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Governance Strategies for Boosting Farmer Capacity and Productivity Amidst El-Nino Challenges in Indonesia

A Noyara Rahmasary, Muh Dimas Arifin, Ika Zahara Qurani

Historically, El-Nino has decreased rice production in Indonesia due to its effect on precipitation patterns. The current El-Nino event is estimated to get stronger, with a greater than 95% chance through January-March 2024.

The government, coordinated by the Ministry of Agriculture, has commenced strategies to anticipate the negative impact, including mapping the El-Nino affected area, disseminating information on adaptive measures, and increasing the availability of climate-resistant seeds, fertilizer, water infrastructure, and machinery.

Learning from the implementation gaps, a more substantial focus to secure agricultural productivity during El-Nino event would be on improving the capacity of farmers and agricultural stakeholders.

El-Nino: The warm episode of Pacific that causes extreme effect globally

As the second semester of 2023 began, people were bracing themselves for the arrival of El-Nino. This climate variability is characterized by warmer-than-average sea surface temperatures in the central and eastern Pacific Ocean. El-Nino can have a significant impact on weather patterns around the world, and Indonesia is no exception.

El-Nino (often stylized as El Niño) is a climate variability that is a slow onset phenomenon. Its onset is declared when the 3-month average sea-surface temperature departure exceeds +0.5C in the east-central equatorial Pacific. El-Nino is often referred as a Pacific warm episode while its sibling, La-Nina, is referred as the cold episode. El-Nino and La Nina is collectively known as El-Nino Southern Oscillation (ENSO). Their effects can alter the patterns of tropical rainfall from Indonesia to the west coast of South America. These changes in tropical rainfall affect weather patterns throughout the world (NOAA CPC, 2023a)

In 2023, the world is still reeling from the effects of the 2015-2016 El-Nino event, which was one of the strongest on record. The event caused widespread droughts, floods, and wildfires, and led to billions of dollars economic loss. Scientists believe that climate change is making ENSO events more extreme. In the past five decades, ENSO events have been 25% more intense than they were before industrialization (Grothe et al., 2020). This is a concerning trend, as it means that we can expect to see even more devastating weather events in the future.

The impact of ENSO has strengthened certain anomalies in specific regions. Goddard & Gershunov (2020) shows that certain extremes have even higher probabilities of happening during El-Nino periods in the future. The extreme includes drought (observed across the tropics), heavy rainfall, flooding, and intense wildfires—which are becoming more common and severe.

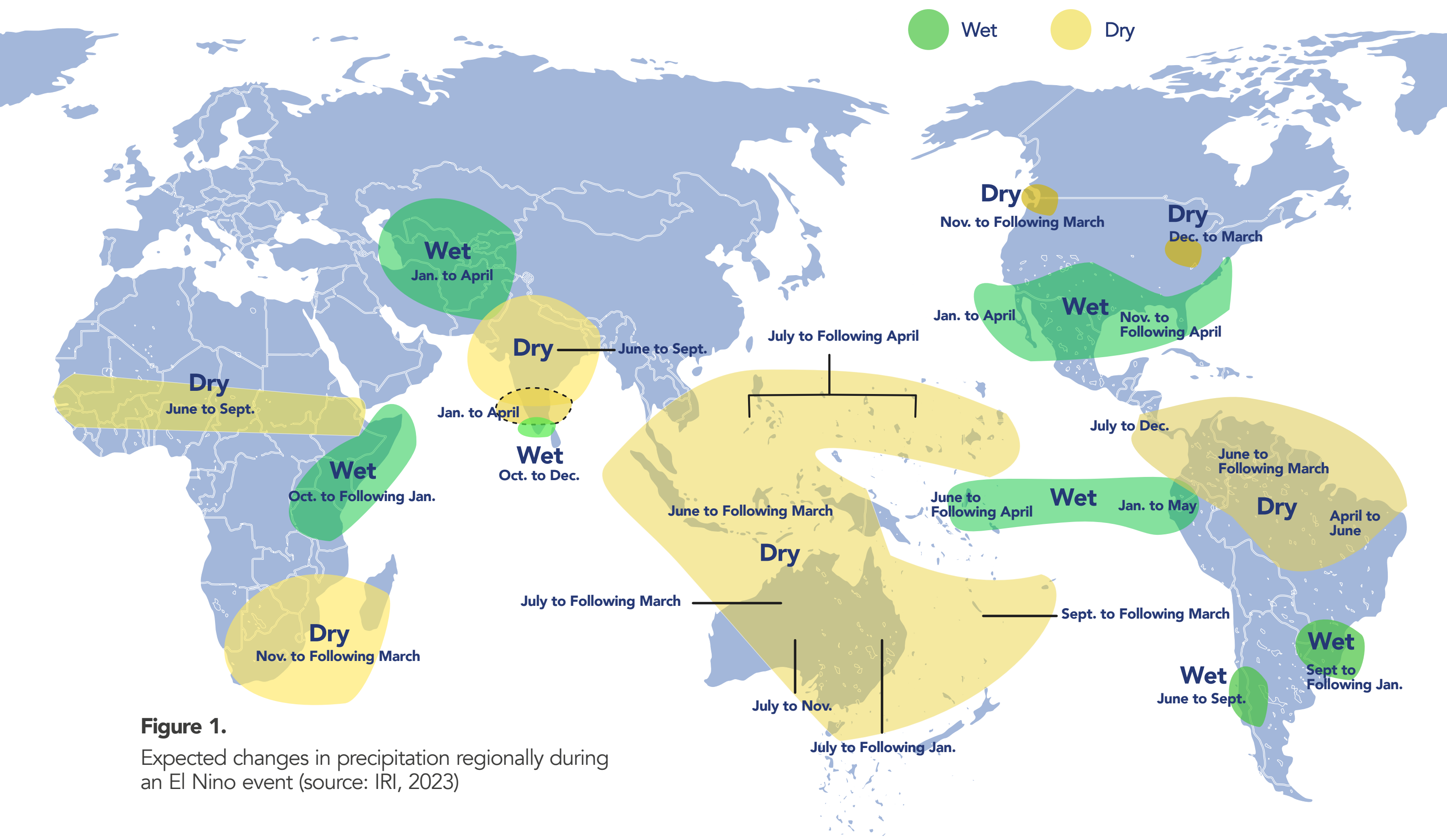

Figure 1.

Expected changes in precipitation regionally during an El Nino event (source: IRI, 2023)

The National Oceanic and Atmospheric Administration Climate Prediction Center (NOAA CPC) is closely monitoring the ENSO event. The latest data shows that all of the El Niño indices are above +1.0°C, which is the threshold for a strong El-Nino impact. The current El-Nino event is anticipated to continue through the Northern Hemisphere winter, with a greater than 95% chance through January-March 2024 (NOAA CPC, 2023b).

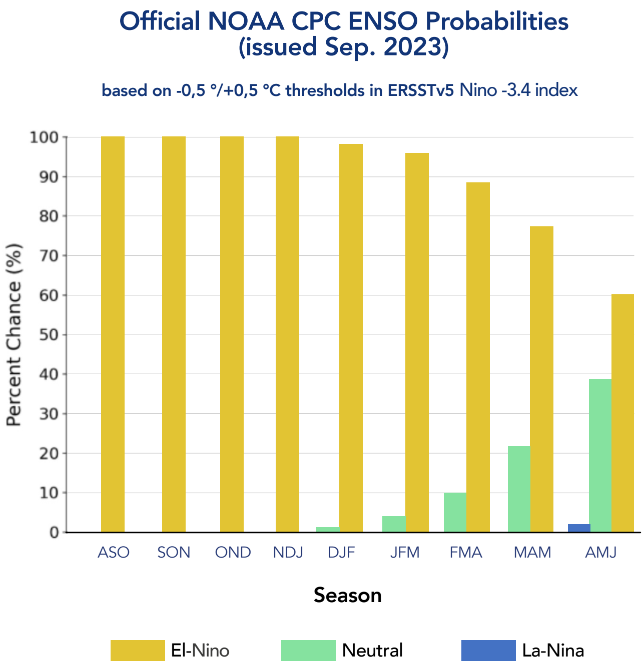

Figure 2.
ENSO probabilities (source: NOAA CPC, 2023b)

El-Nino Impact on Indonesian Agriculture Sector

Climate variability has impacted crop production in Indonesia, particularly on rice, which serves as the staple food of over 270 million Indonesians and is highly susceptible to the changing climate. In a typical year, the Wet Season Planting (WSP) in Indonesia runs from October to December, then followed by two Dry Season Planting (DSP). The WSP constitutes the primary planting period, contributing to approximately 45% of total yield.

However, in recent years, the wet season has been starting later and ending earlier. This has led to crop failures, as the rice plants do not have enough time to grow and mature. Its advances or delays not only determine the planting time of WSP, but also affect the next two DSP (Apriyana et al. 2021). In Indonesia, El-Nino commonly causes lower rainfall while La Nina increases it. They alter the onset and withdrawal of the wet season, making it difficult for farmers to optimize the planting period. The immediate consequences include amplified losses in yield due to climate-related hazards and a reduction in agricultural output.

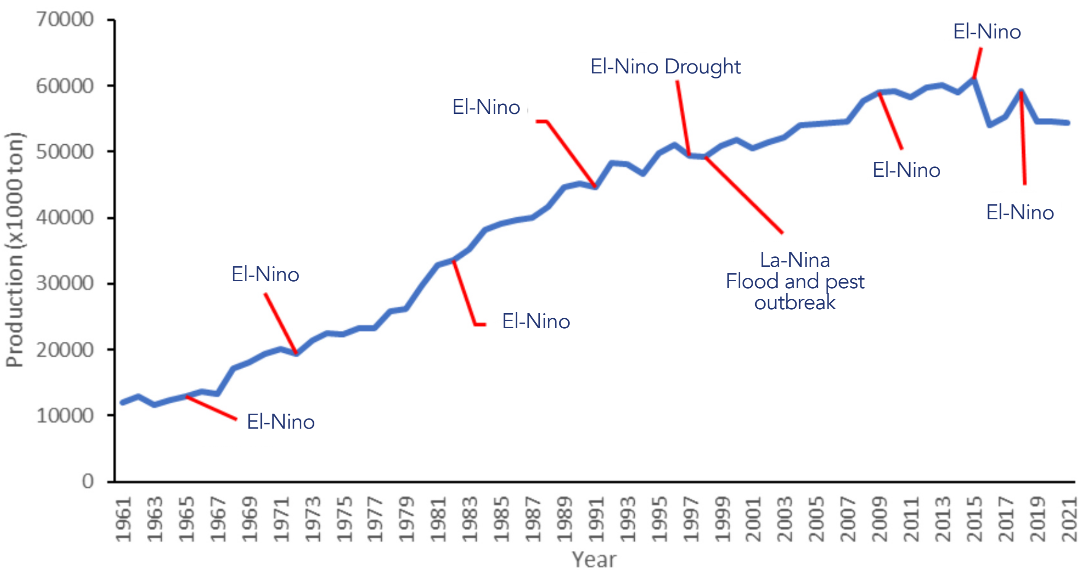

Figure 3.
Annual rice production in Indonesia coincides with El-Nino and climate variability (source: FAO, 2023)

As seen on the graph, some plunges on rice production occurred during El-Nino years. El-Nino had decreased the amount of yield in the country due to its effect on lowering the precipitation necessary for plants to grow. With the current development of El-Nino, the Indonesian Ministry of Agriculture (MoA) has estimated a loss of 380,000 tons of rice due to a moderate El-Nino. In a worsening condition of a very strong El-Nino, the country could lose 1.2 million tons of rice, a higher number than the yield during April 2023 big harvest period (Judith, 2023).

El-Nino also affects food price. A study using cross-section data from 23 provinces in Indonesia from 2010-2017 (with complete cycle of El-Nino, neutral, and La-Nina) showed that El-Nino exerts significant effects on food prices, leading to higher prices for rice, sweet potato, and mung bean. The study revealed that a decrease of 1 millimeter in rainfall can result in an increase of IDR 0.2024 per kilogram in the price of rice Malau et al (2021). During El-Nino period of October 2018 and July 2019, the price of rice increased from IDR 11.000 to IDR 12.000. Similar trend was observed this July 2023 where the price of medium-quality rice rose to IDR 11.920 (Akbar, 2023).

Measures to maintain productivity under the changing climate

The President of Indonesia has reminded MoA to secure the production and the Indonesian Logistics Bureau (BULOG) to prepare its reserves by importing rice (Ramadhan, 2023). The government often decided to conduct rice imports in the ENSO years to secure national food stock. For example, in 2018, 2.3 million of rice was imported to boost food accessibility among the people (Akbar, 2023).

This year, the government has commenced measures to prevent the negative impact of El-Nino in the coming planting season. The collaboration of many government bodies, including the Ministry of Agriculture, National Food Agency (BAPANAS), and BULOG institutes a list of anticipation and adaptation measures.

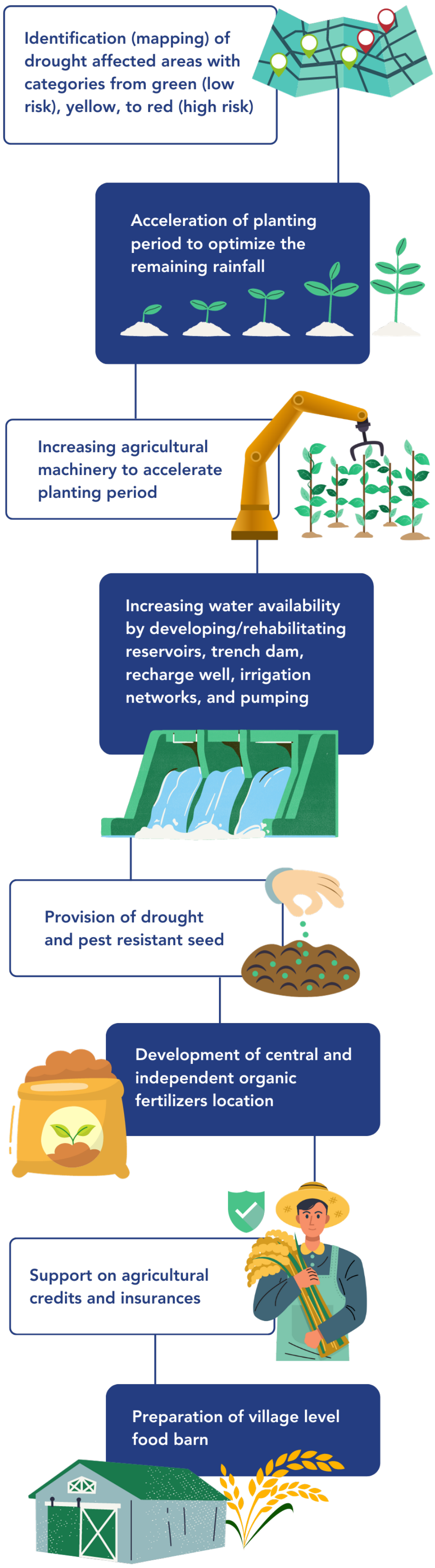

Figure 4.
El-Nino Anticipation and Adaptation Measures of Agriculture Sector (source: Akbar, 2023; Ramadhan, 2023)

Figure 5.
Information on the start of planting period across Indonesian rice field provided by ICCIS (katamterpadu.info)

The initial measure to secure productivity stem from utilizing the prediction of climate parameters, especially rainfall. There are innovations that provide the processed information to help farmers to make decisions regarding their planting practices. For instance, the MoA produces Sistem Informasi Kalender Tanam (Integrated Cropping Calendar Information System, ICCIS) and Drought Risk Prediction while the National Research and Innovation Agency (BRIN) produces Kamajaya (Sistem Kajian Awal Musim Jangka Madya). The farmers can utilize the information from ICCIS to determine the start of planting periode 1-3 months in advance, both for WSP and DSP. ICCIS used the rainfall prediction data to determine the planting schedule.

Providing climate adaptation training can help farmers survive the El-Nino

A study in Ciparay and Bojongsoang (West Java) was carried out to show the farmers the benefit of considering climate parameter on their productivity. Climate parameter prediction is used in a crop simulation model to make informed agricultural decisions for upcoming crop planting.

The model suggests and compares rice-rice pattern to three others: i) rice-maize, (ii) rice-soybean, and (iii) rice-fallow. Maize and soybean experienced lesser yield loss compared to rice during El-Nino period. As a result, the farmers who followed the model suggestion and switched from rice to soybean or maize earn higher incomes.

Soybean on rice field

The cumulative net income differences for farmers with rice-soybean pattern was 27-45% higher than those with rice-rice pattern. Meanwhile, farmers who use rice-maize pattern receive net income of 19-35% higher compared to farmers with rice-rice pattern.

Source: Boer & Surmaini (2020)
Image Source: Pangan News

Not only farmers, the decision makers utilize the information to support them making well-targeted intervention to mitigate the effect of predicted effect. As seen on Figure 4, some measures are best implemented using spatial information, such as the distribution of subsidies for seed, fertilizer, as well as agriculture machinery. The existence of drought-adaptive plant seeds have been made available, such as Inpago 5, Inpago 7-10, Inpari 10 Laeya, Rindang 1 and 2 for paddy and Provit A for maize (Arvan dan Aqil 2020; Yudi et al 2021).

Kirono et al (2016) emphasizes the significance of various uncertainties, such as climate parameters, into the planning of adaptation strategies, particularly for sectors like agriculture, livelihoods, and irrigation. The Indonesian Ministry of Public Works and Housing (MPWH) also organizes a UN-supported Smart Water Management that includes building 61 dams, installing the irrigation system for 500.000 ha field area, and rehabilitating the irrigation system for 2 million ha field area (PUPR 2022).

To maintain sufficient water input during plant growth, innovation is made available to optimize farmer access to surface water as the source of irrigation. In practice, agriculture infrastructure can be built to irrigate smaller areas, yet to be covered in the MPWH irrigation system. These infrastructures include reservoir (embung), long storage, trench dam, and pump installation. This scale of agricultural water infrastructures requires investment costs ranging from Rp 80 million to Rp 875 million, with a variation in service area between 45 to 900 ha (Rejekiningrum & Kartiwa 2022). For smaller water saving technology, farmers could use efficient water distribution systems such as sprinkle, furrow or drip irrigation (Sulaiman et al. 2018).

Apparent gaps in implementing the measures

Even with available strategies to tackle the deterring impact of El-Nino and other climate variability, the real-life implementation varies from one location to another. Studies that surveyed both productive and vulnerable agricultural lands come up with varying results, especially regarding the farmers and farmers group who are the main manager of these arable lands (Herlina & Prasetyorini, 2020; Sekaranom et al., 2021).

In the rice production center of Kebumen, Central Java, Sekaranom et al., (2021) reveals that the majority of farmers understand that the changing temperature and precipitation affect their productivity. They have also taken measures such as adjusting the planting calendar (implemented by 94% of farmers), changing rice varieties to climate-tolerant ones (implemented by 88% of farmers), and using agricultural machinery to intensify their farming practices (implemented by 30% of farmers). However, different findings occur in Malang, East Java, which has a high corn yield. The study there shows that farmers do not selectively use corn varieties because they prioritize the harvest yield. The planted corn variety is one that is easily accessible in the area and potentially has high harvest yields (Herlina & Prasetyorini, 2020).

The distribution of seeds through the program has several persistent problems. It is often not on time, not in accordance with the farmers' desired time, and not aided to cover transportation costs for farmer groups in remote areas. The government has made efforts to empower farmers to produce their own seeds through the programs such as Independent Seed Model Area (Model Kawasan Mandiri Benih, MKMB) and the Thousand Independent Seed Village (Seribu Desa Mandiri Benih, SDMB). However, these programs deal with their own challenges such as financial limitation and market uncertainty (Sayaka 2018; Setiyani & Wulanjari 2020).

Similarly, the fertilizer distribution system in Indonesia is often met with concerns. The distribution is coordinated by PT Pupuk Indonesia in a closed pattern, starting from Line I at producer warehouses, Line II at province level warehouses, Line III at district/city warehouses, and Line IV at retailer/kiosk. Even before the pandemic, the scarcity issues persist in several places (Swastika et al. 2020). As for agricultural machinery, this approach is not widely adopted. It is often attributed to the high costs associated with maintenance and the constraints of working with small cultivation areas (Sekaranom et al. 2021).

Lastly, there are gaps in the hundreds of available innovations which offer information to solve production problems faced by farmers. The innovations are claimed to be available and accessible for everyone, including agricultural extensions, farmer groups, and farmers. Yet, the real utilization might be different (Andriaty & Setyorini 2012). Innovations that are community-based are promising, especially those with various forms of institutional and policy support to reduce risks in the adoption.

However, there is still a lack of attempts to mainstream adaptation innovations into local, regional and national government structures, policies and planning processes (Bhatta et al 2017).

Meanwhile, the government, as the coordinator of agricultural affairs, might face similar problems to ensure the longevity and efficacy of their innovations, such as the dependence on resource availability. Political dynamic leads to short-term goals that design innovation to achieve quick wins (Turner et al. 2020). In consequence, the innovation is sometimes not well-dispersed among the targeted audience, or is not validated enough to optimize the performance. At the end, the utilization of existing innovation relies on how the knowledge and practical transfer reaches the farmers and therefore improves their capacity.

A Challenge for Farmers, A Call for Innovation

Despite the governments' multiple effort in tackling the El-Nino impact, the applied actions are still not implemented equally in many regions. Udin is one of the farmers who has not received any assistant related to drought adaptation. A more innovative strategy is needed to attain larger farmers beneficiaries from the government program.

Udin is a seasoned farmer who has been cultivating rice since 1984 in Sirnajati Village, West Java. Today, he faces a severe drought worsened by the prolonged El-Nino phenomenon. His once-fertile fields are now dry, endangering rice production and food security. His farm usually produces 2 tonnes of rice per year from two harvests. However, due to drought conditions and lack of water, he was only able to harvest once in 2023.

His land needs to be more productive as the drought persists. In past dry spells, he could grow other crops, but El-Nino has made that impossible.

Fortunately, with decades of experience in surviving the volatility of agriculture sector, he managed to save money and rice supply when prices were higher. He showed the importance of money management to cope with unpredictable situations.

With the worsening El-Nino phenomenon, Indonesian government should boost farmer support in terms of technical assistance, funding, knowledge in climate adaptation, and financial management. Strong government innovative strategies will help farmers to address El-Nino impact, ensuring food security and well-being.

Udin and his dry farm are affected by El Nino
Image source: TJF Documentation, 2023

Closing the gaps and improving agricultural capacity

At the moment, the government is working to fix the distribution lines for seed, fertilizer, and machinery. Their complex chains of distribution need to be kept maintained to ensure its consistency (Swastika et al. 2020).

Meanwhile, online-based innovation should pay attention to the (un)availability of infrastructures needed to disseminate the information. Printed media such as newspapers, magazines, books, brochures are still in demand by farmers. Although they are considered slow, expensive, and have limited reach in disseminating information on agricultural technology, these documents can be re-read or stored, making it easier for farmers to obtain information (Andriaty & Setyorini 2012).

A more substantial focus to secure agricultural productivity would be of the farmers as the main stakeholders. Farmers are aware of changes to their environment due to climate change and have their own strategies to enhance resilience. Knowledge transfer derived from innovation can improve farmers' anticipation capability in decision making to better cope with climate change impact. However, farmers are sometimes culturally and ecologically marginalized (Sekaranom et al. 2021; Winarto et al. 2017).

Mobilizing resources to improve the farmer capacity often become the objective of the government programs throughout the years. This capacity of the farmers is expected to be developed continuously so they can actively participate in agriculture development. This can be done via institutional development which provides perpetuity of efforts to the surrounding farmer community (Anantayu 2011; Vintarno et al 2019).

The most common way to improve the institutional capacity is using agricultural extension workers. This extension of MoA can use a participatory oriented approach on the needs of farmers in doing counseling activities (Anantayu 2011).

The number of agricultural extensions vary from one location to another. From 72,000 villages with agricultural potential, only 44,000 extension workers are available. The numbers are still far from ideal (Vintarno et al 2019).

In a more principal approach, the efficacy to boost the institutional capacity should look at the social settings of the area, since it urges social-behavioral changes. Indonesia is known for gotong royong (community help culture) that can also materialize in agricultural water management practice. In Central Lombok, the farmers have structures and procedures that strategize water management, including flexible cropping systems, water allocation mechanisms, and traditional water management practices. Klock & Sjah (2011) find a connection between the number of mosques per village and farmers' capacity to manage challenges. It shows a strong moral component in a village authority often involving religious organizations.

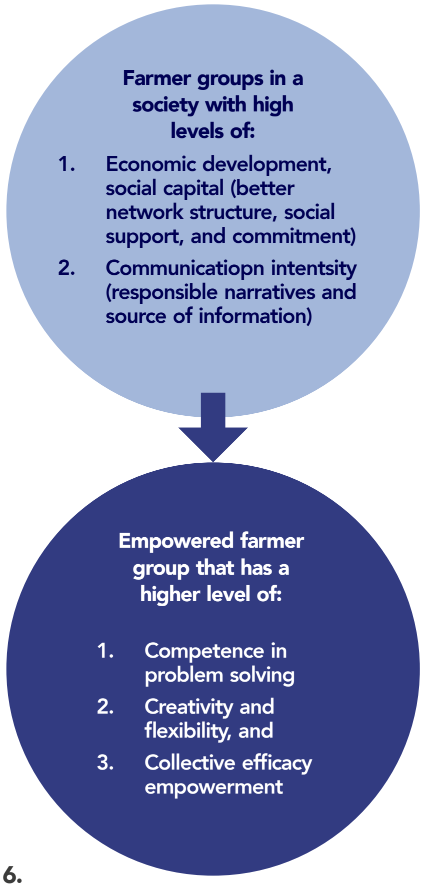

Figure 6.
Building farmer resilience to adapt in the changing climate Mariyani et al. (2019)

Mariyani et al. (2019) use a framework from Norris et al (2008) to comprehend the 'community resilience' from available and observable instruments such as economic development, social capital, information and communication, and community competence. The linkage between these instruments showcases the components of social settings that should be looked after to ensure the outcome of improving a community's capacity.

Apparently, tackling El-Nino in the agriculture sector goes hand in hand with improving the capacity of farmers and agricultural stakeholders to face the changing climate. MoA has unfortunately not yet incorporated El-Nino adaptation measures specifically in their policy and technical documents.

Nevertheless, MoA tasks have defined explicitly on the climate change aspect on each of its subsidiary tasks and functions, as mentioned on the Regulation of the Minister of Agriculture No.40 Year 2020. Moreover, with the transformation of the agricultural research and development agency to standardization agency, the task of testing and standardization efforts to tackle climate change has been made more detailed (Regulation of Minister of Agriculture No. 13 Year 2023).

Using this social knowledge and the agent of change (such as extension workers), farmers and farmer groups can utilize available innovations in improving their capacity. Involving more diverse actors, for example, agrometeorologist and anthropologist in a science field shop, is preferable. With considerable complexity and uncertainty, an essential approach to address the requirements of local farmers would involve a transdisciplinary educational dedication (Winarto et al., 2017). Similar set up can be replicated in more locations using the readily available information and innovation such as planting schedule from ICCIS, climate resilient varieties, and agricultural water infrastructures.

With institutional support, the preparation to face the slow onset nature of El-Nino could be initiated in advance.

As shown by Goddard & Gershunov (2020), model studies find that the opportunity for a better prediction is higher during extremes such as El-Nino. The skillful prediction to anticipate climate anomalies 1-12 months in advance is the first step to disperse the necessary information and support for the farmers. Information systems such as ICCIS, Drought Risk Prediction and Kamajaya need to be well-updated to keep up the accuracy. These measures aim toward the same objective: to improve the farmer's resilience capacity and productivity in the long run.

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ABOUT THE ASSOCIATE AUTHORS

A Noyara Rahmasary
Indonesian Agro-climate and Hydrology Standard Institute, Ministry of Agriculture
contact: annisanoyara@pertanian.go.id

Noya has previously studied water management and worked as researcher in food and agriculture sector. After working in the government institution, she expands her interest to understand the nexus of climate, water, agriculture, and food.

Muh Dimas Arifin
East Kalimantan Agricultural Instruments Standards Application Institute, Ministry of Agriculture
contact: muh.dimas@pertanian.go.id

Dimas was an assistant researcher at the Indonesian Agriculture Research and Development Agency before the agency's dissolution to BRIN. Currently, he is interested in agriculture adaptation and mitigation in facing challenges after climate variabilities and changes through the application of agricultural instruments standards.

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