No	Theme	Detail	Description
1	**Enhance farm productivity and product quality and make production systems more resilient to shocks, including climate shocks**	Provision of digital extension/advisory services (e.g. on use of inputs based on local conditions, identification of crop diseases) - Agriculture supervisory	Indonesia has 67,518 agricultural extensions/advisory services, which is only 0,2 % of the total farmers in Indonesia. This is worsen by the fact that their ages are ranged between 45 to 55. Several points to be acknowledge: - Based on TaniHub Survey on the helpfulness of digital extensions to TaniHub's farmers it is concluded that that farmers knowledges are very limited to production (only), while the problems that Indonesian farmers are facing are more than just about that. - Agriculture production is heavily influenced by local agroclimatic conditions (eg. the type and amount of input use for specific crops highly depends on local soil and climatic conditions); Indonesia's diverse geography highlights the need for the provision of highly localized information. Climate change, which is expected to increase climate variability, also means that agriculture advisory should be able to respond dynamically to such changes. - Mobile phone ownership, rural internet connectivity, and digital literacy, present additional barriers to the adoption of digital extension by farmers. This is exacerbated by the aging farmer demographic in Indonesia, where the majority of farmers are aged between 45 to 55. Many farmers are also risk-averse, hindering them from adopting improved farm practices that they are unfamiliar with. - On the other hand, the Government of Indonesia is encouraging youths to enter the agriculture sector. While millennials are more familiar with the use of digital tools, are open to new ideas, and are keen to develop agribusinesses, those coming from urban centers may lack hands-on farming experience and therefore extension delivery to this group may require a differentiated approach. Given the above, innovations are needed to (i) better tailor the contents of agricultural advisory to meet the specific and dynamic needs of different types of farmers, as well as in the (ii) delivery of extension services to improve the the adoption of enhanced agricultural practices by farmers, to help increase agriculture productivity and farmer incomes. We believe that these digital

	The use of IoT and Big Data tech to enhance agriculture productivity and optimize resource use, incl. through the use of Green-housed farming or precision farming solutions	Indonesia will have to feed a growing and urbanizing population, with changing food preferences, from staple crops to a more diverse range of food items including horticultural products. Indonesian agriculture has experienced stagnating productivity levels, among others caused by a mismatch in the use of inputs and poor agricultural practices. As agricultural land is increasingly converted for non-agricultural purposes, soil fertility is declining due to poor agricultural practices and inappropriate use of inputs, and water may become more scarce due to climate change and forest conversion, including in West Java, it would be crucial to invest in productivity-enhancing and resource-optimizing technologies to increase agricultural production in an economically and environmentally sustainable manner. The use of precision farming technologies would allow the control of growing conditions so that crops receive the right amount--not too little and not too much--of nutrients, water, light, temperature, humidity at the right time for their optimal growth. Field visits conducted by TaniHub suggest that farms using precision farming technologies were able to double their yields compared to those using more conventional farming methods on the same commodity. Furthermore, the use of such technologies were able to decrease by almost 70% the consumption of water as well as 2/3 of the human resources. However, at present, the cost of these technologies are very high, ranging up to IDR 1.5mio/sqm which would make it very challenging for smallholder farmers to adopt. Given the above, innovations are needed to enhance the cost-effectiveness, particularly for the initial investment, of technologies
	Create decision support system from crop planning or guide cultivation process, incl. climate advisory	Agriculture production is inherently dynamic. Farmers must be able to adapt its farming decisions in response to changing weather and market conditions, to ensure he receives a sufficient level of income to meet household needs and cover production costs for the upcoming season. Examples of decisions that a farmer should make, in order to maximize his profit/income, include: - what mix of commodity to grow - how much of each commodity to grow - how much inputs (fertilizer, pesticides, labor, water) to use, how frequent, and when Given: - each specific crop's growing requirements - market conditions (eg. product prices, transport cost to markets, availability of buyer) - agroclimatic conditions (eg. amount of water available from rain/irrigation) - financial resources available (incl. credit) - costs and expenses the farmer needs to cover (eg. production costs, household consumption needs) A production support system could guide farmers in making such decisions. However, such systems would require additional supporting services, including climate advisory services. Advances in remote sensing allows the quick provision of weather estimates, and digital technologies has made it easier for the public to access real-time weather forecast. However such services are still not accessible for the majority of Indonesian farmers, many of whom are still relying on traditional methods to predict weather patterns. This is resulting in a lack of accuracy in their risk mitigation. For example, if farmers could know in advance that the rain intensity would be high (or low) in the next 3 months, they could adjust their farming practices accordingly, eg. selecting a different

		Production Scheduling	intensity would be high (or low) in the next 3 months, they could adjust their farming practices accordingly, eg. selecting a different crop, adjusting the level of input use, applying for crop insurance, etc. to prevent crop failure. Reliable, localized, and easy to understand climate advisory would become more important as climate change may lead to an increase in climate variability, shifts in weather patterns, as well as increase the occurence of extreme weather events. Real case in Indonesia: Some commodities such as cabbages and chilis are non-seasonal plants that have a very stable demand because they are commonly consumed almost everyday by most of Indonesian people. Strangely the prices and availabilty are very unstable. Funnily there is one famous durian seller in Indonesia that has a very stable price and availability throughout the year for one specific Medanese Durian although it is actually a seasonal fruit that could only be harvested once or twice a year (Durian Uc*k). - Supply-demand forecasts. Indonesia's diverse geography and therefore agroclimatic conditions means that there are regional differences in the timing of the production of different agricultural commodities across the country, given the inherent seasonality of some crops. At the same time, the demand for agricultural commodities may also fluctuate throughout the year, particularly around major holidays. A mismatch between supply and demand may contribute to price fluctuations. Therefore, to help farmers obtain a stable price for their produce, it would be important to provide information of the aggregate supply and demand estimate in order for the farmer to be able to adjust the type and quantities of the crops to be grown for a particular season. Such information would also be beneficial for traders to help identify where to source a particular product from or where to channel to at a given point in time, and help provide information to government or other value chain actors to inform import-export decisions.
2	**Facilitate farmers access to markets (finance, input, output)**	Facilitate farmers to operate as a group and business entity through joint procurement, coordinated or centralized marketing, coordinating aggregation and quality control	Agriculture in Indonesia is highly fragmented. Smallholder farmers constitute 93 percent of all farmers in Indonesia, whose landholding averages a modest 0.6 hectares. For comparison, the average farm size in the United States is 180 ha. Small landholdings hinder them from leveraging on economies of scale to enjoy better prices and reduced operational costs on a per hectare basis, as well as make them more vulnerable to economic shocks and climate change. - By working individually as smallholder farmers, their whole opex would be a lot higher. This opex includes logistic, transaction cost, risk of failure, penalty, cost of inputs (seeds & fertilizers), etc. Furthermore, these individual smallholder farmers are difficult to be reached by the government for support. - Fragmentation also makes it more challenging for the government or the private sector to engage with them, due to increased transaction costs. By organizing themselves in groups, farmers can aggregate their input demand as well as their harvest, to obtain a better bargaining position in negotiating prices and accessing services. They would also be better able to manage production risks by diversifying their portfolio. However, many existing farmer groups have limited organizational capabilities. Innovations that would enable and facilitate farmers in operating as a group or business entity (eg. in coordinating production, procurement, marketing,
		Warehouse and Logistical Process	Indonesia's agriculture production is scattered across the archipelago, although roughly 60% is estimated to take place in Java. The country's island geography, long supply chains, coupled with limited logistics infrastructure (eg. roads, storage facilities, cold chain system) and services in rural areas, all contribute to high logistics cost, food quality degradation (incl. nutrient degradation for nutritious food items that are often also highly perishable, like fruits, vegetables, and animal products) and food loss. Supply chain actors compensate the value of postharvest losses and waste into logistics cost, thereby further increasing the prices of agricultural products for consumers. Innovations that improve the cost-efficiency and delivery time of the agri-food logistics system, could help maintain product quality, and help ensure consumer access to nutritious food items at a more stable and affordable price.

Generate demand forecasts for specific commodities in selected markets (domestic and export)	Indonesia's diverse geography and therefore agroclimatic conditions means that there are regional differences in the timing of the production of different agricultural commodities across the country, given the inherent seasonality of some crops. At the same time, the demand for agricultural commodities may also fluctuate throughout the year, particularly around major holidays. A mismatch between supply and demand may contribute to price fluctuations. Therefore, to help farmers obtain a stable price for their produce, it would be important to provide information on aggregate supply and demand estimates, which may also include international trade estimates, in order for the farmer to be able to adjust the type and quantities of the crops to be grown for a particular season. Such information would also be beneficial for traders to help identify where to source a particular product from or where to channel to at a given point in time, and help provide information to government or other value chain actors to inform import-export decisions
Provide market/price market information for a wider range of commodities	Access to localized, up-to-date, and transparent market information would enable farmers make better decisions on production and marketing (eg. which crops to grow, when and where to sell), and better negotiate with traders on prices. In order to create a fair market price, the production cost should be the first to begin with, then followed by the additional factors. However, what happens in reality is that, most products were sold from the farmers to the central market as consignments. Both the central and local governments have websites to display market price information for a number of commodities (eg. West Java: http://priangan.org/, National: https://hargapangan.id/), but a number of limitations remain: - the commodity and geographic coverage are still limited due to data collection challenges - market-level or farm gate information are not always available - most platforms are focused on output prices with limited to no information on input prices - information may not be presented or delivered in an accessible way for farmers
Enhancing access to export markets	The Ministry of Agriculture is aiming to triple Indonesia's agriculture exports. In Semester I 2021, the country's agriculture exports increased by 14% compared to the same period last year. The use of appropriate digital tools may help enhance Indonesia's access to the global agrifood market, through, among others, by easing the identification of export opportunities and requirements and improving traceability of high-value products. Comment: this section needs further elaboration. Perhaps TaniHub could add more detail through their export experience, or other colleagues. Meanwhile waiting for MoA input, I will also try to find more information.
Facilitating access to agricultural inputs and machinery	Farmers require a diverse range of inputs for agricultural production (eg. seeds, fertilizer, pesticides), as well as services (including rental of machinery, among others). However, at the local level, the appropriate inputs, machinery, and services may not always be available commercially, or are very limited. As a result, farmers often have to procure these from outside the region, increasing costs, or resort to less suitable alternatives, which may then lead to sub-optimal results, thereby reducing income. Access to a limited variety and low quality of seedlings may also hinder productivity and/or restrict farmers to growing a limited number of crops. Innovations are needed to help farmers better access a diverse range of high quality inputs and services in a more cost-effective manner, to enable them to diversify their production and/or adopt good agricultural practices.

		Facilitating access to finance	Access to finance is a common bottleneck to farmers. Many smallholder farmers could not access formal bank financing due to limited financial literacy, lack of collateral or formal land title, and small loan sizes, among others. In recent years, there have been several innovations in the financial sector that have tried to waive the requirement for a tangible collateral, for example through value chain financing. However, several bottlenecks remain. Farmer financing needs heavily depends on the types of commodities the farmer is growing (eg. annual vs perennial crops), and would require different arrangements in terms of loan repayment (eg. length of grace period). However, many formal financial schemes do not consider the specific needs of the farmers in their design. Even in value chain financing, smallholder farmers would prefer to be paid on delivery, whereas most buyers usually require term-payment. This interferes with the farmer's cashflow and might affect production in the upcoming season. Assymetric information, lack of farm production records, and the limited knowledge of the financial sector's knowledge on agriculture production also makes it challenging to assess the bankability of a particular farmer. In order to create an innovation, there are supporting technologies needed to be applied. While we believe that this could be a breakthrough movement, the farmers only see it as a high risk investment. In any other type of business, a breakthrough investment certainly need a support from a strong financial institution. However with the high risk that goes a long with it, almost none is willing to jump on helping an agricultural business.
3	**Support public sector decision-making**	Develop decision-support systems for central and subnational government, eg. Developing proof-of-concept for specific AWR/Kostratani features	The Ministry of Agriculture is currently develping a decision-support system based on big data, under the name of the "Agriculture War Room" (AWR). The AWR is envisioned to be able to pull and analyze all agriculture-related data (incl. farmer, production, price, climate, and program data) available within the Ministry, or potentially including those produced by other actors in the agriculture sector, in order to generate insights for decision-making. This would include data collected by field staff and extension officers at sub-district level "Kostratani" , who will in turn act upon the insights generated by the AWR at the local level (eg. by providing appropriate evidence-based advisory to farmers). Information generated by the AWR will then be able to be utlized by a diverse range of actors within the sector. The Ministry of Agriculture is currently seeking for a proof-of-concept(s) for specific use cases to demonstrate the value of this set-up. The proof-of-concept could be developed using West Java as a case study. One of the strategic direction from government, is to conduct innovation program to revitalize more than sixty thousands Field Advisor and Agri School to imporve their productivity and bring higher impact to farmers and other relevant stakeholders From West Java, not yet paraphrased: "Currently, the West Java Provincial Government has difficulty monitoring data and information related to agricultural production, distribution/logistics, and the commercialization of agricultural products. The impact is that the West Java Provincial Government cannot map the level of food security in each District/City for decision making." Open question: to what extent can the solution for MoA also be used for West Java Provincial Government as both are looking for

		Development of specific farmer registry features to support an integrated farmers database for the receipt of government interventions eg. Tools to support collection of specific farmer information	A farmer registry is an agricultural database of farmers containing basic data about farms and farm holders. Indonesia has several existing farmer databases that are currently used as a basis for the targeting of government interventions. However, data collection and maintenance is a challenge, particularly in ensuring that information collected is accurate and remains up-to-date. Sometimes farmers get not suitable subsidized agro-input and equipment, in terms of type, quality (spec), quantity and time of distribution. Beside that, subsidized agro-input and equipment are not supported with market access facilitation that guarantee the market incentive and value added will give to farmers.
		Develop algorithm/method to improve targeting of public sector programs	
		Farmers regeneration	The same thing happens everywhere, not only in our country but in many other countries, that the number of young farmers and agricultural workers are constantly decreasing. Meaning, not only in developing country, but in a developed country with advance agri sector, this issue also occurs. So, farmers welfare might not the only factor in creating this dilemma. One of the strategic direction the government has decided, is to proactively improve the skill of more than 7000 millennial farmers by facilitating them the access to larger market ecosystem and insight on their farm operation