PARTICULAR AGRICULTURAL LAND COVER CLASSIFICATION CASE STUDY OF TSAGAANNUUR, MONGOLIA

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1. INTRODUCTION

The remote sensing and GIS technology and the information technology, make a revolution to traditional agricultural system. Digital agriculture is, also same as precision agriculture, the same name as agricultural information, intelligence agriculture, precision farming or cyber farming [1]. Agricultural land cover land use management and cropping process were characters of intelligence and optimization. This paper describes the current status and trend of the Mongolian agriculture. We mainly describe the agricultural information system and how to building digital agriculture in Mongolia. Digital agriculture started from 1955 in America, it is different from "agriculture gardening" in 55-60`s in Japan, "ecology agriculture" and "green agriculture" coined by advanced country 60-70`s and "agricultural factory" in Israel [1]. It means that whole agricultural procedure (cultivate, fertilizer, etc.) and farmland management, monitoring, modeling and decision makers will be characterized by digital network or intelligence, using technology of remote sensing and GIS. It is an agricultural technology system with the characteristics of integration and information.

Digital agriculture is starting in Mongolia, only last half of decade. Mongolia stretches across Central Asia and occupies an area of 1.6 million square kilometers of mountains, steppe and desert.

Mongolia is landlocked between Russia and China and has no access to the sea. Although famous for its seemingly endless expanses of steppe, Mongolia is a mountainous country with almost 80% of its territory located at an elevation of 1000 m or more above sea level.

Mongolia has an extreme continental climate with hot summers, cold winters, windy and dry springs and pleasantly warm autumns. Only a 1% of Mongolia's land area is suitable for cultivation. Mongolia began to cultivate virgin lands at the end of the 1950s. The main policy objective of this development was to achieve self-sufficiency in grain production.

In the agro climatic environment of Mongolia, such as soil moisture is the most limiting, offers the most limiting constraint to crop production. Spring rains are late and light; contributing to poor seed germination and limited fertilizer impact and heavy autumn rains at harvest contribute to reduced yield and poor quality. Given this constraint, initiatives to improve Mongolian agricultural system.

2.DATA

Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+) images (with path/row132/25-27, 133/25, and 131/26-27) acquired on 1989 and 2000 and ground truth data, respectively. All satellite images were cloud free and of good quality.

The satellites orbit at an altitude of 705 km and provide a 16-day. These satellites also were designed and operated to collect data over a 185-km swath.

3. METHODOLOGY

Spatially variable agricultural production to a large extent is technology-driven. The new tools applicable to this digital agriculture are the advances in electronics and computers such as remote sensing, GPS and GIS. Technologies used in digital agriculture cover three aspects such as data collection, analysis or processing of recorded information and recommendations based on available information [1].

3.1. Image processing

The generation of maps for agricultural land cover land use, crop and soil properties is the most important and first step in digital agriculture. Although the use of remote sensing is a decade old, its relevance to agriculture in spatial variability management is relatively new in Mongolian conditions.

3.1.1. Remote sensing data

In this case, Supervised classification (ML) was done using ground checkpoints of the study area. Data processing and analysis operations were carried out using ENVI 4.3 and PCI GEOMATICA Image Analysis software. The area was classified into four main classes: cropland, bare land, water body and forest. After completing the classification procedure, the classified outputs were combined to make a single classified image and then carried out on the final classified output by computing the percentages of classified images within cropland areas class as using area and unused area in that year.

To assess the accuracy of the classified images compared the reference data. Therefore, for these classes, all reference fields were used to compute the accuracy. For each classified output, the error matrix was generated and the producer’s and user’s accuracy were calculated.

3.1.2. Vector data

Recently, use of GIS in agriculture has increased because of misuse of resources like land, water, etc. GIS is the principal technology used to integrate spatial data coming from various sources in a computer. GIS techniques deal with the management of spatial information of agricultural land cover land use, soil properties, cropping systems, pest infestations and also weather conditions. This is primarily an intermediate step because it combines the data collected at different times based on sampling regimes, to develop the subsequent decision technologies such as process models, expert systems, etc.

In this case was performed using development of vector datasets. To create the vector coverage of the study site, the vector field boundaries were built and digitized from the ground truth data using with ARCMAP software and that the each polygon points was then registered to Geographic lat/Long (Zone-48 WGS84 using) projection and the evenly distributed. The registration was based on first-degree polynomial and nearest neighbor re-sampling techniques.

Each polygon was assigned a numeric code, owners name, measurement of the each polygons, and the crop types of the ground-visited fields were recorded as attribute information. The polygon topology was then created and the attribute database was linked to the polygons to make polygon selection possible through a database query. This map was used to validation of classification result.

5. RESULTS AND CONCLUSIONS

5.1. Result

Supervised classification using six reflective bands of the images acquired on 1989 and on 2000, respectively was carried out using maximum likelihood classifier. Figures. 1 and 2 show the result of the classification.

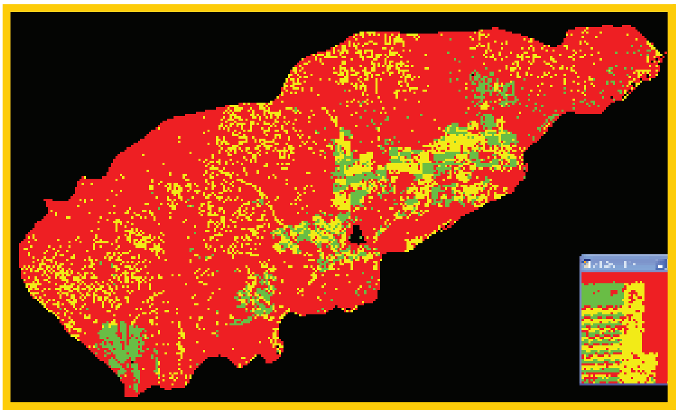

Figure 1. TM-1989.08.21 Tsagaannuur, Mongolia

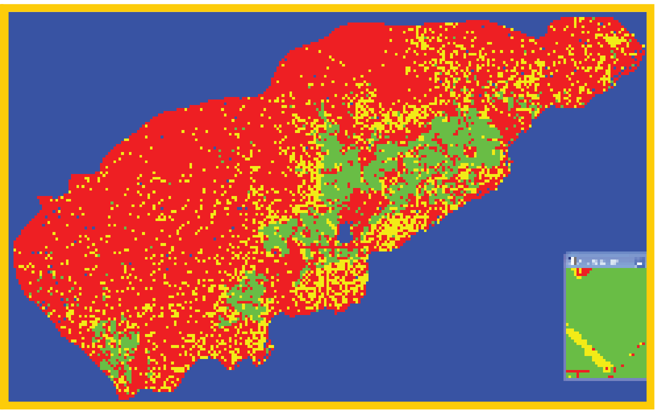

Figure 2. ETM-2000.09.11 Tsagaannuur, Mongolia

5.2. Mongolian perspective

Mongolian government also has called the green revolution program and re-cultivate virgin land program on the last decade. Each program not only increased productivity, but it has also several negative ecological consequences such as depletion of lands, soil erosion, deterioration of environment, health hazards, poor sustainability of agricultural lands and degradation of biodiversity.

According to CGIAR, ‘Sustainable agriculture is the successful management of resources to satisfy the changing human needs, while maintaining or enhancing the quality of environmental and conserving natural resources’ [7]. Therefore, agricultural research seeks the generation of new technologies to reorient the current and future needs and constraints. The new technology should be highly productive, cost-effective and ecologically sustainable. In the present context, maintenance of ecological balances through precise and site-specific management is most desirable. Planners have long recognized that an accurate and timely crop production forecasting system is essential for strengthening the food security. The concept of digital agriculture may be appropriate to solve these problems, to Mongolian conditions.

5.2. Conclusions

Digital agriculture is useful in many situations in developing countries.

During the last 50 years, numerous changes have taken place in the major components of agriculture, both in the positive as well as in negative direction. Therefore, it is the right time to take decisions, how to increase agricultural productivity, as the developing countries have the lowest productivity for most of the food crops. It is obvious that unless the latest tools of science and technology are applied for sustainable and equitable distribution of natural resources of our country, poverty and hunger will persist. The digital agriculture may be able to harness several newer possibilities in managing the farm sector precisely in Mongolia. These technologies should be used to complement the traditional methods for enhancing productivity and quality, rather than to replace conventional methods. Now what we require is the development of a symbiotic relationship between man and nature to harmonize the ecological balance. Digital agriculture adoption would be improved if it can be shown to reduce the risk.

6. REFERENCES

[1] Dawson, C. J., in Precision Agriculture (ed. Stafford, J. V.), BIOS Scientific Publishers Ltd, 1997, vol. 1, pp. 45–58. A.B. Smith, C.D. Jones, and E.F. Roberts, “Article Title,” *Journal*, Publisher, Location, pp. 1-10 Date.

[2] Moran, M. S., Vidal, A., Troufleau, D.,Inoue, Y. and Mitchell, T., Remote Sensing Environ., 1997, 61, 96–109.

[3] Wall, R. W., King, B. A. and McCann,I. R., Proceedings of the Third International Conference on Precision Agriculture (eds Robert,

[4] C., Rust, R. H. and Larson, W. E.), Minneapolis, 23–26 June 1996, pp. 757–766.

[5] Stafford, J. V. and Miller, P. C. H., in Proceedings of the Third International Conference on Precision Agriculture (eds Robert, P. C., Rust, R. H. and Larson, W. E.), Minneapolis, June 23–26, 1996, pp. 757–766.

[6] Fleischer, S. J., Weisz, R., Smilowitz, Z. and Midgarden, D., in The States of Site-Specific Agriculture (eds Pierce, F. J., Robert, P. R., Sadler, J. and Searcy, S.), Soil Science Society of America, 1996, pp. 213–218.

[7] http://www.cgiar.org/