

# Agricultural Land Use Management in Irrigation Project of Southern Taiwan

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**Abstract:** Chianan plain situated in south of Taiwan is the biggest agricultural area, which has a history of 70 years in implementation of a large irrigation project extending over 150,000 ha by Uzanto dam completed in 1930. With the recent high economic growth, sugarcane, paddy rice and cereals cultivated formerly have been replaced by high-profitable crops and fishery ponds aiming at upgrading of land uses. Here, we select a number of typical areas, analyze satellite images in intervals of several years and extract changes in land uses as data. We attempt to construct a system dynamics model related to land uses from the socio-economic aspect.

## 1. Introduction

Farmland use has a close relationship to food production and appears to have a profound effect on the agricultural development. Therefore, understanding the change in farmland use has long been a major focus of research in Agronomy.

In previous papers, many researches utilized map method, photo method, or econometric method for the investigation of land use. However, after the rapid economic growth, the problem of land use

becomes more complex. In order to take account of all factors that affect land use completely, it is necessary to adopt a different approach for the analysis of land use.

In this paper we investigated change in cultivated land use by using remote sensing image data, and attempted to establish a model that indicates the possible change of farmland from system dynamics. The model in our study produces a result close to the reality, thus would be able to provide a future reference for land management for the agricultural authority.

The paper is organized as follows: the first part is a brief description of the Chianan irrigation project and discussion of its effect on agricultural production around that area. Secondly, we analyze the change of farmland use in Chianan irrigated zone using remote sensing image data. Then we use a system dynamic model to discuss the possible changes of farmland use in Chianan zone. The last part is the conclusion of the paper.

## **2.The Chianan irrigation project and its effect on agriculture**

The Chianan irrigation project is located in the south-western part of Taiwan and was built in 1930. Its irrigated area is covering Chia -Yi Hsien, Chia-Yi city, Tai-Nan Hsien and Tai -Nan city(See figure1).



Figure 1 :The location of Chianan irrigation project

Originally, the Chianan irrigation project consists of 2 smaller irrigation systems: Wushanto reservoir irrigation system and Cho main canal irrigation system. The former set up a pumping station in Linnai to get water from Zhoushui river. The latter set up a dam and a tunnel in Nansei to get water from Tsengwen river. In addition, there are 100km of main line, 1200km of branch line, 7400km of little line, 960km of escape canal and 6000km of little escape canal built in the Chianan irrigation project. It was

the biggest irrigation project in Taiwan during the colonial period.

After the Chianan irrigation project was accomplished, there are three obvious effects on the agricultural production:

- (1) Larger irrigated area
- (2) Changed upland fields into paddy fields
- (3) 3-year-rotation system

Owing to the above effects, quantity of crops raised and agricultural revenue increased (see table 1). Peasants who live in Chianan zone have a better living than before.

By the way, the 3-year rotation system was changed from 3-year-once-rice-cultivated to 3-year-twice-rice-cultivated after War II because of agricultural technological progresses such as farmland improvement, seed improvement and the construction of new irrigated facility. Furthermore, on one hand, after the decrease in the rotation area and the crease in the double-cropped field area, the output of rice increased dramatically. On the other hand, as the national income increased, people started to reduce the consumption of rice and increased the consumption of meat, vegetables and fruits. This resulted in excessive supply of rice, therefore, transformation of rice field to farmland was promoted by Taiwan's government since 1970s. Thereby, paddy field began to decrease and dry farmland increased.

Due to economic growth, urbanization in Chianan zone has advanced in the last decade. Cultivated land has been transferred to commercial area or residential area etc. Table 1 demonstrates that c: Irrigated area under Chinan Hydraulic Association is decreasing after 1975.

Table 1: Irrigated Area under Chinan Hydraulic Association

Irrigation Canals	Irrigation Area					
	Total	Double-cropped	Single-cropped	Upland	Rotation Cropped	
	Ha	Ha	Ha	ha	Ha	
1975	160	86866	18242	16789		51835
1980	164	83623	24803	10756	8477	39587
1985	198	81523	24666	9867	8494	38496
1990	198	78943	23601	9301	8739	37302
1995	156	78138	23365	9500	8437	36836
1996	156	78076	23376	9483	8401	36816
1997	156	77916	23310	9456	8359	36791
1998	156	77822	23268	9435	8352	36767
1999	123	77136	23223	9430	7784	36699
2000	123	77091	23237	9381	7784	36689

### 3.Data description and methodology

Observing the change of land use in Chianan irrigation area is an import issue to irrigated management. This study use satellite images to analyze the change of land use in Chianan area in Taiwan. The data and its disposal process is as follow:

#### (1) Data

The main data sources are Lansat TM satellite images. And we also use air navigation chart and GIS data to assist for knowledge based classification. Table2 shows the detail of image data.

Table2: A list of satellite images used in the present study

Mission	Sensor	Path-Row	Obs. Date
Lansat2	MSS	118/44	1Nov72
Lansat2	MSS	126/44	5Dec81
Lansat7	TM	118/44	21Jul90
Lansat7	TM	118/44	7Dec00

#### (2) Study Processing

The study process of Agricultural Land Use Management in Irrigation Project is shown in Figure 2:

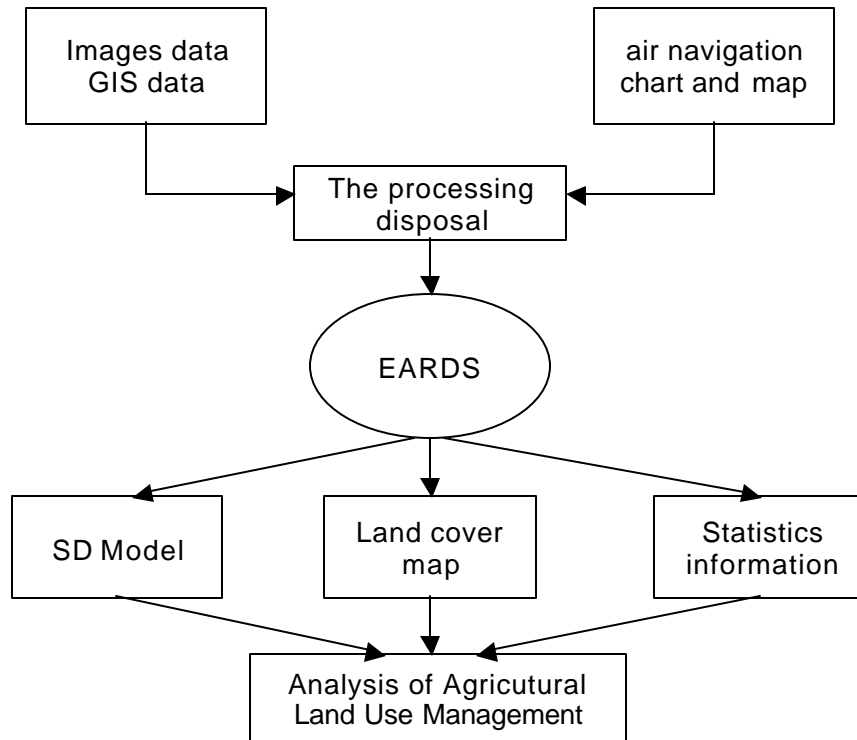


Figure 2: Flow chart of the study

(3). The result of analysis will be given at the time of presentation.

#### **4. Application of system dynamics model to the changes in farmland use**

Land use is relevant to geographical environment and economic activities. Thus, different geographical environments and different regional economic activities would yield different kinds of land use.

In previous research of land use in agricultural economics, the analytical approach used most are time series model and regressive model. However, in order to understand the complex problem of land use, system dynamic approach and econometrics have been adopted increasingly. System dynamic approach is especially well disposed in nonlinear relation or, while lacking part of the data, it also is suitable for analysis of long-term trend.

The system dynamic model developed in this paper is built with the graphical programming language STELLA. In the first step we stipulated the scope of research, then we consider the changes of objects (stock) depend on some factors (flow). Since these factors are influenced by others variables (converters), we connect these stocks, flows and converters with a relation of feedback or infrastructures. Finally, we install coefficient for every variables according to data from the real world and then run the model.

The result from the model is compared to real life data. If they were dissimilar then there were variables that had wrong effects on the model or the coefficients installation was incorrect. Then, we revised the model and ran it again.

From the statements of former sections, Figure 3 shows the sample model to understand the change in farmland. The result of simulation will be given at the time of presentation

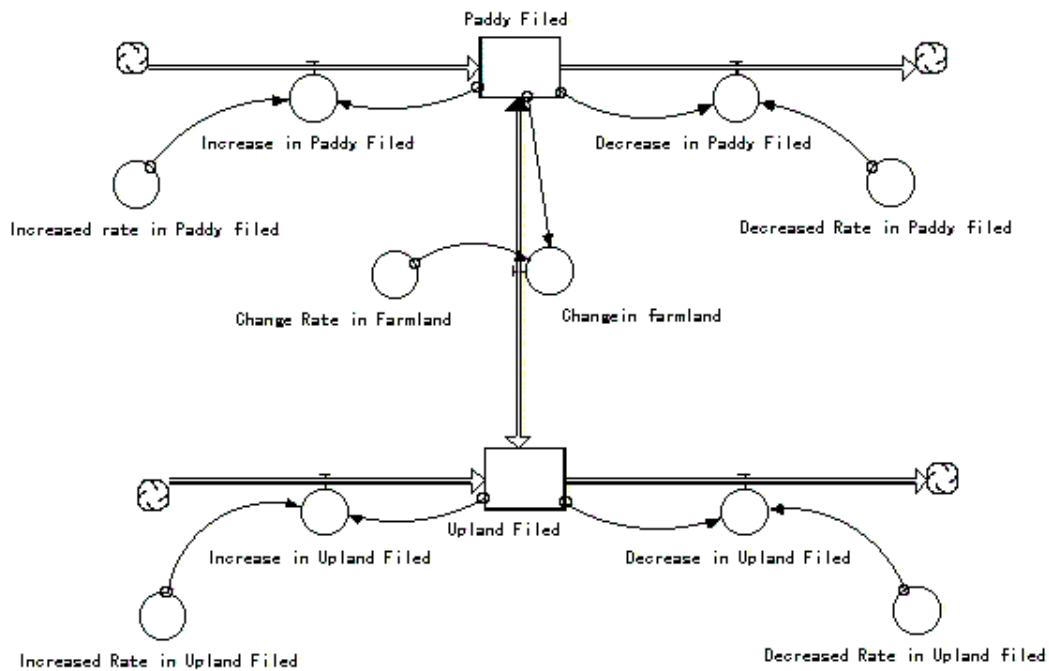


Figure 3: Change in Farmland

## 5. Conclusion

The Chianan irrigation project has played a major role in agricultural development in Chianan zone in the past. Not only did it help raising crops production in the Chianan area but also improved the farmers' economics. However, after the high economic growth, agricultural industry began to go downhill, and the effect of Chianan irrigation project became smaller than before. Recently other than water for agriculture, it has been utilized to provide municipal water and industrial water. The Chianan irrigation project would continue to act as an important role in the economic development in Chianan zone in the future.

In order to understand the complicated relationship of modern society, interdisciplinary academic research has been receiving increased attention. This paper attempts to combine remote sensing image data and system dynamics model to the analysis of farmland use. In the future study we will focus on this approach to difference types of land user.

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