

A Case Study on Industrialization on West coast of the Yellow Sea
(A Preliminary Study by Satellite Image Data)

K. Abe*, Y. Inomata** and S. Ogata***

* Chemical Institute for Industry, Tsukuba 305, Japan

** Kitakyushu Technical College, Kitakyushu 802, Japan

*** Kyushu Institute of Technology, Iizuka 820, Japan

Time series satellite image data were used to discuss the possibility of the industrialization of the Kunsan area. The satellite observation was performed from 1979 to 1987 and it revealed a big change in the geographical features due to the rapid development of this area. From the previous experience regarding the industrialization of the coastal district of the Seto Inland Sea, the Kunsan area is very promising as an industrialized world trade center.

1. Introduction

Satellite remote sensing techniques have been widely used in the fields of natural science as well as social science since the first Landsat satellite was launched in 1972. There are many publications in the field of the natural sciences annually, but very few is regularly published in the social sciences.

There are some reasons for this. First, we engineers do not like to become involved in political troubles when the satellite remote sensing is used for aggressive purposes against foreign countries. Second, it seems that we have no strong desire to apply these valuable techniques to the social sciences in the same way as we do to the natural sciences.

In this paper, the authors discuss the possibility of the industrialization of the Kunsan area located on the west coast of South Korea. Our study take in only the Kunsan area but our results could be very easily applied to whole country.

According to the previous experience regarding the industrialization of the coastal district of the Seto Inland

Sea, most of the salt fields have now become sites for modern factories such as petroleum combines.

Some of the key factors why modern factories were built on the salt fields of the Seto Inland Sea are as follows. First, salt fields provide huge open areas. Most of the factories developed in '60s and '70s were so called mass production factories and they needed spacious areas. The second factor is concerned with the circumstances of residence and labor, i.e., these factories should be moderately remote from residential areas but not too far

away. Third, existing hinterlands are required for development of new industries. In addition to these, it is necessary that railroads, highway roads and harbors are well organized.

The authors found that most of the salt fields met these requirements in the case of the industrial sites along the coast of the Seto Inland Sea. As will be mentioned later, these sites are not an exclusive case but many salt fields in the Bo-hai and the Yellow Sea districts are preferable to other areas that are not salt fields. This is the reason why the authors have paid careful attention to salt fields.

In this paper, the authors focus on the development of the Kunsan area which is the most promising not only in South Korea but in all the north-eastern countries of Asia at the present time.

2. Industrial Development of Kunsan Area

2.1 Outline of the development project

The west coast, including the Kunsan area has attracted attention as an industrial area since the end of 1987 (Nishioka, 1988). The South Korea government published a project report (1989-2001) on the development of the west coast including Incheon, Kunsan, Chonju, Kwangju and Mokpo in December 1987. According to the project, the government plans to develop industrial areas in these cities and re-develop the Kunsan harbor by 2001. A high way network is expected to connect Incheon and Mokpo through Kunsan.

As a matter of fact, the present president Mr. Noh even promised to promote this project during the presidential election. It is said that the Chonra provinces on the west coast are behind Kyonsan provinces in the east



Fig.1 Landsat 3 MSS Mar.28, 1979
Band 4,5,7



Fig.2 Landsat 2 MSS Dec.3, 1981
Band 4,5,7

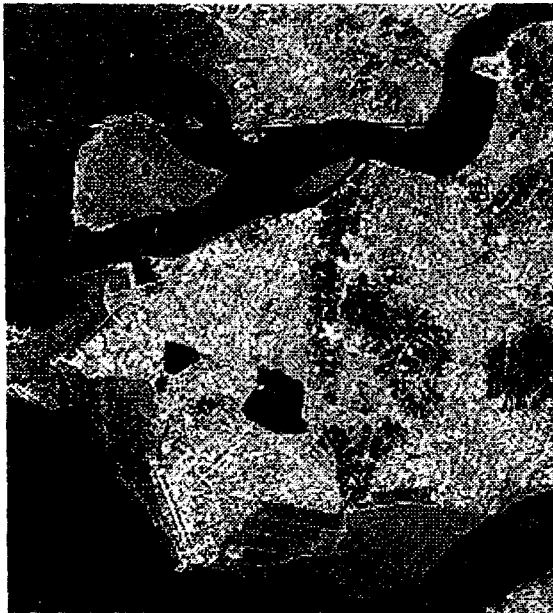


Fig.3 Landsat 5 MSS Oct.21, 1985
Band 4,5,7



Fig.4 Landsat 5 MSS Apr.18, 1987
Band 4,5,7

coast in economical bases. Another purpose for developing the west coast is to promote world trade, particularly with ROC(Beijing China). As will be mentioned later, Kunsan has a geopolitical advantage as an entrance to the sea routes.

2.2 Time Series Observation of Kunsan Industrial Area

2.2.1 Satellite image data and image processing

The West Korean Sea is very shallow and the water level changes greatly



Fig.5 Landsat 5 MSS Oct.27, 1987
Band 4,5,7



Fig.6 Landsat 5 TM Oct.27, 1987
Band 2,3,4

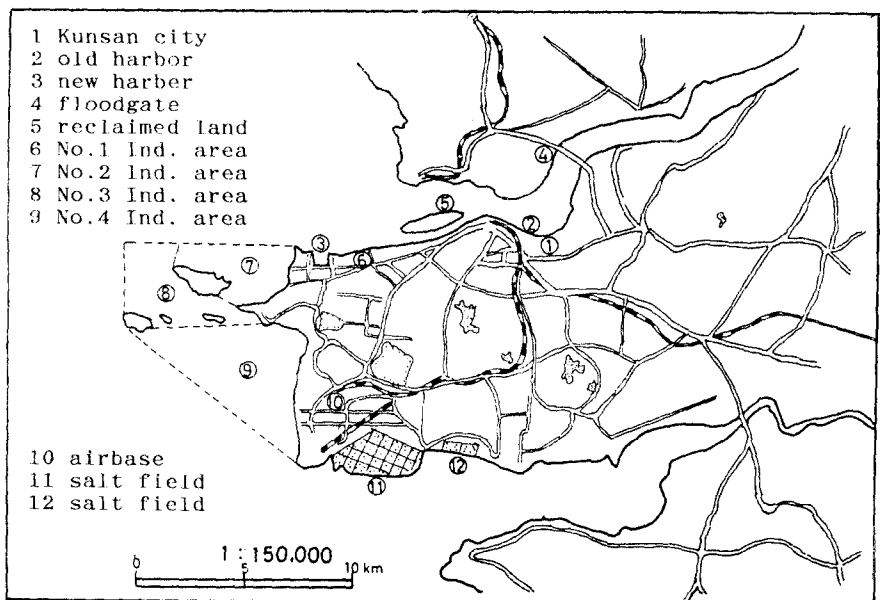


Fig.7 Schematic figure of Kunsan area

between high and low tides. During Japanese occupation of Korea, salt fields were remarkably increased by utilizing this geological advantage.

A big change in geographical features of the west coast was expected because more than forty years have passed since the end of the Japanese occupation. To investigate any geographical change of

this area, therefore, long range time series data were needed. The time series Landsat data used here are shown in Figs.1 to 6. In addition to the Landsat data, MOS-1/MESSR data were frequently used to estimate the areas of salt fields, while SPOT data were used to identify small objects.

Figs.1 to 5 are all filter-operated, enhanced color composite images consisting of band 4, 5 and 7 of Landsat MSS data, but Fig.6 is TM data(band 2,3,4). The filter operation was carried out using the mask before performing a linear stretching enhancement, i.e., a Laplacian edge enhancement is added to the original image.

2.2.2 Observation of development process

Fig.7 shows the schematic figure of the Kunsan area. The reclaiming work of the Kunsan harbor(old harbor) started in 1978. The first Landsat image in Fig.1 was taken one year later. There would be very little change in the land features

between '78 and '79.

As shown in Fig.1, the No.1 industrial area is still quite undeveloped and there are open beaches, i.e., lumps of sludge accumulated in the upstream and the downstream areas of the old harbor. The one in the downstream was reclaimed by heaping up the sludge in the upstream as shown in Figs.2 to 6. A small speck, definitely a concrete structure, appeared in the middle of reclaimed land first in Fig.4 and it has become much longer in Figs.5 and 6. This image represents a wharf which protects the old harbor.

Another wharf to protect the old harbor was completed in the upstream area. A solid extrusion on the right side of the river appeared first in Fig 3, 1985, but there was no extrusion before 1981. This fact means that a floodgate had been completed between '81 and '85 across the river. The dredge work in the old harbor would also had been carried out before '85. In fact, no lump of the sludge is seen in the water as shown in Fig.3, though the lumps of the sludge are seen in Fig.1 and Figs.5 and 6. The TM image in Fig.6 shows the sludge accumulation rate is more accelerated than before. We will touch upon this latter case when we discuss the Nampo harbor of North Korea later on.

As far as the No.1 industrial area is concerned, the reclaiming work was seemingly completed by December, '81 as shown in Fig.2. According to the official report, however, the work was completed in '87 at the latest. It is reported that about 5 square km of the surface was created.

The reclaiming work of the No.2 industrial area began a little after '81 since no concrete block is seen on the left side of the old harbor in Fig.2, but a block can be seen in Fig.3. This project is expected to create 6.8 square km of a new land within '89(Kunsan city report,1987).

2.3 Feasibility Study of Kunsan Industrial Area

2.3.1 Locations and features of Kunsan

(a) Bridgehead of international trade

One of the advantages of the Kunsan area is the fact that it faces the Ryaogong and Syandoug Peninsulas in China which are specified for economic development. Kunsan is 570 km distant from Dairen, the center of Liaodong and 520 km from Yantai, the center of Shangdoug. The distances from Kunsan to other principal cities are 622 km to Quindao, 846 km to Shanghai, 950 km to Osaka and 1,410 km to Taipei.

(b) Transportation network

Taejon is the main center of the railway network on the west coast. Kunsan is connected with Seoul and Inchon in the north, Pusan in the east and Mokpo in the south via Taejon by rail. Kunsan is an important city in the highway network through which the principal cities in the whole country are connected to each other. In addition, some paved roads run southwest from Kunsan to the airport and salt fields. It can be said, therefore, that the transportation of the Kunsan area is well organized.

(c) Capabilities of harbors

There are two harbors in the Kunsan area. It is possible to load and unload a maximum 540,000 ton/year in the old harbor and a maximum 2000,000 ton/year in the new harbor. At the third harbor, which is to be built from 1991 to 2001, up to 210,000,000 is expected to be handled ton/yea. Therefore, the loading and unloading capabilities of the Kunsan area will be very improved after 2001.

(d) Population and composition of industries

The population of the Kunsan city is about 200,000 and the number of households is about 40,000 in an area of 54 square km. The working population is about 63,000. The 1st industry population is 7.9%, 2nd, 39.4% and 3rd, 52.7%. The total figure of the 2nd and 3rd industries exceeds 90%. This fact indicates that Kunsan is a sufficiently developed city.

(e) Water resources

The satellite images(Figs.1-6) show that there are several lakes or dams in the Kunsan area. The small ones in the highland are probably dams for everyday

consumption. It is said that the water supply capacity is 183,000 ton/day(99,000 ton/day for everyday consumption, and 84,000 ton/day for industry). According to the project, the amount of 204,000 ton/day is planned to be pumped up from the river.

(f) Electric power and tele-communication

The Kunsan power plant generates 300,000 kw. This figure is sufficient at present. The number of circuits for telephone and tele-communication is 49,000 in total. Even if the demands increase rapidly, the power supply will be sufficient for all future demands.

(g) Labor force

There are two technical colleges, three vocational colleges, five vocational highschools and one technical highschool in the Kunsan area. In addition, population in this area is said to be stable. Therefore, it is possible to maintain steady labors of good quality.

(h) Development of a new industrial area

As shown in Fig.7, four industrial areas are to be developed by 2001. The fourth one is next to an airbase. We should pay much attention to this aspect since the military has certain demand which may accelerate the industrialization of this area.

2.3.2 Second step of development

Judging from the previous example in the Seto Inland Sea district, the industrialization of the Kunsan area is expected to expand rapidly. Once industries begin to develop, population increases, which in turn is the cause of more industries. In this case, existing salt fields must be involved in the avalanche of industrialization.

There are two salt fields near the airbase. An estimated area from satellite images is 4.4 square km. Kunsan is only about 15 km away from these salt fields and the airport as well. The larger salt field will be No.5 industrial area and the small one will be No.6 in the early part of the 21 century.

3. Promising Salt Fields in Bo-hai and Yellow Sea

3.1 Salt fields in the Liaodong bay

Many salt fields were observed by satellites in the Liaodong peninsula (not shown). Salt fields near Dairen are the most promising as industrial areas. As is well known, Dairen's harbor can handle a large capacity of business and it never freezes over. This fact is very significant at present due to the rapid development of Asia NIES. Both the Yantai Harbor in the Shandong Peninsula and the Dairen Harbors are the main entrances to Japan and NIES.

Dairen is also expected to be the information center for the factories and combines. However, economical development and modernization of China should be done first.

Satellite observation has also revealed that there is a huge salt field at the innermost part of the Liaodong Bay (not shown, Abe and Ogata, 1988; Ogata, 1988). This salt field is promising from the point of view of the industrial development of the north-east district. Details will be mentioned at the oral presentation.

Salt fields in the Shandong Peninsula were investigated by satellite images as well. Yantai should be modernized as

well as industrialized first. As far as satellite observation is concerned, Yantai is quite comparable to Dairen with respect to key factors for industrialization. Satellite images will also be shown at the oral presentation.

3.2 Salt fields on the West Korean Sea Coast

Sea features and salt fields in the West Korean Sea area were observed frequently and carefully using NOAA, LANDSAT, SPOT and MOS-1. Out of many salt fields, the one in the Nampo area is the largest and the most promising as a combine. However, problems at the Nampo harbor may be the same as those at the Kunsan harbor. Judging from satellite images, Nampo's case seems worse than that of Kunsan due to the

construction of a floodgate at the mouth of the river, i.e., downstream from the harbor. The accumulation rate of the sludge must be increased in the upstream area of the floodgate. Details will be illustrated at the oral presentation.

4. conclusions

Kunsan city has geographical and geopolitical advantages in addition to the fact that it is developed sufficiently to expand as a core of the industrialized sites.

To trace back the rapid development of the Kunsan area, time series satellite data were carefully investigated to find any geographic change. From the results of the satellite observation, it can be said that the Kunsan area is the most promising on the west coast of South Korea.

Salt fields near developed cities meet most of the requirements for industrialization. The salt fields near the airbase which is about 15km away from Kunsan city are expected to be included in the Kunsan industrialized site in the early part of the 21 century.

Literature cited

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