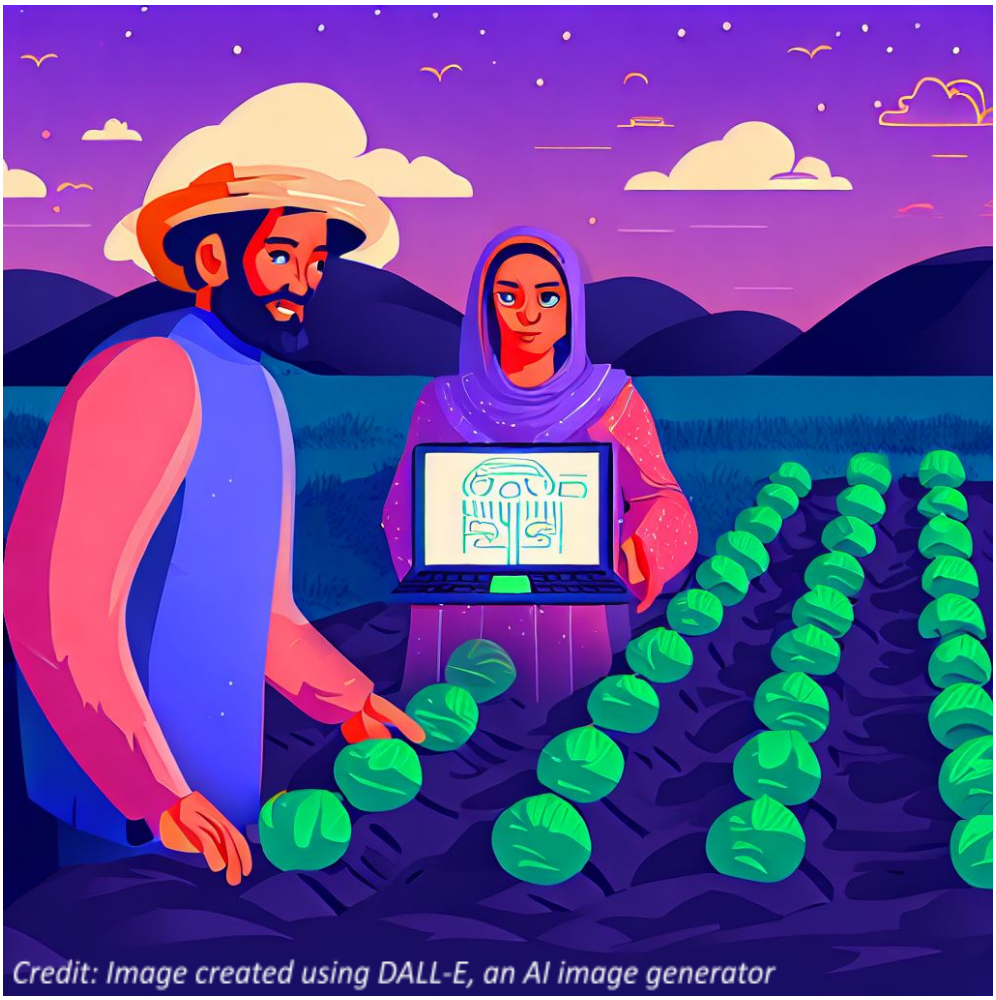
Rapid Landscaping of Artificial Intelligence in Agriculture in Pakistan



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Executive Summary

This report is based on a two-week rapid landscaping of the state of artificial intelligence (AI) in Pakistan, with a particular focus on opportunities for the agriculture sector. It included interviews and focus groups representatives from more than 50 organizations, including government agencies, industry associations, private sector actors, ecosystem enablers, academia, and development organizations.

While this report does not purport to be comprehensive or definitive, the conversations conducted as part of this landscaping revealed several perspectives that were shared by multiple stakeholders, as follows:

- **AI innovation is already happening in Pakistan.** Numerous universities have already set up AI degree programs, the government has funded several AI related efforts (such as the National Center for AI), and several private sector companies have already developed AI solutions that are being deployed in Pakistan and elsewhere.
- **Pakistan requires local development for local needs.** Since Pakistan's languages are not always well represented in global models, some of those solutions are having to be developed locally, albeit with some lag behind global models. This includes the development of optical character recognition software to read and digitize paperwork in local languages, the development of large language models in local languages, and others.
- **Data fragmentation and lack of data standards are omni-present.** Almost everyone we spoke with mentioned the challenges they face from a lack of data standardization and from fragmentation of data–including data that is yet to be digitized–both generally, but also in terms of agricultural related data specifically.
- **There is a regulatory gray area for data protection and data usage.** Pakistan does not currently have approved data protection regulations or laws. For some, this has made data sharing easier, while others were concerned about sharing data in a pre-regulatory environment.
- **There appears to be some disconnect between academic research and industry.** Several private sector actors felt that academic research outputs often do not have a clear commercial fit in the market, and that there is a lack of deep collaboration between academia and industry.
- **There also appears to be a skills gap between fresh graduates and industry needs.** Several universities noted that many of their top graduates go abroad for further

study or employment, while multiple private sector actors shared the need to train fresh graduates for anywhere from six months to three years to bring them up to required standards.

- **Pakistan's youth bulge is also a huge opportunity.** Despite the current skills gaps, there is a huge opportunity to tap into Pakistan's under 30 population to develop a significant and highly trained cadre of AI professionals in Pakistan.
- **Infrastructure limitations remain, especially electrical.** Some stakeholders shared infrastructure gaps that exist in rural Pakistan, especially in terms of electrical grid access, as potential barriers to increased digitization–and by extension, application of AI-enabled technologies in agriculture.
- **Health and education sectors are seen as good opportunities for AI.** While this landscaping focused exclusively on agriculture, several stakeholders flagged opportunities to use AI in the health and education sectors. A few stakeholders are already deploying AI solutions in these sectors in Pakistan.

Given the above, there are several potential opportunities that USAID/Pakistan may wish to further explore as it seeks to contribute to the inclusive and appropriate uptake of AI in the agriculture sector in Pakistan. These can be divided into two overarching areas focused on actions USAID/Pakistan can take through its programs and those that it can do beyond its programs. While this report is framed in terms of recommendations for USAID/Pakistan, some of the recommendations may also be relevant for other actors working in this space in Pakistan.

Within its programs, USAID/Pakistan should focus on making sure that all of its agriculture and related activities adhere to the Principles for Digital Development, and that each activity develops an activity-level plan for using digital technology. Within specific activities, there are also opportunities to work more closely with government partners on digitization (such as the Farmer Service Centers in Khyber Pakhtunkhwa), to coordinate with relevant Pakistan-based actors on digitizing and digital data, to incorporate content related to digital literacy into existing trainings, to engage with the innovation ecosystem in Pakistan, and to carefully and responsibly experiment with AI-enabled tools.

Beyond its programs, there are numerous potential opportunities for USAID/Pakistan to facilitate greater coordination and collaboration between various stakeholders, including around:

- General sharing and learning about AI and its applications in agriculture
- Public data sharing agreements and data standardization
- Linking Pakistani actors with relevant global efforts
- Linking Pakistani and US universities together around AI
- Supporting technical exchange between US-based and Pakistani technology companies

Within Punjab province, the last three bullets above can be further supported by leveraging the Punjab-California Sister State Agreement, where appropriate.

There are also opportunities for USAID/Pakistan to coordinate more closely with other bilateral and multilateral organizations on AI and aligned subjects in order to amplify the potential impact and scale that any single actor could have on their own. Last, there may be opportunities for USAID/Pakistan to coordinate more closely with the Government of Pakistan on its strategic efforts related to digital agriculture, data protection, and AI.

As the application of AI in agriculture is a burgeoning field globally, and still in a fairly nascent stage within Pakistan, it will be important for USAID/Pakistan to continue to stay abreast of how the market and the technical capabilities of AI in the context of Pakistan evolves. Within that context, particular attention should be paid to inclusion, and data privacy and security. Given the fact that Pakistan has one of the largest gender digital divides in the world and that it is still in a pre-regulatory data privacy environment, it will be important for USAID/Pakistan to consider how AI–and digital technologies more broadly–can be introduced and scaled in the agriculture sector in a way that is broadly inclusive and respectful of individuals and communities' privacy and security.

Background

Recent advancements in generative artificial intelligence (AI) built upon large language models (LLMs) have highlighted opportunities to deploy these technologies in the agriculture sector in ways that have the potential to deliver accurate and scalable advisory and predictive services all along agricultural value chains, from farmers to agribusinesses to policymakers. USAID, together with the Bill and Melinda Gates Foundation, published a study earlier this year that examined how AI and automation can be inclusively deployed in the agriculture sector in low- and middle-income countries. Yet, little research has been undertaken to date on this topic within the context of Pakistan.

USAID/Pakistan's Climate and Sustainable Growth (CSG) Office commissioned this rapid landscaping to better understand the AI landscape in Pakistan, particularly as it relates to agriculture, and to identify potential areas of intervention as well as opportunities for development. It builds from previous engagements that the Mission has conducted, including the Pakistan Digital Ecosystem Country Assessment (DECA) and an AI stakeholders sector review meeting in August 2023.

Pakistan is highly vulnerable to the effects of climate change, with the Global Climate Risk Index 2021 ranking it as the eight most affected country over a period covering 2000 to 2019, during which they experienced 173 weather-related loss events and close to US $4 billion in losses. It is also ranked 23rd in the world in the 2024 INFORM Severity Index, further underlying its vulnerability to climatic, as well as other, shocks and stresses. According to the Pakistan Bureau of Statistics, agriculture contributes around 24 percent to the country's GDP and employs half of Pakistan's labor force. FAO estimated that, of the 94 calamity-affected districts hit by the floods of 2022, across the country; the total damage and loss in the agriculture sector was US$ 12.9 billion. Crop loss contributed to 82 percent of the total damage and losses in the sector, followed by livestock with 17 percent and fisheries/aquaculture with the remaining 1 percent. It is within this context that the U.S. and Pakistan governments launched the "Green Alliance" Framework. The framework advances cooperation in agriculture, clean energy, and water. Using new tools to mitigate climate risks in agriculture is the need of the day.

Limitations

This report is based on a rapid landscaping assessment conducted in Pakistan from September 11-22, 2023. It included one week in Islamabad, a two day visit to Karachi, and a three day visit to Lahore to interview agriculture and technology sector stakeholders who are already working on artificial intelligence, or who have an interest in doing so.

This rapid landscaping assessment is based on an extremely limited sample size, so cannot claim to be representative of the current state of AI in Pakistan broadly, or in agriculture. As all of the stakeholder meetings took place in major cities in Pakistan, it also cannot claim to be representative of the actual needs and technology usage of farmers and other agricultural value chain actors, such as input retailers, buyers, and extension agents in Pakistan. Any information about those groups was communicated second-hand via other stakeholders, and may not be entirely reflective of the context facing the populations in communities where USAID's agriculture programs work.

All told, interviews and structured virtual roundtables were conducted with stakeholders from 41 organizations, businesses, academic institutions, and government agencies. In addition, 30 stakeholders participated at two semi-structured, in-person roundtables in Lahore. See Annex I for more details on interview and roundtable participants.

Therefore, the observations and potential opportunities presented in this report cannot purport to be reflective of the full depth of nuances related to how rural and agriculture sector stakeholders in Pakistan are interfacing with digital technology, much less AI. However, it can provide some insights into how a small subset of stakeholders are thinking about AI in the context of agriculture and point to what opportunities may exist to leverage these technologies within USAID's agriculture programming, as well as how USAID can support the development of this sector beyond its programs.

This report should be taken as an initial landscaping, from which additional conversations and research can be undertaken. Before acting upon the findings outlined in this report, it will be important to further explore and verify them. This can be done by USAID's implementing partners or other development or technology sector actors with an interest in this topic.

Brief Overview of AI in Pakistan

In 2022, the Ministry of Information Technology & Telecommunication released a draft National Artificial Intelligence Policy, which "aims to go beyond the meagre approach of adopting technology to fundamentally rethink AI adoption in the local context so that new growth areas can be identified and intervened in considering the existing job market's relevance while empathizing with the growing population of the country."

At a high level, the draft National AI Policy shares some conceptual similarities with USAID's AI Action Plan. It has outlined a vision "To Embrace AI by appreciating Human Intelligence and stimulating a Hybrid Intelligence ecosystem for **equitable, responsible**, and transparent use of AI", which is similar to USAID's vision of **responsible** AI, defined as **equitable**, inclusive, and rights-respecting [emphasis added].

This policy builds on a number of existing government-led or -sponsored efforts on AI, including:

- The Presidential Initiative for Artificial Intelligence & Computing (PIAIC), which launched in 2018 with a focus of providing educational programs in a number of areas, including AI.
- The National Center of Artificial Intelligence (NCAI), which was established in 2018 under the Government of Pakistan's Vision 2025 "to become the leading hub of innovation, scientific research, knowledge transfer to the local economy, and training in the area of Artificial Intelligence." It is hosted by a number of universities, including NUST, NED, and UET Peshawar. There are also a number of National Centers in aligned areas, including the National Centre of Robotics and Automation (NCRA) and the National Center in Big Data & Cloud Computing (NCBC).
- There are also a number of other university-led efforts, such as the Artificial Intelligence Technology Centre (AITeC), which was established under the National Center for Physics at Quaid-i-Azam University; the Center for Excellence in Artificial Intelligence at Bahria University; and the Artificial Intelligence Research Lab (AIRL) at UET Lahore, which does not appear to have direct government support.
- The Center for Artificial Intelligence and Computing (CENTAIC), which was launched in 2020 by the Pakistan Air Force to enhance their AI warfare capabilities.
- The Sino-Pak Center for Artificial Intelligence (SPCAI), which launched in 2022 and is hosted by the Pak-Austria Fachhochschule Institute of Applied Sciences and Technology in partnership with Chinese and Austrian universities with a focus on developing research and development capacity in AI.

The draft policy itself lays out a number of ambitious targets, including training one million people in AI and allied technologies by 2027, training at least 70 percent of public sector employees working in IT and AI potential sectors by 2026, and making 90 percent of the public with internet access aware of AI by 2026.

It also calls for the creation of a nationwide network of Centers of Excellence in AI & Allied Technologies (CoE-AI). Among the proposed priorities for the CoE-AI is a focus on agricultural supply chain optimization, which includes predictive analytics to streamline supply and demand, weather prediction to assist farmers to make informed decisions, and soil monitoring systems.

Whether or not this policy is finalized and made into law remains to be seen. The current iteration has received some public criticism and some of its perceived shortcomings were also highlighted by a number of stakeholders during this assessment. It will, therefore, be important to track its progress and understand the implications of the policy on the use of AI in agriculture, should it be made into law.

It will also be important to track the broader enabling environment, some of which are relevant to the extent to which AI can be widely used in Pakistan. For example, in Freedom House's most recent Freedom on the Net report, Pakistan scored poorly across all three indicators: obstacles to access, limits on content, and violations of user rights.

Key Observations

Based on the stakeholder conversations held as part of this assessment, several key observations emerged. One of the most common threads across many of the challenges identified were related to gaps in coordination and/or collaboration between relevant stakeholders. There was a sense that many of them are focused on their own work without fully realizing the work of others that could add value to their own.

While the following observations were the most common ones raised during our discussions, it is important to emphasize that these are not necessarily all-encompassing of the full range of opportunities and challenges facing the deployment of AI in the agriculture sector.

AI innovation is already happening in Pakistan. While perhaps in its nascent stage, AI is not new to Pakistan. Several prominent universities, including NUST, FAST, NED, MUET and SZABIST have undergraduate and/or graduate degree programs in artificial intelligence, while several others offer courses and bootcamps on AI. A number of universities also offer degrees and courses in fields adjacent to AI, such as data science, automation, and robotics. Academic research specifically related to the application of AI for agriculture is also taking place, and

several agtech and AI startups have successfully launched from research started at Pakistani universities. The country has also set up a National Center for Artificial Intelligence (NCAI), as well as several other National Centers in related fields including Cloud Computing & Big Data.

There are also at least a couple of digital agriculture service providers in Pakistan that are already incorporating AI into their services, while several others we spoke with are seriously exploring whether AI could add value. For example, Rayn's Kisaan Management Services uses AI to facilitate with forecasting and crop yield prediction, as well as providing AI-enabled advisory services to farmers. While still operating at a fairly limited scale, Rayn's platform is demonstrating the potential of AI as a value-add for agricultural services.

More generally, we also heard from stakeholders that there are a number of private sector enterprises working in AI in Pakistan, including those working on computer vision and natural language processing. A number of those enterprises are focused on international markets, and use Pakistan as a development laboratory and proving ground. It is important to note, though, that a detailed mapping of promising AI enterprises in Pakistan is outside of the scope of this assessment.

Local development for local needs. While most official business and paperwork in Pakistan is done in English, Urdu and other local languages are still the preferred language of much of the population. As there is limited internationally developed software that supports these languages, there is a need for locally developed solutions.

One prime example is optical character recognition (OCR) software, which can be used to convert paper-based forms into machine-readable, digital formats. We heard of at least two universities and one private sector company that have developed their own OCR softwares for Urdu, as well as some local languages. One of those said that the software they use works fairly well with type-written text, but struggles with hand-written. Yet despite these efforts, a significant number of stakeholders we spoke with were completely unaware of even one OCR software that worked with Urdu. This highlights the need for greater coordination and promotion of locally developed software solutions.

As noted above, the lack of LLMs in local languages may also present a barrier to robust development of AI systems. We met with at least one Pakistani technology company that is in

the process of developing an LLM for Urdu. With greater coordination, there could be opportunities to develop LLMs in other local languages as well, not to mention strengthening Urdu models. Outside of Pakistan, Mozilla's Common Voice project has been developing voice datasets in a number of underrepresented global languages, including Urdu, Pashto, and Punjabi, which could be useful to Pakistani technology developers as well. Bhashini, which was established by India's Ministry of Electronics and Information Technology has also been developing LLMs in a number of Indian languages, some of which, such as Punjabi, overlap with Pakistan. Similar to Common Voice, they are also crowdsourcing audio and text based models through an effort called BhashaDaan.

Data fragmentation and lack of data standards. Almost every person we met mentioned the constraints they face when it comes to data. Time and again people lamented the fact that agricultural data, including farmer profiles, weather and soil data, and agricultural production data, is often collected by multiple parties, with limited sharing or coordination taking place. While some universities, particularly public ones, noted that it was not difficult for them to access government data for research, this seems to be a significant constraint for technology companies and development organizations. Since they need to understand the agriculture landscape in order to target their services, often their only option is to collect the data themselves from scratch, which can come at a significant cost–and therefore act as a negative drag on innovation.

Not all agricultural data in Pakistan is digitized either, which is another barrier to its use. Weather Walay, for example, needed to digitize decades worth of meteorological data from that government that it needed to build out its models. This can present another barrier to entry for innovators, as the cost to digitize data can add up–and that's assuming that they can even gain access to the paper files in the first place.

There also does not appear to be any national or industry agreed upon standards for data labeling. While this is not a significant problem at the moment given the limited data sharing that exists between ecosystem actors at the moment, this could present a barrier to future efforts at broader sharing.

While there have been efforts to address this data fragmentation, such as opendata.com.pk, which is run by the National Center for Big Data and Cloud Computing at LUMS University,

there has not yet been broad contributions of agricultural data. There is, however, a strong appetite among many of the stakeholders we met with for greater data sharing. A number of them expressed interest in public data sharing agreements or open data for the agriculture sector, although they also recognized some of the entrenched challenges with doing so. At the same time, there also seemed to be a lack of awareness by some stakeholders about data that is already available. As a starting point, there could be value to aggregating what types of agricultural data have already been collected and by who, even before any formal data sharing agreements or open data platforms are operationalized.

Standardizing and expanding local datasets in a machine-readable digital format will be a critical foundational factor if Pakistan is to effectively leverage AI in the agriculture sector at scale, since AI systems require significant amounts of locally relevant training data, or large language models (LLMs), to refine their accuracy. One technology company we spoke with learned this first hand. Due to the lack of sufficient local data, they had to rely on purchasing training data for their AI models from outside of Pakistan, which significantly reduced the model's accuracy when applied to Pakistan.

Regulatory gray area for data protection. In our conversations with legal professionals, the lack of existing data protection regulations was brought up extensively. Although the government has put forward data protection policies in the past, at the time of writing this report, none have been made into law.

This has created a gray area that has impacted how data sharing is undertaken in Pakistan. We heard from at least one stakeholder that this has made data sharing easier because data can be shared between parties without having to worry about any restrictions. However, at least a couple of other stakeholders shared that the lack of a legal framework has made them less likely to want to share data with others.

Some disconnect between academic research and industry. Some of the private sector stakeholders we spoke with noted that there is sometimes a disconnect between academic research related to AI broadly and digital agriculture and the needs of industry. That sometimes leads to research outputs that do not have a clear commercial fit in the market.

During a conversation with software companies, the idea was raised that academic faculty should be required to spend some time working in the private sector so they have a better understanding of industry. This seems to be complicated, however, by Higher Education Commission rules, especially for public universities.

NED University, which is private, has already taken steps to doing just that. To date, they have sent 17 faculty members to work in industry. This could be a model that can be replicated and iterated on by other universities. While it may not be feasible to embed all academic faculty in industry, particularly those from public universities, there are still opportunities to facilitate greater coordination between both sides so that academic research is geared towards answering some of the questions or challenges being faced by industry.

Skills gap between fresh graduates and industry needs. As noted earlier, there are already quite a few universities in Pakistan that are offering undergraduate and advanced degrees in AI. Yet, we heard from multiple stakeholders about the skills gap that exists between fresh graduates and the needs of industry, both in regards to AI, as well as software skills more generally. On the low end, companies said that they needed 6 to 12 months to train fresh graduates on the job, while at the high end, it could take 2 to 3 years. This could, in part, be due to the fact that many of the top performing graduates seek further educational or job opportunities outside of Pakistan in North America and Europe. One university shared that most of their top 20 percent of graduates head abroad after graduation, while for others it was in the range of top 5-10 percent. This consistent brain drain likely has an overall negative impact on the sector.

Companies that invest significant resources in fresh hires also have to worry more about retention, as they do not want to lose all of that time and money invested into training staff. One stakeholder from the gaming sector did note that companies have become a lot more collaborative in recent years, rather than poaching each other's staff. It is unclear if the same conditions apply across the entire IT sector though.

NED University has tried to reduce this gap by entering into agreements with companies to embed students with them during school breaks. While this program is still fairly small, with only 20 students participating to date, it could serve as a model for other universities and private sector companies to experiment with.

Pakistan's youth bulge is also a huge opportunity. Close to two-thirds of Pakistan's population is under the age of 30. At least two universities we met with are trying to capitalize on this by opening up short-term software and AI specific programs, such as the AI bootcamps offered by NUST and FAST Lahore, beyond just enrolled students.

While bootcamps alone are unlikely to develop a significant and highly trained cadre of AI professionals in Pakistan, they can be a piece of a wider effort. These efforts could potentially be amplified by greater coordination between academia, industry, and the government, supported by development actors.

Infrastructure limitations, especially electrical. During a meeting with LUMS, they shared that 30-50 million people in Pakistan are in areas with no electric grid, and 20-30 million are in weak grid areas. Although they reported that small scale solar panels are filling some of that gap at a household level, it is not possible within the scope of this assessment to verify the extent to which solar is filling the gap in the electrical grid.

Health and education sectors are seen as good opportunities for AI. While outside of the scope of this assessment, a number of stakeholders mentioned what they saw as the opportunity to use AI for health and education. Although health use cases may be less transferable to the agriculture sector, advancements in AI for education have the potential to be transferable to information and advisory services aimed at the agriculture sector.

Potential Opportunities for USAID

Based on this initial landscaping, there are a number of actions that USAID/Pakistan can potentially take to support the responsible and inclusive uptake of AI in the agriculture sector in Pakistan, should such actions align with current or future priorities. These have been organized into two buckets: those actions that can be done through USAID/Pakistan's agriculture-related activities (i.e. Within Programs) and those that can be undertaken by USAID directly in its facilitative capacity (i.e. Beyond Programs). The actions listed below should be considered as a menu from which to pick and choose based on priority alignment, rather than a definitive to-do list.

It is also important to emphasize that each of these are only potential opportunities based on the findings from this limited and short-term landscaping. Prior to proceeding with implementing any of these opportunities, it will be critical to validate them further through additional discussions with relevant stakeholders and/or further market research and analysis.

Within Programs

The recommendations for USAID/Pakistan's activities can be broken down into three overarching buckets: those that should be adopted by all CSG-funded activities, those that are activity specific, and those that are activity dependent (i.e. they may be relevant to some activities and not others, depending on their focus).

All Activities

Adhere to best practices for digital development (e.g. Principles for Digital Development). While not specifically AI related, it is important for USAID activities to adhere to best practices for digital development, such as the Principles for Digital Development. It is important to remember that while it is possible to use digital technology in any number of innovative ways, doing so is not always practical given the local context. While it is theoretically possible for a USAID activity to launch an AI-enabled chatbot for farmers today, doing so without considering best practices, localized accuracy, and long-term market fit will most likely lead to failure at best, and harm at worst.

As noted in the U.S. Government Global Food Security Strategy (GFSS), "Digital technology must play an integral role in the USG's work in food systems, rather than being treated as an add-on or an afterthought. This will require an ecosystem approach that considers the benefits, drivers, barriers, and risks of digital technology for all stakeholders in food systems, while prioritizing financial viability of digital products and services, rather than one that is driven predominantly by individualized project needs without longer-term planning."

Doing this effectively requires a nuanced understanding of the current context in the communities where USAID activities work, including how individuals are actually interfacing with digital technologies. National level aggregate statistics are of little help when trying to understand how, if at all, different community members are using digital technology in activity

areas. The Inclusive Digital Design Toolkit, which was developed with USAID funding, offers detailed practical guidance for inclusively implementing digital solutions within USAID activities.

Develop activity-level plan for digital technology based on the digital context in the activity area. Although it may not be required as part of the activity award or contract, USAID implementing partners (IPs) are encouraged to develop a plan for how the activity will responsibly, appropriately, and inclusively make use of digital technologies to support attainment of the activity's development objectives. The plan should be consistent with the Principles for Digital Development and GFSS cross-cutting intermediate result 10 (on digital).

Start with an assessment of the current state of the digital agriculture ecosystem in the geographies where the activity is working. IPs can refer to the Pakistan Digital Ecosystem Country Assessment for a broad baseline of the digital sector in Pakistan. For a deeper dive, the digital agriculture ecosystem assessments conducted by USAID in several other countries may serve as inspiration. Furthermore, USAID's Digital for Resilience and Food Security (RFS) Planning Tool may serve as a helpful tool to identify where the use of digital technologies may be appropriate within your activity.

When developing the plan, particular attention should be paid to the long-term viability (or sustainability) of any digital tools introduced by the activity. It is a lot easier for a development activity to introduce a digital tool than it is to set it up for long-term success beyond the life of the activity. Look for technology partners with a shared interest in providing the digital service, rather than ones who see their relationship with the activity as being purely transactional. Vendor-client relationships where a development project pays for the service often struggle to sustain themselves once activity funding has ended.

The plan should also include considerations for how the activity can contribute to foundational level requirements that will help strengthen the AI ecosystem in Pakistan. For example, think about how data being collected by the activity could contribute to locally developed LLMs.

Activity Specific

Support digitization of Farmer Service Centers in Khyber Pakhtunkhwa (KP). Related to the above recommendation, there may be opportunities for USAID's Economic Recovery and Development Activity (ERDA) to partner together with one or more universities

or private sector actors to support the digitization of Farmer Service Centers (FSCs) in KP. The exact structure of any partnership will have to be considered in more detail, but it could be mutually beneficial for ERDA and the FSCs, as well as other partners to collaborate in this way. Especially if it enables ERDA to better target and serve farmers in areas served by FSCs.

Activity Dependent

Coordinate with relevant Pakistan-based actors on digitizing and digital data. USAID activities tend to collect significant amounts of data about the populations they are working with. By default, USAID activities should be encouraged to collect that data digitally, rather than on paper. There are a number of affordable mobile-based data collection tools available, most of which also allow for offline data collection in areas without mobile connectivity. In addition, activities should work with their AOR/COR to ensure that they are contributing all relevant data to the Development Data Library.

Beyond that, though, it will also be beneficial for USAID activities to coordinate with other Pakistan-based actors who are working to digitize and manage digital data, as there could be opportunities to collaborate in ways that reduce the cost and burden of digitizing data from paper and collecting data digitally. Understanding any efforts to standardize agricultural data will also enable USAID activities to align their data labeling with those standards.

Incorporate content related to digital literacy into existing trainings, as relevant. While it is not within the mandate of USAID/Pakistan's agriculture-related activities to undertake wide scale digital literacy trainings, they should be encouraged to incorporate digital literacy related content into existing capacity strengthening trainings they are conducting in communities.

Pakistan is already part of the digital age, which makes it critical for all of its citizens to have a baseline knowledge of how to use digital technologies, especially mobile phones. Even if there is little uptake of digital technologies in a particular community today, there is no escaping that the world around them continues to digitize. Therefore, digital literacy should be seen as one of the foundational skills necessary to be competitive in the agriculture sector. There are numerous resources available online related to digital literacy, although a good place to start is USAID's Digital Literacy Primer, as well as the digital literacy briefer on agriculture and food security.

Engage with the innovation ecosystem in Pakistan, where appropriate, such as through datathons and hackathons. As noted earlier in this report, there is already a lot of activity happening in the IT sector broadly in Pakistan. While much of the focus of the IT sector has been in servicing overseas clients, stakeholders noted a gradual shift towards more product oriented businesses. This, combined with stakeholder remarks related to forging deeper practical relationships between academia and the private sector, present a potential opportunity for USAID activities to engage more thoughtfully with this ecosystem.

One area of opportunity could be to work with universities, government agencies and the private sector on datathons (events where teams work together to solve practical problems through data science) and/or hackathons (events where teams work together to solve practical problems through computer science). There may also be opportunities to work with the Pakistan Software Houses Association for IT and ITeS (PASHA) on a proposed independent committee they are planning to establish on AgriTech.

Whether or not either approach makes sense will require further exploration. A starting point would be to identify any intractable challenges in the agriculture sector–and within the scope of USAID activities–that have the potential to be solved through the application of data analysis or digital technology.

Experiment with AI-enabled tools, where appropriate, but tread carefully. AI-enabled tools for agriculture are already being developed in Pakistan, as well as in other low- and middle-income countries (LMICs). One of the "simpler" use cases is applying AI to support advisory services, although implementing this effectively requires a significant amount of locally relevant training data.

USAID activities can play around with tools like ChatGPT and FarmerCHAT to better understand the general capabilities of generative AI tools to provide agricultural advisory services, although it is important to note that neither of those are trained for the Pakistani context, therefore they should not be deployed as is in Pakistan.

USAID activities may also consider collaborating with universities and/or private sector companies to experiment with AI tools–perhaps paired with a datathon or hackathon, or

through model farms established at universities. At this stage, this experimentation should be used primarily as a learning tool to understand what might be possible. Activities generally should not invest financial resources into the development of AI tools at this stage, unless there is a very clear market fit and the potential risks have been thoroughly identified and mitigated against.

Beyond Programs

The opportunities for USAID/Pakistan to support AI in agriculture beyond its activities fall into three primary buckets: facilitation of coordination between stakeholders, direct coordination with stakeholders, and engagement with the government of Pakistan.

Facilitating Coordination between Stakeholders

This bucket includes a number of topics and subject areas where USAID/Pakistan could potentially provide value-add by facilitating coordination between relevant stakeholders.

Facilitate coordination around and learning about AI for ag across academia, private sector, and government. Given the aforementioned coordination gap between stakeholders that was mentioned during this assessment, there could be an opportunity for USAID/Pakistan to serve in a facilitative role to promote greater sharing and coordination between relevant actors. Collaboration between universities, private sector, and government can also help to increase the likelihood that all AI and aligned subject graduates are highly skilled and employable.

This could be through hosting one-off events or through a dedicated learning series, which could also bring in international speakers for virtual sessions. If there are sufficient resources and interest, USAID/Pakistan could also consider convening a more formal structure for coordination, such as the Digital Working Group that was established by USAID/Sahel Regional Office.

Facilitate conversations related to public data sharing agreements and data standardization. Related to the above or as a separate standalone, there may be a role for USAID/Pakistan to facilitate conversations related to greater data sharing and standardization. This can also include helping to connect stakeholders in Pakistan with those in other countries

that have made progress on agricultural data sharing, such as the recently established Kenya Agricultural Data Sharing Platform (KADP), and the open source Data in Climate Resilient Agriculture (DiCRA), as well as with organizations that have experience with facilitating data sharing, such as OpenTEAM and its open source agricultural data use documents.

This is consistent with the top priority listed under e-Agriculture in the 2018 Digital Pakistan Policy, which called for the creation of a "mobile 'Agriculture Information Portal' for collection and dissemination of knowledge regarding price, horticultural diseases with remedial actions, water quality, weather updates and supply/demand data from agricultural commodity markets, on a sustainable model." It also appeared to be a priority in a draft digital agriculture strategy that was briefly shown to our team by one of the stakeholders interviewed, although it is unclear if that strategy was at a provincial or national level. USAID/Pakistan should engage with the Ministry of National Food Security & Research to learn more about this strategy and better understand how USAID may be able to support the advancement of greater agricultural data sharing in Pakistan. It may also be worthwhile to connect with the FAO Representation in Pakistan given their previous support to the Government of Pakistan on e-agriculture, which included strategy development.

Facilitate linkages between relevant global efforts and Pakistani ecosystem actors. While many of the stakeholders we met with had connections outside of Pakistan, oftentimes due to past academic or professional experience abroad, there also appeared to be opportunities to further strengthen those connections with entities they may not be familiar with. Examples include the previously mentioned work by Mozilla Common Voice, KADP, and OpenTEAM, as well as convening bodies, such as the International Telecommunications Union's AI for Good program. In addition, USAID/Pakistan can also help make connections with USAID partners elsewhere in the world that have experience using AI in development contexts. This is aligned with target 11 of the draft National AI Policy, which seeks "Harnessing AI through Global Best Practices".

Facilitate linkages between US and Pakistani universities. Several of the universities we met with expressed an interest in establishing deeper relationships and collaborations with US universities, especially when it comes to AI. USAID has formal and informal relationships with dozens of US universities, including those leading the Feed the Future Innovation Labs and through the Minority Serving Institutions Program, amongst others. For example, the Digital

Tools, Geospatial, and Farming Systems Consortium set up under the Funded by the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification has collaborated with academic institutions in Bangladesh, Cambodia, and Senegal.

Facilitate linkages and technical exchange between US-based and Pakistani technology companies. Several of the technology companies and innovation enablers we met also mentioned their interest to establish greater linkages with US-based technology companies, particularly those working on AI. USAID has formal relationships with a number of large US technology companies, as well as many more informal relationships with a wide range of technology companies.

Where relevant and mutually beneficial, USAID/Pakistan can work with USAID/Washington to make introductions and to establish exchanges (such as through the events suggested earlier). There may also be opportunities to work with the State Department's International Visitor Leadership Program (IVLP) for exchanges with AI-focused companies in the US.

Leverage Punjab-California Sister State Agreement. Given that a large number of companies and academic institutions focused on AI and related fields are based in California, there is a significant opportunity to leverage the newly signed Punjab-California Sister State Agreement in support of the previous two opportunities. In addition, PASHA's planned independent committee on AgriTech may have a focus on Punjab, in which case, there could be opportunities to link that into any Punjab-California exchanges. Furthermore, there could be opportunities for the Legislature in Punjab to learn from the California State Legislature's approach to regulating and enabling the responsible use of AI, particularly if progress advances beyond the intent bill introduced in the California State Senate in September 2023.

Direct Coordination with Stakeholders

Increase coordination with other bilateral and multilateral organizations. There have been a number of roadmaps and studies that have been developed around digital agriculture in Pakistan. However, it is not entirely clear whether there has been any coordination done between them. For example, the AgriTech: Crafting Pakistan's Journey To Impact report developed by Tabadlab in collaboration with the GSMA and Telenor, highlights quite a few potential opportunities. The FAO's Development Of E-Agriculture Applications And Knowledge Products Using Innovative ICT Technologies report is another example. USAID/Pakistan should

engage with these and other relevant bilateral and multilateral organizations, such as UNDP's Accelerator Lab, to coordinate efforts, where relevant.

Engagement with the Government of Pakistan

Explore opportunities to align with government led efforts related to AI and agriculture. The finalization of Pakistan's e-agriculture strategy and the establishment of Centers of Excellence in AI & Allied Technologies as proposed under the draft National AI Policy could present opportunities for USAID/Pakistan and its activities. It is advisable for USAID/Pakistan to make connections with the lead agencies of both of these efforts. In the short-term, there could be opportunities for USAID/Pakistan and/or its activities to contribute expertise to the development of these efforts. Once they are finalized, it will be worth exploring whether there is any alignment between their priorities and those of USAID/Pakistan and its activities.

Support implementation of a regulatory sandbox to test AI innovation. Given how new AI for agriculture is, especially in the context of Pakistan, and the risks that can come from poorly designed and governed systems, a regulatory sandbox to enable testing of AI innovations in a controlled environment would be advisable. The establishment of a regulatory sandbox is already specified In the draft National AI Policy (target 10), with the goal of having it operational by 2025. If there is government interest, USAID/Pakistan could potentially help them with this process by providing technical expertise and facilitating introductions to relevant actors from outside of Pakistan. While regulatory sandboxes have been used for close to a decade in the fintech space, they are still relatively new when applied specifically to AI. The OECD's recent report *Regulatory sandboxes in artificial intelligence* may serve as a useful reference as well.

Things to Consider Moving Forward

Pakistan, like much of the world, is still early on in its journey applying AI to real-world uses, particularly in the agriculture sector. This report represents a snapshot in time based on a very limited sample size. Any of the insights included in this report will need to be validated before being acted upon. Furthermore, any actions taken by USAID/Pakistan related to usage of AI should be checked in advance for consistency with the recently released Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence.

Given the rapidly advancing nature of generative AI, in particular, use cases that may seem implausible today could become possible much sooner than we become accustomed to with prior innovations. It will therefore be important to continue to stay abreast of how the market and the technical capabilities of AI in the context of Pakistan evolves. There are also a couple of priority focus areas that USAID and its activities should consider moving forward.

Inclusion. Pakistan has some of the largest gender gaps in terms of mobile phone ownership, with only 52 percent of women owning a phone, compared to 81 percent of men, according to the latest GSMA estimates. In addition, only 20 percent of women own a smartphone, compared to 43 percent of men. Moreover, only 27 percent of Pakistani women use mobile internet–the primary source of access to the internet in Pakistan–compared to 45 percent of men. Furthermore, the GSMA estimates that only 16 percent of Pakistani women regularly use mobile internet, and a mere 9 percent use it regularly for diverse purposes.

Those percentages are even lower in rural communities in Pakistan, with the Pakistan Telecommunication Authority noting in its 2022 Annual Report that the use of mobile phones in the "country's suburban, rural, and far-flung areas, where penetration is not very encouraging due to multiple reasons including online security and safety, and societal and cultural norms." These challenges are particularly acute when it comes to women. As the UNDP noted in its 2023 report *Digitalisation and Women in Pakistan*, "women living in rural areas face unique challenges that limit their access to digital technology and reaping benefits of online communication."

According to stakeholders, rapid implementation of AI enabled tools could even lead to job losses in the agricultural sector. Given the fact that according to Pakistan's Labor Force Survey, agriculture is a major employer in the country, with 37.4 percent of the labor force engaged in the sector, any such disruption could have significant societal and economic impacts. This has the potential to significantly impact women, in particular, as 67.9 percent of women in the labor force work in agriculture, compared to 28.4 percent of men. Thus, further research may be necessary to identify the potential adverse impacts of any labor shedding that may result from the integration of AI into the agriculture sector.

USAID/Pakistan and its activities should be cognizant of these digital divides and plan accordingly so that the introduction of AI-enabled technologies–or any digital technologies, for

that matter–do not further exacerbate existing divides and inequalities. The USAID and Bill & Melinda Gates Foundation funded report *Inclusively Advancing Agri-Food Systems Through AI and Automation* may serve as a useful reference in this regard.

Data privacy and security. Particularly as Pakistan is currently in a pre-regulatory environment when it comes to data protection, it will be critical for USAID/Pakistan and its activities to pay particular attention to data privacy and security, especially when it comes to individuals and communities that USAID supports. Many of the individuals that USAID/Pakistan's agriculture activities work with are likely to have only recently started using digital devices and online services. As such, they may not have a rich understanding of the privacy and security risks that may exist. It will therefore be important to make sure that any individuals, communities, or organizations that USAID engages with have a full understanding of the risks and privacy considerations associated with their using any digital tool, particularly when it comes to AI.

Additionally, it will be important for USAID/Pakistan to follow any regulatory or legal changes that relate to data privacy and security, such as the draft Personal Data Protection Bill, 2023. Some of the requirements of that draft law, such as requiring "critical personal data" to only be processed on servers located in Pakistan, a concept that is often referred to as data localization. While the draft bill does not explicitly define in full what is covered under "critical personal data", if it is overly broad, it could impact the ability of Pakistani companies to make use of AI relevant data services that are located outside of Pakistan. Where appropriate, USAID/Pakistan can work with other donors and stakeholders to provide inputs to the Government of Pakistan as well as provincial Governments on this and any related policies and laws. The implications of any final bills related to data protection will also need to be analyzed to understand how they may impact the uptake of AI in the agriculture sector.

Annex 1: List of Interview and Roundtable Participants

The following list only includes the names of individuals who provided approval to share their names publicly with this report. The total number of organizations/companies and participants was higher than what is listed in the tables below.

Interviews

Organization/Company Name	Participant(s)	Type	Location
USAID Economic Recovery and Development Activity (ERDA) Project, Islamabad	Shad Muhammad Anwar Khattak Zia ur Rehman	USAID implementing partner	Islamabad
University of Agriculture, Faisalabad	Dr. Saqib Ali	Academia	Virtual
National Rural Support Programme (NRSP), Islamabad	Rashid Bajwa	Development organization	Islamabad
National University of Science and Technology (NUST), Islamabad	Rizwan Riaz Ajmal Khan Rafia Mumtaz	Academia	Islamabad
Invest2Innovate, Islamabad	Merai Syed	Innovation enabler	Islamabad
Rayn, Islamabad	Mo Aidrus Hussnain Ahmed	Technology company	Islamabad

MNS Ag University, Multan	Irfan Baig,	Academia	Virtual
Punjab Agriculture Department, Lahore	Hafiz Abdur Rehman	Government agency	Virtual
University of Veterinary & Animal Sciences, Lahore	Dr. Naseem Amjad Muhammad Junaid, Muhammad Naveed ul Haque	Academia	Virtual
Al-Haiwan Group, Lahore	Dr. Muhammad Farooq	Agriculture company	Virtual
BaKhabar Kissan, Islamabad	Fuad Khan	Technology company	Islamabad
Weather Walay, Islamabad	Junaid Yamin	Technology company	Islamabad
Switch, Islamabad	Khizer Alam Khan	Technology company	Islamabad
Pakistan Software Houses Association for IT & ITES (PASHA), Karachi & Lahore	Zohaib Khan, Basma Mona Ali Ihsan Jamil Goheer Mudassir Malik	Industry association	Karachi and Lahore
Proxima, Karachi	Adnan Zaidi	Technology company	Karachi
10 Pearls, Karachi	Mustansir Mustafa	Technology company	Karachi
VentureDrive, Karachi	Imran Moinuddin	Technology company	Karachi

Systems Limited, Karachi	Chaudhry Sohail	Technology company	Karachi
Institute of Business Administration, Karachi	Jawwad Farid, Dr. Shakeel Ahmed Khoja, Dr. Shahid Hussain, Dr. Tahir Syed, Dr. Syed Ali Raza Mohammad Sohaib Saleem Nimra Kamran	Academia	Karachi
Katalyst Labs, Karachi	Jehan Ara	Innovation enabler	Karachi
Linked Things, Karachi	Sophia Hasnain	Technology company	Karachi
NED University, Karachi	Dr. Sarosh Lodhi	Academia	Karachi
Pakistan Innovation Foundation & Innoventures, Karachi	Dr. Athar Osama	Innovation enabler	Virtual
National University - FAST, Lahore	Dr. Hammad Naveed	Academia	Lahore
U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering & Technology, Jamshoro	Dr. Kamran Ansari Dr. Naeem Ahmed Mahoto Dr. Mohsin Ali Memon Dr. Syed Zafi Shehran Shah Dr. Ghulam Hussain Dars	Academia	Virtual

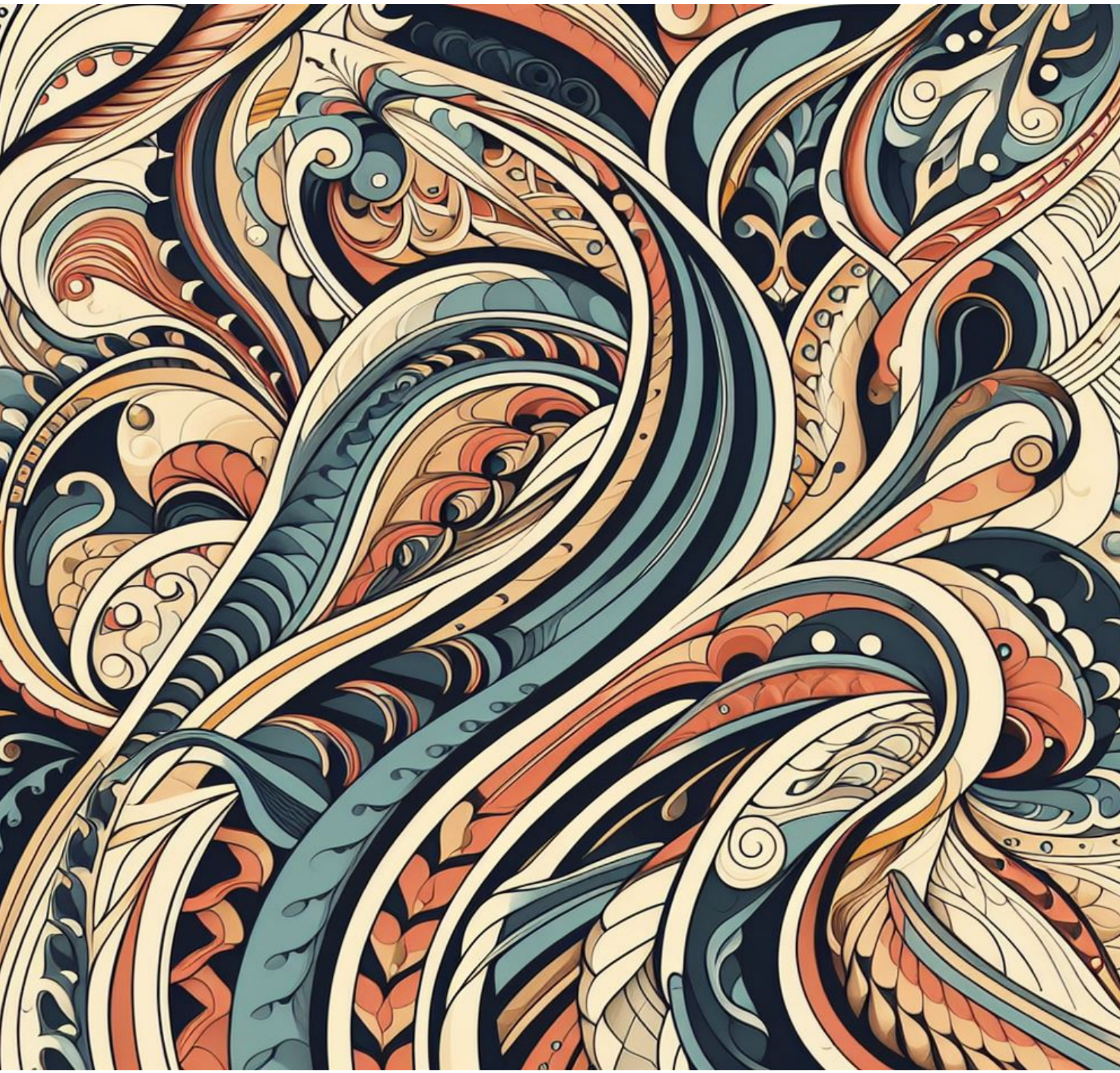
	Naeem Dal		
Lahore University of Management Sciences (LUMS), Lahore	Dr. Naveed Arshad Dr. Safee Ullah Chaudhary	Academia	Lahore
Din Global, Islamabad	Tania Aidrus	Technology company	Virtual

Roundtables

Roundtable focus	Company	Participant(s)	Location
Women in STEM	My Impact Meter, Lahore	Kanwal Cheema	Virtual
	Purpose Quotient (PQ), Lahore	Saleha Asif	
	Co-wried, Lahore	Mahrukh Qadeer	
	Lahore University of Management Sciences (LUMS), Lahore	Dr. Kiran Siraj	
Legal Challenges in AI Development	Ambreen Qureshi & Associates, Lahore	Ambreen Qureshi	Virtual
	Pakistan LNG Limited, Islamabad	Waqas Ghazi	
	Lex Legal Practice, Lahore	Asad Salahuddin	
	Courting the Law, Lahore	Anoosha Shaigan	
	Crown 1207 LLP, Lahore	Daraab Ali Furqan	

	M. Adam Jabbar & Associates, Lahore	Adam Jabar	
	Iqra Saif Agha, Lahore	Iqra Saif Agha	
Finance and Agriculture Sector	Karakorum Capital Partners, Lahore	Majid Munir	Lahore
	FasalPay, Lahore	Habib Saqib	
	M-Labs, Lahore	Yasser Awan	
	Innovation Consultant, Lahore	Imran Chaudhry	
	Model Farms Project, Lahore	Kashif Jamshaid	
Focus Group on Enabling Environment for AI	Small & Medium Enterprises Development Authority (SMEDA), Lahore	Javed Afzal	Lahore
	National University - FAST, Lahore	Sarah Asif	
	Digital Dera, Lahore	Fouad Bajwa	
	Zuhly, Lahore	Azhar Basit	
	Tech-Hive Solutions, Lahore	Ayesha Chaudhry	
	TresLogic Gaming, Lahore	Syeda Ramla Hassan	
	University of Central Punjab (UCP), Lahore	Faizan Khalid	

	Siemens Automotive, Lahore	Ahmed Majeed Khan	
	Datics AI, Lahore	Umair Majeed	
	Arazi Ventures	Umair Sheikh	
	Shalamar Hospital, Lahore	Dr. Hafeeza Naz	



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Imagination is the Only Limiting Factor