Rice Green Revolution and Restoration of Degraded Inland Valley Watersheds in West Africa through Participatory and Self-Support Sawah Development

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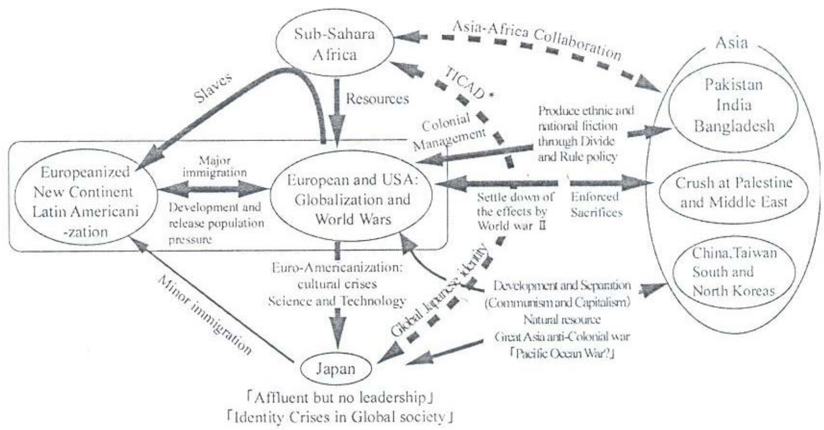
Abstract

Rice production expanded from 2.4 to 7.7 million tons in West Africa (WA) during 1970-2000. Per capita consumption increased from 15 kg to 30 kg, too. Although mean paddy yield was 1.3-1.7 t/ha during the past 30 year, following the pioneering technical cooperation activities of Taiwanese teams regarding to sawah* based rice farming during 1960's and 1970's, the number of rice farmers who are consciously conducting water and soil management has steadily increased in the past 30-40 years. Therefore it seems that within 10-20 years the green revolution will be realized finally in WA. There exist about 10 million ha small inland valley swamps (IVS), which can be developed into sawah* systems by simple and low cost eco-technology with farmer's participation and self-support efforts.

*Sawah System: *The term sawah refers to leveled rice field surrounded by bund with inlet and outlet connection to irrigation and drainage canals. 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 as a whole. Most of the paddy fields in the Asian countries correspond to the definition of the term sawah. 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.*

Introduction : Globalization, Japan, Asia and Africa

The West Africa is a typical region where food and environmental crises are growing increasingly serious and the deteriorating environment is threatening human survival. Apart from natural environmental reasons, the major causes for this can be found in the tragedies many years ago. The slave trade by European countries for as long as 400 years from the 16th to 19th centuries destroyed African communities. Subsequent colonization continued for additional 150 years until 1960. This is probably the main reason for the continuing poverty and crises facing many parts of this continent. Fig. 1 summarizes a historical outlook of the globalization mentioned above. 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 suffered slave trade and colonial rule for more than 500 continuous 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 global history. Japan has been benefited directly from Euro-American science and technology since the Meiji Restoration in 1868. If we understand this, Japan should therefore be more involved in a positive sense in Sub-Sahara Africa.



* TICAD : Tokyo International Conference for African Development

Fig. 1 Regeneration of sub-Sahara Africa destroyed by 500 years of the globalization of Euro-American: possible Japanese contributions to the creation of new world society in 21st century

Sawah hypothesis

Why has the green revolution not yet occurred in West Africa (WA)? The ecological environment of soil and water conditions in this region is very sever. Lowland soil fertility in WA may be the lowest among major tropical areas in the world (Hirose and Wakatsuki, 2002). The main cause of food and environmental crises in WA, however, may be due to the under development of lowland agriculture. Environmentally creative technology, or ecological engineering technology, such as sawah farming is not traditionally practiced in WA. Irrigation and drainage without farmers' sawah farming technologies has proved inefficient or even damaging because of accelerated erosion. Thus, the development of irrigation has been slow. In the absence of water control, fertilizers cannot be used efficiently. Consequently, the high yielding varieties perform poorly and soil fertility cannot be sustained. Hence, the green revolution cannot take place.

Sawah system and integrated watershed approach

The upper part of Fig. 2 shows a concept of macro scale ecological engineering, i.e., watershed ecological engineering. The soils formed in uplands and the nutrients released during rock weathering and soil formation processes in uplands are accumulated in lowlands (geological fertilization). Watershed agroforestry through the integration of upland forestry, upland farming and lowland Sawah systems in a watershed is a typical model of watershed ecological engineering. The optimum land use pattern and landscape management practices optimize the geological fertilization through the control of optimum hydrology. This is an eco-environmental basis for long-term intensive sustainability of Sawah based rice farming in Asia.

Sawah system as multi-functional wetlands

The lower part of the Fig. 2 shows the micro scale mechanisms of intensive sustainability of the sawah system. The sawah systems can be managed as multi-functional constructed wetlands. Submerged water can control weeds. Under submerged condition, because of reduction of ferric iron to ferrous iron, phosphorous availability is increased and acid pH is neutralized, hence micro nutrients availability is also increased (Kyuma, 2003). These eutrophication mechanisms not only encouraged the growth of rice plant but also encourage the growth of various algae and other anaerobic microbes that increase the nitrogen fixation. The quantitative evaluation of

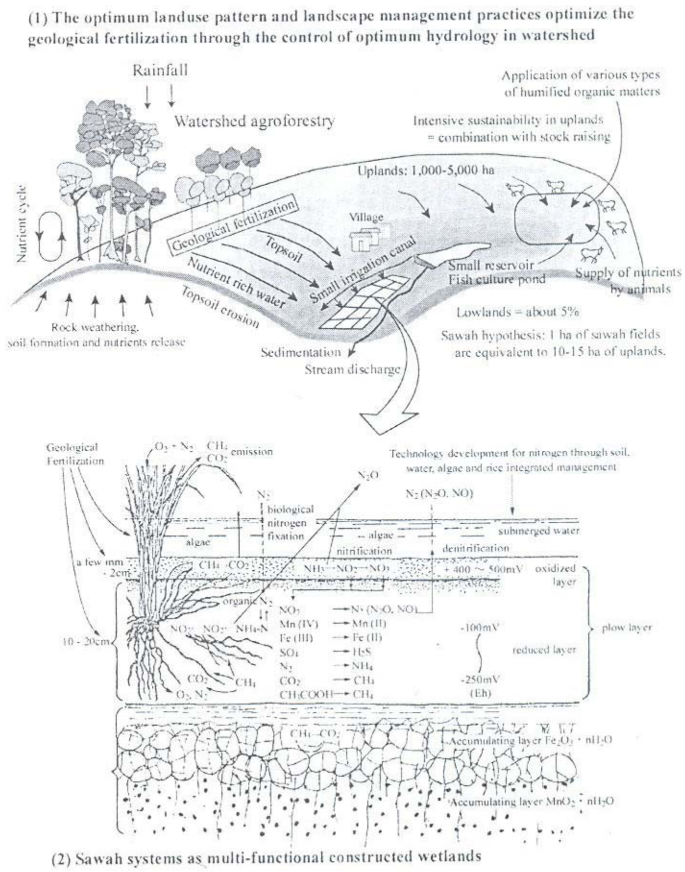


Fig. 2 Macro- and micro-scale ecological mechanisms of intensive sustainability of lowland Sawah systems: (1) Geological fertilization through watershed ecological engineering and (2) Multi-functional constructed wetlands for enhanced supply of N, P, Si, and other nutrients

nitrogen fixation in sawah systems including the role of algae will be important future research topics. It is not yet well evaluated the nitrogen fixation amount of soil microbes under a submerged sawah systems which could reach 20 – 100 kg/ha/year in Japan and 20 – 200 kg/ha/year in the tropics depending on the level of soil fertility and water management (Hirose and Wakatsuki, 2002).

Restoration of degraded inland valley watersheds in west Africa by Sawah type ecological engineering through farmers' participation and self-support efforts

The term, Ecological Engineering Technology, is defined here as an ecology-based sustainable farming technology viable to local socio-cultural systems to increase farming productivity and to improve the environment. The ecotechnologies control water and helps conserve water and soil. Leveling, bunding, and construction of canal and head dyke are the examples of such ecotechnologies, which can be practiced as an extension of agronomic practices using locally available tools and materials. The ecotechnology will be the key technology to attract local farmers' active participation or even self-support efforts for the improvement of basic agricultural infrastructure, such as irrigation and soil conservation measure.

In the past 16 years the authors group had continuously selected various areas of benchmark watersheds, from 100 to 10000 ha for basic agroecological survey and intensive field testing for participatory and self-supports approach for low cost sustainable sawah development under the JSPS and JICA projects with collaboration from Ghanaian and Nigerian counterparts at Guinea Savanna zone of Nigeria and Forest Transitional zone of Ghana (Fig. 3) (Wakatsuki et al., 1998, 2001 and Hirose and Wakatsuki, 2002), which proposed loan based strategy by farmers' self-support efforts on sawah development in est Africa.

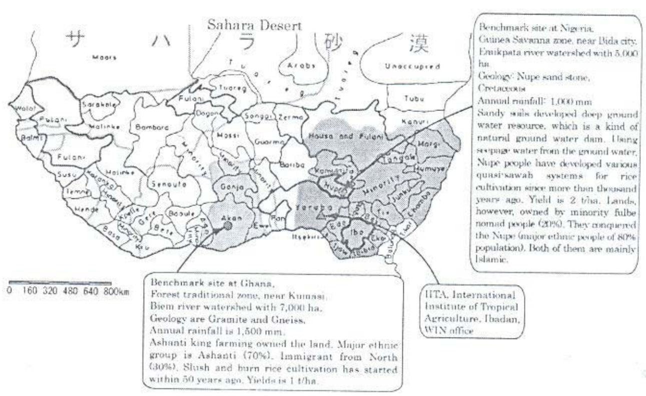


Fig. 3 Two benchmark watersheds in Ghana and Nigeria with major ethnic groups in West African countries

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