Agriculture in Bihar:
A selection of insights relevant to introducing digital support services

Dr Nick Rousseau, Unconventional Connections, and Vimal Kumar, Finovista, August 2020.

Introduction

This document represents the results of our wider consideration of the situation in Bihar and the aims of the BMGF in introducing Digital Farmer Services.

We have drawn on this in putting together the 6 page Concept Note and offer this as an optional additional source to help explain our recommendations/observations. We have quoted the relevant sections from the Concept Note to show how they expand our points. For example…

"As well as working to understand the challenges, we will adopt an 'appreciative enquiry mindset' – seeking to identify positive dimensions which provide levers for driving large scale change. From our assessment to date, we can already identify a number of these – Bihar's recent economic growth, the diversification into horticulture, the success of COMPFED and the Government of Bihar in e-Governance, JEEViKA, the Organic Corridor, Government of India recent announcement to connect all villages to optical fibre, models we have seen to work elsewhere e.g. using satellite data to give lenders confidence and scaling up of new agriculture models in Andhra Predesh."

This reflects evidence referred to below of positive initiatives and progress across all areas.

Overview of the situation

"Bihar is one of the least developed Indian states with high levels of poverty and extremely low participation of women in the formal workforce. Most workers are subsistence labourers rather than landowners and little surplus is generated to sell. Agricultural productivity is constrained by limited use of landholding, modern farming methods, volatility of weather, weak agricultural support services and the lack of market-oriented production, a poorly functioning agricultural markets and a low level of crop diversification. There is reason to believe this is changing which include economic growth that is well above the average for India and that the Government of Bihar has received many awards for e-Governance and data provision.

BMGF is looking to enable Bihar to transform to Level 2 from existing Level 0-1, as per Timmer Agri Transformation model, using Digital Farmer Services (DFS) to play a number of vital roles: Reaching out to masses in real-time; analysing a range of inputs to support better decision making and enabling a data-driven supply chain model to handle very low surplus/volume with minimal cost through interfaces that reflect users' tasks, motivations and diversity.

The different systems, institutions and climatic zones within the region will need to be understood and the relevant players around the value chain effectively engaged to build an understanding of their needs, and secure their buy-in. This will ensure that, through the major programme following this work new digital services can be designed and implemented to deliver positive change at scale. Understanding the complex eco-system is vital, particularly at a time when the State Government could change and develop new policies. For instance, digital technology could support increased regulation of local markets and improving the

transparency of sales channels to larger players upstream could create opportunities for increasing tax revenue."

The state of Bihar is remarkable given that agriculture accounts for nearly 25% of its Gross State Domestic Product (GSDP) and roughly 77% of the population are employed in the agriculture production but a third of those in rural areas are below the poverty line (1). The worker population ratio (WPR) for male workers in rural Bihar is over 60% but for female workers is closer to 4% (3).

More positively, from a very low base, GSDP in Bihar grew by 10.5% in in 2018-19 (3), which is well above the average for India. It would be valuable to understand where that growth is coming from and the sectors driving it. It may be that larger farms are driving this.

Source: krishi.bih.nic.in

Bihar's four agricultural zones.

Farmers from Bihar act as a primary source of cheap labour for rest of the country. During off-season these farmers migrate to other more prosperous parts of the country to work as temporary labourers. Many of them return home after a few months to take care of their farms but many remain abroad working as migrant labourers (as the earnings from manual work may exceed that from farming). During the recent Covid-19 lockdown, the Bihar migrant workers were affected the worse, with no jobs or savings many of them chose to travel on foot back to their homes in Bihar.

Bihar is also characterized with a rigid caste structure. The higher caste farmers are comparatively richer and more educated and therefore have better access to technology as well as finance. Bulk of the farmers are however from the lower castes, poorer, with very small landholdings. They are forced to work as contractors for bigger landowners (though contract farming is illegal) and are stuck in the vicious cycle of indebtedness and poverty. Understanding the caste dynamics and how it plays out in farming economics is a very interesting and unique challenge in the context of Bihar!!

A visit organised by the UK Government in November 2019 to understand Indian agricultural productivity identified that it is constrained by limited use of modern farming methods, volatility of weather, weak agricultural support services and lack of market-oriented production (9). This is particularly true of Bihar, where farmers' income and productivity is the lowest in India.

In 2019, a DFID Funded study of the factors constraining growth in the agricultural sector in Bihar found that poor functioning of agricultural markets indicated by instability in the prices of agricultural produces and low level of crop diversification are the reasons for slow or lower rate of agricultural growth in Bihar (8).

However, as FAO note (5), simply introducing technologies is not enough to generate results. The different systems and institutions within the region will need to be understood and effectively engaged to create conditions where digital services can operate effectively and be adopted to deliver real change. Work is especially needed to ensure the necessary conditions for digital transformation are created in rural areas. Agriculture is a vast system of causes and effects and digital agriculture needs to be recognised as a small but potentially transformational part of this complete picture.

Markets and produce

"we recommend consulting farmer groups and other members of the supply chain to identify a small number of crops upon which to focus. For example those that have highest potential and raise significant challenges, probably a mix of: Staples (rice, wheat, maize, pulses etc.), perishable fresh food and vegetable produce (potatoes[1], onion, eggplant, cauliflowers, mangos, lychee) and Dairy, Goat ; Poultry and Fishery. Identifying where transportation and spoilage costs consume a significant part of the value chain margins could also help identify where the biggest difference could be made. The dairy and livestock sector are others that could be a focus and COMPFED seems to be very successful in enlisting the loyalty of farmers due to reliable year-around sales and payments."

Bihar farmers are changing what they grow – there is a big transition with the shift to highly diversified horticulture, which has been encouraged by the Government (6). The data shows that the larger farms are now getting 100% of their sales from cultivation, with the percentage reducing as farmers get smaller (6). This is a key development for the state and a focus should be on looking for the best way to support smaller farms to take advantage of this trend but requires support in getting produce to wider markets and minimising the percentage of the perishable produce that is lost. Overall, we believe that lack of proper institutional and marketing arrangements are responsible for low crop diversification in the state of Bihar.

We would recommend an early piece of work being to consult farmer groups to identify a small number of crops to really focus on – those that have highest potential and raise significant challenges, probably a mix of staples (maise?) and perishable horticulture produce (potatoes – where 52% of the crop can be left unsold (6) and mangos?). Identifying where transportation and spoilage costs consume a significant part of the value chain margins could also help identify where the biggest difference could be made.

The dairy sector is another that could be a focus as BMGF have noted that livestock farming

[1] 52% of the potato harvest is unsold.

is not delivering the returns for farmers that it could. COMPFED seems to be very successful in enlisting the loyalty of farmers due to reliable year-around sales and payments (2). In 2018-19, COMFED has inducted more societies in Supaul Milk Union in Bihar and the daily milk collection grew by 18.7% (3). It seems this sector is concentrated around Patna (3) but could be spread wider. Would be important to talk to COMPFED about their plans and the barriers they have identified.

The key is a combination of farmers supplying markets/customers/consumers with what they want (not what is convenient for the farmer to produce) and getting the products to where there is demand. The diversification may be a challenge and could be useful to work on how to send signals to farmers that lead to a narrowing of the range of produce that will lend to bigger players being able to get involved. The culture shift to do this often big. It will take time to establish new routes to market but digital could have a key role in unlocking this and ensuring info flows. In order to capture the optimal value from the perishable produce and to pass on the benefit to the farmers, there is a need to develop integrated cold-chain and other integrated agri-logistics systems (6).

We understand that the practice of contract farming is not widely adopted (and may even be illegal?) despite the fact that it brings a secured market for sale of products, pre-determined price, technical information and inputs supply. The absence of such arrangements is an important constraint for low diversification of crop area.

Bihar has a genuine comparative advantage in productivity and farm production costs. However, we understand that, this advantage is not carried through to the wholesale level, at which Bihar's prices are above those of its competitors (2). This indicates that middle-men are exploiting the state's reputation for quality to award themselves large profits that are not passed down to the farmers.

The operation of markets at different levels is clearly complex, fragmented and under-regulated. There are cases where the use of technology is helping make a real difference.

There is scope for more processing of food products. As with the rest of India, the only sectors where this is significant is grain milling and diary (4). Incentives to increase this have been hampered by lack of absorptive capacity and a combination of training and digital support could help grow SMEs in the food processing sector.

The levels of corruption in India a significant factor and farmers can be very suspicious of outsiders and large corporates. Counterfeit farm inputs are abundant in Indian agriculture with 40% of all pesticides being essentially useless (9). Digital systems based on blockchain or other models could play a role in increasing transparency and traceability.

Farmers as individuals vs groups

"Farmers need to be empowered to work collaboratively in order to increase their power within the value chain and, as a result, extract a greater share of income from what they produce, but this will require significant effort and incentives to overcome long standing socio-economic, cultural and caste barriers. This suggests that our investigation should include: Exploration of broad options for digital services supporting collaborative farming arrangements, peer support and collective action within markets; Looking for models elsewhere of digital services, remote monitoring and improved communications support signals from large players getting to farmers; and Examining cultural and other barriers to

collaborative working and identifying if/how digital tools can contribute to the engagement with the required incentives."

Bihar has unique challenges e.g. many landowners do not cultivate themselves and leave that to other farmers under land lease or sharecropping. Government subsidy schemes assume they will be used by the landowners for farming and as a result benefits do not always reach the right people. It may be useful to explore if this is likely to change in the future as it seems landowners are powerful and resistant to change. Either way it will be important to consult the landowners to see what might motivate them to play a more positive part.

The very small nature of farm holdings is clearly a major barrier to securing investment, improving productivity, enabling aggregation and pooling of the output from farms and in organising the market linkages and reducing post-harvest losses. It would also help farmers realise higher prices for their produce by building ability to select destination markets, thereby generating considerable off- farm/non-farm employment opportunities for the rural youth.

Various models of collaboration exist and can be very effective, however we have also heard that farmers can be suspicious and less willing to work for the collective good. The DFID study found that most farmers were aware of FPOs in the surveyed villages, but they have not come together to constitute an FPO (8). Even in the villages where FPOs were registered, they are found to be non-functional. Most farmers were optimistic that FPOs can play a potential role in reducing the current problems in marketing of agricultural produce. The lack of such an organisational set-up on the ground is a constraint for obtaining better price through collective bargaining.

Large scale players can provide "commercial pull" as opposed to "policy push" (i.e. attempts at land reform) – which can result in more rapid change than Government interventions.

JEEViKA has been a central player in supporting innovations in farmer collaboration and has received recognition for its excellent achievements, forming very large numbers of Self Help Groups (SHG), many of which have been federated into Village Organizations (VO) and Cluster Level Federations (CLF) (3). These structures and how they operate and could be supported should be a key focus for investigation.

Infrastructure, e-literacy and tech support

"A well-developed digital infrastructure, as well as e-literacy, especially in rural areas is a precondition for the implementation of digital services to support the agriculture and food systems but is not yet in place. Our investigation might therefore include: Seeking to collaborate with the Government of India/Bihar and the World Bank/private sector to put in place interventions that will help drive growth in infrastructure, e-literacy and take-up of mobile phones, etc.; Identifying and building relationships with the Government of India Ministry of Telecommunications and champions within the Government of Bihar for e-governance, with whom we could work."

A well-developed digital infrastructure, as well as e-literacy, especially in rural areas, is a precondition for digital agriculture and food systems (5).

While nationally there are 87 mobile cellular subscriptions per 100 people (11), in Bihar 104 million people (Census 2011) live in a vast underdeveloped area where fixed-line telecom

service is weak (rural tele-density in Bihar is 46 connections per 100 person but growing (3)) and, until recently, only 2 percent of people have a mobile phone (12). The World Bank IFC has financed Idea Cellular's entry into Bihar and they now have 2.4 million paying subscribers in Bihar. We should investigate how this was achieved and what can be learnt from it. Our contacts in the Ministry of Telecom that has targets for 100% mobile phone ownership will enable us to engage their support.

The internet subscribers base per '000 population ((latest Telecom Regulatory Authority of India (TRAI) data – (16)) is low in Bihar - 20.60 in rural and 92.99 in urban as of September, 2019. Further, Bihar has 85.24 mn mobile connection (54.11 mn in rural and 31.12 mn in urban), around 50% of which have the internet. All the major telecom players are present in Bihar.

The Department of Telecom (DoT), Government of India is planning to provide broadband connectivity of 50Mbps to every citizen by 2022 and the Prime Minister has just announced fibre optic cabling to get to every village in the country within 1,000 days. This could contribute to this being the perfect time for the BMGF initiative and should lead to a good level of cooperation from Government bodies.

The existing Department of Agriculture, Government of Bihar dedicated portal (14) provides subsidy and other support to farmers and over 15.33 mn farmers are registered users. There is also the JAM platform (15 - Jandhan, Aadhar and Mobile) that has been set up to help the Government implement direct benefit transfers for farmers at scale. We should investigate usage patterns and farmers' assessment of these.

E-literacy will also be a major factor. There was an increase of 15% in the literacy rate of Bihar from 47.0 percent in 2001 to 61.8 percent in 2011 (3). We should investigate the current position and its implications for digital communications. BMGF might consider working with the GoB on a major e-literacy campaign, linked to the delivery of high value apps for farmers.

The availability of power has increased from an average of 6-8 hours to 20-22 hours in rural areas and from 10-12 hours to 22-24 hours in urban areas (3). The per capita consumption of the electricity in the state has risen from 145 kwh in 2012-13 to 311 kwh in 2018-19, implying a growth of 114 percent in six years.

There is a Government push for rural and urban infrastructure development involving inland waterways, roadway, airport, warehouse, cold chain, and rural digital infrastructure (50Mbps to every citizen by 2022). This project focuses on identifying farmers'/farming challenges within the consolidated view of current and emerging infrastructure in order to present the critical requirements for developing/implementing digital farmers services in the state of Bihar. The ICT infrastructure in the state has been strengthened through implementation of BSWAN, SecLAN, State Data Centre, Common Service Centres, Wi-Fi Projects, Aadhar, Bharat Net, etc. and expansion of IT Institutions (3).

Department of Telecom (DoT), Government of India's role will be very important, as we understand, this body would be probably going to manage largest dataset in world and responsible for providing communication infrastructures in Bihar.

Designing and managing digital government programmes requires a high level of administrative capacity which is beyond the capabilities of many administrations in developing countries (5). However, Bihar has received many awards in the field of e-

governance and is actively working to make all government services accessible to the common man in their locality (3), through common service delivery outlets. This would be valuable to explore, as it could suggest avenues and champions within the GoB for our agenda.

Nature of Government

"The different systems, institutions and climatic zones within the region will need to be understood and the relevant players around the value chain effectively engaged to build an understanding of their needs, and secure their buy-in. This will ensure that, through the major programme following this work new digital services can be designed and implemented to deliver positive change at scale. Understanding the complex eco-system is vital, particularly at a time when the State Government could change and develop new policies. For instance, digital technology could support increased regulation of local markets and improving the transparency of sales channels to larger players upstream could create opportunities for increasing tax revenue."

Agriculture is primarily a state government matter and is a highly politically sensitive topic involving central government and underpinned by socio-economic structure of India. The central government sets price controls, tariffs and other barriers. It also plays a role through promotional schemes for particular varieties of crops and agricultural products. The states have responsibility for implementing agriculture policies, meaning states affect conditions for delivery of agri services, technology and investment. Given the limited revenue receipt from its own sources, the Government of Bihar has been dependent on the central transfers and the grants for resources (3). Understanding the complex eco-system is vital to any agriculturally based programme, particularly at a time when the State Government could change and seek to introduce new policies.

The two Government of Bihar ministries of greatest relevance will be:

- Agriculture
- Animal & fishery resources.

We will also want to talk to the ministry responsible for eGovernance/open data.

In Bihar, revenue expenditure and capital expenditure in agriculture and irrigation have generally increased since 2000-01. However, there is a slump in both revenue and capital expenditure from 2014-15 onward. The average share of capital expenditure was 39.0 per cent during 2000-01 to 2007-08, which declined to 34.0 per cent during 2008-09 to 2016-17. The falling government expenditure particularly capital expenditure in agriculture and irrigation is worrisome (8).

Post the election could be a good time for BMGF to build a relationship with the incoming Agriculture Minister and offer resources to assist. The new administration will be keen to have initiatives that can be announced. Increasing regulation of markets supported by tech could make a substantial difference and would link well to the DFI drives as well as increase tax revenue potential if can tax the larger players upstream.

We have identified the following relevant Indian government schemes (17, 18, 19) to investigate:

- Agri Infra Fund (AIF) of INR 1 Lakhs crore / US$ 15 bn for post-harvest infrastructure,

- A scheme for supporting 10,000 FPOs - to include 25 million farmers who still do not have the Kisan Credit Card,
- The digital agri-stack which will be a key enabler for online market places and smart agriculture. We have only been able to found a reference to this that focuses on support for the livestock sector - Under the digital Agristack, aiming to provide a unique ID for 570 million animals over next 1.5 years to enable farmers to confirm their parentage, breed and productivity.
- The NITI Aayog 'Transformation of Aspirational Districts' Programme aims to improve the socio-economic status of 117 districts from across 28 states. Bihar has 13 Aspirational districts - we will reach out to 10 places[2] in Bihar during the project to hold workshops/meetings.
- Hon'ble CM of Bihar requests national Government to include even non-raiyats (non-land owners) as beneficiaries of their schemes.

Need for finance

"All the data points to lack of investment going into Bihar and the regional share of investment from institutional sources is relatively low. There is a key need to get more finance to the farmers in ways that give institutional lenders/investors' confidence while minimising the risk of farmers getting trapped in debt. This suggests that one test of the potential BMGF interventions is whether it would lead to digital services unlocking an increase in the outreach of banks for farm loans. "

All the data points to lack of investment going into Bihar. For example, Fixed Capital Expenditure (FCE) in agriculture as per land holding size is much lower in Bihar than other states (6). There is a key need to get more finance to the farmers in ways that give institutional lenders/investors confidence do not risk farmers getting into trapped in debt. Achieving an increase in the outreach of banks for farm loans in Bihar should be a key measure of success for the programme, as its share of investment from institutional sources is relatively low (6).

In general, finance and risk-bearing arrangements seem to be under-developed (2) and an area where digital services can make a huge difference. Generally, this is about evidence and transparency and working with intermediaries who can support farmers to spend money wisely. We have heard that farmers would prefer not to borrow from traders, probably due to concerns about trust, but there could be major banks that work through these? We have supported very productive models that use satellite data (13) so that banks etc. can see the state of farms, to unlock credit.

Support to farmers

"There is a recognition that 'Agricultural Extension' and 'Farmer Friend' need to empower farmers with information and resources (including women centric), and that the focus of capacity building should be on the principles of agri-business extension, not just production. This means strengthening the existing extension system in a great many areas where digital services can play a very valuable part. This implies that we should examine if Ag Advisory Services need significant support and if we can align with the measures being developed from

[2] Sitamarhi, Sheikhpura, Purnia, Nawada, Muzaffarpur, Khagaria, Katihar, Jamui, Gaya, Begusarai, Banka, Auranagabad and Araria

the Government to strengthen this, enabling ICT based services to become viable and effective."

The DFI Committee (7) in defining the mandate of Indian Agriculture, describes Agricultural Extension as:

"*a system of empowering farmers with information, knowledge, technology, skills, risk and farm management practices, across agricultural sub-sectors and along all aspects of the agricultural supply chain, so as to enable the farmers to realise higher net income from their enterprise on a sustainable basis*".

This seems particularly helpful in this context, especially as the recommendation is also that the focus of capacity building should be on the principles of agri-business extension, in contrast to the production-centric extension practised hitherto. This means strengthening the existing extension system in a great many areas where digital services can play a very valuable part: delivery of real-time market information; integrating farmers with agri- value system platforms; promoting use of warehouses including pledge loan facility and e- NWR trade; connecting with agri-logistics, as also retail and primary wholesale markets, electronic trade platforms; promotion of contract farming; scaling up farmer producer organisations (FPOs); farm mechanisation; extension of water use efficiency, effective pest management, production and marketing of organic products; primary processing; scientific storage; entrepreneurial skills for farmers to manage small scale agri-business; introduction of new on-farm, off-farm and non-farm income generating activities; intensification and diversification strategies; providing psychological counselling to farmers to manage distresses; developing managerial competencies of farmers and extension personnel and effective use of ICT by farmers.

ICT based Extension Services are recommended to streamline information flow and reduce the impact of dropping staff capacity within the services. The challenge will be in putting effective systems in place for this to work as that is likely to require substantial human capital to train up all parties in the necessary skills.

The institution of Farmer Friend is also critical as it serves as a grass-root platform between the extension functionaries and the farmers (7). In addition, gender concerns about women in farming can be addressed by enrolling women as farmer friends and by developing schemes that are women-centric.

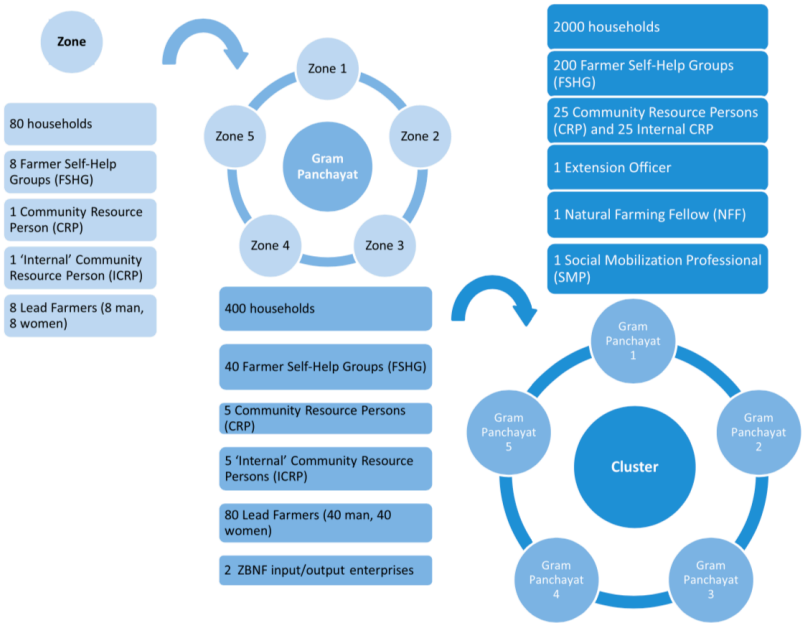
Farmer engagement

"There is considerable evidence that bottom-up planning processes involving farmers in the preparation of strategic research and extension plans and in the subsequent determination of appropriate interventions are critical to the mobilisation of farming communities as champions of change. "

There is considerable evidence that bottom-up planning processes involving farmers in the preparation of strategic research and extension plans and in the subsequent determination of appropriate interventions are critical to the mobilization of farming communities into champions of change (2). The initiatives piloted in Bihar to deliver two of the most visible and important public services in the agricultural sector— agricultural technology and surface irrigation—confirm that the involvement of local stakeholders in decision-making and implementation can improve development outcomes (2).

A recent study identified some important lessons about scaling up new farming practices in rural India (10). Zero Budget Natural Farming (ZBNF) is a form of agricultural system redesign being practiced at scale in India, particularly in the state of Andhra Pradesh. ZBNF is an emerging set of agricultural practices designed dramatically to reduce farmers' direct costs (hence 'zero budget') while boosting yields and farm health through the use of non-synthetic inputs sourced locally ('natural farming'). Andhra Pradesh has set out the aim of 'rolling out' ZBNF to all 6 million of the state's farmers through a state-led programme of training and extension. While this is not focused on digital technology and support, it does have relevance for any programme of change. The key lessons from this were:

- The need for clear policy directives, accompanied by adequate financing and institutional support. Key to the sustained scaling of ZBNF in Andhra Pradesh has been the layering of initiatives, allowing for momentum and experience to build (see diagram on next page). Previous programmes on community supported sustainable agriculture have put in place an institutional architecture on which the ZBNF programme is able to capitalize.
- The emphasis on farmer-focused, participatory extension, building human capital (farmer learning) and two types of social capital – links between farmers (bonding capital) and between farmers and 'experts' in the agricultural research and innovation ecosystem (linking capital).
- The need to proactively engage with gaps in knowledge provision and exchange. If farmers are encouraged to transition away from familiar methods/crops, they need sufficient guidance on how to deal with new crop pests, etc. These farmers call for more and better formal support and training, and also restructured regulation and markets that allow for profitable sales.
- The importance of farmer-led and farmer-focussed knowledge-exchange.



Institutional-levels supporting ZBNF roll-out in each zone, gram panchayat and cluster

We would recommend that the aim should be to identify some specific aspects of farming

and food production/sales that will drive real and desired benefit for farmers and other stakeholders, and where digital services could make a really transformational difference and unlock what is not currently possible, and then invest in a programme that is about both technical change and agricultural change together – this will provide the best conditions for acceptance of the digital services and the prospects of scaling up.

The Factors that will determine the relative priorities of the possible areas for intervention

"The inception work with BMGF will include anticipating the indicators that would strengthen or reduce the case for each of the potential action areas. We have started to map these in the insights document. An example is shown in table (1) below.

Unlock, make interoperable and improve use of key government datasets	***Positive indicators**: Data is regularly updated, useful and could add value to farmers. Owners of the data are happy to engage and share it. Strong eGovernance systems and culture.*	***Negative indicators**: Strong resistance from senior Government officials who own the data. Evidence that the data sets are inaccurate or not capturing the reality on the ground. Evidence the data sets are not trusted by farmers and others.*

Table (1) Example Action Area indicator assessment"

Ultimately, each of the 9 interventions being considered can be assess in terms of its:

- Level of challenge – from very easy and low risk to extremely challenging and high risk
- Level of impact – from only making a marginal difference to offering real prospects of transformational change

We have reviewed the interventions being considered and set out some initial ideas regarding what evidence would support each, and what would also suggest it might be more challenging or have less impact.

Possible area for intervention	Positive Indicators	Negative Indicators
Provide *customized advisory* at scale, bringing in as many private, public, community partners as possible through digital platform and deep *farmer engagement models*	Evidence that the advisory services can harness digital support. Evidence that farmers will generally take a long time to actually change and adopt tech themselves. Evidence that organisations can work effectively together and identify complimentary roles.	Crowding of the landscape and of excessive numbers of tools will confuse. Evidence that small number of coordinated solutions will have more impact. Risk of too many players who do not cooperate

Fuel the ag advisory system and proposed new digital platform with *demand-driven, integrated datasets*	Capacity to build these data sets. Suitable data sets are identified that are relevant and applicable. The Agstack seems to be relevant and there are realistic prospects of it being implemented to a good standard.	
Support innovations to create robust *farmer profiles* (e.g. a 360-view on what farmers are producing, adoption of improved practices, farmer demand/challenges) and collect and transmit accurate farm-level data	Ability to gather that information from farmers. The DISYS work will be fit for purpose.	Diversity of crops is too high and players unwilling to share data.
Provide *market price information and linkages*, particularly for women	Consulting women indicates they would have capacity to make use of this or can be trained in it. System provides sufficient flexibility for farmers to adjust in the light of info about price and demand. Risks of this distorting markets or behaviour can be managed.	
Work with *farmer producer companies (FPCs) and farmer producer organizations (FPOs)* for data collection, advisory and markets	These are functioning and effective institutions. JEEVIKA are supportive.	Farmers are suspicious of these and reluctant to engage. They are too patchy and inconsistent around the state.
Unlock, make interoperable and improve use of key *government datasets*	Data is regularly updated, useful and could add value to farmers. Owners of the data are happy to engage and share it.	Strong resistance from senior Government officials who own the data.

	Strong eGovernance systems and culture.	Evidence that the data sets are inaccurate or not capturing the reality on the ground. Evidence the data sets are not trusted by farmers and others.
Leverage *ag-data platforms and standards* to achieve harmonization of datasets	Analysis of the datasets suggests that harmonisation is a realistic possibility	
Improve *linkages with R&D institutions* to improve farmer-facing services, focusing on climate smart content	R&D institutions have real relevant and sensitive knowledge and skills. Systems and programmes exist to incentivise academics. Cultural and caste barriers can be overcome.	
Support *inclusive smart farming innovations*, accommodating specifically for illiteracy, multiple languages and offline solutions	Evidence that suitable interface tools exist.	Evidence that take up of mobile phones or other tech will be too long coming.

References

1) *Agricultural Statistics at a Glance 2019* Government of India Ministry of Agriculture and Farmers Welfare Department of Agriculture, Cooperation and Farmers Welfare Directorate of Economics and Statistics, 2020
2) *Bihar Agriculture: Building on Emerging Models of "Success"* January 2007, Agriculture and Rural Development Sector Unit, South Asia Region, World Bank Discussion Paper Series Report no. 4.
3) *Bihar Economic Survey 2019-2020*, Finance Department, Government of Bihar
4) Debdatta Saha*, Economics of the Food Processing Industry - Lessons from Bihar, India,* Springer 2020
5) Nikola M. Trendov, Samuel Varas, and Meng Zeng *Digital Technologies in Agriculture and Rural Areas Briefing Paper,* Food and Agriculture Organization of the United Nations Rome, 2019
6) *Report of the Committee on Doubling Farmers' Income Volume II "Status of Farmers' Income: Strategies for Accelerated Growth" Inter-linkages between Input Costs, Diversification, Capital Formation and Income*, August 2017
7) *Report of the Committee on Doubling Farmers' Income Volume XI "Empowering the Farmers through Extension and Knowledge Dissemination" Agricultural Extension & Knowledge Diffusion, Skill and ICT: Empower every Farmer in every Corner*, November 2017
8) *Study on Agricultural Diagnostics for the State of Bihar in India*, National Council of Applied Economic Research, November 2019
9) *UK-India Science and Innovation Future Agri-Tech Partnerships: Scoping Report* following Scoping Mission December 2019
10) Zareen P. Bharucha, Sol B. Mitjans & Jules Pretty (2020) *Towards redesign at scale through zero budget natural farming in Andhra Pradesh, India*, International Journal of Agricultural Sustainability, 18:1, 1-20, DOI: 10.1080/14735903.2019.1694465
11) *https://databank.worldbank.org/source/world-development-indicators*
12) *https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/mobilephones_tellingourstory*
13) *https://ag-space.com*
14) *https://dbtagriculture.bihar.gov.in/*
15) *https://www.ibef.org/research/india-study/jam-trinity*
16) *https://trai.gov.in/sites/default/files/PIR_08012020_0.pdf*
17) *https://pib.gov.in/PressR17)eleaseIframePage.aspx?PRID=1634724*
18) *https://niti.gov.in/sites/default/files/2018-12/FirstDeltaRanking-May2018-AspirationalRanking.pdf*
19) *https://timesofindia.indiatimes.com/india/nitish-kumar-asks-centre-to-include-non-land-owner-farmers-as-beneficiaries-under-pm-kisan/articleshow/69805914.cms*