Chapter 1 Introduction

1-1 Rice cultivation in Africa and Asia

There exist two main rice cultivars in the world: Asian rice (*Oryza sativa*) and African rice (*Oryza glaberrima*). Asian rice is further subdivided into Indica- and Japonica-type rice. Both Asian and African rices have a very long history of cultivation; the domestication of Asian rice is said to have taken place in the midstream area of the Yangzi River, China about 7,000-8,000 years ago and that of African rice, in and around inland deltas on the Niger River several thousand years ago (Sato 1996, Buddenhagen and Persly 1978).

African rice is grown partly by natural flooding and river flooding in African-type lowlands but mostly (over 80%) is planted in uplands or hydromorphic condition, and no sawah* systems have been developed unlike in Asia. Since Westerners introduced higher yielding Asian rice varieties into Africa in the 15th century and after, African rice is now grown in only about less than 5% of land and Asian one is planted in almost all parts of the continent. But because cultivation method is still the traditional system, that is, planting rice in upland farms, the mean yield including irrigated rice has remained about 1.6 t/h in the past 30 years. In Asia, while upland rice is grown by shifting cultivation in some regions, lowland sawah based rice farming is the main system used now in coupling with high yielding varieties and various fertilizations. Therefore, the mean yield of tropical Asia is now more than double of that in West Africa.

Sawah fields are the system adaptable to a lowland ecosystem but require eco-technological skills, including those for minimum changing of topographical and ecological features, such as both land leveling, bunding and irrigation/drainage systems. The eco-technological skills for sustainable water management based on the maintenance, improvement, and proper operation of the systems are also important. But in tropical Africa, this type of farming technology, which is essential to lowland use, has not traditionally developed at all. This is why lowlands in Africa have mostly been left unused. In other words, rice and other crops have been grown at the cost of forests in uplands.

***Sawah:** The term sawah refers to leveled rice field surrounded by bund with inlet and outlet connecting irrigation and drainage (Fig 2-1). The term originates from Malayo-Indonesian. The English term, Paddy or Paddi, also originates from the Malayo-Indonesian term, Padi, which means rice plant. The term, Paddy, refers to rice grain with husk in West Africa. Most of the paddy fields in the Asian countries correspond to the definition of the term sawah. Paddy field is almost equivalent to sawah for Asian scientists. However, the term paddy fields refers to just a rice field including upland rice field in West Africa. Therefore in order to avoid confusion between the terms rice plant, paddy, and the improved man-made rice-growing environment, the authors propose to use the term *sawah*.

West Africa has the most lowlands potentially convertible into sawah fields in the continent: these lowlands make up about 80% of Sub-Saharan Africa. Based on the amount of rainfall, the area of lowland distribution, and the topographical features, it was estimated that West Africa has about 20 million ha of potential for lowlands sawah development, of which about nine million ha are small inland valleys and the rest is floodplains and deltas (Wakatsuki 1995 and 2000, Wakatsuki et al 1998). The West African inland valleys resemble to small lowlands in "satoyama (Tabata 1977)" systems in Japan (sato means home country and yama means small mountains). The slopes of valley bottoms are gentle, 0-3%, water flow is not large, normally 10-1000 litter/sec, and the unit area of lowland is small, normally 1-100 hectares. Because of these, it will be possible to develop small-scale irrigated sawah fields in inland valleys in Africa by people's collaboration of rural community without any need of foreign assisted large engineering works, if we can develop appropriate eco-technology and transfer such eco-technological skills to local farmers through OJT, On-the-Job Training.

Studies on the development of rice cultivation in West Africa have been carried out mainly by the two international research organizations on agriculture: West Africa Rice Development Association (WARDA; headquarters at Bouake, Cote d'Ivoire) and International Institute for Tropical Agriculture (IITA; headquarters at Ibadan, Nigeria). IITA and WARDA were founded at the end of 1960 and early 1970 respectively by the financial aid of CGIAR, Consultative Group of International Agricultural Research, such as the Rockefeller, Ford and other foundations, World Bank, FAO and industrialized countries of OECD, including Japan, so as to realize in Africa, too, a "Green Revolution" successfully achieved by the International Rice Research Institute (IRRI; headquarters in the Philippines) in Asia. Since 1990 WARDA was taken over from IITA and assigned for R & D on rice in West Africa as sole institute of CGIAR. But since the Association laid major emphasis on improvement in the productivity by an IRRI-type breeding strategy, especially on the breeding of upland rice, from the beginning, few examination was made as to the importance of the sawah systems to West African-type rice production.

Apart from the traditional and cultural reason, two reasons have been emphasized for the justification of the past and present upland oriented research and development adopted by WARDA. (1) Major traditional rice cultivation is upland and (2) the development of irrigation systems is very costly compared to the rice price in this region (Ishii 2001). Recent big scientific breakthrough by the efforts of WARDA (1999) on inter-specific hybrid rice, or NERICA, new African rice, between Oyrza Sativa and Oryza Glaberrima, is still targeting the improvement of upland rice (Ishii 2001) at the moment. However, the author's thinks, upland rice system even with NERICA will not sustainable and responsible for the degradation of environment in West Africa. As we described in this report, the first priority should be given to the R&D of lowland sawah based farming systems in West Africa. The NERICA will be the most useful in Sawah based systems. In this sense, although the authors understands the stepwise target of WARDA (1999) for the adoption of NERICA to the stabilization of upland rice at the moment, then rainfed lowland in inland valley bottoms, and finally the irrigated systems, the first step of the stabilization of upland rice is questionable. Therefore, the authors propose the NERICA strategy of WARDA (1999, 2000) should integrate the eco-technology based sawah strategy described in this report as soon as possible.

Although some of Japanese researchers emphasized the strategic importance of lowland sawah system (Tsutsui 1994), but were unable to gain support of Western and African

scholars in the past. In recent years, however, the importance of lowland agriculture in Africa has finally been recognized and the R&D consortium for West African inland valleys (IVC, Inland Valley Consortium) has been active, mainly at WARDA/IITA, by the support of Dutch and French teams. But this consortium's R&D activities, especially phase I, were focused mainly inventory and classification and not targeted sustainable development of inland valleys. The phase II will start 2001 (WARDA 2000) and is targeting the sustainable development. In addition to research oriented activities, past strategy of the IVC had influences of somewhat shortsighted convince that sawah systems are those of the Asian systems and will not suit the African environment (IITA 1992). Despite this, sawah systems are gradually being evaluated more positively as a result of the pioneering activities of the Taiwanese team and other sawah projects using ODA from Japan, South Korea and other Asian nations. African rice researchers who experienced Asian sawah systems are increasing. They support sawah based strategy for the sustainable rice development in West Africa.

In the 1986-1990 period, the author's team investigated lowland soils and the rice farming systems in the entire West Africa with the support of the Japan International Cooperation Agency (JICA). Then in the period from 1992 to 1996, the team conducted on-farm demonstration studies with the participation of local farmers in the benchmark watershed areas established in a Guinea savanna zone in central Nigeria, receiving the research fund for international joint studies from the Japan Society for the Promotion of Science and a Grant-in-Aid for Scientific Research of the Japanese Ministry of Education, Science, Culture and Sport and other financial aid. Finally as we described in this report, the JICA assisted joint study project with Crops Research Institute, Ghana, on "Integrated Watershed Management of Inland Valleys in Ghana and West Africa, August 1997 to March 2001", established a new eco-technology approach for participatory and cost effective ways for sustainable sawah development in the benchmark inland valley watersheds in a Forest transition zone near Kumasi, Ghana. Those results were described in this report. As emphasized in the reports of these projects, people in Africa increasingly understand that while upland cropping, such as upland rice growing, is inevitably accompanied by deforestation, sawah systems development in lowlands will pave the way for restoration of lost forests and will be a sustainable strategy that would realize both of "increased food production and environmental conservation in Africa" in the future.

1-2 Japan and African Development

Sustainable traditional agriculture is established by a continuous contact of the ecological environment with human communities. Farming activities integrate life, the ecological environment and culture. Therefore, if agriculture is devastated, it will cause not only a food crisis as observed in Africa but also result in a crisis of education, culture and mentality owing to the loss of moral and dreams as seen in present Japanese society. The crisis of Japanese agriculture and that of African agriculture have a common element in this respect. The critical situations that now face Japanese agriculture and community are the results of the fact that Japanese people have become blind to the important roles of agriculture and Japanese culture, placing too much emphasis on the logics of economy. On the other hand, in "Africa, the reverse of Western community," the situations are so serious that the functions of agriculture and culture are clearly recognized. Africa will give Japanese community a chance to return to the basics, that is, agriculture. In this sense, Africa might become a savior of Japan.

The present socioeconomic crisis of tropical African countries has agricultural and the environmental crisis behind it. The main reasons that sustainable intensive agriculture and forest management system have not been developed in tropical Africa are (1) the slave trade by Western countries that continued for several hundred years after the time of Christopher Columbus, (2) social destruction as a result of African people becoming victims of the development of the New Continent, and (3) subsequent colonization for over one hundred years until the independence of African countries in 1960 and after. Africa's long-term "contact" with the West caused serious distortions of the ecological environment as well as its community, which include intense ethnic opposition and corruption of leaders. A community that experienced slave trade and colonial rule for more than 500 years had no great possibility of turning out those leaders who would fight for a just cause. The fact that Christian justice accompanied this slave trade and colonization was a tragedy of history.

On the other hand, the 500 years when Africa was victimized allowed the West to globalize itself and accumulate wealth, which then brought the development of Western science and technology and "affluent life." Since the Meiji Restoration in 1868, Japan has received the benefits of these Western science and technology and grew to an economic power. But the 500 years were the age of the globalization of Western values and at the same time that of deterioration of the global environment. While the conquest of the world by Western countries during these years brought a richer and more convenient life to us, it also caused the destruction of African communities and the disruption of the global environment.

If we understand this, we need to consider that Africa, the continent victimized by the West, is the "main battlefield" of global environmental issues. If we are to overcome the negative effects of Western modern civilization and science and build a new global community that could solve environmental and North-South problems, it is considered that Japan should base itself on Asia but should also involve itself positively in Africa rather than concentrating on Asia only. Japanese leadership for TICAD, Tokyo International Conference for African Development, II in 1998 and III in 2003 are the good policy in this history of Globalization.

1-3 JICA/CRI Sawah Project

The tropical monsoon climate is mother ecology of the sawah-based rice farming systems. About 70% of water cycling of the earth mainly due to the monsoon exists in Asia, which is sustaining 100million ha of sawah based rice farming and produces food for 2 billion people (assuming a yield of 4t/ha and annual rice consumption of 200kg per capita). About 15% of the world monsoon also prevails in West and Central Africa (Yasunari 1991), which may be able to sustain about 20 million ha of sawah farming and to support food for an additional 400 million people.

Inland valley bottoms and hydromorphic fringes cover about 50 million hectares in West Africa (Windmeijer and Andriesse 1993), of which about 10 million hectares have potential for small-scale irrigated sawah based rice farming. In Ghana, potential area for small-scale irrigated sawah in Inland Valley Watershed is estimated for 700,000 hectares, 3% of total land area, 1-3% of Guinea Savanna Zone and 3-5% of Forest Zone. If we include flood plain, total potential area for irrigated sawah may reach to one million hectares in Ghana.

In Ghana, rice is cultivated under three systems, namely, rainfed upland conditions, irrigated conditions, and rainfed lowland conditions in inland valleys. Production under rainfed upland conditions has been very risky due to unreliable rainfall, shallow and erodible soils of low fertility. Also, production under the big irrigation scheme has not been very encouraging. The numerous small inland valleys found scattered across the country where the control water is the main problem offer the best rice ecology. The valley bottom rice development project was initiated in 1989 to develop sustainable technologies for integrated soil, land & water, and crop management in the production of rice and other crops in the inland valleys. Although, considerable progress has been made in addressing some of the researchable constraints, there is the need to devise simple and low cost and environmentally friendly system for managing the inland valleys that can be adapted by the resource poor farmers. The Asian experience in Sawah development, which looks at not only the valley bottoms but also total watershed, is worth applying in the inland valleys in Ghana.

The main goal of the project is the development of sustainable production systems at whole watershed, which allows intensification and diversification of the lowland production system and stabilizing improved production systems on the upland. Furthermore, the project will lead to the development of a tool for land use planners and decision maker for integrated watershed development. As shown in Fig. 1, the joint study was able to successfully achieve the examination of various *sawah* systems developed in the inland valley.

1-4. Major Implementation schedule of the project

This project was officially started on August 1997 and terminated March 2001. However there were preliminary activities during 1994 to 1997. Actually the project planning was started on August 1994 at the time the Japanese team leader made the first official meeting and field survey with the Ghanaian team leader by the support of Ministry of Education, Culture, Sports and Science and Technology, Japan. As shown in Table 1-1, although mainly both Japanese JICA experts and Ghanaian counter parts conducted this joint study project, various collaborators were also worked in close linkages of the project members. Such collaborative activities have been continued even after the termination of the project for the follow up activities.

Table 1-2. Major Events during Project Period

No.	Date	Event
1	July-August, 1997	Implementaion survey, R/D
2	November, 1997	Open symposium on the Project at Shimane U., Matsue, Japan
3	January, 1999	Interim evaluation, M/M
4	March, 1999	International Workshop at JICA, Tokyo
5	May, 1999	Interim report
6	November., 1999	Farmers' day
7	December, 1999	Selection of the best farmer's group
8	August, 2000	Ghanaian evaluation
9	September, 2000	Japanese evaluation
10	February, 2001	International Workshop at Accra, Ghana
11	September, 2001	Final report

Apart from the project operation at the project site, the project has special training programs in the close linkage between JICA training program, research institutes and universities in higher degrees such as master and doctor. The project so far trained

Ghanaian counterparts as follows.

Ph D program:

(1) Completion: Mr. K.O.Asubonteng from SRI during 1998-2001

(2) Under doctor course training: Mr. Owusu-Sekyere Ebenezer from FoRIG during 1999-2002, and Mr. Annan-Afful Ebenezer from CRI during 2001-2004

(3) Under the preparation based on the joint study project: Mr. Joseph Ofori from CRI during 2002- 2005(proposed)

Table1-1. Implemented Schedule of Japanese Experts and Ghanaian Counterparts, and various collaborators