ASSESSMENT FOR RICE CROP ADAPTATION IN KENYA USING SATELLITE AND GIS DATA

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ABSTRACT: Rice is third cereal crop after maize and wheat in Kenya. The rate of consumption of rice has been growing rapidly and it is likely to overtake wheat near future. Rice production in Kenya is small, and about 80% of consumption is imported. It is necessary to develop rice production.
First, we indicate rice production system using Satellite and GIS data. In Kenya, paddy development in Mwea started in 1950's and improvement and enlargement are continuing now. Recently, New Rice for Africa (NERICA) is developed, and NERICA is a new group of upland rice varieties that perfectly adapt to the rain fed upland ecology in sub-Saharan Africa.
Next, we developed a land suitability map for rice cultivation using Meteorology, Topography, and Soil data at GIS, and we are checking the real land use at the land suitability map using satellite data. We realized there are some newly planting areas for NERICA, and newly paddy areas are searching now.

1. INTRODUCTION

Rice production is mainly in Asian countries, and a small amount of rice is producing in all over the world such as Europa, North and South America, Australia and Africa. Rice crop has the largest capacity of supporting the population per square km (km^2) agricultural field than other cereal crop such as wheat and maize. For the reason, the developing countries in Africa are enlarging both of the rice consumption and production.
Most important activity of increasing rice production of the area is New Rice for Africa (NERICA) project[1)]. NERICA was the new varieties and it created by crossing African rice and Asian rice.
Key features of the new varieties include:

a. An increase in grain head size from 75-100 grains per head to 400 grains per head.
b. An increase in yield from 1 ton per hectare to 2.5 tons per hectare, yield increases to 5 tons per hectare with fertilizer use.
c. Contains 2% more protein than their African or Asian parents.
d. They are taller than most rices, which makes harvesting easier.
e. They resist pests, and they tolerate drought and infertile soils better than Asian varieties.

Kenya has 38 million people, and rice consumption is 200,000-300,000 tons per year. The production of rice in Kenya is between 35, 000 -50,000 tons per year and the self-sufficiency rate is only 10-25%. It is necessary to enlarge rice production at the country and Asian technology of rice crop cultivation may be useful for this area.
It is important to overview the agriculture in Kenya, and to assess for rice crop especially NERICA adaptation in Kenya using satellite and GIS data. We are studying for three years and same papers already published[2)].

2. CLIMATE AND AGRICLTURE IN KENYA

We gathered meteorological data from Kenya Meteorological Department etc. and made summary counts (Fig 1). The average annual temperature and total rain fall for the coastal town of Mombasa (60 m height) are 26.3 ^oC and 1073 mm, the capital city, Nairobi at Dagoretti Corner (1,798 m height) are 17.8 ^oC and 1,061 mm, Eldoret (2,120 m Height) are 17.2 ^oC and 1,025 mm, and Lodwar (506 m height) 29.7 ^oC and 148 mm,
The long rains occur from April to June and short rains from October to December. The hottest period is from February to March and coldest in July to August. In these rainy seasons, agricultural productions are performed.
In Kenya, Temperature is high at February, March and April, and it is low at July, August and September.
Average temperatures are strong relationship with elevation (Fig. 2). Rainfalls are very small relationship with elevation (Fig. 3)

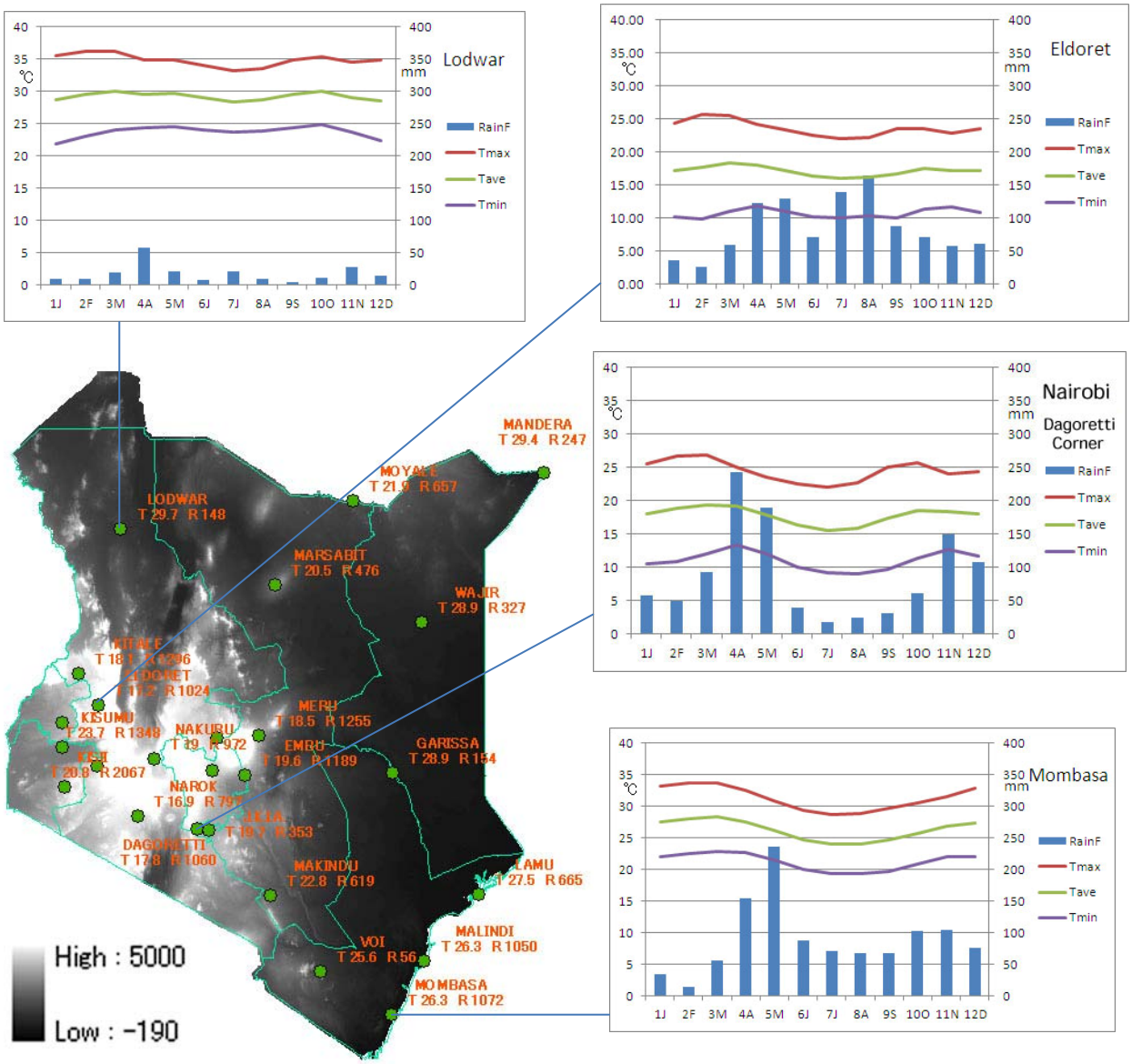

Fig. 1 Elevation Map and Climate Data

3. GROWTH CHARACTERISTICS OF RICE

There two types of rice producing systems. One is paddy rice and the other is upland rice. Paddy rice means that rice is growing almost every year at same paddy. Upland rice means rice is growing at ordinary agricultural field temporally with crop rotation or sifting agriculture. Main target of NERICA is upland rice and we also interesting to upland rice.

3.1 Temperature

Rice has two growth stages. First is vegetable growth stage and second is reproductive stage. At the just starting time of reproductive stage, rice is necessary for above 18 ^{o}C. The accumulated temperature of rice growing period is necessary at least 1800 ^{o}C, and it means 20^{o}C times 90 days.

3.2 Precipitation

Growing rice is necessary precipitation 20 mm within 5 days, and it means 360 mm at three months. At least, it is necessary of 600 mm /year.

4. GIS AND REMOTE SENSING DATA AND MAKING RANKING MAP

GIS and remote sensing data of Kenya were collected form web side. Landsat /TM data were at USGS home page and we downloaded these data and mosaicked to one scene (Fig. 5). Land Use Map (Fig. 6) was in the Global Map Home Page, Soil map (Fig. 7) was in Kenya Soil Survey Home Page, and Soil PH Map (Fig. 8) was in International Soil Reference and Information Centre Home Page.
Agro-Climatic Zone Map (Fig. 9) was made by Kenya Soil Survey, National Agricultural Laboratories. Using the Zone Map we got the information of temperature (Fig. 10) and rainfall (Fig. 11) at Kenya. We overlaid temperature and rainfall information, and Ranking Map for Suitable Rice Planting (Fig.12).

5. DISCUSSIONS

Ranking Map for Suitable Rice Planting is very similar with the Agro-Climate Zone Map, because data source is Agro-Climate Zone Map. Now, we are planning to add the information of other data such as soil type, soil PH and land use.
We compared comparing with Map for Suitable Rice Planting and Present States. Present States are interpretation of Landsat/TM images. Color composite of Landsat/TM images is R: Shortwave Infrared, G: Near Infrared, B: Visible light (Red) and listed Fig.12.
In Mwea area, existing paddy place is scored at bad place of rice planting. The reason of incorrect matter is not include water systems. High elevation area of Mt. Kenya had many rainfalls and using the rainfalls, irrigation systems were developed. At the paddy fields, the information of water systems are important and further studies are necessary.
Some monthly climate data were prepared, and using the data we will study at monthly not the average of year. It must gather more data about climate data using satellite data.

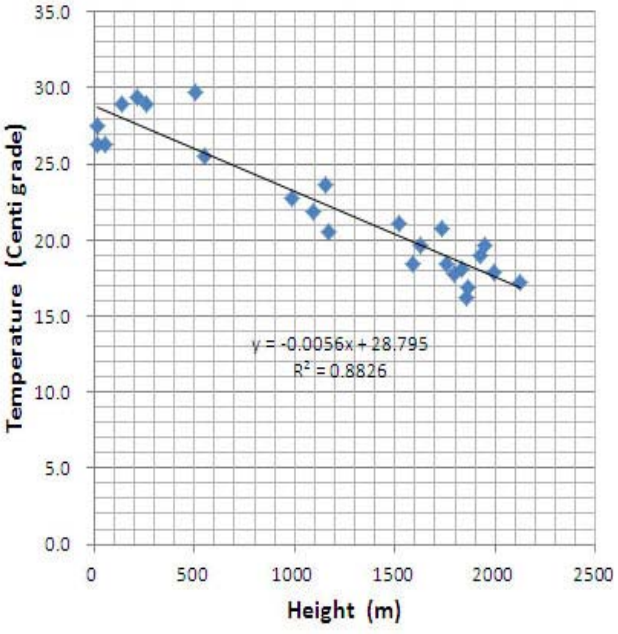

Fig. 2 Elevation and Temperature

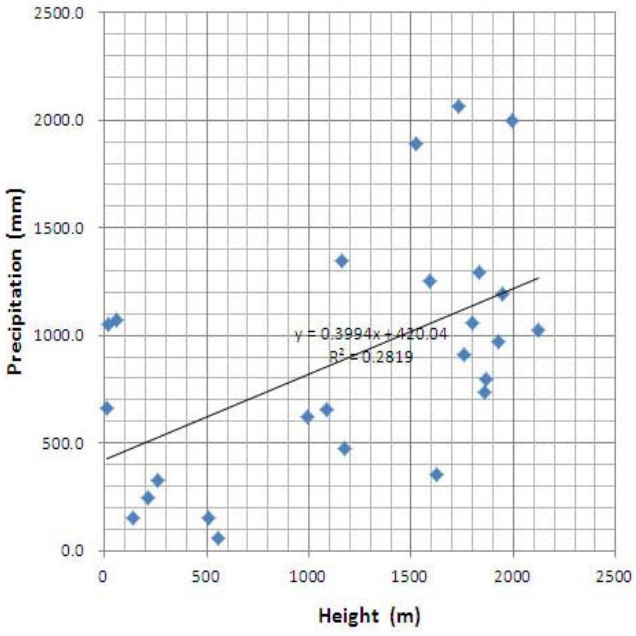

Fig. 3 Elevation and Rainfall

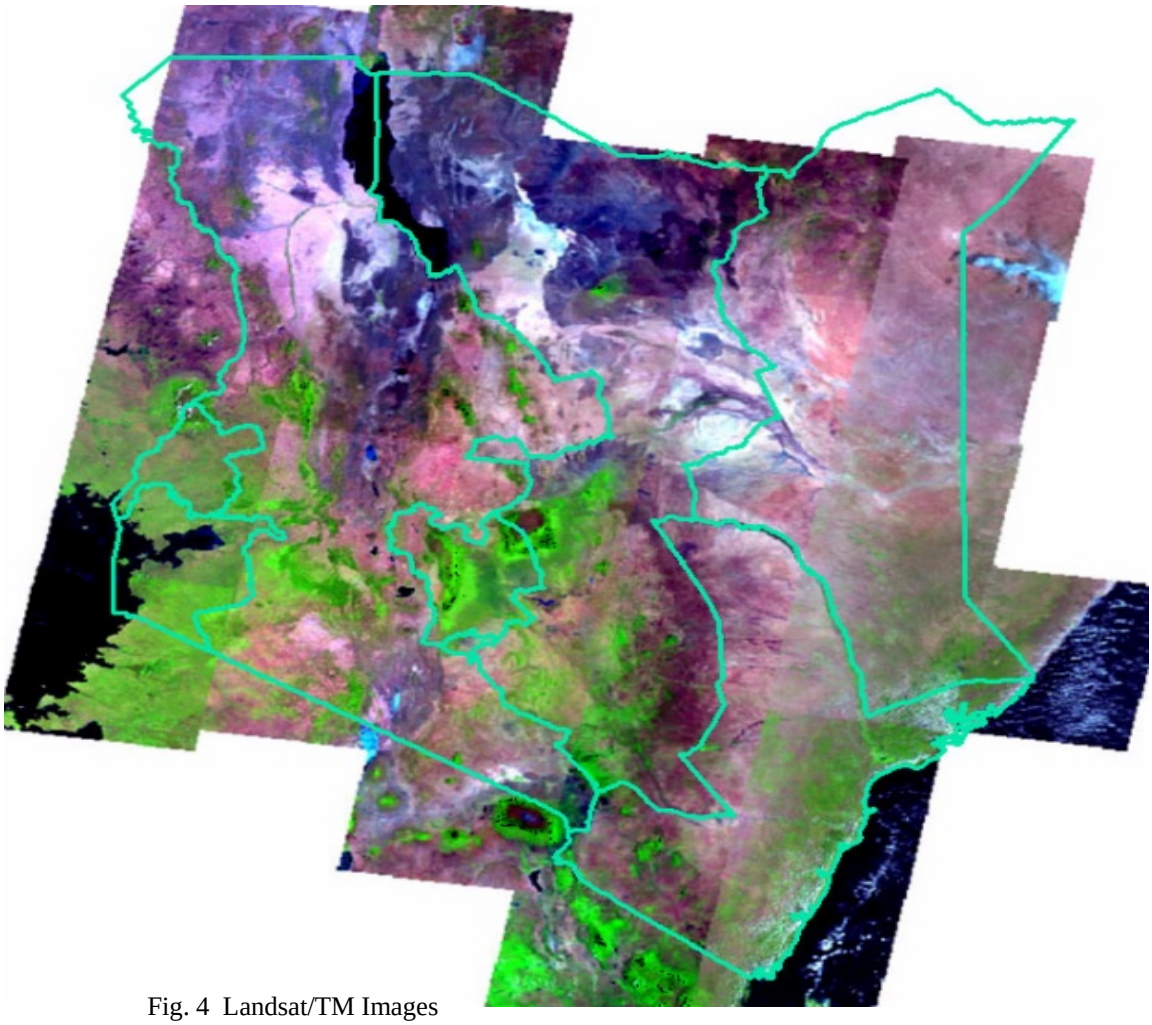

Fig. 4 Landsat/TM Images

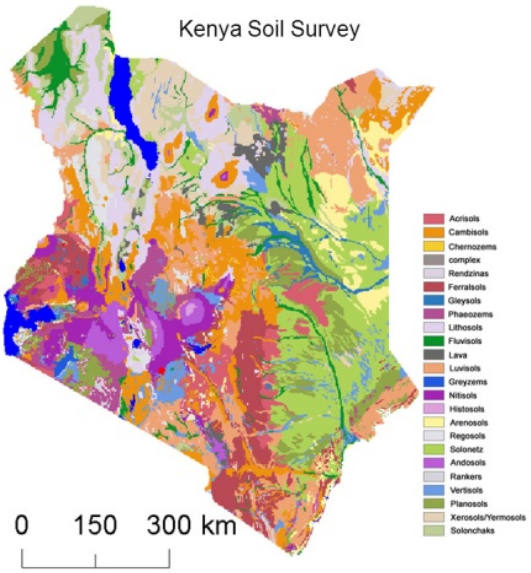

Fig. 6 Soil Map

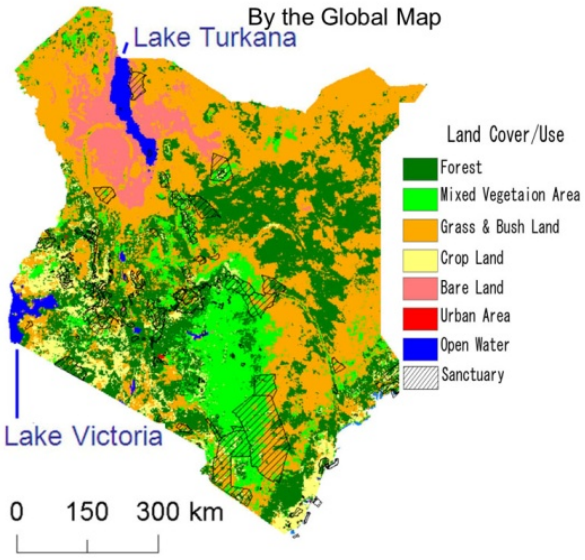

Fig. 5 Land Use Map

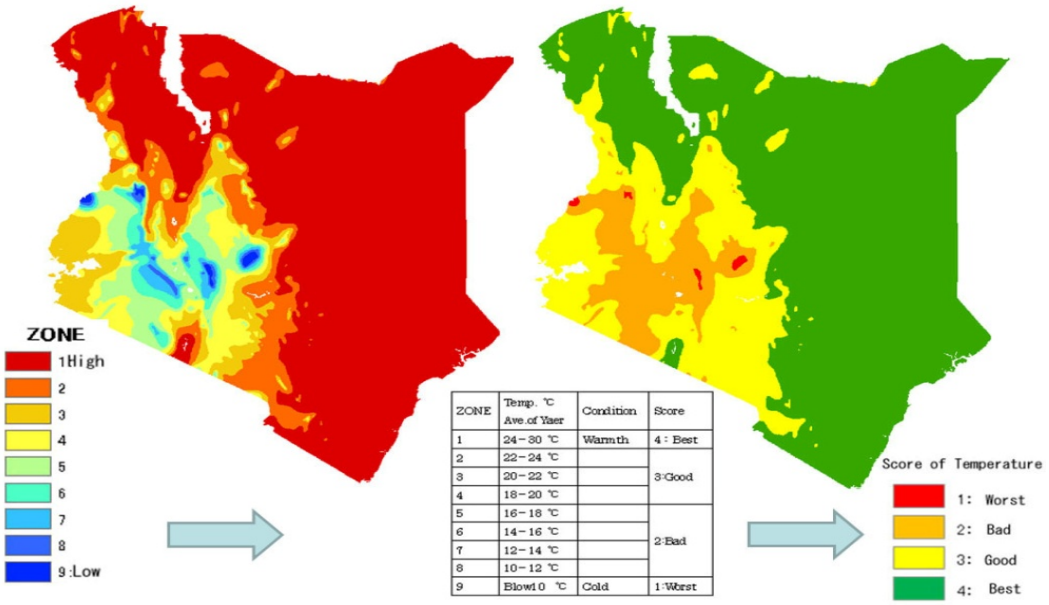

Fig. 9 Scoring for Temperatures

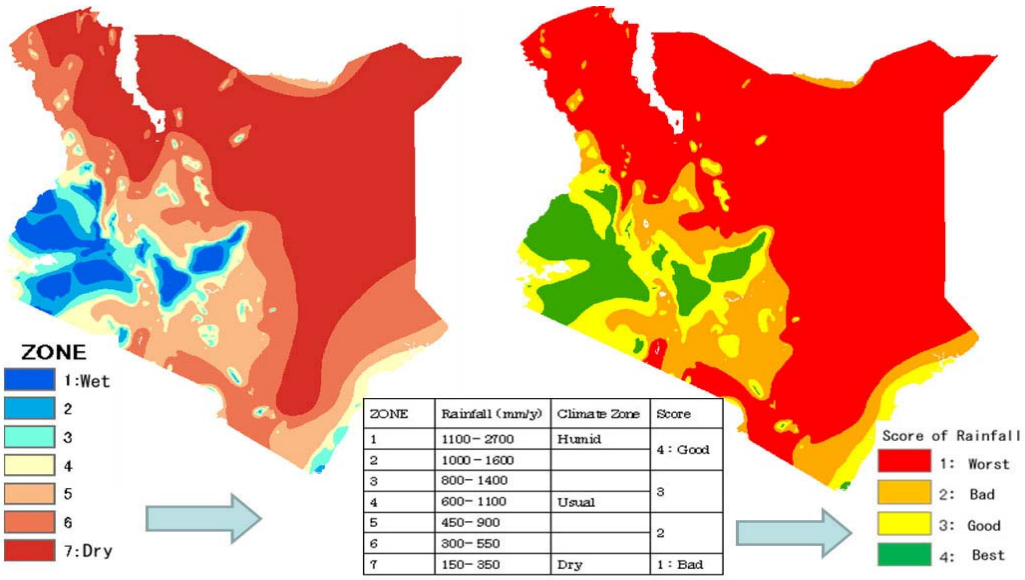

Fig. 10 Scoring for Rainfall

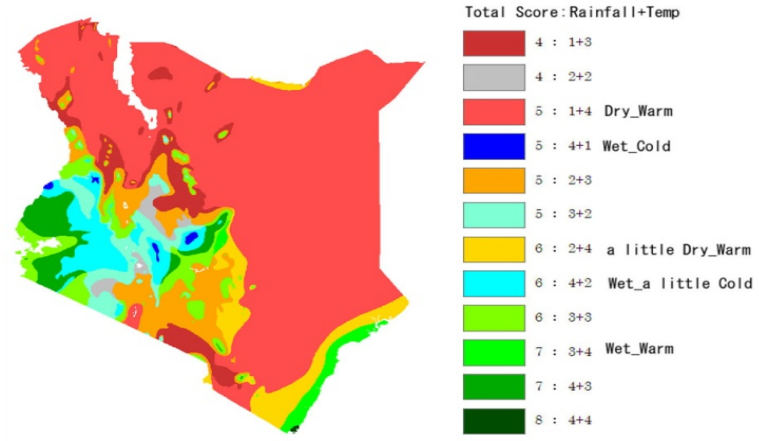

Fig. 11 Ranking Map for Rice Planting

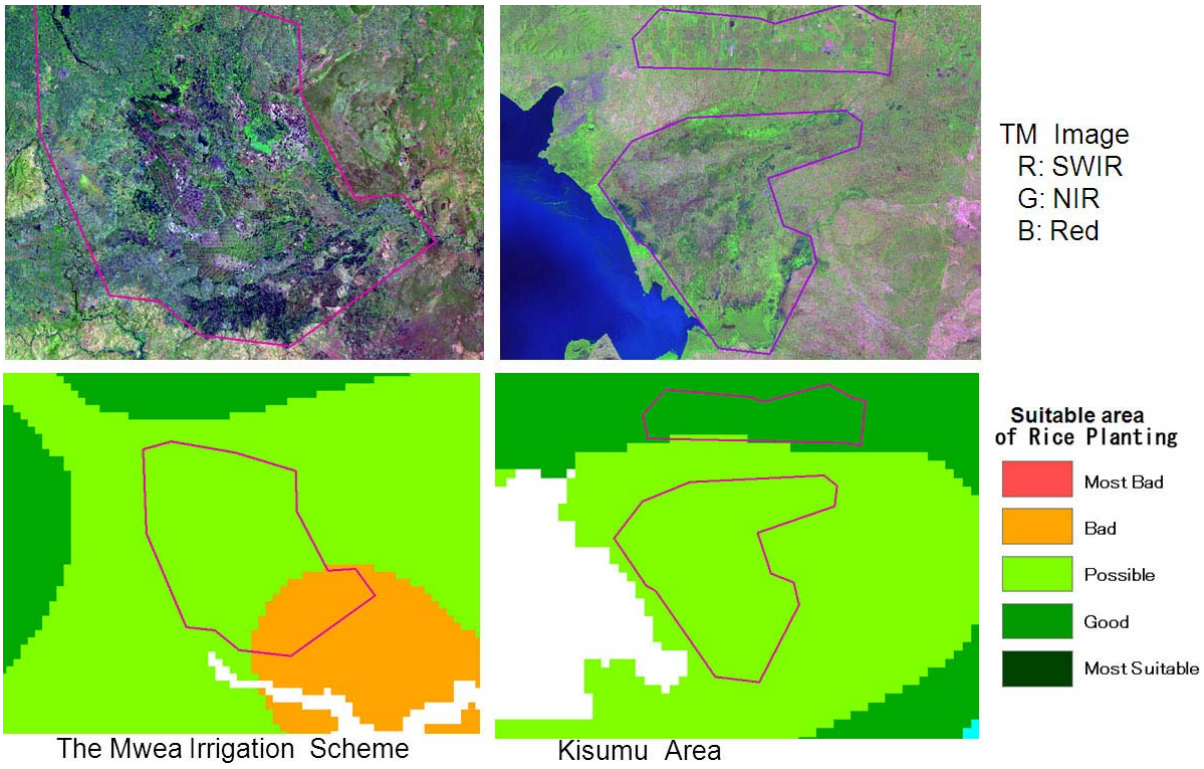

Fig. 12 Comparing with Present State

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1) Africa Rice Center (WARDA). NERICA: Rice for Life, (http://www.warda.cgiar.org/publicationsNERICA8 .pdf. Retrieved 2008-07-07). 2001

2) Ichiro NAKAGAWA, Katsuya YABE, Genya SAITO, Chinatsu YONEZAWA and Sigeo OGAWA, Potential map for rice planting of East Africa, Proceedings of the 30th Asian Conference on Remote Sensing, 2009