Save Rice, Save Lives

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Hunger persists in Indonesia as most local farming practices remain stagnant since Indonesia's independence. On the grounds that Indonesia has been controversially admitted as a developed country,[1] national hunger should be resolved immediately. The International Food Policy Research Institute (IFPRI) has provided us with a solid statistic – 22 million Indonesian people are suffering from chronic hunger.[2] The principal cause for hunger is poverty,[3] and in terms of sustenance, it translates to food productivity scarcity. Positioning food productivity as an imperative, we should consider its direct impact on farmers' income and national hunger.

Rice serves as the most consumed staple food in Indonesia, which is the sole reason the exercise from planting to storing them has been given the utmost attention. There are 7 main steps for growing rice: Seed selection, land preparation, crop establishment, water management, nutrient management, crop health, and harvest.[4] In Asia, Indonesia placed 4th for producing 5.13 tons/hectare of rice with a population of 255.1 million. When compared to Vietnam**,** Japan, and China, Indonesia pales in comparison with regard to production to population ratio.[5] A common factor from this comparison is Indonesia's lack of agricultural technology. So far, agricultural technology has been innovated remarkably on all 7 steps but one – crop health – with the goal of increasing crop production, but is this the case for Indonesia?

Quality control on rice plants have relied just on pesticides to keep pests and diseases away. Truth be told, it is actually found out that pests and diseases have a massive contribution on rice crop failures with an astounding level of 25-41% using contemporary management.[6] In Lampung, Indonesia, farmers claimed to have harvested quintals when they are supposed to procure 6 tons of rice.[7] This helicopter view clears up the matter. Instead of increasing crop production, Indonesia's food self-sufficiency programs should focus on increasing crop productivity by reducing crop failures. To counter this, especially on a specific crop, we have to implement Site-Specific Crop Management (SSCM).

SSCM is an agricultural management based on information and technology to identify, analyze, and manage crop fields spatially and temporally for profits and safety.[8] SSCM is equipped with tools that have replaced conventional appliances. The implementation of SSCM on rice health control requires a real-time monitoring system that could cover the vast domain of rice fields. Swarm robotics appear as an ideal solution as numerous automatic units for real-time and repetitive monitoring.

Swarm robotics is a field of robotics where robots in massive amounts are coordinated in decentralized order.[9] Swarm robotics are inspired by social insects, which tackles sophisticated tasks with numbers instead of one complex mechanism. The use of swarm robotics for monitoring comes as an affordable solution. The proposed idea of swarm robotics has a simple construction mechanically and electronically so no particular skills are required for operation, maintenance, and reparation.

The overall concept focuses on automated usages with high frequency and real-time monitoring. The most vital component that distinguishes an infected from a healthy plant is its color, particularly spotted on its branch. Brown planthoppers are widely prominent for these causes up to 60% in figure. This hemipterous insect, with its needle-like mouth, injects two viruses into the plant: Ragged stunt virus and grassy stunt virus. At the same time, they suck essential nutrition from the plant for their well-being. Early symptoms after the planthoppers' infestations are shown by brown spots on the branch, and can spread radially throughout the plant, completely withering it.[10]

These robots will be utilized to detect color alteration of rice plants to prevent further damages. To achieve the former statement, the robot has to be equipped with a color sensor. When color alteration is discerned, it will report the location of the infected rice plant to a server with a built-in GPS via radio frequency. Given the terrain of a rice field, the robot will also be equipped with tracks, as can be found in an excavator to tread on sandy and muddy terrains. Overall, the robot will approximately cost IDR 3 million inclusively with a projected 5-year maintenance schedule.

The production value of rice in Indonesia is approximately IDR 18.5 million/hectare.[11] Taking previous variables into equation, if one swarm robot were to be implemented for one hectare of rice, followed by extra measures, we could save up to IDR 12.8 million/hectare. With reference to crop production, Indonesia could produce 8.70 tons/hectare of rice instead of the 5.13 tons/hectare.

To achieve the implementation of swarm robotics for rice quality control, a close-up and persuasive approach in introducing this idea to local farmers is mandatory. As we know, low-wage workers are liable to job losses in the face of automation and they tend to be narrow-minded. The steps taken should incorporate a brief explanation of its prime benefits and how it could impact the entire agricultural practice. This could be done next mid-year hopefully after the pandemic is over. Iterations on the final design are done based on their feedbacks, whether it could suit them or even if the solution has to be pivoted completely. Once done, a phase for validation by engineers should follow through to ensure the design's and prototype's functionality. This could take weeks to months after the approach, depending on the topography and climate of the rice fields.

To secure funding, the notion should be pitched to potential investors after the prototype works. In this case, an appeal should be made to the Ministry of Agriculture and Ministry of Research and Technology as the use of this idea would benefit the public good. Another alternative is to initiate a funding program on websites and social media. One concrete platform is Kitabisa.com. Social medias or video-sharing platforms such as Instagram and Youtube are also available to promote the widespread of this project for donations.

As soon as funds are acquired, a socialization should be on its way. A lot of volunteers should be included for personal approaches to farmers throughout Indonesia as social medias are not usually within farmers' reach. This can be done by cooperating with non-governmental organizations such as Foodbank of Indonesia or even with university students who are agents of change. The complementing steps will already enclose the scope of implementation: Workshops and trainings. The program could be considered successful if it increases crop production by 10% three years after its initiation with all safety and design factors accounted.

The potential innovation could be highly correlated to the Sustainable Development Goals, which highlights zero hunger, no poverty, and decent work and economic growth. In the face of world crises, the implementation of swarm robotics will help raise social lives of our hard-working and earnest farmers and increase quality of food resources for better healthcare and welfare. Hopefully, after achieving food-sufficiency, we could reduce incoming imports of staple food while elevating our current economy with exports. Our people are within adversity to obtain their daily bread, just to make ends meet. With our current capability, Indonesia is just several steps away from sustainability and hopefully prosperity. Save rice, save lives.

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