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Managing Land Use and Its Constrains in Developing Agriculture: A Policy Brief to Indonesia

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Land is a major factor to fulfill human needs by serving as the backbone of agricultural, industry, mining, public housing, and other human activities. Land use change is necessary and essential for economic development. Degraded land in Indonesia was 24.3 million ha in 2013, caused mainly by inappropriate land use. No soil and water conservation measures were applied in such areas to prevent severe erosion, sedimentation and degradation of water condition (quantity and quality) in the downstream area. Therefore, good land management practices are essential to sustain high agricultural productivity without degrading land and the associated natural resource bases and ecosystem services essential for sustaining land productivity. The aim of this review article is to recommend Indonesian government as a policy brief to address the issue of land use in Indonesia. It is intended also as a reference for researchers and policy makers working on land use issues in Indonesia.

Keywords: Agriculture; productivity; land; farmers.

1. INTRODUCTION

Indonesia is the most significant archipelago in the world with the land area entirely around 190 million hectares, including 55 million hectares of agricultural land, and 129 million hectares of land forest. Of the agricultural land, 24 million hectares consist of arable land, with 20 million

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hectares under permanent crops and 7 million hectares being irrigated. Indonesia is the world's fourth most populous country. The population is estimated to increase from about 245 million in 2013 to 288 million in 2050 [1]. Land-use activities whether converting natural landscapes for human use or changing management practices on human-dominated lands have transformed a large proportion of the planet's land surface. By clearing tropical forests, practicing subsistence agriculture, intensifying farmland production, or expanding urban centers, humans are changing the world's landscapes. Although land-use practices vary significantly across the world, their outcome is the same as in Indonesia: (a) to produce food and fiber and (b) to acquire natural resources for immediate human needs. Moreover, the rapid population growth in Indonesia has resulted in an increasing need for land. The fact that land has to be used by many sectors and that there is the necessity to meet growing food demand in a sustainable way means that land use planning is necessary [2] The core of land use planning is the land suitability for a given utilization; therefore, it is necessary to evaluate land suitability [3]. Land evaluation is the assessment process of land performance for specific purposes [3,4]. Assessment results can then be used to predict the land's potentials for utilization [4]. The selection of land is essential, because using unsuitable land will have implication for low production, which in turn results in the inefficient utilization of resources [5].

In practice, land suitability alone would not be sufficient for planning land utilization. Land which is suitable for a given use may have been used or allocated for another purpose. Therefore, when designing land utilization, it becomes essential to conduct land availability analysis as well. The problem for the agricultural sector is that often the land utilization for agriculture is surpassed by the use for a variety of other sectors because agriculture has a lower land rent, for example, compared with industrial and residential land utilization [6]. Indonesian agriculture has maintained high levels of productivity in the main categories of crops production, i.e. lowland and upland rice, and maize. Rice is grown under intensive cropping with irrigation systems (lowland rice) and rain-fed or upland conditions (upland rice). Under dependable irrigation, two crops per year are commonly grown by farmers, and occasionally up to five crops can be planted in a 2-year period [7]. Human activities now appropriate nearly one-third to one-half of global ecosystem production, and as development and population pressures continue to mount, so could the pressures on the biosphere. As a result, the scientific community is increasingly concerned about the condition of global ecosystems and ecosystem services. Thus, land use presents a dilemma. On the one hand, many land-use practices are essential for humanity because they provide critical natural resources and ecosystem services, such as food, fiber, shelter, and freshwater. On the other hand, some forms of land use are degrading the ecosystems and services on which we depend. A natural question arises: are land-use activities degrading the global environment in ways that may ultimately undermine ecosystem services, human welfare, and long-term sustainability of human societies?

Land-use change has allowed civilizations to grow crops, feed livestock, obtain energy, build cities, and carry out myriad other activities that underlie material advancement of any society and progression through major societal transitions. Land-use change also profoundly alters ecosystems as vegetation is cleared and biomass is diverted for human consumption. Unintended environmental consequences potentially undermine future land-use options. [8] Sub divided the general concept of sustainability into four main pillars: (a) productivity, (b) stability of production, (c) soil and water quality, and (d) socioeconomic feasibility. Current trends in land use allow humans to appropriate an ever-larger fraction of the biosphere's goods and services while simultaneously diminishing the capacity of global ecosystems to sustain food production, maintain freshwater and forest resources, regulate climate and air quality, and mediate infectious diseases. This assertion is supported across a broad range of environmental conditions worldwide. Nevertheless, the conclusion is clear: modern land-use practices, while increasing the short-term supplies of material goods, may undermine many ecosystem services in the long run, on both regional and global scales. Confronting the global environmental challenges of land use requires assessing and managing inherent trade-offs between meeting immediate human needs and maintaining the capacity of ecosystems to provide goods and services in the future. Assessments of trade-offs must recognize that land use provides significant social and economic benefits, even while leading to possible long-term declines in human welfare through altered ecosystem functioning.

Fortunately, in the past four decades, scientific advances and the application of improved knowledge and technologies by land managers and some farmers have resulted in significant total and per capita food increases, reduced food prices and the sparing of new land that otherwise would have been needed to achieve the same level of production [9].

2. SUSTAINABLE LAND MANAGEMENT AND ITS CONSTRAINS ON AGRICULTURE

Sustainable land management (SLM) is a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods. SLM is necessary to meet the requirements of a growing population. Improper land management can lead to land degradation and a significant reduction in the productive and service functions [10]. It is now known that the challenges to sustaining land productivity will need to be resolved in the face of significant but highly unpredictable changes in global climate a key factor in natural and agro-ecosystem productivity. Other major issues that will influence land use evolves to meet the challenge of food security include globalization of markets and trade, increasing market orientation of agriculture, significant technological changes, and increasing public concern about the adverse effects of unsustainable natural resource management. At present, land management faces the new pressures on land resources. The new approaches in land management should focus not only on productivity and profitability, as in the past, but also on evaluating the impacts of human interventions on specific landscapes [11]. The main objective of the sustainable land management is to harmonize the two complementary goals: providing environmental, economic and social benefits both for present and future generations - that is maintaining and enhancing the performance/quality of the land resources (soil, water and air). Sustainable land management determines the land use according to the changing human needs while ensuring the long-term socio-economic and ecological functions of the land. Sustainable land management is a knowledge-based procedure that guides the decisions on land management toward the most feasible and cost-effective options in achieving land use intensification, particularly agricultural production, and improved environmental management [12]. Agricultural intensification is a key and desirable way to increase the productivity of existing land and water resources in the production of food and cash crops, livestock, forestry, and aquaculture. Generally associated with increased use of external inputs, intensification is now defined as the more efficient use of production inputs. Increased productivity comes from the use of improved varieties and breeds, more efficient use of labor, and better farm management [13]. Although intensification of production systems is an important goal, these land management systems need to be sustainable to provide for current needs without compromising the ability of future generations to meet their needs.

The current situation of farming system in the remote area of Indonesia depends on slash-and-burn agriculture, whereby forest is cleared to cultivate root crops, cereals, groundnuts, and other crops. The number of cattle and small ruminants is low. Cash income is based on forest products and wild game rather than on cash crops. Rain-fed farming and land management systems in humid areas are characterized by their physical isolation. A lack of roads and markets also hinders their economic development. Deforestation and consequent loss of biodiversity is a serious issue that affects the local to global levels. Because of locally increasing population pressure, fallow periods are shortened, resulting in soil fertility loss and yield decline, which can drive further deforestation. Cereals, root crops, and tree crops are cultivated for food and cash. They use little irrigation. These systems often have an important livestock component. The mixed-maize system in the remote area also has good potential, but it is currently in crisis because shortages of seed, fertilizer, and agrochemicals and the high prices of fertilizer relative to the maize prices have sharply curtailed agricultural investment. As a result, yields have fallen and soil fertility is declining, while small holder farmers are reverting to extensive production practices. In these systems, the main sources of vulnerability are market volatility, lack of improved and appropriate farming technologies, lack of off-farm opportunities, and drought (in the drier areas). In most cases, the farms utilize diversified mixed crop livestock systems, producing food crops (such as cassava, sweet potatoes, beans, and cereals) and perennial crops (such as bananas, coffee, and fruit trees). Crop productivity is reduced due to high altitudes, lower temperatures, and shorter

cropping seasons compared with the lowlands. Steep slopes and thin soil horizons that are prone to erosion characterize these systems. Livestock can be an important system component that depends on the extensive upland grazing areas. Sales of cattle or small ruminants are often the main source of cash income. Many highland areas are home to the last remaining primary forests. Extensive forested areas are sometimes used for grazing and constitute agricultural land reserves that can be put into production through slash-and-burn techniques.

3. POLICY CONSIDERATION OF LAND USE AND ITS IMPACT TO SOCIETY

Livestock performs many functions in the global economy and at the household level, such as providing food, improving economic security, enhancing crop production, generating cash income, and producing value-added goods that can have multiplier effects and create a need for services [14]. Land management invariably implies nutrient, water, and vegetation management, and sustainable land management demands integrated technological, policy, and institutional interventions. Increases in crop yield or pasture through improved agronomic practices (for example, optimum nutrient inputs) could enhance water-use efficiency while the nutrient outflow through harvested products (for example, livestock feeding on residues) could be high. In general, policy makers have not considered the effect of livestock on land productivity as a policy objective in itself but merely as an input for achieving other policy objectives. Land degradation is not considered as posing a severe policy concern unless it threatens the livelihood and immediate regional and national objectives [15]. Increasing needs of food, feed, and fiber for the ever-increasing population in the semi-arid tropical regions of the developing world are putting pressure on the rain-fed areas to make a greater contribution from the vast area under dry land agriculture. The smallholder farmers rely on dry land subsistence productivity for their livelihood, but the productivity of dry land systems remains low because of low and erratic distribution of rainfall coupled with low to negligible inputs of nutrients. With little investment in the management of soils, large areas under dry land agriculture are in various stages of physical, chemical, and biological degradation [16]. Strategies that can achieve sustainable improvement in dry land productivity by facilitating an integrated land and water management and conservation approach should be highlighted, along with a particular focus on integrated nutrient management of soil [17].

Many of the problems associated with managing land stem from a lack of systematic and operational approaches for assessing and monitoring land degradation at different scales (village to global) [18]. As a result, there is no mechanism for sound interventions and no basis for reliable evidence-based learning from the billions of dollars that have been invested in SLM programs. Recent scientific and technical advances are enabling diagnostic surveillance approaches used in the public health sector to be deployed in SLM. Land degradation surveillance provides a spatial framework for diagnosis of land management problems, systematic targeting and testing of interventions, and assessment of outcomes [19]. The activity provides a scientifically rigorous framework for evidence-based management of land resources, modeled on well-tested scientific approaches used in epidemiology. Widespread application of this approach principally requires investment in capacity building of national teams in the approaches and methods [20]. Operating costs for implementing a national surveillance system in the field are modest, and existing soil or natural resource survey departments could easily take up this role [21]. The advanced data analysis techniques used are the most difficult area for adoption [22,23]. An efficient solution to this barrier could be an establishment of regional analytical centers that would provide sampling schemes (global position system points, standardized forms, and protocols), remote-sensing information, and processing of field data posted by field teams on the Internet [24,25]. The centers would also fulfill a technical and scientific capacity building and support role.

CONCLUSION

This particular study is focused to recommend Indonesian government as a policy brief to address the issue of land use in Indonesia. It also recommends giving some inputs in the screening policies by which the vested land can be profiled whether those are used in proper purposes. Therefore, during designing land utilization, it becomes essential to conduct land availability analysis as well as advance protocol so that miss use of land can be reduced.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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