

14th General Assembly

National Report

International Cartographic Association

2011, Paris

A map of Iran is centered on the page, with its edges appearing as if torn from a light blue background. The map is white with a light blue outline. The text 'I. R. IRAN' is printed in large, bold, dark blue letters across the center of the map. Surrounding the map are labels for the Caspian Sea to the north, the Persian Gulf to the south, and the Oman Sea to the southeast. The entire background of the cover is a repeating geometric pattern of interlocking stars and polygons in a light blue color.

CASPIAN SEA

I. R. IRAN

PERSIAN GULF

OMAN SEA

National Cartographic Center

National Report

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*Wherever maps communicate with international language;
books and libraries keep silence with respect.*

Late Mobarham Pourkamal

Introduction

Iran is a country with the area of about 1,650,000 square kilometers that contains a great topographic diversity and 2500 km coastline. The National Cartographic Center of Iran (NCC) is the main authority for production of maps and spatial information under Vice President on Planning and Strategic Supervision. It has more than half a century of experience in this respect.

The latest technologies for mapping and spatial information production are utilized by NCC experts. This organization undertakes supervision and technical control of mapping and spatial information projects based on the quality management system copying with ISO 9001-2000. These projects are carried out by NCC and other public and private mapping sectors. Production of base maps at 1:25,000 scale, marine charts at both 1:25,000 and 1:100,000 scales, design and establishment of National Geodetic Control Points as well as Geodynamical Networks, establishment of national, regional, and urban spatial information databases, production of small scale base maps at 1:50,000, 1:100,000 and 1:250,000 scales and production of National Atlases are some of NCC accomplishments. The development of surveying and mapping in the last half century in Iran has faced considerable challenges in different aspects. This was not possible without great efforts of spatial data producers and users as well as

people in research and education area. The issues such as growing demands for cartographic products, great interests in GI Sciences education, revolutionary movement towards digital technology, standardization efforts in this field and popularity of GIS and remote sensing applications have accelerated the development of GI Sciences in Iran.

In the field of mapping and geographic information which are needed by decision makers and general users, mostly governmental organizations concentrate their efforts on small-scale base maps of the whole country. Other governmental surveying offices and private sectors are mostly involved in high resolution geographic information productions needed for national and provincial projects.

Also, most of researches in the fields of photogrammetry, remote sensing, GIS and digital mapping have been carried out by national organizations, institutions and universities. However, a few private companies have also made remarkable researches on the commercial products and services.

Topographic Maps

Topographic maps are one of the most important tools for decision making and planning in an extensive country like Iran. This is a vital issue during the time that the country is confronting with a large, disperse population. On the other hand, topographic maps are necessary to exploit rich natural resources in Iran. Also the globalization trend has increased the level of life expectancy, life style and rate of developments. All of these requirements have caused government to pay more attention to the improvement of infrastructures required for sustainable development.

It is important to note that topographic mapping is an endless, time consuming, labor intensive and cost effective task. The current situation of topographic map production shows a dramatic change in maps available to the users. The change is not only in terms of number of map sheets, but also the laws of independent user access to geographic information have been revised.

Topographic mapping are produced in two different approaches. The most common approach is using digital photogrammetry techniques, and generalization from available maps is the second approach. Large to medium scale (1/2000, 1/10000, 1/25000) topographic maps are produced by using the first approach and smaller scale maps (1/50000, 1/100000, 1/250000, 1/750000) are produced by generalization.

The following map series have already been available to the users:

- 1/2000 map series of cities and towns:

Due to the privatization policy of government, the compilation of these map series has been assigned to private sector. Therefore NCC has been responsible for management, aerial photography, triangulation, and supervision of this task. A total number of 1026 cities and towns are mapped in this project. Currently, 3224 sheets from 800 cities and towns have been completed. The project details are as follows:

Photography Scale: 1/5000,	Camera Focal length: 150-300mm,
Flying Height: 750-1500 m,	Planimetric Accuracy: 1:1000,
Counter Interval: 1m,	Project Duration: 5 years.

- 1/25,000 scale base map series:

In 1991, The Iranian Parliament assigned to the National Cartographic Center (NCC) of Iran the production of base map series at scale 1:25000. The purpose of these map series was to fulfill the need for rebuilding the country in the post war era. The whole country was divided into 132 blocks containing 96 sheets in each block. The total number of sheets is about 10000, considering some blocks near the borders that contain some parts of Iranian territory. Production of these maps started in analog format and 549 sheets were produced while the rest switched to digital form. Maps of border areas were produced by using satellite imageries due to the restrictions for aerial photography. Satellite images of SPOT5 HRG together with SPOT5 HRS DEM have been used in this respect. 9041 digital map sheets, covering the whole country, have been produced by the end of Sept. 2010. This program consists of the following phases and characteristics: aerial photography at 1:40,000 scale, film development, photo printing, aerial triangulation, stereo plotting, graphical editing, stereo checking, graphic processing, NTDB (National Topographic Data Base) and cartography. Other project details are as follows:
photography scale: 1:40,000, camera focal length: 150mm
flight height: 6000 m,
contour interval: 10m

- 1:50,000, 1:100,000, 1:250,000 scale base map series;
These map series are produced by generalization of 1:25000 scale map series.
2146 sheets at 1:50000, and 80 sheets at 1:250000 have been derived.

Atlases

Atlases are one of the essential tools for researchers and decision makers for studying specific subjects. In June 1992, the government officially assigned the National Atlas Project to NCC. The project began with a number of meetings at NCC for the purpose of consultation between experts working in different fields. At the beginning, uncertainty of other organizations about the aim of national atlas, its information characteristics and their responsibility towards it, were factor of major concern. Thus, project divided in two phases:

- In the first phase the aim was production of one volume including all available subjects as General Atlas. This phase was named as assessment in which not only NCC examined its own abilities and needs, but also other organizations were familiarized with the atlas and its advantages.
- In the second phase, more detailed information was provided for policy makers, scientific, academic and research centers, by producing specific-purpose atlases in 19 volumes. In order to increase clarity of data, these atlases were a combination of maps, graphic, diagrams, and texts; contrary to the General Atlas which was consisted of maps and diagrams alone. The subjects which are covered by these atlases are indicated in their titles as: Population, Health, General Education, Higher Education, Geology, Agriculture, Communication, Industry, Animal Husbandry, Energy, Transportation, Handicrafts, Tourism, Cities, Environment, Workers, Commerce, History and Maps.

The project was completed in 2002. Since it was in great demand by users, continuous updating of these atlases becomes part of NCC's responsibilities. The subjects which have been updated so far are: Population, Agriculture, Health, General Education, Higher Education, Geology, Industry, Animal Husbandry, Energy, Transportation, Labor.

With the movement towards digital production and digital usage, published paper atlases do not fulfill current user needs. Therefore PDF versions were immediately produced. Currently, the atlases are prepared to be delivered more interactively through the World Wide Web.

Thematic Maps

Thematic maps produced by GI Science community facilitate interrelated different disciplines. They present derived information from different sources, and combine different topics with spatial reference in an understandable and meaningful manner for variety of users. Due to the wide spectrum of map users and interests, thematic maps can play an important role in sustainable development.

One of the main target groups for thematic mapping activities are tourists who need specific information for their own purpose based on locations. In the past, due to the low state of tourism and limited number of visitors, there were few private companies producing thematic maps. Nowadays, with the growth and importance of the tourism industry and continuous increase in the number of tourists, the private sector is not able to meet users' requirements. In the past decade, NCC, as the main organization responsible for mapping activities, has undertaken this task to produce high quality up-to-date maps for the whole country, including provinces, cities and ... , as:

- General Map of Iran in 1:1000000 Scale,
- General maps of provinces, at different scales ranging from 1/300,000 to 1/600,000,
- Strip maps of important transit routes,
- Iranian road map at 1:2500000 scale,
- City Guide Maps of important cities,
- Atlas of Tehran at 1:15000 scale,

- Seismic hazard map,
- Strategic statistical maps for different purposes,
- 3D models of provinces and different parts of Iran.

Charts

Charts are known as one of the oldest cartographic products. Regarding the geopolitical characteristics of Iran, charts have been considered as a remarkable tool for development. This is because of two important facts: first, due to Iran's long coastline along the Persian Gulf and Oman Sea, and second, that Iranian air space is the most commonly used route for flights from east to west and vice versa. Therefore, two types of charts are being produced:

- **Hydrographical Maps & Navigational Charts;**

Due to the fact that both Persian Gulf and Caspian Sea are high potential areas for oil & gas production, hydrographic maps are essential for navigation, research, exploration and extraction. Therefore, NCC has been equipped with hydrographic ship, IRAN-ABNEGAR, with professional equipment for bathymetry and positioning. In addition, there are several hydrographic boats working along the coast of the Persian Gulf, Oman Sea, and Caspian Sea. The main hydrographic map series are as follows:

- 1- Digital Nautical Chart of Persian Gulf and Oman Sea:
 - I. 84 completed, 26 undergone at scale 1:25000 and larger
 - II. 18 completed, at scale 1:25000 to 1:100000
 - III. 30 completed, at scale 1:100000 and smaller
- 2- Digital Nautical Chart of Caspian Sea at scale 1:25000 and larger:
 - I. 32 completed, 11 undergone

- II. 1 completed, at scale 1:25000 to 1:100000
 - III. 7 completed, at scale 1:100000 and smaller
- 3- Electronic Navigational Charts of Persian Gulf and Oman Sea:
- I. 32 completed
- 4- Electronic Navigational Charts of the Caspian Sea:
- I. 3 completed
- 5- International Charts Persian Gulf and Oman Sea:
- I. 10 completed
- 6- Tidal observations Persian Gulf and Oman Sea:
- I. 15 permanent tidal stations
 - II. 50 temporary tidal stations

- **Aeronautical & Obstacle Charts;**

The most commonly used aeronautical charts are published by Jeppesen Co. However, these charts are usually not up-to-date due to the continuous changes of routes in Iran. Therefore, Civil Aviation Organization (CAO) had to publish several corrections in text format which were describing changes according to maps delivered by Jeppesen Co. The information is not very well defined for pilots who are flying among Iranian airports. Since 1997, a joint project between NCC and CAO has been defined for production of Iranian Aeronautical Charts at 1:2200000 scale. Then, production of obstacle charts has been added to this project.

Image Maps

Image mapping, although known as a new product, has a long historical record that goes back to the invention of aerial photography. In the past, the image maps produced using conventional aerial photography and analogue photo rectification techniques, which were called photomaps. About two decade ago with commercialization of high resolution satellite imagery, map production using these images brought forth products including natural visible objects, infra-red and ultra violet information of earth features. These products were mostly small scale image maps which were suitable for general environmental studies. Today, with accessible high resolution remotely sensed data, there has been revolutionary increase in demand for different types of image maps in Iran. Due to the characteristics of image maps and high initial investment needed for obtaining these products, projects are prepared on request considering the coverage which is not nationwide. Major accomplished projects are as follows:

- Coverage of oil and gas potential areas in south west of Iran using Spot images.
- Image maps of 400 Cities using IKONOS images.
- Satellite orthoimage map of Saari, Kermanshah, Ilam, Orumiyeh, Ardebil, using SPOT Stereo images.
- Cadastre map of Shalmanrud cultivated areas, using orthophoto at 1:10,000 scale (aerial photographs).

- Tehran ortho-image map using DK2 Russian satellite imagery (2m pixel size, Panchromatic mode), published in 35 sheets and at 1:10,000 scale.
- Drought monitoring in Iran using NOAA data, done by Iranian Remote Sensing Center

Cadastral Maps

Cadastral maps, known as land registry maps, deal with ownership. These maps are large scale, with a considerable amount of attribute data. Since the land titling or land registration does not fulfill current requirements of today's complexity of ownership, having a fully digital information system is inevitable. Dramatic population increase and urbanization in caused unbelievable increase in parcel value. This raise the importance of sophisticated cadastral systems and a comprehensive mapping project, even at larger scale than for base map projects. In order to prepare such a system, a comprehensive cadastral project has been decided which is detailed below:

The scale of cadastral maps is 1:500 or 1:1000 in the cities and 1:1000 or 1:2000 in the agricultural areas, based on density and land value. It also has been decided to collect extra data such as contour lines at a 25 centimeter interval, with an enormous wealth of detailed information which allows the preparation of a GIS at 1:1000 scale. The procedure is similar to which is used to prepare the 1:25000 map scale for the country. Further information regarding the registered documents from the beginning of the project to 2011 is as follows:

- About 148000 Land registry books
- About 145000 Land registry books have been entered into Data Base
- Over 750000 hectares corresponding 90000 map sheets at 1:500 scales have been mapped for cadastral purposes

- Cadastral map production of about 1200000 hectares of urban areas is in priority

The cadastral maps produced by the end of 1996, includes around 71 features with 270 fields in database. Since then, only 4 features with a few fields in database are included on the maps for legal purposes.

These cadastral maps will not cover the entire country and it will be limited to populated areas and agriculturally viable lands. Regarding large extent of Iran, completion will take a long time.

It should be noted that the GIS office within the Municipality of Tehran, also prepare 1:2000 map scale for own purposes. It will be integrated with cadastral activities in Tehran.

Geological Maps

Geological maps present necessary fundamental information for any constructional and development activity. Geological science has been used by ancient Iranian engineers. King Darius established a canal in Egypt about 2500 years ago. This has been documented on an ancient stone written in three languages (Persian, Ilamian and Egyptian) in Cairo Museum, which was discovered 33 kilometers west of today's Suez Canal. Due to the existence of huge mineral resources and also the seismic characteristics of Iran, great attention has been paid to geological studies. The Geological Survey of Iran is the responsible organization for geological map production. The projects which have been done or are under execution are as follows:

- Complete coverage of Iran at 1:250,000 scale have been completed.
- Huge number of geological maps at different scales was printed using traditional map publishing technology.
- Coverage maps of Iran at 1:100,000 scale are nearly completed and 431 sheets (covering 90% of country) has been printed with digital mapping techniques. The remaining parts are desert and border areas.
- Coverage maps of Iran at 1:25,000 scale have begun since 2010, and 20 sheets has been printed with digital mapping techniques.

Geodetic Works

Geodetic works are a base for all mapping activities. Iran is a comparably large country and consequently, a great effort is needed to cover the whole area with necessary horizontal and vertical reference points. NCC provides the following data in this respect:

- Iranian Permanent GPS Network (IPGN), With 118 permanent GPS receiver, is established for better understanding of tectonic deformation and estimation of future hazards. IPGN consists of two parts: a base network covering the entire country, and three local networks. The base network, consisting of 41 GPS stations, has been established in areas of main tectonic activity: the Zagros Mountains, Central Iran, Alborz mountains, East of Iran, Makran, Loot and Kopeh-Dagh. The remaining receivers were used to create three local networks in the most densely populated and active zones. The main task of the GPS stations is to collect and store raw GPS data and send it to the main processing center in Tehran on a daily basis for final processing.
- Local Geodetic Networks, which are established to monitor land movements in populated and highly active zones. Earthquakes in these areas would heavily endanger many economic, social, cultural and industrial activities. Established local networks are:
 - Tehran with 31 permanent GPS stations, some of them are belonged to the Base Network,

- The Eastern and Western Azerbaijan and Ardabil with 25 permanent GPS stations and,
 - Northern Khorasan province with 29 GPS stations.
- National Geodetic network, including;
- Zero order network, consists of 10 stations with distribution of the whole country by use of two frequency GPS receivers. It is connected to IGS International Network in order to correct the first order geodetic network.
 - First order geodetic network consists of 242 stations,
 - Second order geodetic network with 2607 stations with the spacing of 20 to 25 kilometer between points. It has been established inside the first order network, in order to increase the availability to the stations. and,
 - Third order geodetic network with 4000 stations which are established in populated areas with 8 to 15 kilometer distance between them.
- Campaign GPS networks for geodynamics studies, with about 250 stations carried out during inter seismic period in order to obtain the slipping rate of the active faults. Besides, the potential of earthquake caused by each individual fault can be studied. The results are used for better understanding of seismic hazards in Iran. All measurement were done by dual frequency GPS receivers and choke ring antennae and then processed by Gamit/Globk software.
- National DGPS Network is an enhancement to GPS that uses a network of fixed, ground-based reference stations to broadcast the range corrections to the rover stations. Thus, the difference between the known fixed position and the position obtained by GPS satellite data is calculated at the rover station. This network has recently established with limited coverage (only in large cities) while is being intended to cover the entire country. Accuracy of point positioning by GPS is about 3-10 m now, which will be improved to 1m using DGPS.

- National Leveling Networks, which are established along the roads, including about 32000 benchmarks of:
 - First order network (33500 km, established and measured 3 decades ago, and recently re-leveled),
 - Second order network (32400 km),
 - Third order network (31000 km) and,
 - Precise leveling networks for geodynamic purposes (6000 km).

- Gravimetric networks, consist of:
 - Zero order network with 29 stations (measured in absolute sense by FG5),
 - First order network with 700 stations , containing their gravity (tied to the zero order network in relative sense), coordinates (measured by GPS) and orthometric height (precisely leveled from national leveling network benchmarks),
 - Second order network with 2100 stations (tied to first order network in relative sense, GPS and precise leveling) and,
 - Third order network with about 20000 points which are measured by relative gravimeters and GPS for obtaining their gravity and coordinates respectively.

Activities on National Databases

NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI)

Since 2005, a comprehensive study of national SDI has been performed and the National SDI strategic plan was developed. In order to implement NSDI in Iran, “National spatial information composition” was composed with addressing to different sectors related to spatial information in the country, and the implementation of NSDI has been entrusted to Higher Council of Surveying and Mapping (HCSM) by Vice Presidential decree in June 2010. The HCSM appointed NCC to conduct SDI implementation and cooperation in local and national levels.

NATIONAL TOPOGRAPHIC DATABASE

Due to information content, completeness and coverage extent, there is a great demand for use of 1:25000 base maps as a base for the Iranian National Geographic Information System. Therefore, NCC has been assigned by the government to be the coordinator of all GIS activities in Iran. To fulfill this task, NCC created National Topographic Database, based on 1:25000 scales. The standard was published in 1994 in 5 volumes which included the basic conceptual model. This model has been defined in such a way that all GIS users in Iran are able to use it as a base model and enable them to expand any parts of it, according to their project specifications, without any reconstruction of NTDB. All of the produced 1:25000 maps have been input to this database.

NATIONAL GEO-DATABASE

A one-size-fits-all approach has repeatedly proven to be ineffective since different data providers have different technical requirements that limit accessibility to the data. For this reason, NCC has designed and developed a comprehensive, enterprise, and nationwide Geo-database which support multiple applications.

The Geo-database contains above 160 seamless feature classes (a.k.a. themes or layers) of digital topographic datasets for Iran. These feature classes represent the seamless integration of more than 9400 traditional map data files in vector (e.g. roads, flood zones, city limits, etc.) at 1:25000 scale, imagery (e.g. satellite imagery, digital geosciences maps. etc.) and grid (e.g. Digital Elevation Models, etc.) formats.

NCC is also developing a spatial data clearinghouse as part of the national spatial data infrastructure.

NATIONAL GEOGRAPHIC NAME DATABASE

Attribute data collection is a major activity in revising, compiling and preparing base maps and developing NTDB. One of the essential attributes is geographical names which is the base information for most of the map features. Due to the fact that names of places or features are changing during times, there must be a complete record of these changes to enable evaluation of name certainty. NCC has undertaken this task to setup a database dedicated to geographical names. The minimum feature selection has been defined based on existing features in 1:25000 scale map series. This database includes names ratified by the Interior Ministry, their Toponymy, local names, previous names, altered names of human habitats and geographic features. Another important point is Persian language and Toponymy of Persian names with Latin alphabet. NCC has defined a standard for this database and a field feature identity booklet has been published. More than 110000 geographic names are input the database. They are attributed to above 200000 features that cover 90 percent area of the country. This information is available to the users via WWW in different ways.

Digital Elevation Model

Representation of Earth relief was one of the key elements of any topographic mapping activity and also many other products, which use elevation data. Digital Elevation Model or the digital methods of storage and representation of relief and its applications to a large extent have merged with decision making support systems since computerization of those disciplines and fields. Most probably, DEM is one of the most commonly required data by the Geoinformation user community. Nowadays, suitable actions and proper decisions in any construction activity, even underground, cannot be made without relevant elevation information. DEM is a multi-purpose product, for example, the same set of data may be used for finding the best location for telecommunication antenna and mobile network analysis, and those same set of data can also be used for water shed management. DSM (Digital Surface Model) is another type of DEM which also presents height of buildings in urban area. It is utilized mostly for telecommunication applications. Hill-shading is a sophisticated cartographic presentation of DEM which can make a better looking maps with more understandable height visualization. Some of Iran's nationwide projects in DEM & DSM generation are as follows:

- DEM generation with 10 meter spatial resolution and national coverage, using topographic information from 1:25,000 scale map series, by NCC. It began in 2001, and at the present, more than 90% of the country is covered by it. It is worth noting that, SPOT-HRS images with 1 arc second (about

20m) resolution , and 8-12m accuracy within 90% confidence level, have been used for the DEM extracted for border areas.

- 3D data base for mobile network design with 100 m resolution and national coverage, using stereo satellite images and 1:250,000 scale map series.

- Hill-shading production for different thematic maps.

Education & Academic

There are Bachelor of Science courses in cartography in almost all geography departments in state and open universities. But there are no Master or PHD courses in cartography. Even in surveying engineering universities that geospatial sciences are more on consideration, post study courses in cartography as a presentation part of geospatial data processing, attention has not been located yet.

To solve lack of expert labors, NCC has its own Surveying College. This college in addition to its duty for education of necessary technicians for mapping projects has specific short courses for NCC staff and outside applicants. These courses are intended to update participants knowledge to the latest technology.

Other Activities

NATIONAL GEOINFORMATION ACTIVITIES OF MINISTRIES

Ministry of Road and Transportation:

- Positional and attribute data collection of 80000 Km of roads and 300 utility points
- Implementation of National Road and Transportation System

Ministry of Power:

- Positional and attribute data collection of national power network
- Implementation of National Geo based Power Management System.
- Prototyping of National Power Distribution Plan in 5 provinces.
- Design and implementation of power industries metadata as a part of NSDI.

Ministry of Agriculture:

- Land coverage extraction of whole country from MODIS satellite Images.
- Production of 1:1000, 000 Soil resources and potentialities map of Iran.
- Production of Soil moisture and temperature regimes of Iran.

NATIONAL COUNCIL OF GIS USERS

As mentioned, NCC is the coordinator organization in National GIS and activities related to NSDI. One of the necessities of its duty is to define

users and their information and interaction requirements. Any information system should meet the needs of the producing organization and also the working requests of users that it supports. The interaction with users of information systems implies that the user determines the usefulness of the system. Therefore, NCC has established a National Council of GIS Users (NCGISU) to collect user needs and to interact with them. Members of NCGISU are representative of all related ministries, and the Council has provincial branches in all provinces. Each provincial committee reflects its needs to the NCGISU and soon after discussion and improvement it will be considered by NCC to provide required changes.

The NCGISU has held 188 sessions and provided a five year strategic plan for 2010-2014. Eleven committees have been defined to execute the works of the council in this plan. Creation of spatial database for main cities is one of the main tasks of the provincial councils. The NCGISU website with URL; NCGISU.ncc.org.ir has been launched this year.

GEOMATICS CONFERENCE & EXHIBITION

One of the most important activities and comprehensive gatherings within the GI Science community in Iran is the annual Geomatics Conference & Exhibition of NCC. All active organizations, academic centers, private sectors and individual specialist in all related subjects gather together within this great event to share their knowledge and experiences with each other.

Next conference which is 19th National Geomatics Conference will be held along with 2nd International Conference on Mapping and Spatial Information (ICMSI) on May 2012 in Tehran.



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