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GrowAsia



Digital Agriculture in ASEAN: Strategies for Donor Impact

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1. Introduction

There are over 70 million smallholder farmers in Southeast Asia.¹ In many cases these families represent some of the poorest people in the region and they often struggle to produce enough to earn a sufficient income or even feed their own families. These farming families face a number of challenges which limit productivity:

1. Small farm sizes;
2. Limited access to markets;
3. Vulnerability to changing weather patterns;
4. Volatile commodity prices; and
5. Rising labor and input costs.

Over the last 15 years or so, mobile and smartphone ownership and mobile coverage in rural Southeast Asia have increased steadily. As a result, farmers and agribusinesses are increasingly able to use digital technologies to address the five challenges outlined above. There are systemic challenges, however, that need public sector and donor support to overcome, particularly to drive positive outcomes for smallholder farmers.

This report (1) illustrates how seven different digital technologies are reshaping agriculture in the region and (2) highlights how the International Fund for Agricultural Development's (IFAD's) strategic investment decisions could shape and accelerate the adoption of technologies, fulfilling IFAD's mission to "transform rural economies and food systems by making them more inclusive, productive, resilient and sustainable".²



1 Estimated from: [The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide](#), FAO, 2015

2 [Vision](#), IFAD, 2021

2. Decade of Technology Advancement: Where does ASEAN stand?

First Wave: The digital transformation of agriculture in ASEAN started to gain traction roughly in the last decade as mobile phone penetration in rural areas increased. Farmers, traders, lenders and retailers were increasingly using mobile calls, SMS and chat applications to make deals, book shipments, agree on prices, and learn from each other. This trend has continued to accelerate and is already having an impact on farmer productivity, market access and lending. We will refer to this wave as the **Farmer Mobile Communication Wave**.

Second Wave: The second wave began around 2015, as agribusinesses began to adopt new technologies particularly to trace the origin of the agricultural products they buy and to drive efficiencies in smallholder value chains.³ We will call this the **Agribusiness Digitization Wave**.

Despite the emergence of these two waves, ASEAN is well behind its neighbors. Smallholder digital technology adoption in China and India is significantly higher than in ASEAN. In China, the adoption of agricultural drones is expanding rapidly, supported by China's strong local drone manufacturing sector as well as subsidies provided by the Chinese government. These policies are motivated by China's need to address the shortage of rural labor and to improve productivity while decreasing the overuse of crop protection products.⁴ Farm digitization solutions are also seeing an uptick of interest from investors who see the potential of these solutions to help the Chinese government reach its food security goals.⁵

India has over 450 agritech startups and from 2018-2019 experienced 25% year-on-year growth, according to a recent industry association report.⁶ India is home to some of the most established digital advisory services as it was an early mover in the launching and scaling of these solutions.⁷ It also has some of the most established traceability solutions, such as SourceTrace and CropIn. More recently, generalist venture capitalist funds are also looking more upstream at opportunities in farm digitalization, supply chain technologies and financial services for farmers.⁸

Many of the technologies which we refer to here as 'emerging' in ASEAN are already well established in these markets. There is currently an opportunity for donor organizations to understand what is possible in ASEAN, and to take a leadership role in helping governments, businesses and farmer groups in the region realize the promise of these technologies.

3 Some examples: PT Koltiva was founded in 2013 to provide software as a service to Swisscontact's Sustainable Cocoa Production Program and was incorporated in Switzerland in 2017 to support PT Koltiva's global expansion. OPTEL's GeoTraceability [prototype for palm oil](#) was developed and deployed in Malaysia in 2016.

4 [China's Agriculture Drone Revolution](#), Ipsos, 2019

5 [China AgriFood Startup Investing Report](#), AgFunder, 2019

6 [Agritech in India: Emerging Trends in 2019](#), NASSCOM, 2019

7 [Digital Agriculture Maps](#), GSMA, 2020

8 [India AgriFood Startup Investment Report](#), AgFunder, 2020

Our Approach

In this report we address **seven technologies** that donor organizations such as IFAD could support. We describe each technology and assess how well aligned each technology is with IFAD's mission. We then go on to explore (and rank) the levers that donor organizations can use to drive the growth of these technologies. Finally, we provide specific recommendations on which technologies IFAD is best placed to support and how.

First Wave: Farmer Mobile Communication

The Technology

Farmers have always held important business relationships with traders, lenders, retailers, and trucking operators. These transactional partners allow farmers to access markets, finance, and inputs. However, these relationships have not always worked well for farmers. In part this is because most farmers lack a broad network of transactional partners. Limited by the impractical nature of meeting face-to-face with a wide range of counterparties, it is common for farmers to deal with just one retailer, one trader and one lender. This limits the farmer's bargaining power, learning and growth opportunities.

During Grow Asia's interviews with 100 farmers across the region for our [agritech adoption study](#), we saw that these relationships have begun to change as mobile phones became more available. Farmers who continued to only engage with the same parties benefited from more efficient and faster communication. Meanwhile, others began to engage with new counterparties to secure better deals, or even transition to growing new crops.

But farmers do not just rely on transactional relationships – they also benefit from communicating with other farmers. In fact, learning from other farmers is regularly cited in farmer surveys as their leading source of information. Other farmers provide opportunities to learn, but also to unearth new sources of agri-inputs and test new ideas. These relationships have also benefited from SMS, voice, and chat-based technologies.

These new communication platforms offer not just one-to-one communication, but also allow farmers to build larger and more efficient communication networks, which were more limited when communication was primarily face-to-face or via phone calls. In particular, farmers are joining large crop-based chat groups on Facebook or WhatsApp to share photos, growing techniques and industry news for their crop. These smartphone-enabled peer group dialogues have allowed farmers to gain access to much more information than they had previously.



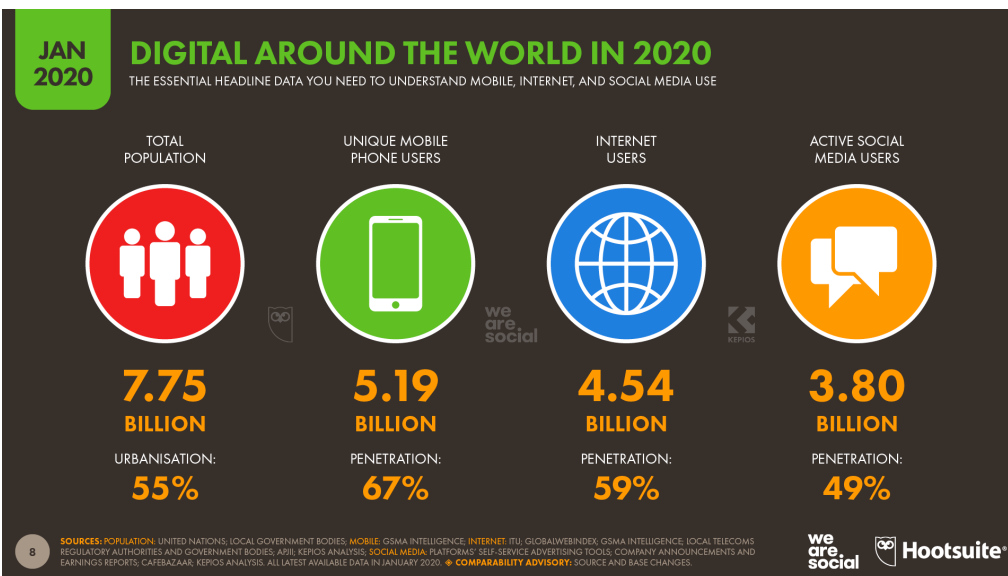
Examples of First Wave technology use by farmers:

First Wave Technology	Use
SMS	A farmer sending an SMS to multiple traders to secure the best price for a corn shipment.
Chat Rooms	A group of over 10,000 chilli farmers in Indonesia sharing photos and live outbreak data on yellow leaf curl in a WhatsApp group.
Applications	A truck driver using Line and Google Maps to set up their daily schedule with over 20 farmers, saving farmers and the driver time through more accurate arrival times.
Social Media	A farmer scrolling through Facebook and discovering a new fertilizer advertisement on their retailer's feed.

Enabling Factors

The Farmer Communication Wave is largely farmer-driven and is not directed by companies or government agencies. Adoption is improving price visibility, reducing communication costs, and improving information flows. Farmers are learning new techniques either directly from online videos, or from other farmers who have watched and shared such videos.

The First Wave is made possible by increasing rural network coverage, low-cost mobile devices and permissive government policies. The First Wave can also take place in a 2G environment (albeit with slower download speeds), which makes these technologies accessible to most farmers across Asia. The year-on-year growth of these technologies suggests that this wave will continue for many years to come. For example, the number of active social media users in Asia grew by over 9% from April 2019 to January 2020, while the number of mobile phone connections now exceeds the population in the region.⁹ These figures suggest increasing rural penetration.



Source: [Digital 2020 Global Overview Report](#), We are Social, 2020

Second Wave: Agribusiness Digitization

The Technology

The second wave began about five years later, around 2015, as entrepreneurs began building digital solutions for agribusinesses operating in smallholder value chains. Many of these solutions were initially focused on traceability but included tools for managing field and sales teams as well as monitoring farms remotely using satellite data. Agribusiness Digitization solutions are therefore presented as the second technology for donor consideration.

These tools are used by businesses, not farmers, so the restrictions of smartphone ownership and rural coverage have not significantly limited their growth.

At the core of these technologies are large online databases incorporating the details of thousands of farmers. These technology providers can integrate a wide range of data such as field worker GPS locations, disease outbreaks, weather and satellite imaging. This data allows them to offer increasing value to trading companies, input companies and milling operations. This industry is likely to be highly consolidated going forward, as the region likely only requires two or three major solution providers.

Examples

CropIn, the most well-funded Asia-based smallholder agritech startup to-date helps agribusinesses monitor farmer suppliers and field staff.¹⁰ Koltiva, the start-up whose technology has the largest reach in the ASEAN to-date, helps FMCG clients trace their supply of goods such as palm oil and cocoa back to the farm on which it was grown.¹¹ The Olam Farmer Information System allows Olam to provide personalized advice to each smallholder farmer who signs up and also provides Olam's customers with information about the origins of its products.¹²

¹⁰ [CropIn raises US\\$20 Million in Series C funding round](#), Business Wire, 2021

¹¹ [Koltiva](#), Koltiva AG, 2021

¹² [Olam Farmer Information System](#), Olam International, 2021

Second Wave Technology	Use
CropIn	Helps agribusinesses monitor farmer suppliers and field staff; most well-funded (to-date) Asia-based smallholder agritech startup
Koltiva	Helps FMCG clients trace their supply of goods such as palm oil and cocoa back to the farm on which it was grown; technology has widest reach in ASEAN to-date
Olam Farmer Information System	Provides personalized advice to each smallholder farmer who signs up and also provides Olam's customers with information about the origins of its products

Enabling Factors

The growth of this wave has been more limited than the Farmer Communication Wave. Farmer communication is ubiquitous across regions and crops. The Agribusiness Digitization Wave is narrower in scope. It remains the preserve of large agribusinesses and is focused on cash crops such as cocoa, coffee and palm oil. Its continued expansion depends on changing consumer attitudes around traceability and safety. The focus on relatively high-value crops also means that its reach to the poorest and most vulnerable smallholder farmers is limited. Agribusiness Digitization Wave technologies also require access to a 3G network and more expensive mobile devices.

In summary, farmers are increasingly using Facebook, WhatsApp and SMS to improve communications with counterparties (buyers, retailers and lenders) while larger agribusiness are leveraging digital tools for record keeping and managing their suppliers and customers.

We are confident that both these trends will continue for the foreseeable future. Farmers will continue to use their phones - and especially social media - more and more to communicate with each other and with counterparties. Agribusinesses will continue to use increasingly complex databases to manage their smallholder value chains to provide transparency to their customers, mitigate risk and improve the efficiency of their supply chains.



3. The Next Decade: Third Wave Technologies

With the First and Second Waves consolidating momentum in the sector it is helpful to project forward how current technologies might continue to empower smallholders. These are the technologies where donor investment could change the game for farmers.

We foresee the development of the remaining five of seven technologies in the next wave:

- Digital payments by farmers
- Digital trading platforms
- Digital lending platforms
- Hardware innovations for smallholder farmers
- Digital farmer advisory services

None of these technologies are guaranteed to turn into the next wave for smallholders in ASEAN yet each could play a significant role. We are seeing all five emerge in India and China where the context is similar to ASEAN.

2010
Wave One

2015
Wave Two

2020
Wave Three

Generic Platforms: Farmer Mobile Communication

Farms use SMS, chat and calls to learn and transact

B2B Platforms: Agribusiness Digitization

Agribusiness use digital tools to manage their supply chain

What might happen?

Digital Payments by Farmers

Farmers adopt digital payments

Digital Trading Platforms

Traders manage their business using digital tools

Digital Lending Platforms

Farmers lend form digital platforms

Hardware Innovations for Smallholder Farmers

Farmers use IOT and automation technologies on their farms

Digital Farmer Advisory Services

Farmers use applications which provide weather and advisory services

Digital Payments by Farmers

Digital payments are growing rapidly, including online credit card usage and digital wallets such as PayPal and WePay. Users choose digital payments over cash because these are more convenient and secure and can be executed remotely.

We expect to see more farmers in ASEAN begin to adopt these tools to pay for inputs and receive payments for crops. Such usage in the agriculture sector is already common on small farms in China and has a strong chance of growing in ASEAN.

The trend toward digital payments in urban ASEAN for general goods and services is already well established. For example, 68% of young Indonesians use a digital wallet at least once a week.¹³ Four companies – GoPay, Ovo, Dana and LinkAja – are investing heavily in the growth of the industry in Indonesia. When Wing Money was established in Cambodia in 2008, less than 4% of the country's population had a bank account.¹⁴ In 2018, over 27% of the population was using Wing Money and executing transactions worth 80% of the country's GDP.¹⁷

Digital Trading Platforms

The existing network of traders in the region who buy from farmers will increasingly use digital tools to manage their businesses. Traders will increasingly manage their inventory, trucking routes and customer communications using databases and apps. These technologies will allow them to buy from more farmers, manage their cash flow and ensure better truck utilization.

A small number of “digital first” traders are emerging. TaniHub buys and sells smallholder crops on a digital platform. Similar businesses are emerging in Myanmar, the Philippines and Thailand. Many of these businesses have expanded in 2020, as COVID-19 has cut off conventional marketing routes.

At a future point, we may not just see traders using digital tools, but also farmers trading their products directly on digital platforms and fully embracing e-commerce, such as on Chinese e-commerce platform Pinduoduo. However, as smallholder farmers' direct use of e-commerce platforms is still nascent in Southeast Asia, we have not included it for IFAD's consideration, but IFAD and other donors might want to track developments in this space.

Digital Lending Platforms

The most common capital requirement for Asian farms is to cover the cost of inputs such as fertilizers and crop protection products. Localized cash-based lending models currently dominate the market. Farmers are presented with two main sources of finance to cover these costs: the retailer who sells them the product, or the trader who will buy their crop at the end of the season. These “village-level” funding options are usually expensive, often charging more than 10% interest per month.

These high interest rates reflect the inherent riskiness of informal lending, but local, community-level village lenders can charge such high interest rates because farmers often do not have access to loans from commercial banks. Banks struggle to sell smallholder loan products because smallholder farmers are expensive to reach. Village-level lenders are part of the farmer's communities and have hyperlocal insights that the banks do not have access to on each individual farmer's credit worthiness. Village-level lenders can also serve smallholder farmers because they do not incur the compliance costs associated with Know Your Customer regulations and general paperwork that commercial banks must comply with.

A range of digital solutions are emerging which solve one or more of these challenges. Digital lending solutions can help address all four limitations, which are: lowering the cost of acquisition, helping to gather data on the farms, reducing the cost of the Know Your Customer process, and reducing the paperwork required.

It seems promising that digital lending will provide a viable and scalable alternative to in-person village level lending.

At present, much of the digital lending to farmers is by peer-to-peer (P2P) lenders.¹⁶ These solutions are peer-driven in the sense that farmers loan money from a “peer” (usually an urban professional) rather than a bank or financial institution. This has allowed these solutions to grow because they are less constrained by regulation and by the policies and procedures of banks. Once these peer-to-peer businesses have established their credit scoring and customer questions models, we expect to see them expand beyond peer to peer and access larger pools of capital from more formal financial markets, particularly from impact investors.

¹³ Ipsos Press Release, Ipsos, 2020

¹⁴ WING Money in Cambodia, IFC, 2008

¹⁵ Wing Wins Two Gold Stevies at the 2019 International Business Awards, Wing Money, 2020

¹⁶ Accelerating Financial Inclusion in South-east Asia with Digital Finance, ADB, 2017; Reaching Out to the Underbanked: The Alternative Lending Opportunity in South East Asia, iSTOX, 2021

Hardware Innovations for Smallholder Farmers

A cluster of new devices are being developed for farms. Firstly, there are drones and robots which automate on-farm tasks including spraying, weeding, and harvesting. Secondly, there are a range of IoT (Internet of Things) sensors being developed to help farmers monitor their farmland and inform effective decision making. Thirdly, certain critical machines like harvesters and combines are being miniaturized which makes them more affordable, at least for wealthier farmers, and also opens up opportunities for digitally enabled rental services, like Tun Yat's tractor rental service in Myanmar.

Perhaps the most promising technology are aerial spray drones which are widely used in China and are beginning to be imported on a trial basis into Southeast Asia.

Digital Farmer Advisory Services

Smallholder yields in Southeast Asia are well short of both international benchmarks and yields on larger farms in the region. At least part of this gap can be attributed to a lack of knowledge and information; including on seed selection, pest identification, climatic conditions and planting timing.

Digital advisory applications seek to solve this problem by providing advice and information to farmers. A typical solution will provide some generic advice over a social media platform and seek to migrate farmers over to an Android mobile application, where the farmer creates a profile, and receives more customized advice.

Digital advisory has a range of advantages:

- Once the technical material and interface are created, adding each additional farmer adds very little marginal costs to running the platform itself, and is much cheaper than in-person advisory.
- Advice can be highly targeted to the farmer's specific plot, crop type and stage in the crop cycle. Personalization is also being enabled by artificial intelligence(AI) technologies.
- Once trust is established, the business has the potential to grow rapidly, with one farmer suggesting the advisory application to another.

However, it is worth pointing out that ease of dissemination in itself does not improve the quality of agronomic advice. Extension messages still have to be derived from up-to-date, rigorous scientific research and have to be carefully designed so that farmers are able to understand and implement them.

Myriad digital advisory types have been tested including Q&A with agronomists, advice driven by satellite imagery and pest identification using image recognition.



Startup Landscape

Farmer Advisory



Digital Marketplace



Mechanization Platforms



Peer-to-Peer Lending



Traceability



Source: *Smallholder Agritech Southeast Asia Landscape 2021 Report*, Padang & Co, 2021

4. Digital Ecosystem Actors

As we narrow in on how donors and development organizations can drive change, it is important to map not just the technologies themselves but also who is behind them. Understanding who the key actors are that make these technologies possible is important to selecting which levers IFAD and other donors can pull to drive the change aligned with their mission. In this section we map out six actors that must be considered and engaged in any investment processes.

Digital Agriculture Innovators

At the core of any new technological development ecosystem are the innovators who conceptualize and then build new solutions. Over the past three years, a critical mass of startups have emerged in the region. Some have a profit first approach, and others an impact first motivation.

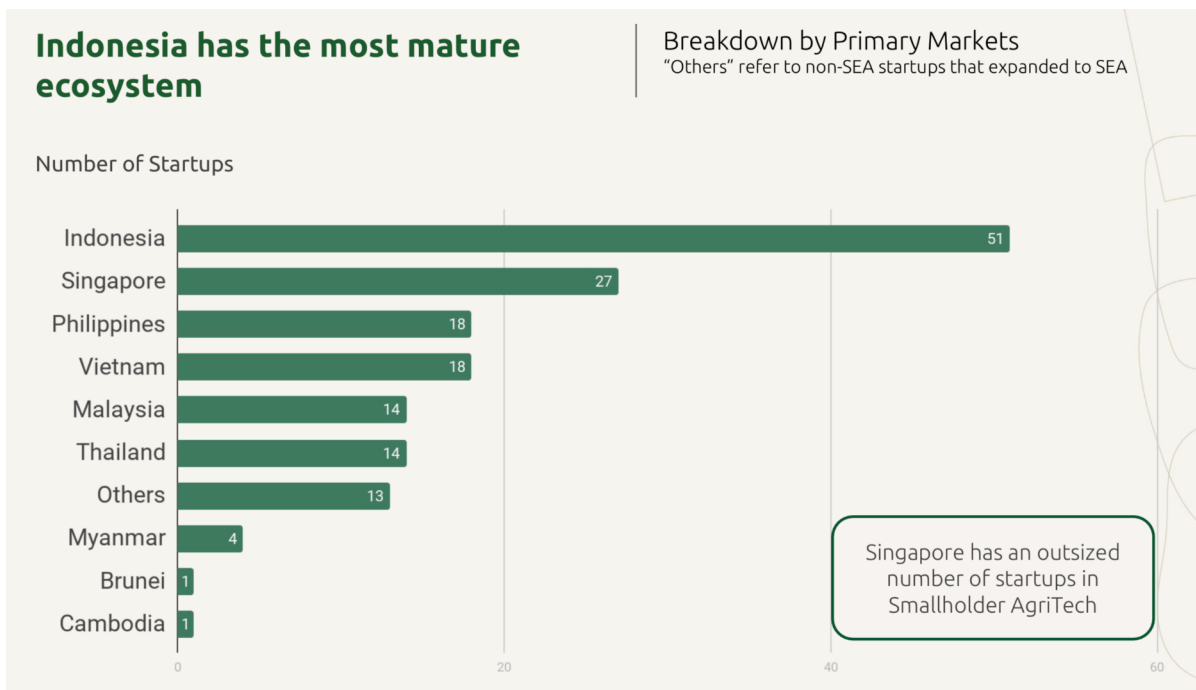
The Agribusiness Digitization Wave was catalyzed by innovators, who built the solutions that agribusinesses needed and which were then scaled as more agribusinesses adopted them. Some of these solutions, such as SourceTrace, GeoTraceability and Koltiva are no longer startups and are operating at scale. It remains to be seen what the exit strategy will be for agritech companies, even the ones who have successfully scaled. Digital agriculture innovators, however, did not play a particularly important role in the Farmer Communication Wave.

New startups are also being formed around prospective third wave technologies. In this cohort of startups, most are at the seed stage and are still working out their business and partnership models to go to scale.

The development of new technology is a challenging and risky process for innovators. They must work out the underlying technology as well as revenue and service delivery models all at the same time, while also seeking investor funding.

There are more than 130 start-ups¹⁷ in the region who have a technology that connects with smallholder farmers. Over 60 of these are listed in the [Grow Asia Directory](#). These companies are concentrated in Indonesia, Philippines, Singapore and Vietnam and Thailand.





Source: *Smallholder Agritech Southeast Asia Landscape 2021 Report*, Padang & Co, 2021

Corporate Agribusiness

These are the national and multinational enterprises that interact with smallholder farmers either as a provider of goods and services or as an off-taker of farm produce. They have a critical but different role in each wave:

- Agribusinesses use farmer communication technologies to connect with growers.
- They are the primary clients of Agribusiness solutions.
- They are a potential pathway to scale for Third Wave technologies if they choose to partner with Third Wave solutions/startups.

Agribusinesses use either an in-house or open approach to technology engagement, and sometimes a mix of both. The in-house approach is typified by agribusinesses such as Olam, Syngenta and Yara International, who are developing digital solutions in-house to create a longer-term competitive advantage. Meanwhile other companies, such as Ferrero and Corteva, are equally interested but choosing a more open approach, partnering with outside innovators/startups in the first instance.

Mobile Communication Platform Owners

Large global technology companies build and operate the leading communication platforms farmers use, such as Facebook, Google, and WeChat.

While these platforms are at the core of the First Wave, and are having a significant impact, the owners of these platforms have little to gain from the smallholder farmer sector, and generally do not actively seek relatively low-income rural users. In Grow Asia's experience, discussions around building farmer portals or other rural specific services into these platforms with these technology giants have not proven fruitful.

Mobile Network Operators

Mobile network operators (MNOs) are important actors as they deploy infrastructure, sell access to cellular networks and provide cellular services in their area of coverage.

For MNOs, deploying remote, rural infrastructure can be twice as expensive and generate potential revenue opportunities as little as 1/10 compared to urban areas. This makes the business case for improving mobile internet in rural areas challenging. MNOs are also faced with weak demand for mobile internet services relative to urban populations. On the supply side, one important area that IFAD could work on is supporting ASEAN governments to create a favorable regulatory environment to support expansion of rural mobile coverage in a way that is also commercially sustainable. This is important as it ensures that mobile networks will be continually upgraded and maintained.¹⁸

IFAD, and other donors, can play an important role in supporting ASEAN governments to create a favorable regulatory environment to increase the supply of mobile coverage. As a rural development research organization, IFAD is well-placed to undertake research that can definitively demonstrate to ASEAN policymakers the rural income gains that can be made through increasing rural mobile broadband coverage. The empirical data gathered from the studies could enable ASEAN governments to prioritize support for increasing rural mobile coverage.

IFAD can also play a role in increasing demand for mobile broadband services in rural areas by supporting innovators whose solutions help to develop the local digital ecosystem and by supporting more governments to increase the effectiveness and therefore uptake of digital extension services in rural Southeast Asia.

Governments

Most governments in ASEAN have not been active drivers of innovation in this sector. One crucial contribution they could continue to make would be through policies which deliver greater rural mobile coverage. This could be through effective spectrum licensing regulations that support the investment required to expand mobile access, subsidies for rural cellular towers, or policy support for infrastructure-sharing on a voluntary basis.¹⁹ Countries where data is cheap and widely available (such as India) are leading in the adoption of First and Third Wave technologies.

Governments in ASEAN appear to have an interest in engaging with the private sector and more directly using technologies, but national digital agriculture programs and actions have been limited to date. Singapore is a clear exception in the region with stated ambitions to become a regional agritech hub and financial support for agri- as well as foodtech incubators and accelerators.

¹⁸ [Enabling Rural Coverage](#), GSMA, 2018

¹⁹ [Enabling Rural Coverage](#), GSMA, 2018

Investors

A range of funds in the region manage money for their investors and seek high risk/high return equity investments in startups. 31 of these funds have made an investment in a smallholder agritech solution.²⁰ They seek an equity stake in promising startups at early and growth stages and aim to support startups to improve their business model and reach scale.

Of particular interest are those funds with an agritech focus or mandate (such as AgFunder and Trendlines). In reality, however, much of their focus is on alternative proteins and urban farming where they can realize high growth investments. Smallholder technologies have shown themselves to be more challenging to scale and face more challenges to achieve the exponential growth that venture capital firms are seeking.

Impact investors have been showing interest in the food and agriculture space²¹, but across the various parts of the value chain smallholder farmer production is one of the most fragmented and hardest to measure impact on due to smallholders' diversity and also the lack of baseline data. The most notable impact investments in the region to date, in TaniHub and CropIn, occurred only in the past year or so.

More mainstream investors entering the sector



Source: *Smallholder Agritech Southeast Asia Landscape 2020 Report*, Padang & Co, 2020

Accelerators and Competitions

Accelerators are typically run by corporate agribusinesses and investors. Each year an accelerator will select a cohort of startups whom they train and support over the year. Some accelerators invest cash in the startup and can take an equity stake in the company. Agricultural accelerators in ASEAN including AgFunder's GROW Accelerator, Trendline's 3i, United Nations Development Programme (UNDP)'s Cultivate and IFC's AgTech Vietnam. From outside the region, SproutX in Australia, The Yield Lab and Thrive have supported some ASEAN focused startups.

Competitions focus on earlier stage ideas and simply allow teams to compete for the best new ideas. Grow Asia's Hackathons and the Rabobank Challenge are leading examples from the region.

²⁰ *Smallholder Agritech Southeast Asia Landscape 2020 Report*, Padang & Co, 2020

²¹ *How Does Agtech Fit an Impact Investing Thesis?*, AgFunderNews, 2016

5. Barriers and Levers for the Uptake of Digital Agriculture Technologies

We have described a total of seven emerging and current technology areas which donors and other development actors could support. Two of which are already growing and five which might. In order to decide how donors and other development organizations might support further growth, we must first identify where the blockages are for these technologies. Why aren't these technologies growing as quickly as they might? We will then pair each barrier with a lever – an action that donors, such as IFAD, could take to remove or mitigate the barrier. A focus has been placed on government barriers, as this is an area of focus for IFAD.

Barrier 1: Lack of funding for early-stage startups

Early-stage startups need investment to grow. It is very unlikely that a new technology can be delivered to farmers or agribusiness through revenue alone. Meanwhile, smallholder technologies rarely meet the requirements of early-stage venture capital funding. While these businesses have a very high investment risk (typical of venture capital), they are unlikely to achieve growth rates required by venture capitalists. This is placing the sector in a bind. While there are startups that could one day generate significant impact, they lack the funding to take the next step.

The extent to which this is a barrier varies significantly between the technologies. The First Wave technologies - which are not agriculture-specific - are already growing fast. They generally have access to capital as their platforms targeted global, urban users initially and were subsequently taken up by rural smallholders in Southeast Asia and other regions. Meanwhile, digital trading and payments are better understood by investors and create linkages with higher growth urban markets, which might help them to attract funding. Digital Lending, Hardware Innovations for Smallholder Farmers and Digital Farmer Advisory Solutions are not very attractive to commercial investors but could have a significant impact on farmers. According to AgFunder's analysis of ASEAN agrifood-tech investment, less than 12% of investment into ASEAN agrifood-tech startups in 2019 went into the above categories, with most investment focused on downstream solutions closer to the consumer.²²

Lever: Early-Stage Funding

The most promising lever which IFAD might pull to remove this barrier is to offer early-stage funding by supporting accelerators or providing challenge funds²³ or prizes linked to specific outcomes for farmers. A 2020 study done by the Global Accelerator Learning Initiative (GALI) on acceleration in Asia-Pacific found that accelerated ventures are significantly more likely to increase their revenues than ventures that were rejected from acceleration programs.²⁴ One way to ensure these investments are tied with market demand is to make private sector co-investment a requirement during the process and to source for challenge statements from corporate agribusiness partners.



²² ASEAN 2020 AgriFoodTech Investment Report, AgFunder, 2020

²³ Enterprise challenge funds, UNDP, 2021

²⁴ Acceleration in Asia-Pacific, GALI, 2020

Barrier 2: Lack of coordination and momentum

The lack of shared understanding of the opportunity for these technologies hampers growth. For example, many startups are not on the radar of investors who would invest in them if they were to meet. Governments are sometimes unaware of technologies which could enable better extension or lack the in-house capabilities to make deploy them. Agribusinesses might not know about relevant technologies that would allow them to improve efficiencies as the startup landscape is dynamic and can be fragmented among the various ASEAN countries. Bringing the sector together to promote promising new technologies, share ideas and build partnerships could address this knowledge barrier.

A second, related issue is one of motivation or momentum. Businesses adopt new technologies partly because they know about them, but also because they *perceive* them as interesting or exciting. This is driven in large part by seeing their competitors engage. Agritech in the region suffers not just from a lack of connections between partners but also a lack of momentum because of the industry's fragmentation and the difficulties associated with scaling up across the region. Agriculture's (necessary) rootedness in local realities, unique specificities of each ASEAN country, its regions and supply chains, not to mention the language barriers between ASEAN countries, contribute to the fragmentation of the ASEAN agritech landscape.

Momentum may also be hindered in areas that require a substantial upfront financial investment such as expansion of physical mobile network infrastructure and setting up digital farmer registries. There is also a lack of data on smallholder farmers that could enable businesses, governments, and donors to make more targeted interventions that could improve smallholders' productivity, livelihoods, or sustainability. One of the challenges typically cited in this area is the lack of developed privacy legislation that would ensure that such data is not misused.

Lever: Partnership Brokering and Information Sharing

Small, low-cost network-building steps such as partnership brokering and information sharing could help to solve both the connection and momentum problems and could drive significant growth. Conferences, pitching contests, startup showcases and publishing reports could build knowledge and generate momentum.

Singapore is an interesting regional example as it has put itself on the map in the past three or so years as a hub for agritech startups and investments. In Singapore's case, government agencies have driven much of the partnership brokering. The Economic Development Board (EDB) and Enterprise Singapore (ESG), which handle inbound foreign investment as well as the startup ecosystem have worked closely with agrifood-tech startups to catalyze partnerships with domestic companies to facilitate their Singapore market entry or regional expansion. The Singapore government also sponsors startup events such as Singapore Week of Innovation and Technology (SWITCH) to help drive the growth of the startup ecosystem in specific verticals, including agrifood-tech. Other private sector-run events such as ID Capital's Future Food Asia Awards, which include sponsored cash prizes to the winning startups, have also driven the growth of the sector in Singapore.

Singapore has also addressed the lack of funding for early-stage startups by appointing co-investment partners under its Startup SG Equity program, to catalyze millions of dollars' worth of investment into the agrifood-tech sector.²⁵ In Singapore's case, the public sector has taken the lead in generating this momentum, motivated in part by the need to address the city-state's food security concerns.

One way that IFAD or other donors could address the lack of data on smallholder farmers in ASEAN - and related privacy concerns - is by supporting farmer organizations to collect their own data. IFAD and other donors could provide digital literacy capacity-building, training and/or provision of equipment. Government agricultural extension agents could be involved for learning purposes as well. Farmers would be empowered to decide how their data is shared and with whom. With farmers' agreement, governments or IFAD could then sponsor access to Application Programming Interfaces (APIs) for agritech startups so that they can build solutions with demonstrable benefits to smallholders. This could help to demonstrate both the benefits of data-sharing and the viability of farmers owning their own data.



Barrier 3: Government policies hamper growth

In specific technology areas, legacy government policies can be a barrier to growth and impact. For example, in the case of digital payments, Know Your Customer legislation can hamper growth. The harder the government makes it for digital lenders to sign up a customer, the less loans are provided. The same is also true of data laws, which can prevent startups and agribusiness offering effective data drive services to farmers. Governments must find the delicate balance between enabling digital innovation for the public good and safeguarding citizens' privacy. In some cases, there is a lack of incentive for regulatory reforms since it would not be in the interests of incumbent financial institutions to enable innovation in digital payments, for example. It is important for regulatory frameworks to include proportional and appropriate Know Your Customer requirements that can enable low-cost, low-value payments that smallholder farmers require.²⁶

Lever: Policy Advocacy

This lever would see IFAD engage in policy advocacy. IFAD could commission empirical research to support policy advocacy and to deepen ASEAN governments' understanding of the potential benefits of policies that enable digital payments, on the most vulnerable farmers. IFAD could also provide case studies and tools to support governments enacting more effective policies.

Barrier 4: Governments are not proactively adopting digital agriculture technologies

Governments not only enact policy but are also technology users. There is potential for governments to become early flagship adopters and therefore initial anchor clients of promising technologies such as digital lending, payments and farmer advisory/extension services. This can accelerate the growth of startups that provide technologies beneficial to smallholders, but face difficulties in obtaining private sector financing, by providing them with an early, stable revenue stream.

Lever: Government Adoption

IFAD could drive adoption by supporting the cost of government adoption of these technologies in ASEAN, potentially on a trial basis. This could be documented in a case study or research product that could subsequently be used to inform other regional governments.

With four levers to hand, and seven technologies, we have now established a matrix of 28 options for IFAD. Any one of the levers may be applied to any one of the technology options. However, only some options will be effective. We provide answers to the three critical questions that IFAD and other donors can use to evaluate their potential impact:

1. Does this technology have the potential to grow? In Grow Asia's view, IFAD should only support technologies which are inherently viable and for which there is market demand. Without market demand, technologies will not continue to scale once the donor-funded project is completed. Donor budgets are relatively small compared to potential agribusiness investment in these technologies, therefore donor funding should be used strategically to overcome structural barriers to private sector investment, rather than to prop up solutions that will continue to be dependent on donor funding.
2. Can this technology deliver on IFAD's mission "to transform rural economies and food systems by making them more inclusive, productive, resilient and sustainable"? It is important to address this question to make sure that any technologies supported explicitly target the areas mentioned above and will improve the lives of the most vulnerable farmers.
3. Can IFAD's support potentially make a significant difference to the adoption of this technology?

IFAD's strategies should be built around technologies that provide a clear "yes" to all three questions.

6. Assessment of IFAD's Potential Impact through Digital Technologies

Farmer Mobile Communication

Does this technology have the potential to grow?

As mentioned previously, adoption of mobile communications technologies by farmers in rural ASEAN is going to keep increasing as rural mobile coverage improves. Farmers want to be connected to goods and service, and to family members and friends who have migrated to cities, so they have multiple reasons, both economic and social, for using mobile communication platforms.

Can this technology deliver on IFAD's mission?

In our ranking of technologies against IFAD's mission, we gave Farmer Mobile Communication technologies a high ranking, given their strong potential to deliver on IFAD's mission. We also see significant potential for IFAD to drive adoption, particularly given the agency's linkages into farmer groups and government extension agencies.

Can IFAD drive adoption?

In Grow Asia's view, as these mobile communication technologies are already inherently appealing to many farmers, we do not see a need for IFAD or other donors to drive adoption, but more to focus on supporting the expansion of rural mobile coverage through policy advocacy and commissioning research, as previously suggested.

Agribusiness Digitization Solutions

Does this technology have the potential to grow?

Agribusiness Digitization solutions are likely to grow as long as they continue to provide benefits for agribusinesses and improve their profitability or help them to manage reputational risks or meet consumer demands in some way.

Can this technology deliver on IFAD's mission?

We see Agribusiness Digitization Solutions, while likely to grow, and no doubt positive for farmers, as poorly aligned with both IFAD's mission, and its capacity. The use of these technologies is limited to too few large companies to drive change at scale, and when applied are used primarily to drive efficiencies for agribusinesses rather than farm productivity or improving smallholder farmers' livelihoods. These solutions are also mostly deployed with farmers who are relatively well-resourced and already integrated into agribusiness value chains.

Can IFAD drive adoption?

As mentioned above, since these solutions are being proactively used by agribusinesses in their supply chains, it is not necessary for IFAD to drive their adoption. We give these technologies a low ranking for IFAD's potential ability to drive more inclusive adoption of these technologies that benefits the most vulnerable smallholder farmers.

Digital Payments

Will this technology grow?

This technology is very likely to expand. As more transactions are executed on websites and other digital platforms, digital payments are crucial. The cost of transacting in cash in terms of working capital, security costs and the cost to governments of providing cash-based pensions and subsidies will continue to drive growth.

The growth of digital payments in the smallholder sectors in China, and to a lesser extent India, suggest solid future growth in ASEAN. Payments are likely to accelerate when a tipping point of rural users adopt the technology. This happens when creating a “network effect” where new users are attracted to join in order to transact with a large base of existing users and service providers. In many urban areas, the number of users has already crossed the tipping point.

Does this technology deliver on IFAD’s mission?

Digital payments alone provide only a marginal direct benefit to farmers, perhaps reducing transaction costs some of the time. However, they are key enablers of two of the other technologies: e-commerce and digital lending.

Farmers in ASEAN typically buy inputs from a village store, sell to a local trader and lend from a village-level lender. Above, we argued that this limitation is driven by the need to meet these people face-to-face. However, this limitation of their circle is also driven by the need to transact in cash. A digital wallet is a passport for a farmer to broaden their exposure. The change will not be instantaneous, but digital payments at least enable access to other suppliers, customers, and financing options to farmers. The resulting disintermediation and greater competition will empower farmers.

Credit is a particularly promising avenue since formal lenders such as banks rarely lend to smallholder farmers. Transacting in cash makes both disbursement of funds and collection of payments prohibitively complex and expensive. While digital payments cannot address all the limitations of formal lending, these technologies will drive greater access for farmers, and as a result more competitive loan terms.

We ranked digital payments as highly aligned with IFAD’s mission, as they have the capacity to drive lending, access to more counterparties and ultimately, e-commerce.

Can IFAD drive adoption?

Increasing adoption of digital payments in ASEAN is very likely to play out, even if IFAD and other development sector actors do not get involved. However, adoption will not be uniform, and even with donor intervention the benefits may not be inclusive of the poorest farmers.

IFAD’s best levers to drive growth are policy advocacy and government adoption.

Digital payments are highly policy driven. Historically, governments have regulated digital wallets on the grounds that they undermine more formal government-regulated banks and could potentially enable money laundering. However, the value of more informal accounts and payments (broadly called fintech) is being recognized by governments. IFAD and other development actors have an important role to play in helping governments to understand the benefits of these technologies and build pro-poor and pro-farmer legislation around digital payments.

Governments not only enable pro-poor digital payment through policy but they also enable payment by using these payment platforms themselves. For example, a key driver of digital wallets is the adoption of this payment method by government pension agencies or agencies administering government assistance programs. Once the government begins making digital payments, adoption by the private sector follows in short order. The same is also true of payments to the government. For example, the adoption of a digital wallet payment option by government electricity authorities also drives adoption. IFAD could advocate for adoption of digital payments by governments, particularly in rural areas when disbursing subsidies and providing support to farmers.

Given the strong link between government policy and digital payments, we gave this solution a **high** ranking for IFAD’s potential ability to drive more inclusive adoption.

Digital Trading Platforms

Will this technology grow?

Traders will always seek to improve their margins and the efficiency of their business operations. As discussed above, the use of SMS and other messaging services is widespread and traders will naturally seek out other options as they emerge.

Does this technology deliver on IFAD's mission?

As these traders adopt digital tools, they will become more efficient which has a positive impact on pricing for farmers, but the difference is marginal.

Can donors drive adoption?

IFAD has strong relationships with farmer groups and governments and has historically not worked closely with traders. Even the governments that IFAD supports do not hold deep relationships with crop traders or guide their business operations through policy.

The adoption of digital tools by traders is mostly outside IFAD's capacity for impact and does not align well with the organization's objectives. Direct investments in these technologies were ranked as **low** for their alignment with IFAD's mission and capacity to drive growth.

Digital Lending Platforms

Will this technology grow?

Peer to peer lending is already gaining some momentum. However, digital lending could well expand beyond the confines of peer lending. Already some impact investors are taking on portfolios of loans on these platforms. In the future, banks and other lenders are likely to see the potential of the high interest rates and scale that is possible in this market.

Once the fintech sector has established a solid customer base, we expect the banks to "crowd in" to rural digital lending.

Does this technology deliver on IFAD's mission?

Digital Lending is highly aligned with IFAD's mission. The rise of such lending could have a substantial impact on the rates farmers pay when buying seeds and fertilizers. The increased availability of loans will drive greater access to high quality inputs.

It is widely acknowledged that technologies already exist to close the yield gap in Asia, lower interest rates could make all the difference in finally seeing these technologies used at scale.

Can donors drive adoption?

IFAD is well positioned to drive this technology. The agency could use a suite of tools from partnership brokering and information sharing to early-stage funding and policy advocacy to unlock growth.

This technology is ranked as **highly** aligned with IFAD's mission and its capacity to drive growth.



Hardware Innovations for Smallholder Farmers

Will this technology grow?

The growth of hardware adoption in the region is hampered by cost. With such low profit margins on smallholder farms in ASEAN, investment in hardware solutions that cost even US\$10 or US\$20 will be out of reach of the poorest and most vulnerable smallholder farmers. On this basis, we are not optimistic about the prospects for on-farm sensor systems and weather stations.

More likely is the adoption of “pooled hardware”. We expect to see solid growth in drone spraying, as the cost of deploying one drone is shared across dozens or even hundreds of farms. The use of local weather stations that again deliver value to hundreds of nearby farmers is another good example.

Does this technology deliver on IFAD’s mission?

These technologies have a marginal alignment with IFAD’s mission. Over the foreseeable future more hardware solution providers will focus on wealthier and larger farms.

Can donors drive adoption?

IFAD could, as part of a broader strategy of partnership brokering and information sharing, promote hardware technologies which are useful to the agency’s target groups. However, these technologies are not typically driven by government policy or adoption by government extension agencies.

This technology was ranked as having moderate capacity to deliver on IFAD’s mission, a **moderate** potential for IFAD to drive adoption.

Digital Farmer Advisory Services

Will this technology grow?

The growth of ASEAN farmers’ adoption of advisory applications has stalled. While a number of such solutions were developed, the combination of farmers preferring advice from trusted local sources and the inability of these solutions to find a viable business model have hampered growth. However, the growth of more informal advisory including the use of Facebook, phone calls, SMS and online chat groups is growing quickly.

Does this technology deliver on IFAD’s mission?

Connecting farmers with better growing techniques and technologies is very close to IFAD’s core mandate. While a commercial model for these types of apps seems to be elusive, perhaps there is scope for governments to support digital extension.

Can donors drive adoption?

There is significant scope for IFAD to use partnership brokering, information sharing, advocacy, and adoption support to drive the use of digital extension technologies by government, input companies and buyers. Exactly how to use chat, social media and other tools to deliver quality extension (and mitigate the impact of poor quality advice on these same mediums) as an area rich in potential to learn and grow as a sector.

This technology is **moderately** aligned with IFAD’s mission, and there is some potential for the agency to drive growth.

7. Summary

To summarize the discussion above, we have ranked each of the seven technologies as:

- Highly prospective, with significant potential for IFAD and other donors to have an impact
- Moderately prospective, which should be considered if it can be delivered in complementary fashion alongside high prospective approaches
- Low, which represents a poor use of donor resources
- Not applicable, where a lever is simply not relevant to that solution.

	Will it grow?	Does it deliver impact?	Can donors drive it?
Farmer Communication Platforms	H	H	H
Agribusiness Solutions	H	M	L
Digital Trading	H	L	L
Digital Payments	H	H	M
Digital Lending	M	H	H
Digital Farmer Advisory	L	M	M
Hardware	L	M	L

Table 1: Alignment with impact

	Match, Broker, Learn	Policy	Government Adoption	Early-Stage Funding
Farmer Communication Platforms	H	H	H	Not Applicable
Agribusiness Solutions	L	L	L	L
Digital Trading	L	L	Not Applicable	L
Digital Payments	M	H	H	L
Digital Lending	H	H	H	H
Digital Farmer Advisory	M	L	M	M
Hardware	L	L	L	L

Table 2: Potential impact of applying each lever

8. Recommendations to IFAD and Other Donors

Invest in Digital Lending

IFAD may wish to consider investing in a full suite of activities to support digital lending to farmers in ASEAN. Farmers stand to benefit significantly from greater access to finance as this technology grows. Furthermore, a range of levers including partnership building, policy advocacy and early-stage funding of these solutions is within IFAD's capacity and also likely to drive growth.

The availability of capital at the start of the cropping season to support the acquisition of quality inputs remains one of the most promising yet untapped opportunities to address productivity, farmer incomes and food security. Leveraging digital technologies to allow lenders to acquire farmer customers more easily, undertake credit-scoring and collect payments could lead to impact at scale.

Promote Digital Communication Tools

IFAD should promote the use of digital communications between farmers and businesses, with government extension agencies, farmer groups and buyers. Farmers are quickly adopting these channels. Ensuring that the sector uses them to effectively bring extensions services and new technologies to farmers would have widespread impact.

IFAD is well positioned to work with governments, farmer groups and extension agencies to ensure that chat and messaging solutions for farmers are rigorous and scientifically based, up-to-date, relevant and easy for farmers to understand and implement.

Enable Government Support of Digital Payments and Expanding Rural Mobile Coverage

IFAD should also consider supporting the adoption of digital payments through policy advocacy with governments in the region. Increasing access to digital payments by smallholder farmers would also enable access to digital lending as well as to other goods and services.

IFAD could work with or support organizations that are closing the mobile coverage gap. One way could be to support these organizations in demonstrating to policymakers the benefits that the most vulnerable rural populations could receive if mobile coverage were expanded and/or improved. This could support policymakers' justification of financial support or reforming spectrum licensing regulations to spur private investment in mobile infrastructure. This could be done, for example, through undertaking empirical research among smallholders who remain stuck in the mobile coverage gap.



9. Investment Principles

Much of this report has focused on what to invest in. However, *how* donors invest is also extremely important. The dynamic nature of digital technologies give rise to a number of principles which should guide donors' approaches:

Flexibility and adaptability: With the pace of change in the digital landscape in ASEAN, any future program needs to be adaptive to emerging needs and opportunities that will emerge over time.

Supporting not directing: Supporting the ongoing emergence of sustainable and scaled private sector solutions requires the program to allow these solutions to innovate and develop in their own ways.

Diversity in technologies: Due to a wide range of emerging digital solutions, Grow Asia and IFAD will support a variety of solutions that are smallholder relevant, but not always necessarily through direct service provision.

Promoting key themes: Not all digital solutions will have specific gender, youth or climate outcomes but the program will seek to promote learning and innovation in these areas.

Connected and collaborative: The program will seek to collaborate with other emerging digital programs wherever it makes sense. It will also need to be connected at the country level in ways that add unique value.

Multi-stakeholder: Any IFAD program should work in a multi stakeholder fashion to build commitment across the ecosystem to a common vision and approach to realizing the potential of digital solutions for smallholder farmers, defining clear pre-competitive areas for collaboration and co-investment.





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