SURJAN'S ROLE IN SUPPORTING SUSTAINABLE AGRICULTURE IN DEVELOPING COUNTRIES: MINI REVIEW

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ABSTRACT
Small farmholders face many problems in developing countries, such as variations in cultivation crops, availability of water due to climate change, and less information on cultivation technology. In several Asian countries, crop cultivation in swamp areas faces the problem of water drainage systems that cause plant stress if there is no cultivation technology. One of the technologies farmers can adopt, particularly in swamp areas, is Surjan. This technology was created by building raised beds and sunken beds alternately. Therefore, an intercropping system can be used in Surjan to increase agricultural land productivity by cultivating various plants in one area. Besides, the farmers can meet various nutritional needs from various crops that can enhance biodiversity. Also, the farmers may reduce losses in agricultural yield. Cultivating plants using Surjan is essential to deal with climate change and extreme weather, such as floods and drought.

Keywords: biodiversity; climate change; extreme weather; sustainable agriculture

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INTRODUCTION

In developing countries, agriculture contributes to gross domestic product (Sessu, 2018; Kureski et al., 2015). However, this is separate from facilities for farmers, such as small agricultural land, agricultural land conversion, and low ability to create new agricultural land (Jouzi et al., 2017; Zhang et al., 2023; Lai et al., 2020). This condition requires technology that can increase production and preserve the environment, making agricultural activities sustainable and improving farmers' welfare.

Multiple cropping patterns have been widely and long implemented by developing countries as a strategy to solve this problem (Peng et al., 2022; Lienhard et al., 2020). The system increases land productivity (Xiang et al., 2022; Waha et al., 2020). Furthermore, multiple cropping can break the cycle of pests or diseases, protect the soil, make maximum use of water and nutrients, and provide yield stability that supports sustainable agricultural activities (Li et al., 2019; Kumawat et al., 2022).

A type of multiple cropping pattern that can provide product diversification at one time from one land is intercropping (Alcon et al., 2020). Farmers can benefit from two or more agricultural products from one land. If one crop cannot be harvested due to pests, diseases, or natural disasters, farmers can still harvest other crops (Huss et al., 2022; Burgess et al., 2022). This concept has become more profitable by pairing one plant with another that can fertilize the soil (legumes) or break the wind (Jensen et al., 2020; Chen et al., 2010).

One widely known intercropping type is the alternating bed system (Beets, 1982). This planting pattern is created by building raised beds and sunken beds alternately. This system is created in areas by creating high beds that can be planted with plants that cannot tolerate waterlogging, while between the beds (sunken bed) can be planted rice that is tolerant to flooding (Das et al., 2021).

The alternating bed system has long been known in Indonesia, especially in Central Java and Yogyakarta, under Surjan or Sorjan (Trisnawati et al., 2022; Gabriel et al., 2017). Surjan is taken from the name of traditional clothing from Central Java and Yogyakarta, with a distinctive pattern with striations (Susilawati & Nursyamsi, 2014). This name was then taken to replace the alternating bed system because it has the same pattern when viewed above the land.

SURJAN AS A STRATEGY FOR INCREASING LAND PRODUCTIVITY AND DEVELOPMENT OF MARGINAL LAND

Like multiple cropping in general, Surjan can increase the ability of land to produce per unit area per year (Clough et al., 2001). One of the lands that can be utilized is swamp land. Farmers in developing countries have long known the use of swamps as agricultural land; for example, various rice cultivars can be planted in low and tidal swamps (Al Masud et al., 2020; Lakitan et al., 2019; Maniruzzaman et al., 2023; Rumanti et al., 2018). With minimal technology and without water drainage, farmers plant flood-tolerant rice and various other crops using the Surjan system (Utami et al., 2023). Horticultural crops or other food crops are planted in higher beds, while rice is planted between the beds (Nasrudin et al., 2021). Surjan allows farmers to cultivate crops other than rice in swamp areas.

Lebak swamps contain sulfides and other elements, while tidal swamps contain salt, which is dangerous for plants (Koch & Mendelssohn, 1989; Janousek & Mayo, 2013). Selecting rice cultivars tolerant to salt stress and anaerobic conditions is an option in this swamp (Rumanti et al., 2018; Dar et al., 2014). The content of dangerous ions in raised beds can be washed away by rainwater so that they are no longer harmful to plants (Takeshima et al., 2023).

SURJAN AS AN EFFORT TO INCREASE BIODIVERSITY

The existence of monoculture agricultural businesses can reduce biodiversity, mainly if carried out intensively (Dudley & Alexander, 2017). Agricultural activities using multiple cropping have been known to increase biodiversity, thus making the ecosystem more stable (Brillouin et al., 2021; Gaba et al., 2015). The concept of sustainable agriculture defines a stable ecosystem.

Several studies revealed that Surjan can increase biodiversity, like other types of multiple cropping (Trisnawati et al., 2022; Herdiawan et al., 2021). The presence of two or more types of plants can reduce pests and diseases or bring in predators, thereby providing ecosystem balance on agricultural land. Low levels of pests and diseases, or the presence of predators, will bring two benefits to agricultural activities. First, there is an increase in the yield and quality of agricultural products (Sun et al., 2018; Wan et al., 2022). Second, costs for controlling pests and diseases in agricultural activities will be reduced (Sattler et al., 2021).

SURJAN AS CLIMATE CHANGE MITIGATION

One indicator of climate change is rainfall and rain distribution changes, which can cause droughts or floods (Grusson et al., 2021; Zhang et al., 2015). These changes can also cause plant susceptibility to pests or disease attacks (Jamieson et al., 2012; Milici et al., 2020) that cause a decrease in crop yields and even harvest failure.

The Surjan system can avoid adverse situations due to drought or flood. The area between the raising beds is usually saturated with water, thereby storing water reserves in the event of drought, which plants can use both in the raising beds and in between (Rusmayadi et al., 2022). Raising beds prevent plants from being inundated due to flooding, while the plants in sunken beds are tolerant to submergence (Pujiharti, 2017; Kaur et al., 2020).

IMPROVING NUTRITION AND COMMUNITY WELFARE THROUGH SURJAN

With the limited area of agricultural land owned by farmers in developing countries, farmers become subsistence, where the harvest can only meet the needs of their family members (Wharton, 2017). The existence of two or more different types of plants planted in the Surjan system means that farmers can harvest two or more different products (Sulaiman et al., 2019). The existence of Surjan gives farmers more choices in what types of commodities they should plant.

Commodity diversification can provide farmers with nutritional options for consuming them, not just rice as a source of carbohydrates. Farmers can plant soybeans as a source of protein, peanuts as a source of fat, or vegetables and fruit as a source of vitamins and minerals (Suryaningndari et al., 2018; Hairani & Noor, 2020; Mariyono, 2019). In this way, the nutrition of farming families can be fulfilled. Diversification also allows farmers to sell several products based on their farming yields. Moreover, if a commodity fails to harvest, farmers can still get a harvest from other commodities, so farmers can still live from the remaining commodities.

CONCLUSION

The existence of Surjan is an attractive offer for subsistence farmers in developing countries to meet the nutritional requirements of their families. Surjan also gives hope to these farmers to face climate change and extreme weather, maintain crop yields by increasing the stability of agroecosystems, and expand planting areas on marginal land.

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