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The Korean Cartographic Association

REPORT ON ACTIVITIES OF THE KOREAN CARTOGRAPHIC ASSOCIATION REPUBLIC OF KOREA

The Korean Cartographic Association (KCA) is the Republic of Korea's professional body for cartography, founded in 2000 for the advancement of mapping and cartographic sciences. This society is the leading center for cartographers and cartographic research. The KCA has over 300 members sharing interests in the theories, methods, and practices of maps and cartographies. The KCA work reaches each year through academic conferences and journal publications and promote all aspects of map, mapping, and cartographic themes to a wide range of potential users.

The KCA is managed by the council, which is chaired by its president. The member of the KCA council and the president are elected from the KCA members and serve for a two-year term. The council consists of 18 members including one president, two vice-presidents and other representative division directors. The KCA membership include researchers, map makers, mapping companies, publishers, academics, educators, individual cartographers, GIS specialists and ordinary members of the public with an interest in maps and cartography.

The KCA has five specialist divisions that it derives advice from:-

- Finance division
- Publication division
- Academic division
- International relation division
- Research division

The KCA has published the official peer-reviewed periodical of the KCA, *the Journal of Korean Cartographic Association*.

REPORT ON ACTIVITIES
OF THE NATIONAL GEOGRAPHIC INFORMATION INSTITUTE,
MINISTRY OF LAND AND TRANSPORTATION,
REPUBLIC OF KOREA

1. INTRODUCTION

In Korea, the surveying and mapping activities can be roughly divided into three groups: national base mapping, nautical charting and commercial mapping. The national base maps are produced by the National Geographic Information Institute (NGII), Ministry of Land and Transportation (MOLT) on various scales ranging from 1:1,000 to 1:1,000,000. The NGII continuously updates these maps with 2, 5 and 7 years depending on urban, rural and mountainous areas, respectively.

Along with conventional paper map, the NGII has already started creating digital maps of 1:5,000 scale since 1991. The first phase of digital mapping project initiated from 1995 under the National Geographic Information System (NGIS) Master Plan (1995~2000) had been completed by the year of 2000. The main purpose of the project was to produce 1:1,000, 1:5,000 and 1:25,000 scales digital maps. And coastal sea area maps have been producing by the NGII. The NGII is also establishing and managing the geodetic network, leveling network and gravity network.

The nautical charts are produced on scales from 1:3,000 to 1:3,500,000 for the purpose of harbor administration and navigation by the National Oceanographic Research Institute, the Ministry of Maritime Affairs and Fisheries. Other kind of maps such as tourist map, road route map, etc. are produced private mapping firms based on the products of NGII's. In addition, thematic maps namely forest maps, soil maps and geological maps are published by the government affiliated institutes and agencies.

Since it became highly aware of the significance of the GIS, the central government has initiated a full-scaled implementation of the NGIS Master Plan in 1995. The NGI plays a crucial role in surveying and mapping activities, and responsible for the Geographic Information Subcommittee of the Steering

Committee in the NGIS Master Plan. In order to come along with National project, the NGII has already expanded its organization and members. The progress has rapidly been achieved in the generation of national digital base maps, underground utility maps and thematic maps.

2. COVENTIONAL MAPPING

2.1 Large Scale Topographic Maps

Since 1975, the NGII has started the large-scale topographic mapping to cover the entire country of Korea. The total 16,249 sheets of 1:5,000 map have been finished at 2000 and the NGII started compiling of 1:10,000 scale topographic maps for 6 big cities in 1990 with reduction of 1:5,000 maps. The total 282 sheets of City map in 1:10,000 scale was produced in 1997.

2.2 Medium Scale Base Maps

The NGII had produced the national base map series of 1:25,000 scale using photogrammetric method since 1967, and finished the coverage of the entire country in 1974. The total number of sheet is 789 covering 100,000km². From 1985 to 1997, NGII had revised the total 353 sheets of 1:25,000 scale map.

The 1:50,000 scale topographic map series were begun to compile by reduction of 1:25,000 scale maps in 1973, and 239 sheets were completed in 1974. The NGII has been conducting a revision survey and recompilation for these maps based on the following principles:

- a) The update of the 1:25,000 map series is carried out at every 2 (urban areas), 5 (rural areas) or 7 (mountainous areas) years, depending on the extent of unit change of each map sheet.
- b) The 1:50,000 sheets are revised simultaneously when there are revision on corresponding 1:25,000 scale national base maps.

2.3 Small Scale Topographic Maps

Small scale maps are 1:250,000 and 1:1,000,000. The 1:250,000 maps have been compiled from 1:50,000 maps in 1985 and total 13 sheets which cover a

southern part of the Korean Peninsula were totally revised once in 1991. And 9 sheets which cover the northern part of the Korean Peninsula had been compiled in 2000. The 1:1,000,000 maps was compiled from 1:250,000 maps in 1993. The NGII had provided the 1:1,000,000 series to the United Nations for the International Map of the World. The NGII had produced this scale of map in compliance with United Nations mapping standard such as map symbol and preparation method.

3. DIGITAL MAPPING

Since 1991 the NGII has introduced the computer aided mapping system, the NGII provide digital maps on scale 1:5,000, and 1:25,000. To beginning the 1st NGIS Master Plan, the digital mapping of 1:1,000, 1:5,000 and 1:25,000 scale has been in rapid progress.

3.1 1:1,000 Scale Digital Map

In the 1st NGIS Master Plan, the 79 major cities had digitized by the year of 2000 with total number of map sheets of 12,428. The central and local government are responsible for the even investment. Since 1995, the 1:1,000 digital map was made by the NGI. For the 1:1,000 scale maps, the photogrammetric techniques are mainly implemented for the digital mapping. The digital topographic maps are producing through matching funds (50:50) with local governments for urban areas. NGII has produced the 1:1,000 scale digital topographic maps for 82 cities spanning approximately 9,000km² and suburb areas spanning 50km².

3.2 1:5,000 Scale Digital Map

The 1:5,000 scale digital map is also the topographic base map, which is planned to cover the whole country. The covering areas are about 70,000km² and total number of map sheets is 16,200. But the NGII has a full responsibility of the maintenance and updating the whole 1:5,000 digital map. The central government and 7 government-affiliated companies have been investing the generation of 1:5,000 digital maps. The 1:5,000 maps are digitized through the combination of scanning the existing maps and the photogrammetric techniques. All information

on the national maps have been revised every two years and important data such as large buildings and roads have been done every two weeks. The total 18,074 sheets of 1:5,000 Scale Digital Map were produced in 2018.

3.3 1:25,000 Scale Digital Maps

At the beginning, the 1:25,000 scale maps had planned to be digitized, especially for the mountainous areas. But the NGII had changed the plan to cover the whole country and produced 1:25,000 scale digital map by reduction and generalization of 1:5,000 scale digital map. The total 750 sheets of 1:25,000 Scale Digital Map were produced in 2000.

3.4 Framework Data

Since the 2nd NGIS master plan(2001~2005), it has introduced new concepts for the NGIS base map as a framework data. It was required urgently to build the national framework data. The national framework data was the skeleton of diverse spatial information capable of overlapping and adding spatial data, both schematically and spatially upon need basis. Therefore the phase 2 NGIS master plan(2001~2005) focused on the establishment of framework data base as follows;

- a) Administrative boundary: national, provincial administrative boundaries
- b) Transportation: road, railway, airport, seaport, shipping facilities etc.
- c) Hydrology: marine and water resource, stream, basin, watershed, lake, etc.
- d) Cadastral information: Cadastral maps, land registration
- e) Geodetic reference frame: surveying control point, Geoid model,
- f) Topography: DEM, contour, and height data
- g) Facilities: including national, municipal and provincial designated cultural properties
- h) Satellite images and aerial photographs

In making a selection of framework data in theme, the following elements shall be considered;

- Geographic information based within the fundamental framework of NGIS
- Basic geographic information that is both widespread and can be used manifold;

- Geographic information that can be merged both figuratively or spatially, or piled up

In 2001~2002, the pilot project was carried under direction of NGII which held Geographic information subcommittee. The aim of these pilot project was to develop strategies, guidelines, standardization for framework data. From 2003, the main project began to use the results of pilot project.

4. OTHER MAPPING

4.1 National Atlas

In 1989, the NGII published "The National Atlas of Korea" comprising 77 kinds of the items for better understanding of national status based on the criteria such as population density, housing, industrial productivity, medical insurance, expenditure, precipitation and so on. It has been widely used.

The NGII completed "National Atlas of Korea II" from 1990 to 1993. It consists of 132 items. 55 more items added to the first National Atlas. It revised at every 10 year from now on, and other versions for children and concise national atlases have also been published in 2018. Besides these paper Atlases, the NGII has published digital Atlas and serviced on the Internet, www.ngii.go.kr.

4.2 Coastal Sea Area Map

Korean Peninsular is surrounded by sea on three sides. To develop coastal area, hydrographic data are in great demand. The NGII has conducted hydrographic survey and has been producing the coastal area map in 1:25,000 scale since 1977. Until 2000, the NGII had conducted 11,486 km^2 hydrographic survey and made 152 sheets, and has produced 1:25,000 scale topographic maps including coastal areas within information on water depth and sediments displayed.

4.3 World Map (Robinson Projection)

The NGII with the Korean Cartographic Association has produced world maps in

Korean using Mercator's, Robinson, Eckert's, Winkel Tripel and Goode homolosine projections. The world maps have also been produced in multiple languages: English, French, Spanish, Portuguese and Arabic using Robinson projection.

4.4 Mapping of North Korea

The NGII has undertaken the mapping project of North Korea and completed in 2016. Since the late of 2016, the NGII has serviced digitalized maps of North Korea by combining satellite images at 1:25,000 scale, especially at 5,000 scale, major areas of North Korea, such as Pyongyang, Nampo, and other city areas are mapped and serviced. The total 254 sheets of 1:5,000 Scale, 2,525 sheets of 1:25,000 scale, and 557 sheets of 1:50,000 scale have been produced in the forms of orthogonal imagery map and 1:25,000 scaled digital topographic map.

4.5 National Internet Map

The NGII has produced Internet maps and POI (Points of Interest) information from the national base maps to serve background maps for websites of public and private sectors. Approximately 10 million POIs are open for the use through Open API (Application Programming Interface) at Geospatial Information Service Platform of the NGI.

On-Map, a geoweb format, has been developed as a concept map framework aiming for easy to access and use by all ages. Various map scales, 1:5,000, 1:25,000, 1:50,000 and 250,000, are servicing in geo PDF format and downloadable from Geospatial Information Service Platform of the NGI. It also covers coastal area base map.

5. OTHER MAPPING ORGANIZATION

5.1 Korea Hydrographic and Oceanographic Agency (KHOA)

Korea Hydrographic and Oceanographic Agency (KHOA), the Ministry of Maritime Affairs and Fisheries conducts the hydrographic surveys which can be classified into harbor, passage, coastal and ocean surveys based on coverage and the scale. The purpose of the comprehensive survey is to collect hydrographic

information such as depth of submerged dangers, obstructions, underwater topography, and character of the bottom for safe navigation. On the basis of the results from these surveys, the KHOA edits and publishes nautical charts which can be used by all mariners to ensure navigation safety.

The KHOA makes and provides several kinds of nautical chart such as general chart, sailing chart, general charts of coast, coastal and harbor chart in various scales. Each chart covers different area and can be used according to user's purpose. Since 1996, the Korea Hydrographic and Oceanographic Agency have conducted annual surveys for basic maps of the sea in Korea's jurisdictional sea area. The survey for basic maps of the sea is intended to secure scientific inquiry data needed for systematic marine management, such as boundary delimitation and sea traffic safety in the jurisdictional sea area, marine resource development, and marine policy setup pursuant to the UN Convention on the Law of the Sea. As a result, in 1996 to 2010, the 1st-phase survey was completed, which covered bottom topography, gravity, terrestrial magnetism, and the shallow subsurface, throughout the eastern, western and southern sea areas totaling 343,000 km². Moreover, from 2008, a detailed submarine topographic survey has been conducted in the western and southern sea areas totaling 242,000 km².

The outcomes are used in producing a basic map of the sea, which comprises bathymetric chart, free-air gravity anomaly chart, total magnetic intensity chart, and sub-bottom echo character chart. This basic map is designed for use in research, education, and marine resource development.

5.2 Other Mapping Organizations

The Ministry of Defense has the biggest mapping agency and produces various kinds of maps for military purposes. The local government, public organization and private mapping firms can also produce the needed maps for their own purposes. These maps compiled by sheet or book, or contained in the publications, are drawn on the base maps by the NGI, by adding the information they need to present.

The NGII supposes to supervise these thematic maps (except military maps) to secure the accuracy and precision according to "The Survey Act". The thematic map production occupies the significant portion of map supply in Korea.

6. GEODETIC WORKS

Fundamental geodetic works in Korea was principally executed from 1910 to 1918. The national geodetic network consists of 189 first order triangulation points, 1,103 second order triangulation points, 3,045 third order triangulation points and 11,823 fourth order triangulation points. The leveling network consist of 2,020 1st order bench marks and 4,045 2nd order bench marks.

The NGII is maintaining and updating the data continuously and provides the data for public and private sectors.

6.1 Precise Geodetic Network

The NGII started the precise geodetic network in 1975 in order to transfer from its old geodetic data obtained by conventional methods to more precise new geodetic data by trilateration, using high-precision electro-optical distance measuring instruments. The geodetic network is classified into two parts. One is the primary precise geodetic network composed of 1,292 first and second order triangulation points, and the other is the secondary precise geodetic network composed of 14,868 third and fourth order triangulation points.

1,165 out of 1,292, the primary precise triangulation points, were surveyed, and 6,325 out of 14,868, the secondary precise triangulation points, were surveyed, as of the end of 2000. The NGII had adjusted the survey result of the precise geodetic network in 1998~2000. From 1996, the NGII has surveying these networks with GPS. The new data can serve not only for mapping as revised framework, but also for resurveying of cadastral maps.

6.2 Leveling Network

The NGII has started the precise leveling in order to revise its old data by using precise leveling instrument and investigate the variation of geometrical height in 1993. The leveling network is classified into two parts, 2,020 fifth order bench marks and 4,045 second order bench marks. 2,130 bench marks were surveyed as of the end of 2000.

6.3 Gravity Survey

The NGII started fundamental gravity survey in 1987, in order to adjust height value of bench marks and establish gravity network. The gravity survey is done usually at bench marks and some triangulation points when bench marks are not available. End of 2000, 1,825 of 3800, all of gravity survey points, was surveyed.

6.4 Permanent GPS Observation System

With the advent of Global Positioning System (GPS) and the subsequent demands of rapidly expanding positioning and navigation community, the NGII has upgraded the traditional geodetic network by developing and operating the permanent GPS observation system. Current plans allow for the permanent GPS observation system such as Korean Active Control System to play a key role in the delivery of integrated GPS services through efficient access to the system and by improving the effectiveness and accuracy of GPS applications.

The nationwide permanent GPS array has been operated by the Geodesy Division of the NGII since September 17, 1998. The system is named GARD II(The GPS Automatic Remote Data Processing System). This network is designed both for crustal deformation monitoring and serving as a highly precise geodetic network in the GPS age. Most of the processing is carried out automatically.

The new nationwide GPS array will bring us more precise information not only of crustal deformation but also of other geophysical phenomena such as ionospheric disturbances and water vapor distribution. Accumulation of the data will produce a seismic hazard map. Moreover, the new network will serve as an active controlling system by GPS in Korea. The new nationwide GPS array consists of 14 GPS permanent reference stations and a single data analysis center. The NGII is developing this technology further to provide similar capabilities in real-time.

7. FUTURE PLANS OF THE NGI

The NGII has been planning to upgrade the accuracy of various kinds of national control points through completion of the secondary precise geodetic

network succeeding to the primary precise geodetic network, to accelerate the efficient digital mapping system for more accurate revision and production of maps, and to construct the digital map data base.

The primary role of the NGII is to maintain the Korean Terrestrial Reference System, ensure its compatibility with current positioning technology, and to facilitate efficient access to it. Therefore the NGII had decided to change the current national geodetic reference system and introduce a new geocentric datum. The new system is the international terrestrial reference frame and base on the GRS80 ellipsoid. In 2003, the NGII initiated the new geodetic reference system and prepared full implementation of the new system continuously.

The first phase of the National Geographic Information System (NGIS) Master Plan was completed in the year of 2000. The main purpose of the first phase was to establish basic GIS infrastructure such as to produce various kind of digital maps. The second phase of the NGIS ended in 2005 was to the spread of GIS application, maintain the digital maps.

The main focus of 2nd NGIS master plan are:

- Establishment of national framework data base
- Set-up of clearinghouse and distribution network of GIS data
- Research and development of technologies
- Human resources development

These enormous tasks were successfully proceeded in close cooperation between government, academia and private sector as well as international cooperation. During the second phase of NGIS the NGII has planned to update the digital maps and provide framework data. And also to contribute the implementation of the regional and global Spatial Data Infrastructure as Asia-Pacific Spatial Data Infrastructure (APSDI) and GSDI, the NGII will be closely cooperate with the member countries of PCGIAP and GSDI.

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REPORT ON ACTIVITIES
OF THE KOREA HYDROGRAPHIC AND OCEANOGRAPHIC
AGENCY,
MINISTRY OF MARITIME AFFAIRS & FISHERIES,
REPUBLIC OF KOREA

1. GENERAL

The Korea Hydrographic and Oceanographic Agency (KHOA) began conducting hydrographic surveys and oceanographic observations covering the national jurisdictional area since it was established in November 1949 as Hydrographic Office, and has contributed to safety of navigation, marine development through production, and distribution of charts and publications.

The office was reformed and renamed as the Korea Hydrographic and Oceanographic Agency (KHOA) it came under the authority of the new Ministry of Maritime Affairs and Fisheries in 1996. Since then, KHOA has conducted a unique and comprehensive oceanographic researches like survey for the production of national basic maps of the sea , territorial sea baseline survey, tidal and tidal current observation by the extension of its research range such as various operations in the fields of marine environment preservation, marine resources, oceanographic spatial data, etc. from such services as maritime traffic safety, etc. and has played an important role for distribution of electronic charts and digital charts, and real-time data via the internet to users.

1-1. HYDROGRAPHIC SURVEYING

KHOA completed the first hydrographic survey of 1 million kms covering harbor, passage, coastal and ocean area in the national jurisdictional area of 447,000 km²(4.5 times of land area), for 40 years until 1995 since it started in 1957, and has continuously conducted survey covering the main harbors and routes, with a survey frequency of 3-10 years.

From 1996 after completion of the first project in 1995, following the international trend, KHOA has made every effort for the production of the national basic maps

of the sea as a set which is composed of a Bathymetric chart, a Total magnetic intensity chart, a Free-air gravity anomaly chart and a Sub-bottom echo character chart, using a new survey vessel Haeyang 2000 (2,500 tonnage class).

OCEANOGRAPHIC OBSERVATION

There are 24 tidal stations around the main ports of Korea, all of which are operated by a telemetry system and those data are provided on a real-time basis to users via the internet.

KHOA has carried out various observations to obtain not only ocean current data, but also water temperature, and salinity, etc. on a regular basis to publish ocean and tidal current charts, as well as for the preservation of marine environment, etc.

NAUTICAL CHARTING AND PUBLICATIONS

KHOA has produced 273 charts and 46 publications including Sailing Directions, Tidal Tables, and List of Lights. To face the era of electronic chart, KHOA has also been developing ENC since 1995 and has completed 205 ENCs covering the Korean coastal area to date using international standard S-57 Edition 3 and has distributed it from 2000.

2. STATUS OF NAUTICAL CHARTING

2-1. NAUTICAL CHARTS

According to chart scale, nautical charts have been divided into 5 kinds like Overview chart, Sailing chart, Nautical chart, Coastal chart, Harbor chart. Although about 50 kinds of charts have been published on average, paper charts and digital charts of 100 charts have been yearly published by the usage of chart production computerization system as of the end of 1994.

2-1-1. STATUS OF CHART PRODUCTION

Classification	Scale	Kinds
Overview	Less than 1/4,000,000	1
General	1/4,000,000 to 1/1,000,000	9

Nautical	1/1,000,000 to 1/300,000	10
Coastal	1/300,000 to 1/50,000	58
Harbor	More than 1/50,000	128
Total		206

2-2. MISCELLANEOUS CHART

KHOA has published Bathymetric chart, Plotting sheet, Territorial Sea chart, Fisheries chart, which are used for marine resource exploration, safe fisheries, etc.

Classification	Kinds	Remarks
Fisheries chart	24	
Bathymetric Chart	20	
Position Plotting sheet	10	
Fisheries Trap Net chart	5	
Various delimitation charts	4	
Others	4	
Total	67	

2-3. NATIONAL BASIC MAPS OF THE SEA

KHOA has published the national basic maps of the sea as a set which is composed of a Bathymetric chart, a Total magnetic intensity chart, a Free-air gravity anomaly chart and a Sub-bottom echo character chart and these maps has been used as the basic data for marine development, exploration of marine resources.

2-4. TIDAL CURRENT AND OCEAN CURRENT

KHOA has published 22 current charts, by which characteristic of currents in observed area can be understood according to variation of seasonal tide and tidal current , and also publishes Korean Marine Environment Atlas including temperature, salinity, water color, etc. in the Korean Coast.

2-5. STATUS OF CHART PRODUCTION FROM 1999 TO 2001

KHOA has published not only new edition of chart based upon updated information obtained by revision survey and regular surveys, but also new chart which is caused by establishment of new port and user's demands. It has provided users with updating information for revision of chart via weekly based Notices to Mariners, and also publishes about 100 charts per a year including updates like depth changes by reclaiming works, reprint of chart.

Type \ Year	1999	2000	2001
New chart	6	5	1
New edition	37	25	16
Reprint	23	36	53
Block chart	32	31	35
Total	98	97	105

3. ELECTRONIC NAVIGATIONAL CHART (ENC)

KHOA joined in digital chart production since chart computerization system was introduced in the end of 1994, and on 5-year project since 1995, KHOA commenced its project and completed 205 ENCs using international standard S-57 Edition 3 until 1999, and has distributed it to users from 2000.

Year	Main Contents	Remarks
1995	- Development of standard specification - Test production of ENC and its development	Standard DX-90 Format
1996	- ENC production of 60 charts	Standard S-57 Edition 3
1997	- ENC production of 105 charts	
1998	- ENC production of 40 charts - Development of ENC distribution system	
1999	- Sea trial of ENCs - ENC Update	

4. FUTURE PLAN

4-1. CHART PRODUCTION USING WGS-84

Although KHOA have published charts based upon TOKYO Datum, All vessels obtains positions based upon WGS-84 using GPS system. In Korea, there are 300-400m gap in position between Tokyo datum and WGS-84. Therefore there is the possibility of marine accident due to erroneous plotting of position and for the prevention, KHOA is planning to publish WGS-84 based charts.

4-2. DIGITAL CHART PRODUCTION FOR SMALL VESSELS

ENCs based upon IHO S-57, has been mainly used in ECDIS installed in the larger vessels and KHOA will distribute digital chart for Electronic Chart System (ECS) to 90 % of domestic vessels in Korea.

4-3. CHART PRODUCTION FOR SMALL FISHING VESSELS

KHOA is also planning to publish 470 charts, which describe limitation of fisheries agreement for those vessels, which will be convenient to use it even in small space.

4-4. PRODUCTION OF BASIC OCEANOGRAPHIC MAPS AND THEMATIC MAPS

KHOA progresses a database establishment project for oceanographic geographic information in order to produce basic harbor, coastal and oceanographic maps which is necessary to comprehensive management of the national jurisdictional area and based upon the establishment, various thematic maps such as coastline information map, beach information map, marine environment information map, coastal prevention information maps will be published and distributed.