

## **Toward Sustainable Agricultural Production System: Major Issues and Needs in Research**

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### **Abstract**

Current agricultural sciences are expected to contribute to find new values and functions of agriculture by taking environmental issues into account in addition to increased productivity. Modern agriculture has started harming environments, which include not only those surrounding the human life but also those that ensure sustainability of agricultural production. Development and progress in one aspect impose load on resources and threaten sustainability. Thus, we need to continue to find ways for sound coexistence between nature, environment and human activities. Long-term research is needed to understand the trade-off relationship between sustainability and productivity, which incorporates not only different disciplines of science but also includes social, cultural and economical components.

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### **1. Agricultural production and environmental issues**

The expectations of society from agricultural sectors and the consequent roles of agricultural sciences have been changing with time. In Japan, agricultural productivity has remarkably increased especially after World War II, in which agricultural activities are supported by the progress of production technology. The target of agricultural sciences then was focused on increased productivity that is quite simple and clear. On the other hand, the current agricultural sciences are expected to contribute to the proposal of new values and functions of agriculture by taking environmental issues into account in addition to increased productivity, which is extremely difficult and challenging. That is the subject that will be examined in this paper.

The trend of the dependency on chemical materials for crop production that often leads to increased productivity had been intensified in the latter half of the 1960's in developed countries and later spread to developing countries. In many of the developing countries, the production of cash crop, especially those intended for export was more encouraged than the production of subsistent crop, which often reflects in statistics as increased agricultural production. On the other hand, the ecological implication of increased export of agricultural products is the removal of resources from the land, which has been causing various environmental degradations. In turn, it causes excess deposition of the resources in importing countries. In Japan, for example, importing large

amount of bioproducts has been causing serious pollution in ground water, river and sea (Kawashima, 2002).

### **2. Establishment of agricultural production based on cycling and coexistence**

Agriculture is, in principle, an industry that makes solar energy available to human utilization in sustainable ways by fully utilizing the cycling function of nature. In such sustainability, one of the most important issues has been the conservation of soil fertility. Such sustainability has been historically proven by examples in shifting cultivation system with a relatively long uncultivated period; farm lands along the Nile, which have been continuously supplied with nutrients; lowland rice fields in Asia, utilizing rotation cropping system with legumes. Prevention from soil erosion is also an important component for the sustainability. Thus various mulching systems and minimum tillage technology have been developed for that purpose (Evans, 1998).

On the other hand, examples of causes for land degradation include overgrazing, deforestation, salination due to inappropriate irrigation and ill drainage. Furthermore, in its long history, 'modern' agriculture has started harming environment rapidly. Such environments include not only those surrounding the human life but also those for agricultural production itself, which means agricultural activities tend to degrade the production environment and threaten sustainability.

Desertification, which is mainly caused by adverse human activities, is the typical example.

It is essential to understand that the issue of sustainability is not for agriculture only but it has now become a biosphere and global issue. The influences of the use of resources and energy by human activities have reached the global level. We have not yet found effective measures to combat poverty that is the major cause of environmental degradation. Development and progress in one aspect impose a load on resources and threaten the sustainability. This is the very reason why we need to continue to find ways for sound coexistence between nature, environment and human activities.

Degradation of global as well as agricultural production environments seriously affects food safety. It is important, however, to take into consideration the food safety not only for consumers but also producers. Especially in Japan that is a huge food import country where the food self-sufficiency rate is now as low as 40 % on calorie base, we are seriously challenged as to how to construct a sound coexistence relationship between producers and consumers beyond border, and between cities and rural areas (agricultural sectors). This issue is directly related to our policy for future agriculture as well as our own daily lives.

It is estimated that a total of approximately 12 million ha of farm land overseas is now being used to produce foods to feed the Japanese people, which is about double that cultivated in Japan (The Japanese Ministry of Agriculture, Forestry and Fisheries, 1996). Including others resources such as woods and fiber that are essential to our daily lives, a huge amount of lands are used for Japanese people. It is, therefore important to understand the fact that our lives in Japan are made possible only in relation with many people who are engaged in the production and processing of those foods. That must be the first step towards the establishment of a real society of coexistence.

### **3. Trade-off relationship between productivity and sustainability**

Intensification of agricultural production that has been supported by the use of chemical materials and mechanization is often counter posed against sustainability. However, as discussed earlier, the increase in food production for the last few decades has been largely dependent on that in crop productivity per unit area. The environmental problems that were discussed above must have aggravated and the sustainability more adversely

affected if the increased population for the period were fed only by the increased food production due to the increase in farm land area. The intensification itself only accelerates the rate of use of resources like nutrients and water but is neither directly related with the sustainability nor the cause of environmental degradation.

### **4. Direction for future research**

The world population exceeded 6 billion in 1999, and is continuing to increase. Because it is not possible anymore to return to sustainable agricultural production with low input, emphases must be placed on long-term research that are intended to establish sustainable crop production technology while maintaining high productivity.

One of the key issues in such research is locality. For example, in the research during the Green Revolution, it was believed that a crop exists that guarantees high productivity in any parts of the world. The research indeed substantially increased crop productivity, while at the same time segmented cycling chains and had weakened the coexistence society. Afterwards, the International Rice Research Institute that was heavily involved in the Green Revolution, had shifted the research. The target region is first ecologically characterized. The rice plants that are grown under different ecological conditions are treated as if they are totally different crops. Then the scientists from various disciplines work together on the identified problems (IRRI, 2004). To further develop and establish the sustainable production technology, further integration of social, cultural and economical factors will be needed in the long-term research project.

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