

Sawah Technology (5Supplement) Google earth observation on endogenous sawah system development throughout the Kebbi state, during 2010-2017

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1. Panoramic view of Kebbi state

Figure 1 shows the panoramic view of Kebbi state (Google Earth 2018, Times Atlas 2007). The total area of floodplains and inland deltas suitable for sawah system development is estimated to 400 - 500 thousand ha. The Rima river flood plains have the largest potential for irrigated sawah systems in Kebbi. According to the official report, Kebbi state has been cultivated 380,000 ha of wetland rice in 2013, of which the Rima river flood plains occupied 50%, Niger river 35%, Zamfara river 4%, and remaining 11% including Ka river (Dakingari 2013). According to the report by Abdullahi et al (2014) on the "Assesment of water availability in the Sokoto Rima River Basin", which comprises of four states, Sokoto, Kebbi, Katsina and Zamfara, two large scale irrigation schemes are operating in the basin, i.e., Goronyo in Sokoto and Bakalori in Zamfara. Both schemes are irrigating about 20,000 ha agricultural lands, mainly for rice cultivation. However, Kebbi state has no such large scale irrigation schems.

As desribed in the Sawah Technology (5) Kebbi Rice Revolution, Nigerian NCAM team performed sawah technology training and demonstration in cooperation with the World Bank assisted Fadama III at the six locations in Kebbi state duing 2011-2014. The six locations are core rice centers in Kebbi state, i.e., Arugungu, Birinin Kebbi, Jega, Sangulu, Suru, and Bagudo. These are shown in Fig. 1. In addition to thoses sites, this report will evaluate the expansion and improvement of small pump irrigated sawah system platform by farmers' self-help efforts. The state of the development of new sawah systems by farmer's own power that started from 2011 can be clearly observed by comparing Google Erath's 2009 or before and 2016-2018 pictures taken by chance before and after our sawah technology training and demonstration. Figure 2-95 below show how much power and speed of myriad power of Kebbi farmers' self-help development.

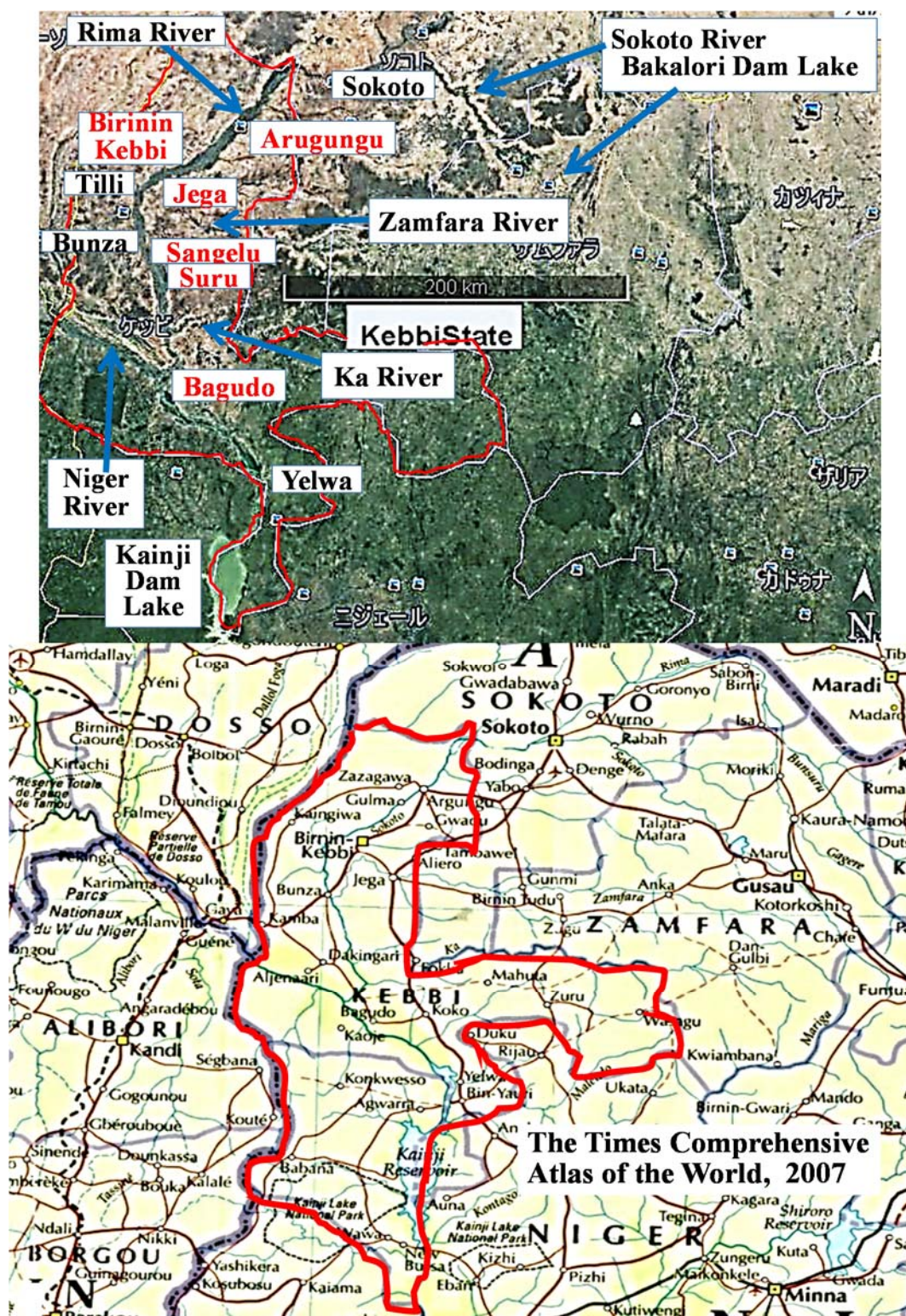


Figure 1. Panoramic view of Kebbi State, The above is Google 2018 and the below is Times Atlas 2007

2. The Rima River floodplains from the Sokoto state border to Arugungu city area: 40,000 ha

Figure 2. Flood plains in the F, G, H, I, J region near the surrounding flood plains A, B, C, D, E and Sokoto state boundary in addition to Arugungu (AR), the center of rice cultivation in Kebbi province Progress of paddy rice cultivation between 2009/2010 and 2016/2017 It is shown in Figure 3-21 by Google Earth below. The area of the flood plain in Kebbi Province in the picture is about 40,000 ha.

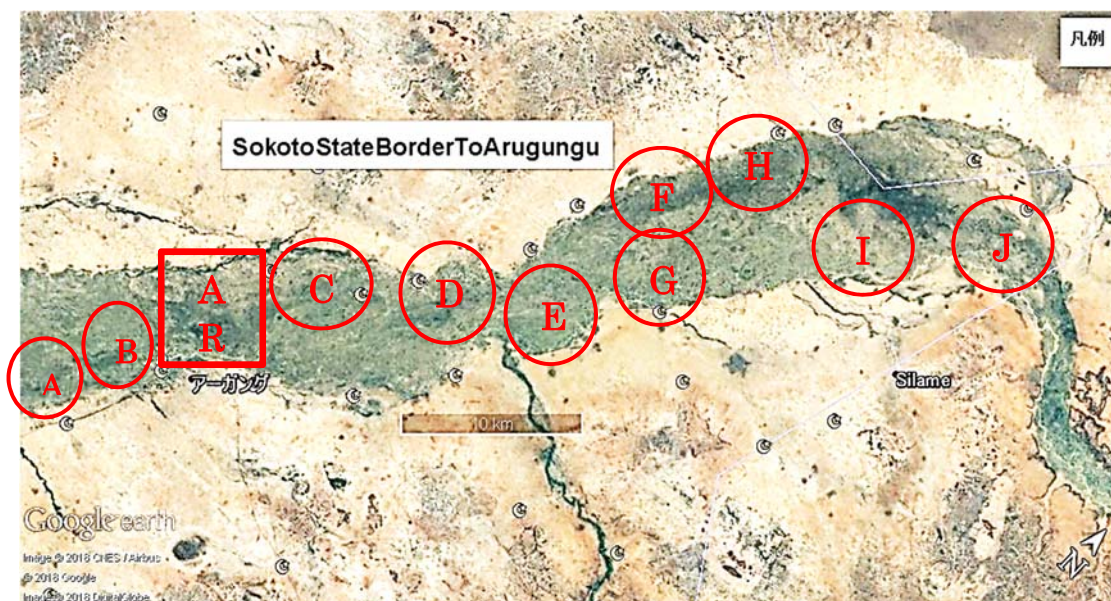


Figure 2. and the rice cultivated rice plant. The upper portion near I and the boundary of Sokoto state in Fig. 2 appear to be black, which means that the forests remain with high specific height.



Figure 3. Google earth images in 2010 (above) and 2016 (below) near the J area of flood plain of the Fig.2, near the Sokoto state border. Total area shown in the photograph is about 10 ha. Length of the scale marker is 100 m.

In 2010 image, micro rudimentary sawah plots and ridge rice plantings can be identified in the swamp area.

In 2016 image, the rice cultivation area expanded but mostly rice fields are micro rudimentary sawah plots and ridge cultivation, which are similar to the Sokoto state majority.

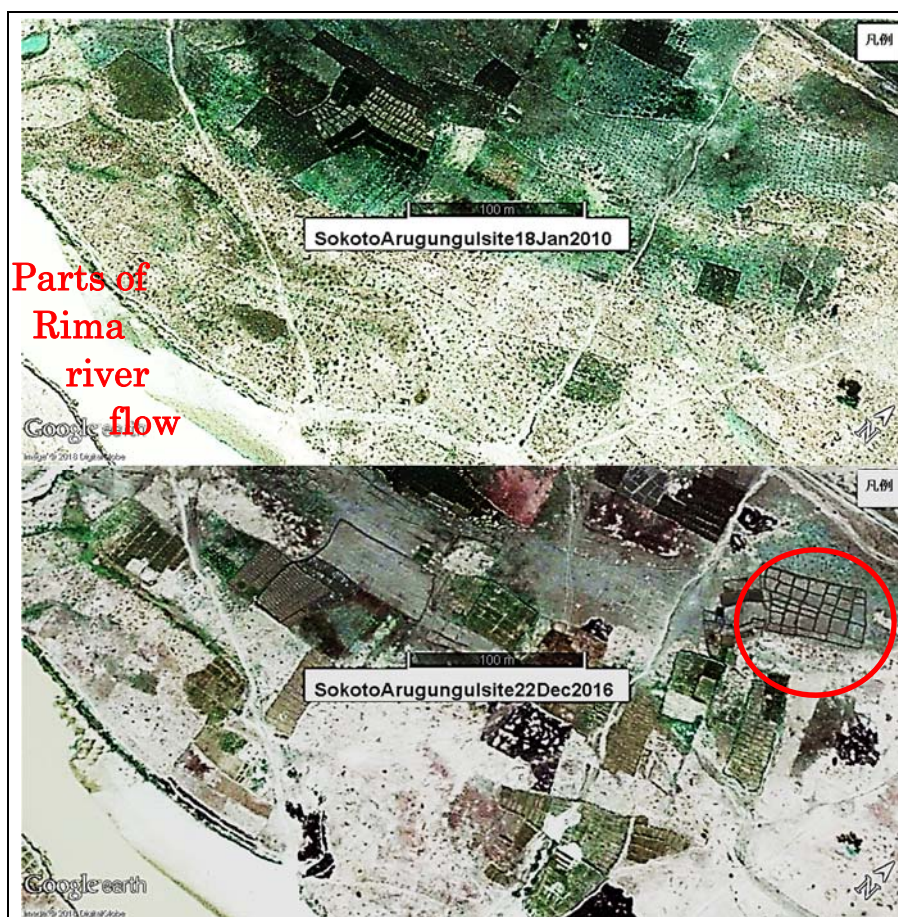


Figure 4. Evaluation of the progress of sawah platform improvement in 2010 (above) and 2016 (below) by Google images near the flood plain I near the Sokoto state boundary of I area of Fig. 2. The total area shown in the photograph is about 10 ha. The length of the scale marker is 100 m. In 2010, micro rudimentary sawah plost and ridge rice cultivation are common in the depressional part of the floodplain. In 2016, the rice cultivation area expanded, but mostly micro rudimentary sawah and ridge rice planting except for red cicled area, which seems a new sawah plots?



Figure 5. Evaluation of the progress of sawah platform improvement in 2010 (above) and 2017 (below) by Google earth images at the floodplain H (Fig.2) near the Sokoto state boundary. The total area shown in the photograph is about 10 ha. The length of the scale marker is 100 m. In 2010, almost no sawah plots are recognized. In 2017 about 80% of this flood plain are occupied by sawah plots, mean size about 100 m². These were developed by farmers' self-help efforts, which is clear all sawah plots are developed based on the land use demarcation of 1 acre to 1ha size. It is impressive that almost all seasonal river bottoms are occupied by sawah plots.



Figure 6. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain G (Fig.2). This location is the area approaching to the rice center of Kebbi, i.e., Arugungu. The total area shown in the photograph is about 10 ha. The length of the scale marker is 100 m. Almost 100% of the flood plains were occupied by ridge rice cultivation in 2009. In 2016, however, sawah plots based rice farming became major although still micro sawah plots and less than 50 m² size and ridge rice cultivation. The sawah bunds are strengthened and clearly identified.



Figure 7. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain F (Fig.2). The location is just middle between Arugungu and Sokoto state border. The total area shown in the photograph is about 10 ha. The length of the scale marker is 100 m. In 2009, non sawah rice fields, micro sawah plots and ridge rice cultivation were common. In 2017 60% area are covered with the standard sawah plots of 100 m² size, the rest are non-sawah, micro sawah and ridge rice cultivated cultivation.

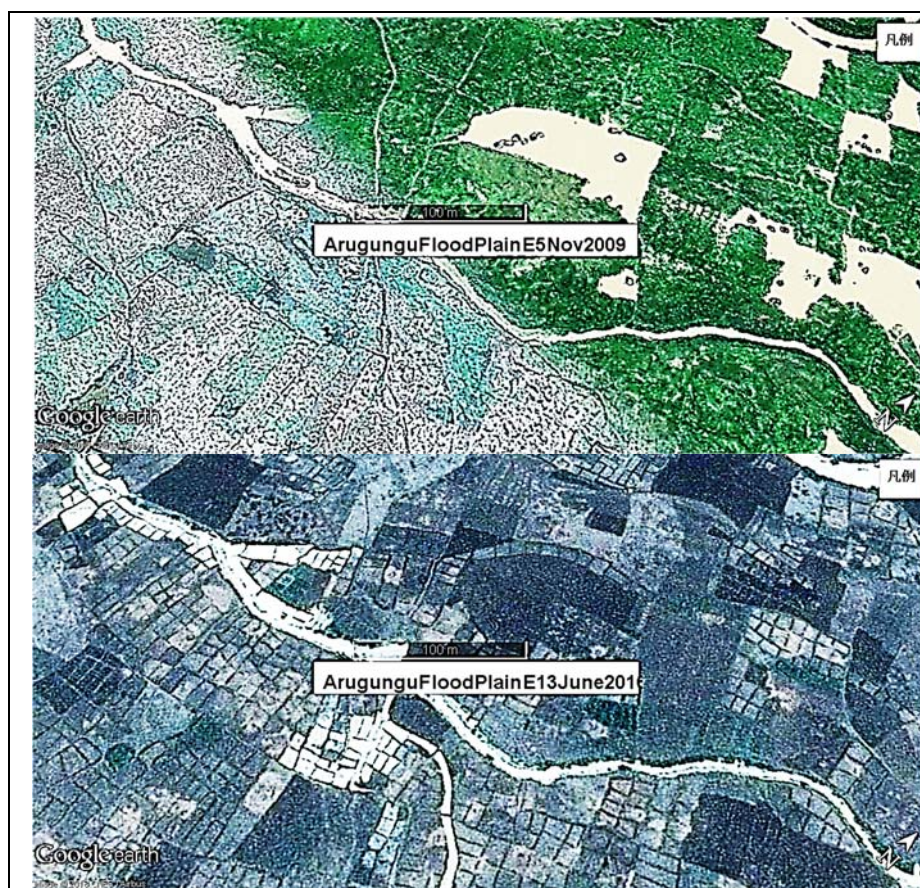


Figure 8. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain F (Fig.2) near Arugungu floodplain E. The total area shown in the photograph is about 10 ha. The length of the scale marker is 100 m. In 2009, non-sawah rice fields and ridge rice cultivation were all over the flood plain. In 2016, 70% area are covered with standard sawah plots of 100 m² mean size. The rest areas are non-sawah and micro rudimentary sawah.



Figure 9. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain F (Fig.2) near Arugungu floodplain D. The total area shown is about 10 ha. The length of the scale marker is 100 m. In 2009, although more than 80% are non sawah, it can be seen that the development of micro rudimentary sawah system started with 5 places of floodplain, each 0.5-1 ha. In 2016, more than 80% area are covered with sawah plots, mean size is about 70 m², with clear bunding systems. But still some minor areas have ridge rice planting.

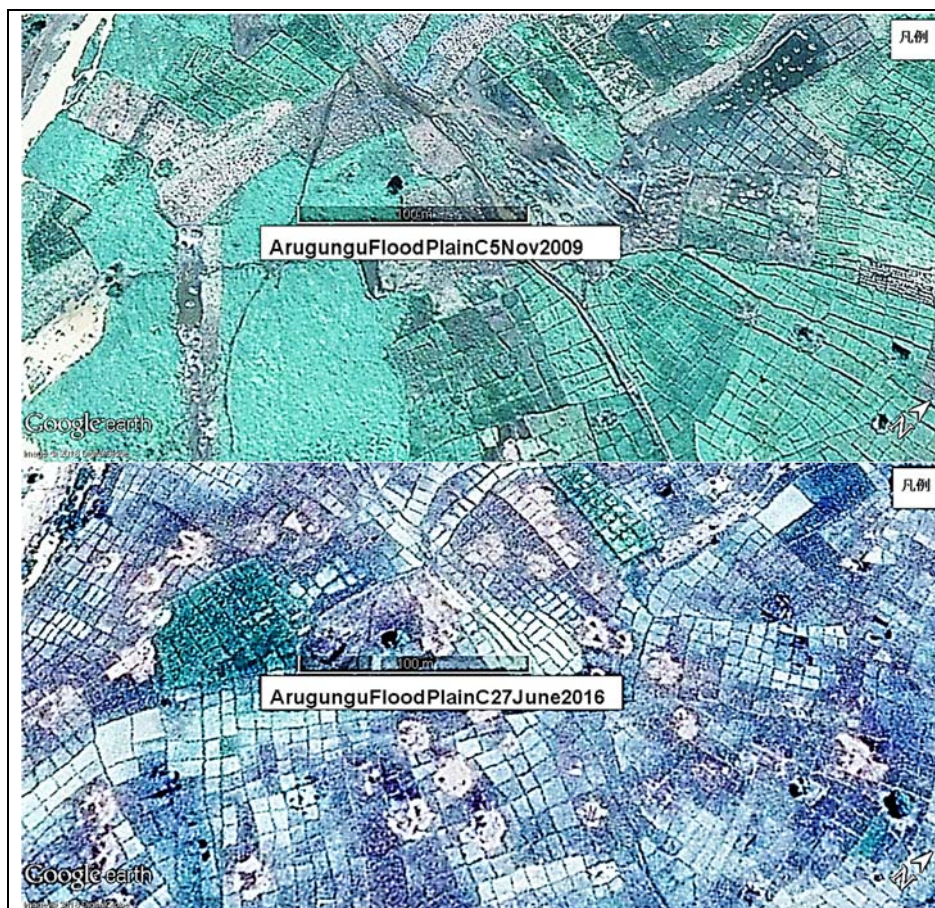


Figure 10. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain C (Fig.2) near Arugungu floodplain. The total area shown is about 10 ha. The length of the scale marker is 100 m. In 2009, about 40 % of the area is occupied by sawah plots. In 2016 almost 100% land are covered with standard sawah plots. Mean size of the sawah plots is about 80 m².

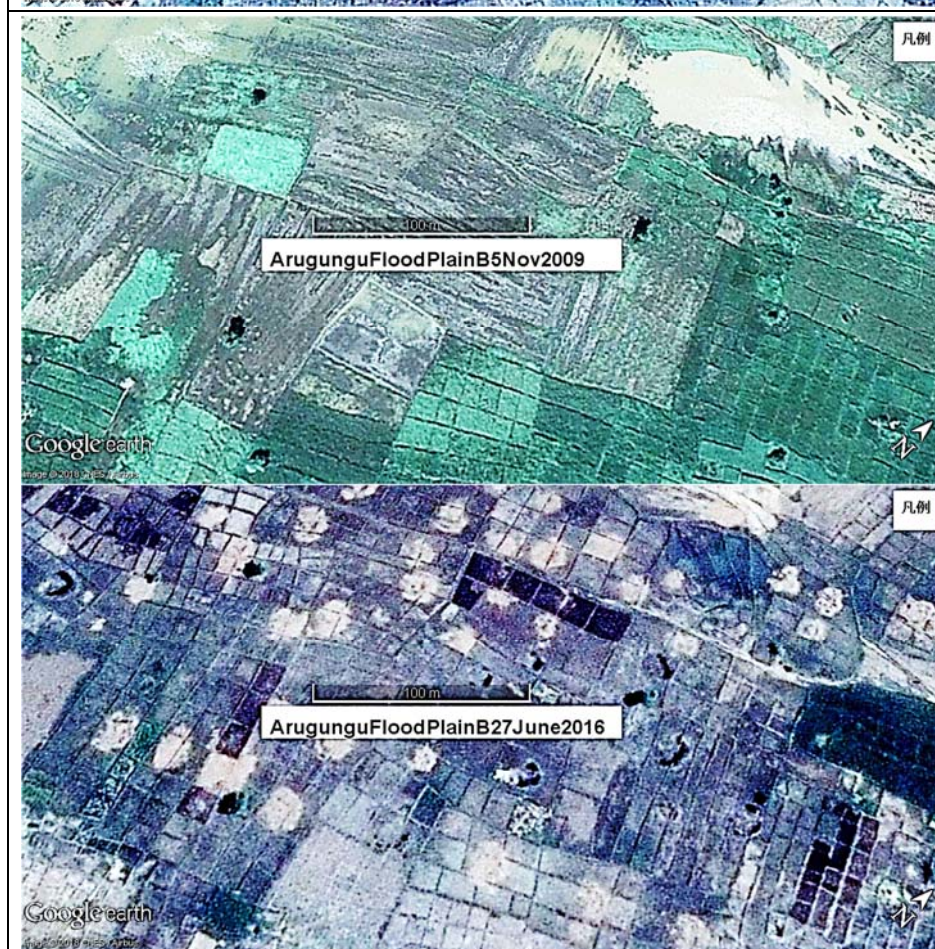
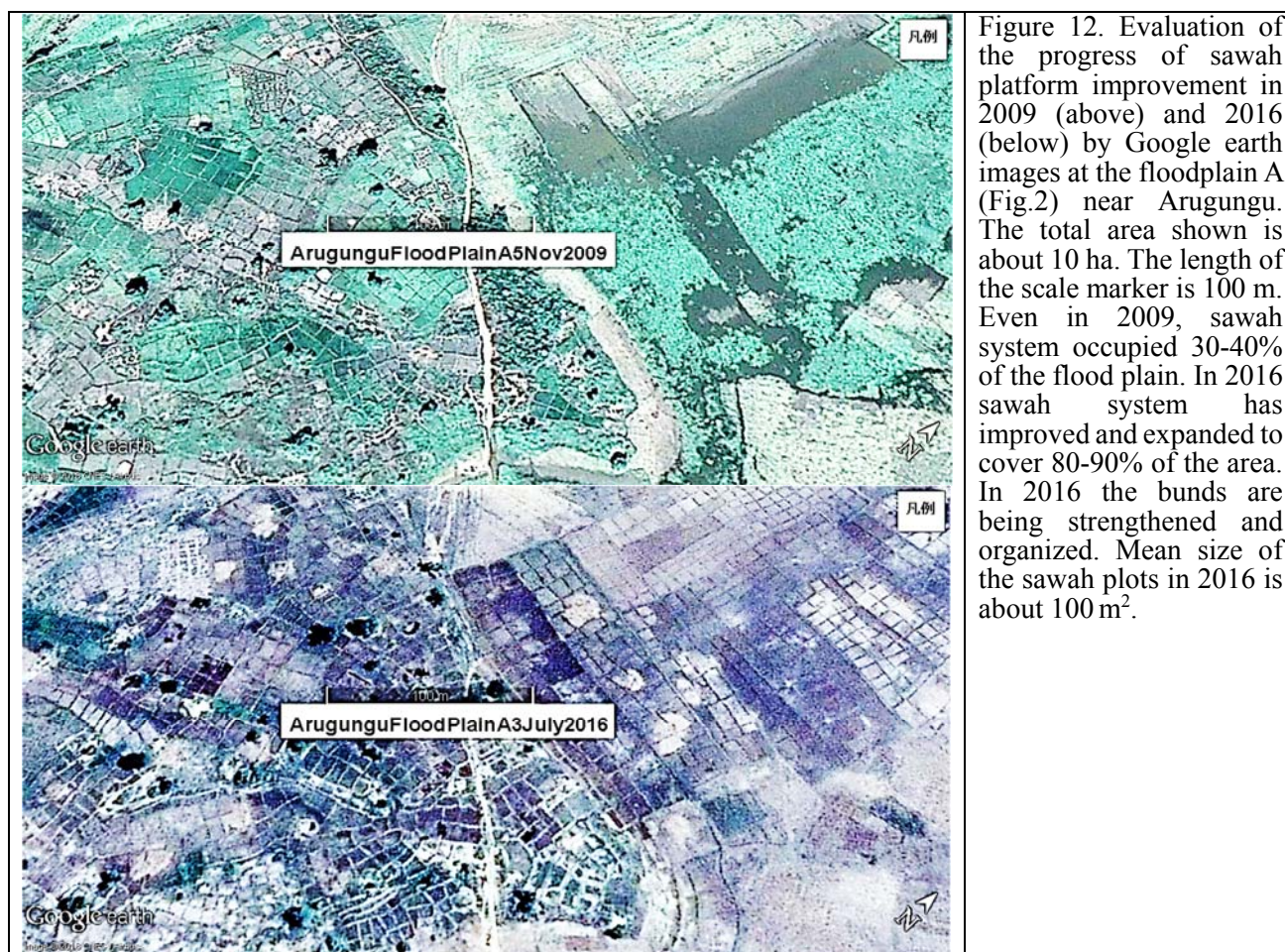
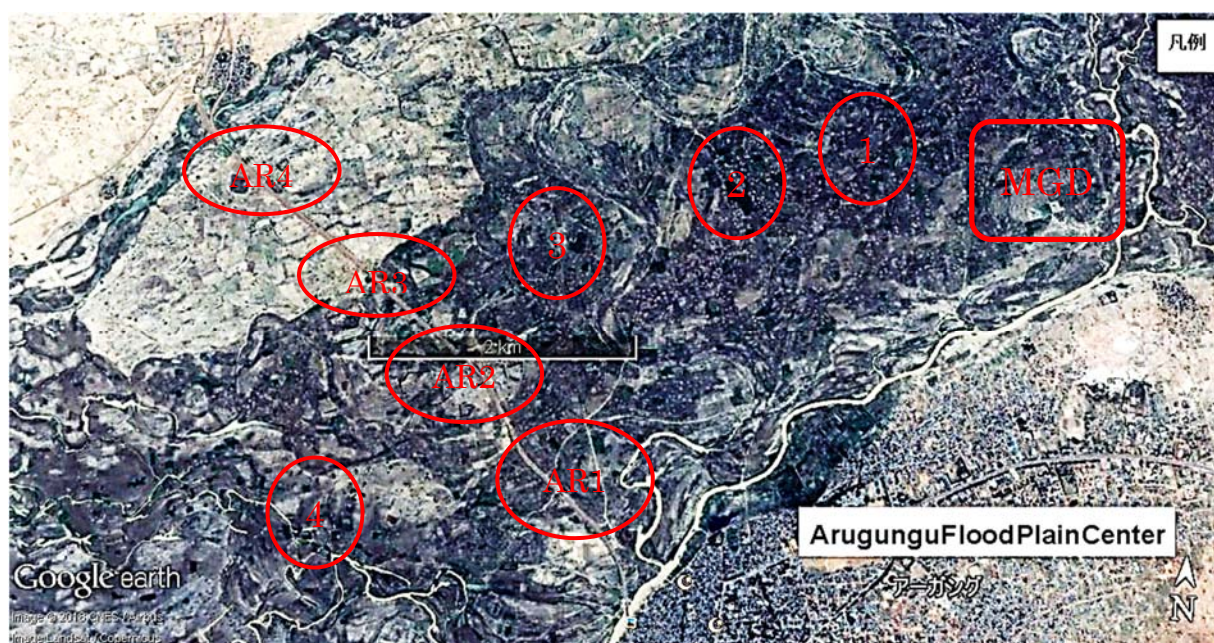


Figure 11. Evaluation of the progress of sawah platform improvement in 2009 (above) and 2016 (below) by Google earth images at the floodplain B (Fig.2) near Arugungu. The total area shown is about 10 ha. The length of the scale marker is 100 m. In 2009, about 30 % of the area is occupied by sawah plots. In 2016 almost 100% land are covered with standard sawah plots. Mean size of the sawah plots in 2016 is about 150 m².



3. An expanded observation of the Rima river flood plains near Arugungu City: 5,200 ha



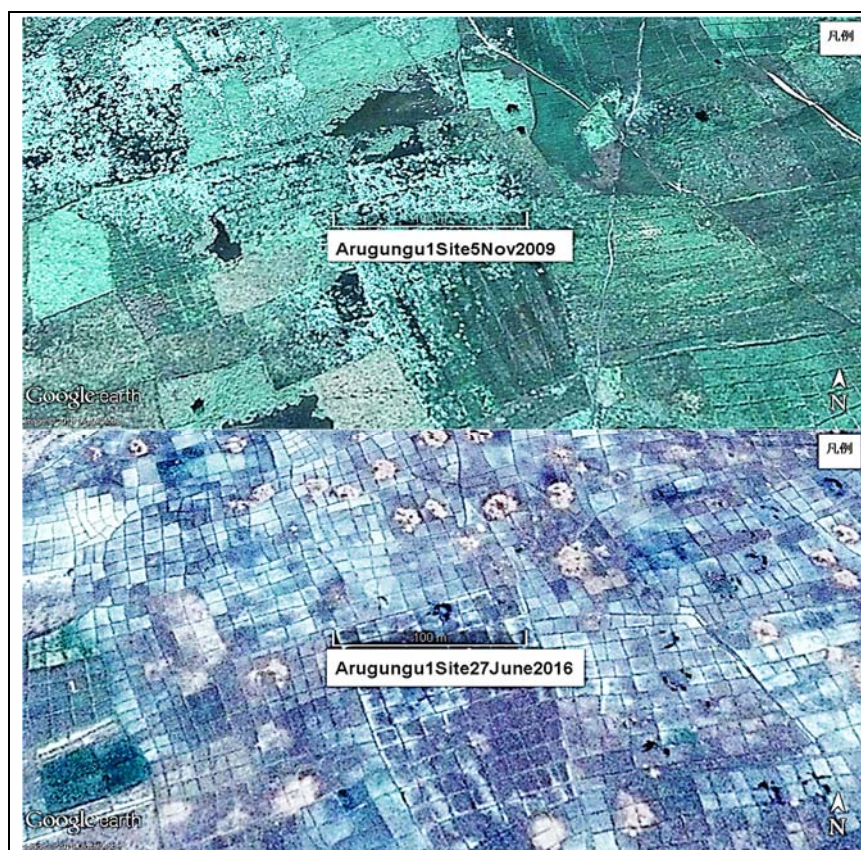


Figure 14. Evaluation of the progress of sawah platform improvement in 2009 (above) and in 2016 (below) by Google earth images at the Arugungu (1) site (Fig.13). The total area shown is about 10 ha. The length of the scale marker is 100 m. In 2009, rudimentary sawah system occupy about 10% land. In 2016, 100% land are occupied by improved standard sawah plots. Mean size of the sawah plots in 2016 is about 140 m².

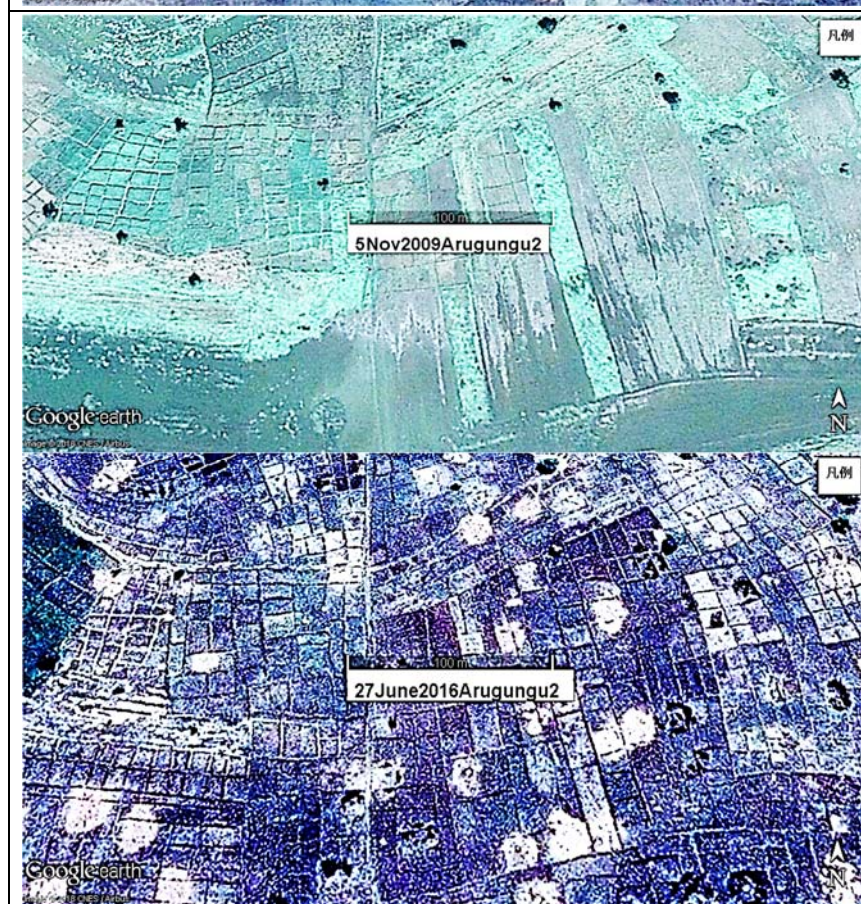


Figure 15. Evaluation of the progress of sawah platform improvement in 2009 (above) and in 2016 (below) by Google earth images at the Arugungu (2) site (Fig.13). The total area shown is about 10 ha. The length of the scale marker is 100 m. In 2009, rudimentary sawah system occupy about 10% land. In 2016, 100% land are occupied by improved standard sawah plots. Mean size of the sawah plots in 2016 is about 160 m².

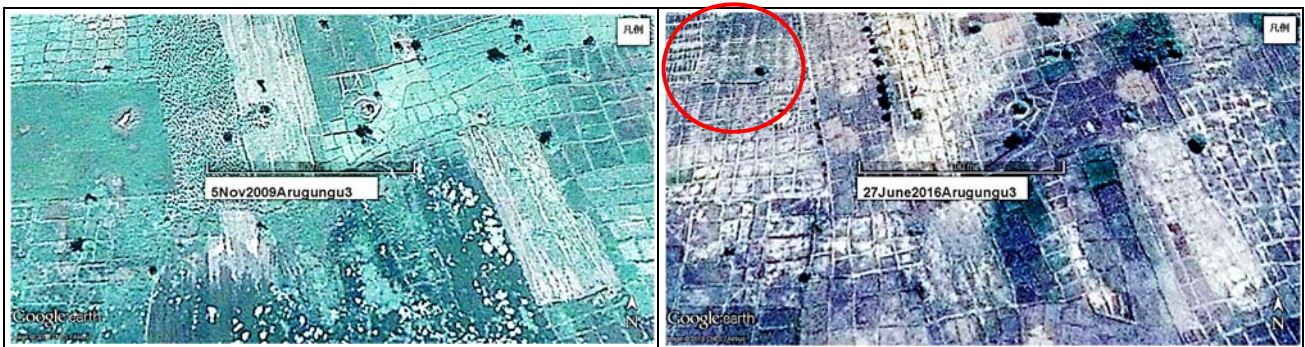


Figure 16. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (3) site (Fig.13). Scale marker is 100 m and area is 10ha. In 2009, about 20% land is sawah system. In 2016, 100% land are improved sawah plots. Mean sawah plots size in 2016 is about 160 m^2 . However red circle area is ridge rice planting.

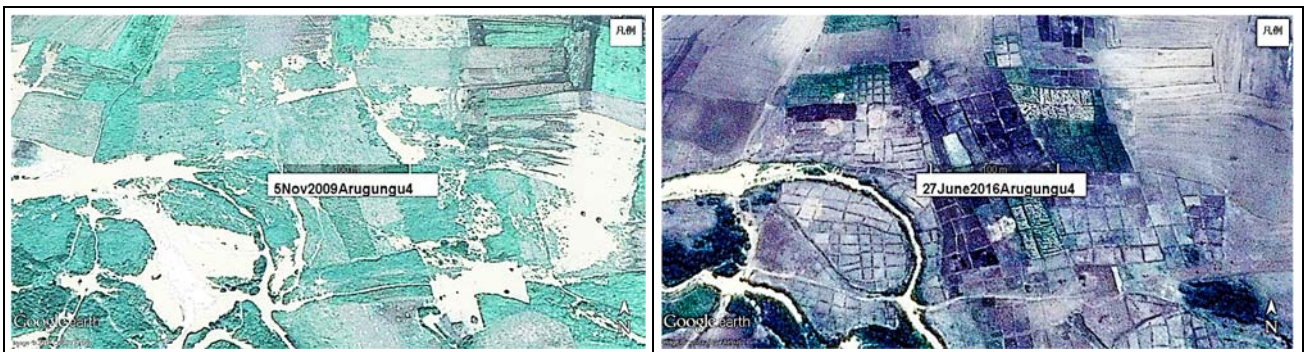


Figure 17. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (4) site (Fig.13). Scale marker is 100 m and area is 10ha. In 2009, there is no sawah system. In 2016, 50% land are improved sawah plots. Mean sawah plots size in 2016 is about 150 m^2 .



Figure 18. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (AR1) site (Fig.13). Scale marker is 100 m and area is 10ha. In 2009, 30% land, left side of the road, are belong to Emir's standard sawah system. Other is micro rudimentary sawah or non sawah fields. In 2016, 100% land are improved standard sawah plots with good bunding and leveling. Mean sawah plots size in 2016 is about 200 m^2 .



Figure 19. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (AR2) site (Fig.13). Scale marker is 100 m and area is 10ha. In 2009, 15% land is micro rudimentary sawah and remaining is non sawah fields. In 2016, almost 100% land are improved standard sawah plots with good bunding and leveling. Mean sawah plots size in 2016 is about 140 m^2 .



Figure 20. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (AR3) site (Fig. 13). Scale marker is 100 m and area is 10ha. In 2009, 10% land is rudimentary sawah plots and remaining is non sawah fields. In 2016, 80% land are improved standard sawah plots with good bunding and leveling. 10% land, which are shown in three red circles, are ridge rice planting. Mean sawah plots size in 2016 is about 120 m².

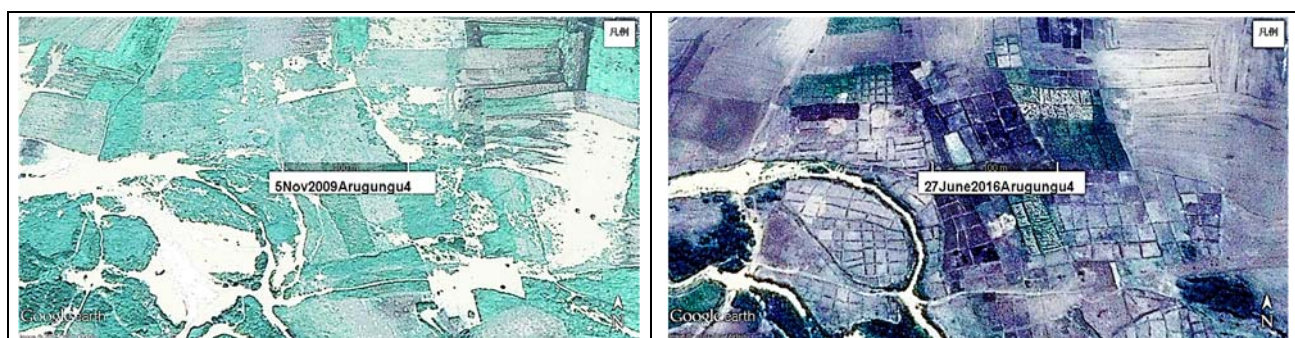


Figure 21. Progress of sawah platform during 2009 (left) and 2016 (right) by Google earth at Arugungu (AR4) site (Fig. 13). Scale marker is 100 m and area is 10ha. Mostly in non-sawah fields in 2009, 30% in standard sawah plots in 2016. As can be seen from Fig. 13, it is estimated that this area is comparatively high topographic position among floodplains, suitable for upland crops rather than paddy cultivation. Mean sawah plots size in 2016 is about 120 m².

4. The Rima River floodplains from Arugungu to Birinin Kebbi area: 56,000 ha

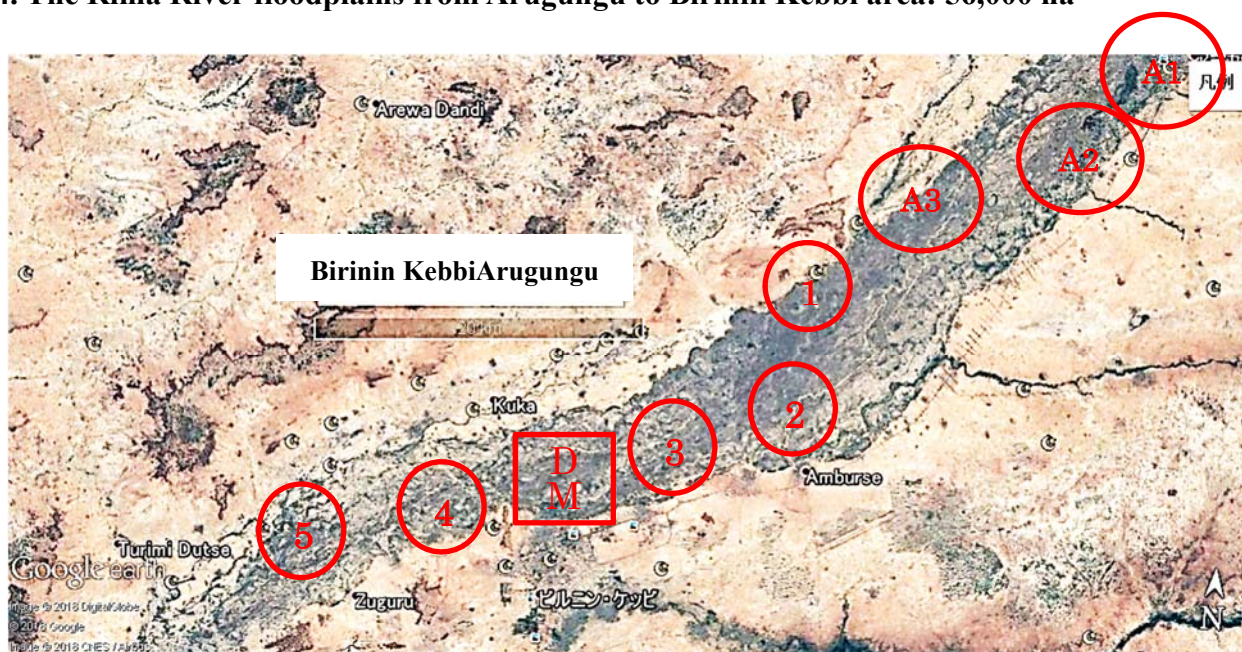


Figure 22. The Rima river floodplains from Arugungu area to Birinin Kebbi area. The scale marker length in the figure is 20 km. The area of the floodplain in this picture is about 56,000 ha. DM is irrigated rice farmland by Kebbi state government and details are described in Fig. 23 and 24A and B as well as Fig. 24(1) and (2) in **Sawah Technology (5) Kebbi Rice revolution**. Progress of sawah system platform between 2009 and 2016 of the area shown in the Fig. 22 are described in the following Figure 23-30 below. If we compare the progress of sawah platform improvement between the Fig. 13 (Arugungu) area and the Fig. 22 (Birinin Kebbi) area, Arugungu area is more advanced than Birinin Kebbi area.