in Agriculture

25. Focus should be on improving farmers profitability oŕ yield or reduced inputs

26. Facilitating focused projects supported by NABARD and other organizations.

27. Means to study the impact of digital interventions in agriculture.

28. Development and dissemination of technologies for judicious use of irrigation water is crucial for soil regeneration.

29. Development of user friendly sensors at field level for all weather parameters

30. Concerted research on Organic farming and its gradual adoption will help in regenerating soil without compromising food security.

31. Discussion on actionable focussed areas.

32. Workshops on 2-3 topics by experts Involve knowledgeable, practicing farmers.

33. Build ecosystem for Micro Mechanization - Improve operational efficiency through small and compact machines that can help farmer mechanize tasks that tractor can't like spraying, de-weeding, planting, harvesting, etc

34. Create an Agri Centre of Excellence at one of the leading Agri university for people from different streams to brainstorm and facilitate validation of use cases.

35. Build knowledge repository for regenerative agriculture practices to educate people of best practices

36. Common language and understanding with respect for each other between the agriculture scientists and others

37. Disconnect between the need on the ground vs the need articulated --for e.g. it seems all the technology required is aldready available to the farmers as articulated by NABARD etc.

38. Roles and responsibilities -- Given that this is a diverse group of people connected by the 'genuine interest' in agriculture looking to see how they can leverage their expertise for the cause -- but it wasn't clear whether the 'voice of the farmer' is captured in this exercise

39. Based on discussion, more institutional funding needs to be channeled to research institutions as many firms heavily rely on agriculture and it would be in their benefit to provide some funding to research institutions.

40. We as a research group should form a collective with farmers and get fundings for research from firms directly benefitting from farming like Reliance food, BigBasket, Swiggy foods, Mahendra tractors, John Deere farm equipments, Tata chemicals Ltd. etc.

41. Go from Idea to Implementation. Solve Foundational issues first. We need to solve problems together. Avoid duplication. Involve student community. Make it a cultural movement. No less.

42. Now we come together and discuss what each of us are doing -- we duplicate work, and solutions wont be compatible or not interoperable with each other.

Instead, state the problem, and solicit solutions. If this is carefully managed, all solutions feed on each other and we solve Ag holistically.

43. Community Farming

44. Technology can't be focus - it is "how" or means

45. It appeared to me that agricultural scientists and agri-bank people had differing views on government's role and effectiveness.

46. All efforts to be made towards starting a Centre for innovative agriculture technologies. This idea seemed to have support from all participants.

10. Suggestions for Improving the Roundtable Format (through Google Form)

1. Fewer topics and go indepth

2. To involve more agri experts

3. Yes, rather than having open discussion without much end goal, all attendees should give 2-3 minutes talk on how they are helping in the agricultural economy. After seeing everyones work we can plan on collaborations amongst attendees which would be very beneficial.

4. Next time, we can ask demonstrations like an Applied/ Demo Track. This workshop should become the Tech Conference in Agri in India and world.

5. Two formats -- debate, regroup, create plan-of-action, review and iterate; Good read here https://twitter.com/jalehr/status/1574738154338205697?s=20

6. Group discussion to be on focussed theme area with well laid objectives/ questions for discussion. An expert in the field/ theme should conduct the discussion to compile a concrete and meaningful points for action

7. Round table on Sept. 23 should be limited to one or two topics of relevance.

8. One day full session is appropriate for detailed deliberations

9. We need longer brainstorming sessions. Please be selective on presentations and give at least 15 mins.

10. It was a symposium more than a roundtable.

11. Maybe in the future, we should further drill deeper and I look forward to a few follow on sessions before the larger one in Sept