Developing Sustainable Agricultural Systems : Determinants, Future Approaches, and Role of Different Partners

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Introduction

More attention has been paid to sustainability issues in recent years. It is a major topic and considerable effort has been expended in defining and interpreting the concept of sustainability.

The notion of sustainability, as suggested by the CGIAR, encompasses the successful management and conservation of natural resources for agriculture, fulfillment of changing human needs, maintenance and enhancement of the quality of the environment.

There are a number of well — defined alternatives, including some that rather narrowly emphasize agroecosystem diversity and resilience, and others that stress the ethical duty of mankind to serve as steward of natural resources for the benefit of future generations. Still others emphasize the global nature of food security and resource quality as an opportunity for trade.

All of these definitions, and their corresponding indicators, are inadequate, even when combined. Researchers and policy-makers must take explicit account of possible fallacies of scale, and alternatives levels of analysis, when they deal with the design of diverse and sustainable systems.

Determinants of agricultural sustainability

Land, water and fertilizer

The dramatic slowdown of grain yield increase in Indonesia over the last decades is due largely to the limited availability of new productive cropland and fresh water for irrigation expansion, and to the declining response of crops to additional fertilizer use.

In Java, farmers are already having difficulties producing more food from their fields. But in the future they will have even less land for growing food crops as factories, roads, houses, and parking lots encroach upon fields.

Although the amount of water on Earth does not change, its availability for food crop cultivation will become only a trickle of what is once was. The battle for water is becoming fierce as the population increases and economic development intensifies.

In irrigated and rainfed lowlands, the relatively heavy application of fertilizers for years in addition to the fairly high yields make nutrient imbalance a serious problem. Fertilizer fatigue is an ailment that rice and other food crops increasingly experience — adding the same amount of fertilizer or more does not result in higher yield as it used to for many farmers.

Another major contribution to the success of agricultural development has been the development of effective plant protection products or PPPs. Little attention, however, was given to the possible environmental side-effects of PPPs. Recently, public perception of the benefits of PPPs in the context of food production has completely changed, as new pathotypes of diseases and biotypes of insects have emerged.

[1] Secretary of Agency for Agricultural Research and Development (AARD),Indonesia

Population pressure and economic expansion have led to deforestation and a shifting cultivation intensity above the regeneration capacity of soils, which has resulted in a decline of soil fertility as well as increasing erosion and widespread land degradation.

In the upland ecosystem, where soils are more weathered and leached, acidity, Al toxicity, deficiency of P and other nutrients have all resulted in reduced yield.

Soil acidity is serious in tidal swamps because of the presence of acid sulfate soils, accompanied by Fe toxicity, as well as some deficiencies of P and micronutrients.

Socio-economic conditions

Simple economics dictates that when people see an opportunity to earn more, they move especially from low-paying, back-breaking seasonal agricultural work.

Today, the rural landscape is increasingly populated by old people, children and women.

Farm-to-market roads are generally inadequate in the outer islands. The same holds true for other communication facilities. As a result, marketing of farm products is slow, which requires further processing prior to consumption.

Use of fertilizers began to decline as government withdrew subsidies, because of the budgetary burden and due to the fact that crops stopped responding so well to additional fertilizers.

Future approaches

Strategy of agricultural development

Short-and medium-term agricultural development programs follow the vision of agricultural development — creating a modern, resilient and efficient agriculture directed toward the development of a prosperous community. The action program is designed according to the dynamics of socio-economic conditions. Based on the changes in the strategic environment that occurred during the economic crisis, agricultural development program for 2001 -2004 will focus on:

* Optimal and sustainable utilization of agricultural resources (land, water, genetic resources, capital, manpower and technology),

* Promotion of comprehensive agricultural diversification, with horizontal, vertical and regional dimensions,

* Universal application of the participatory, location-specific technology, refinement and development process, and

* Increase of profits from the agribusiness systems approach, for the production of agricultural commodities with high scientific and technological contents that are competitive and contribute to the relative increase of welfare.

Assuming the return of growth to the business, industrial and service sector, the future of agricultural development must begin to plan to acquire and utilization of high, capital-intensive, and value-added technologies that enable competition in the new strategic environment of trade and investment liberalization. The advanced technology, however, should be technically practical, economically feasible, socio-culturally acceptable and environmentally friendly.

To achieve this objective, the development of specialty agricultural products is anticipated based on regional comparative and competitive advantages. This does not imply that other commodities are eliminated from certain regions. From an agroecological and resource suitability perspective, the priorities for the production of commodities in seven regions of Indonesia are indicated in Table 1.

Table 1 Priorities for the production of agricultural commodities based on agroecological and resources suitability

Region	First priority	Second priority
* Sumatra	Estate crops (increasing productivity of small scale units)	Food crops, horticulture, livestock and fisheries (technologies and farming systems suited to the local agroecosystems)
* Kalimantan	Plantation crops (focus on peoples' plantations)	Food crops (especially rice in tidal swamp areas),cattle (extensive use of savanna, and secondary crop wastes and animal feeds)
* Sulawesi	Food crops (especially rice in tidal swamp areas),cattle (extensive use of savanna, and secondary crop wastes and animal feeds)	Other agricultural commodities
* Nusatenggara	Livestock and multipurpose for land conservation (make use of savanna)	Food crops in hedgerow cropping with leguminous trees
*Maluku	Fisheries and plantation crops (high opportunity for export)	Other agricultural commodities
* Irian Jaya	Food crops and plantation crops (focus in Membramo and Merauke)	Other agricultural commodities

Ecological risk assessment

Agriculture itself has altered, and will continue to alter ecological systems. With modern and efficient crop production, a balance has to be maintained between productivity and the protection of the environment and of the indigenous flora and fauna.

More attention has to be paid to the implementation of more precise measures to control unwanted pests, weeds, diseases, and to improve soil nutrients through the adoption of integrated crop management and integrated pest management.

Population growth

The government has to develop a sense of urgency to warn that unless population growth can be slowed quickly, it will push human demands beyond the carrying capacity of the land, leading to environmental degradation, economic decline and social disintegration.

If the country succeeds in stabilizing the population at 225 million, it will satisfy one of the conditions of an environmentally sustainable society. People should recognize both the country' s natural limits and the need to respect those limits.

Role of different partners

International collaboration

Competition has increased among research institutes in various countries to obtain international collaboration funds through bilateral and multilateral collaboration.

Funds originating from a loan will be directed toward the implementation of strategic and thematic research and toward facilitation of research to improve the capacity of both researchers and research institutes.

The international agricultural research network is required to improve agricultural research collaboration with IARCs under the CGIAR, such as IRRI, ISNAR, IFRI, ILRI, CIP, ICRISAT, etc. A network will also be formed bilaterally with JIRCAS, JICA, ACIAR, CIRAD, ORSTOM, CIIFAD, etc. A model of research networks initiated by IRRI such as irrigated lowland rice research consortium, rainfed lowland rice research consortium, upland rice research consortium may also be developed with other international research institutes.

Technology commercialization

Rapid progress in agricultural research and development, particularly in the case of biotechnology, has stimulated the need for protection through intellectual property rights (IPR).

To anticipate the implementation of the WTO compliance, two important aspects will be evaluated: (1) the Uruguay Round, (2) TRIPPs . A management system relating to IPR (patent, licenses, copyright, trade mark, material transfer agreement) has been established by AARD .

Concluding remarks

The principles of sustainability, are as follows: over the long term, species extinction cannot exceed species evolution; soil erosion can not exceed soil formation; forest destruction cannot exceed forest regeneration; carbon emission cannot exceed carbon fixation, human births cannot exceed human deaths. The consequences of not abiding by these principles are generally self-evident.