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Effective use of space-based information to monitor disasters and its impacts
Lessons Learnt from Drought in Iran
prepared by Iranian Space Agency (ISA)

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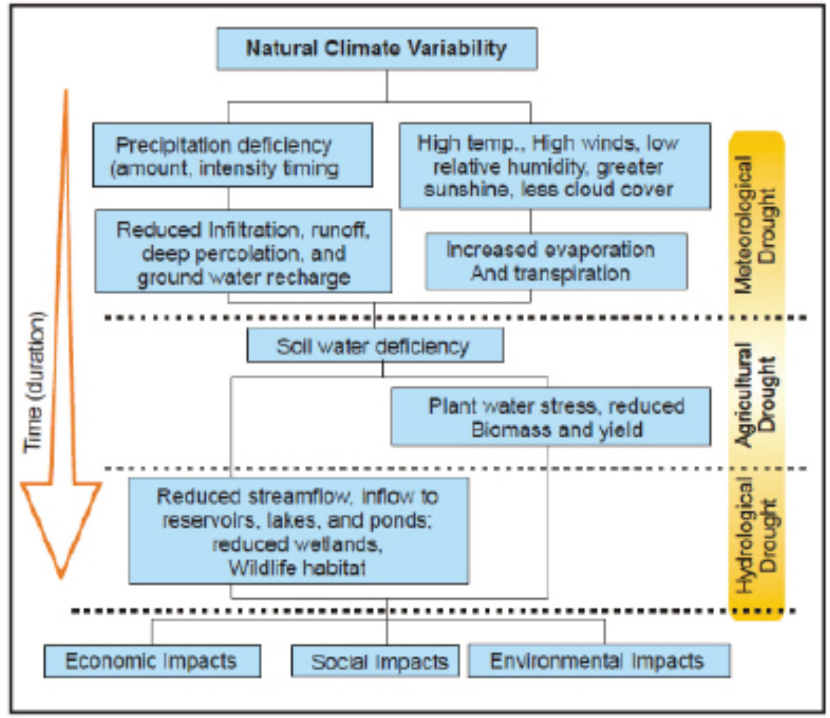
1. Drought in Iran

Drought can be defined as a temporary climatic anomaly with no rain, especially during the planting and growing season. It is one of the most complex and least-understood of all natural events and affects more people than any other hazard. In contrast to the effects of floods, earthquakes and hurricanes, the damage created by drought is usually nonstructural, but is spread over a larger geographical area. Its effect accumulates slowly over time and lingers for years. Since the onset and duration of drought is difficult to determine; people generally are not fully aware that they are in the midst of such an event.

Vulnerability factors such as an under-developed infrastructure, lack of facilities, absence of authority, lack of communication between political and economic systems, ineffective markets, lack of social benefits, and inadequate institutional support contribute to the negative effects of drought on a country-wide scale. High population growth, urban development, expansion of deserts and deforestation are additional factors that intensify drought. The effects of drought can occur months or years



Sequence of drought impacts
Source: National Drought Mitigation Center, University of Nebraska-Lincoln

habits, deteriorating air quality and increased soil erosion.

The economic, social, environmental, and psychological effects of drought are the products of both the natural event (meteorological drought and lack of precipitation over an extended effects of drought on a country-wide scale. High population growth, urban development, expansion of deserts and deforestation are additional factors that intensify drought. The effects of drought can occur months or years after the drought has ended. These effects are largely nonstructural and are spread over a larger geographical area than those from other natural disasters. The nonstructural characteristic of drought hinders the development of accurate, reliable, and timely estimates of severity.

Drought affects lives and communities in three major ways. The economic impact of drought includes losses to the timber, agriculture, and fishery industries. Much of this loss is passed on to the consumer in the form of higher prices for commodities. The social impact of drought includes increased likelihood of conflict over commodities, fertile land, and water resources. Other social effects are the erosion of cultural traditions, loss of homelands, changes in lifestyle, and increased threats to health from increasing poverty and decline in proper hygiene. Environmental impacts of drought include loss of species biodiversity, changes in migratory

The economic, social, environmental, a
psychological effects of drought are the produc
of both the natural event (meteorological droug
and lack of precipitation over an extend
period of time) and the vulnerability of socie
to the natural events. In other words, the effec
of drought are determined by the frequency a
intensity of drought and by the number of peop
at risk and the degree of risk.

Iran is heavily affected by drought events w
a particularly severe one occurring from 199
2002. This drought inflicted $3.5 billion
damage, killed 800,000 head of livestock a
dried up major reservoirs and inland lakes. Th
resulted in a decrease in cultivation and in t
yield of cereal crops. Since that time, most rive
in the country are either dry or severely deplete

The Zayandeh-rood River was once a ma
water artery running through the historic city
Isfahan. It was a thoroughfare that nourish
some of the earliest civilizations in record
history and sustained the people of Isfahan up
modern times. For the past two years, the riv
has been bone dry. Its banks have not recede

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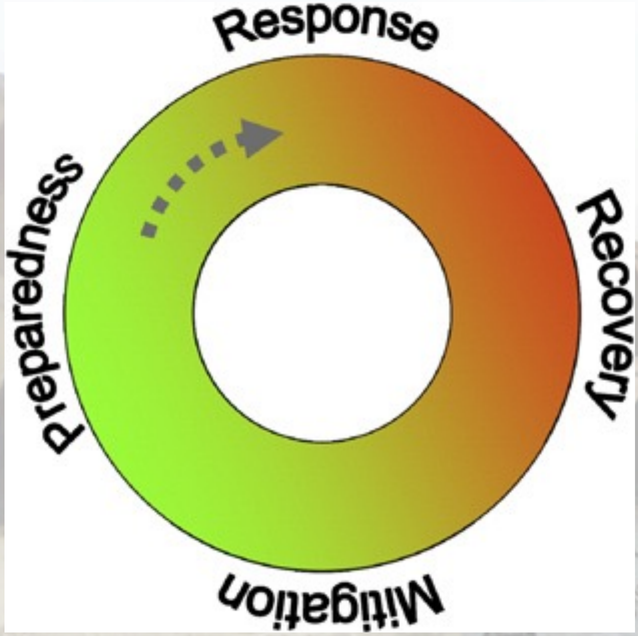
Section2:Earth Observation in the Drought Management Cycle

-The information needs of response agencies at different stages of drought management.

-Mitigation
-Preparedness
-Response
-Recovery



Drought Management Phases

2.1 Mitigation

Mitigation is the most important function for bringing disasters under control. This refers to long-term measures that decrease risk, such as the development of technological solutions, legislation, land-use planning, and insurance. Drought mitigation should prevent or decrease the effect of drought. It calls for strategies such as construction of reservoirs, conservation of existing water sources, optimizing the use of water, altering farming practices, and desalination of water.

A comprehensive and systemic plan to mitigate drought is required to understand the causes, effects and management mechanisms of drought and to select and design an appropriate approach based on location-specific circumstances. The main objective of any drought the effect of drought. It calls for strategies such as construction of reservoirs, conservation of existing water sources, optimizing the use of water, altering farming practices, and desalination of water.

A comprehensive and systemic plan to mitigate drought is required to understand the causes, effects and management mechanisms of drought and to select and design an appropriate approach based on location-specific circumstances. The main objective of any drought mitigation plan should be to enhance drought risk management through development of fundamental drought information tools. Such a plan must make use of currently-available meteorological, climatic and remote sensing data that can be used to generate information products relevant for drought risk management.

Geospatial tools allow effective integration and modeling of data from parameters such as

2.2 Preparedness

Disaster preparedness focuses on developing plans to respond to a disaster as it threatens to occur. At its simplest, preparedness is an estimation of emergency requirements and their mobilization in time to meet urgent need. Disaster prediction (long-term) and disaster warnings (short-term) are prerequisites to ensuring disaster preparedness.

Preparedness for drought necessitates greater institutional capacity at all levels of government and efficient coordination between stakeholders. Drought preparedness implies increasing the coping capacity of individuals and communities to deal with drought. Drought preparedness planning should also provide significant benefits for the act of preparing for potential changes in climate. In the drought preparedness phase, geospatial information can be used for drought monitoring, prediction and early warning.

2.3 Response

Disaster response is an activity that addresses short-term and direct effects of an incident. These activities include immediate actions to preserve life, property and the environment, meet basic human needs, and maintain the social, economic, and political structure of the affected community. Response also includes the execution of emergency operations plans, mobilizing emergency services and incident mitigation activities designed to limit loss of life, coordinating search and rescue, and assessing personal injury, property damage, and other unfavorable outcomes.

The provision of space-based products and services such as maps, satellite imagery and geographic information that shows the extent and degree of damage (mapping the extent of the damage) and identification of suitable sites for rehabilitation is important for response and humanitarian aid agencies. The products generated from space-based information minimize possible harm caused by a disaster.

2.4 Recovery

The objectives of the Emergency Drought Recovery Project are to alleviate the impact of current drought through measures to regenerate crops and livestock productivity, improve rural roads and potable water supplies to generate current income for affected populations. It will

Iranian Drought Monitoring Checklist

Meteorological Data

Agency: Islamic Republic of Iranian Meteorological Organization (IRIMO)

Monitored Indices: Daily, weekly, and monthly rainfall, snow fall.

Hydrological Data

Agency: Ministry of Power

Monitored Indices: Water storage in reservoirs/ponds/lakes, river flow, groundwater level, yield and draft from aquifers, water loss through evaporation, leakage, seepage.

Agricultural Data

Agency: Ministry of Agriculture

Monitored Indices: Soil moisture, area under sowing and type of crop, crop water requirement, status of growth, crop yield, alternative cropping possibilities, land holdings.

Data from Space

Agencies: Iranian Space Agency, National Geographic Organization, National Cartographic Centers

Monitored Indices: Vegetation monitoring, rainfall, surface wetness and temperature monitoring.

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3. Space Technology Products and Services by Iranian Agencies

The products and experiences of major organizations in charge of drought management in Iran that use space technology are introduced in this section.

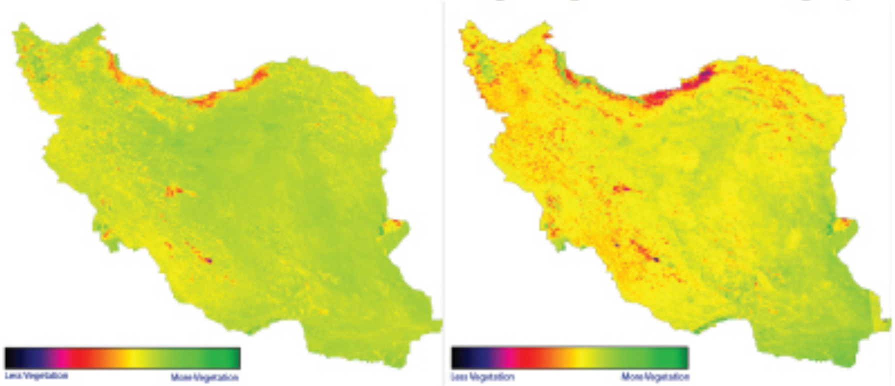
3.1 Drought Monitoring

The assessment of vegetation changes over time is an important factor in order to investigate drought impacts. Periodical compositions of vegetation indices and other climate indices produced by remote sensing data help to analyze drought effects visually as well as by statistical measures. Several agencies in Iran are providing these maps for provincial and national levels such as the Iranian Space Agency (ISA), the Fars Agriculture and Natural Research Center and the Isfahan Agriculture and Natural Research Center. They each focus on different regions or different effects of drought (see checklist).

Examples of monitoring systems based on drought meteorological indicators (e.g., standardized effective precipitation index) include satellite indices, rainfall estimates, soil moisture models and climatic/hydrological parameters such as precipitation, temperature, evapotranspiration, stream flow, and reservoir levels. Whereas climate data brings real-time information about the primary factors regulating climatological drought, remote sensing data, with its higher spatial resolution, provides better details concerning the land cover types affected and the effects of climatic drought on agriculture and natural vegetation.

Commonly-used remote sensing-based indices for drought monitoring include vegetation indices, surface temperatures and a combination of both. Traditional approaches to drought monitoring consider data from the NOAA-AVHRR data system. With the availability data from other satellites with advanced sensors capable of providing information on bio-physical and terrain parameters, remote sensing is better equipped to perform drought monitoring. The new generation of satellite sensors such as Visible Infrared Imager Radiometer Suite (VIIRS) on the National Polar-orbiting Operational Satellite System preparatory platform can provide more useful information for drought monitoring.

The three most popular VIs for drought monitoring among Iranian remote sensing experts



Drought Vulnerability Map of Iran for 1999 (left) and 2001 (right)

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Section 3. Space Technology Products and Services by Iranian Agencies

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are the Normalized Difference Vegetation Index (NDVI) and the Vegetation Health Index (VHI) to assess the condition of the vegetation and the Vegetation Drought Response Index (VegDRI), a hybrid product integrating satellite data and in-situ climate data.

Example Case 2001–2003 from Fars Province

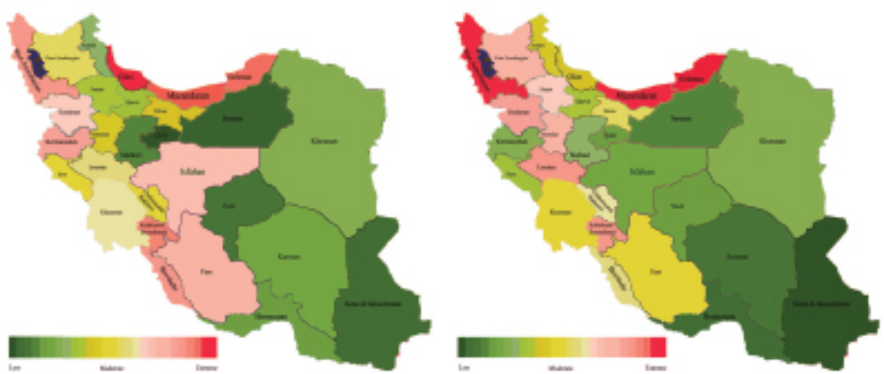
The province of Fars has experienced severe drought and ground water problems in the last decade. Ten-day maximum NDVI and VHI maps were produced. Remotely sensed data was then compared with hydrological and meteorological data from 1998 to 2007. The Standard Precipitation Index (SPI) was used to quantify the precipitation deficit and the Standard Water Index (SWI) was developed to assess the groundwater recharge deficit.

The SPI maps reveal that meteorological drought and stress appear mostly in the southern, central, and eastern parts of Fars province. The period from 2001 to 2003 appeared to experience severe drought. VHI maps show a high visual correlation with SPI, but the quantitative correlations for each county do not provide reliable results. When the scales of the parameters are different, weak correlations may develop when, in reality, one parameter is entirely dependent on another. A better and more meaningful picture is provided by spatial correlation through visual comparison instead of the use of correlation coefficients. This is especially true for events like drought, which have regional aspects.

The PDSI maps indicate good vegetation conditions for the majority of the study period. Good vegetation cover cannot be confirmed by looking at the precipitation-PDSI Pearson correlation or the precipitation-NDVI results. In arid and semi-arid climates where ground water is used for irrigation, vegetation cover is not simply related to the level of precipitation. A strong Pearson correlation between PDSI and SWI for the same month for the majority of counties in Fars province can be attributed to irregular water consumption by the region's farmers. The main cause of this kind of irregular water consumption is the government's "assurance purchase law" for agricultural products. If a region shows positive vegetation indices (as demonstrated by satellite images) despite being located in an arid or semi-arid region, it is possible that the actual precipitation and ground water resource conditions are misrepresented.

3.2 Drought Modeling and Prediction

A drought early warning system can provide decision-makers with timely and reliable access



Drought Damages Mapping in Iran by using NDVI (left) and VCI (right)

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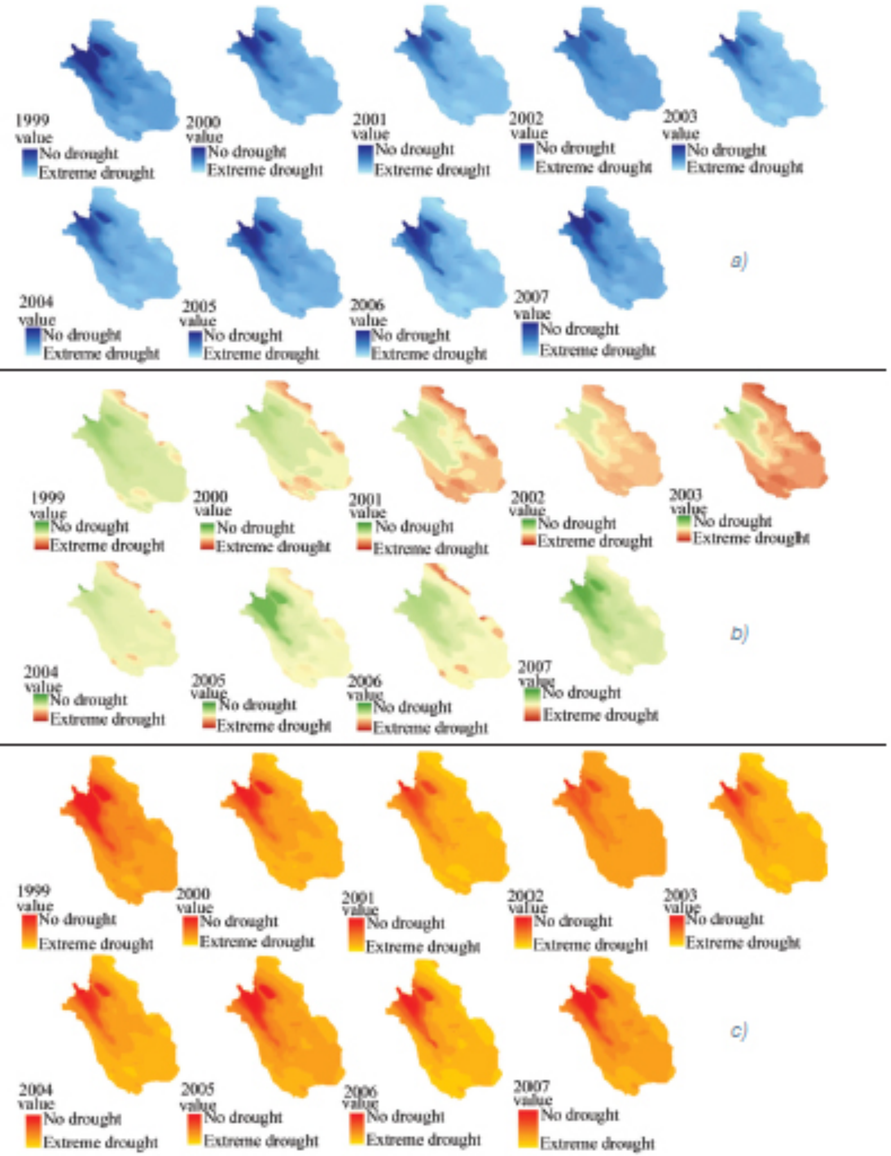
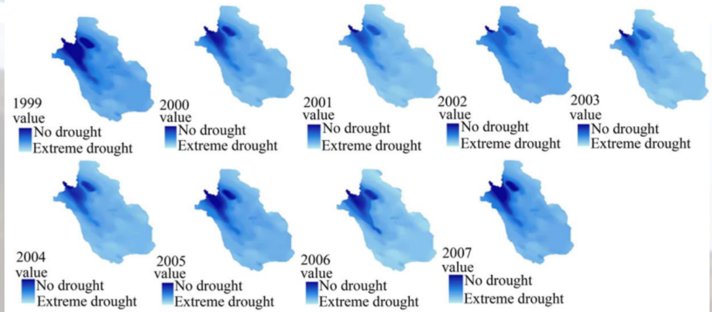


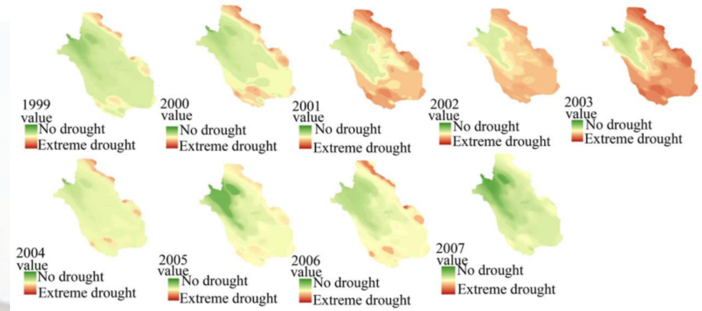
Fars Province: Visual spatial correlation between (a) SPI and (b) VHI during 1999 – 2007 (c) Drought Severity Classes map

3.1 Drought Monitoring

Example Case 2001-2003 from Fars Province

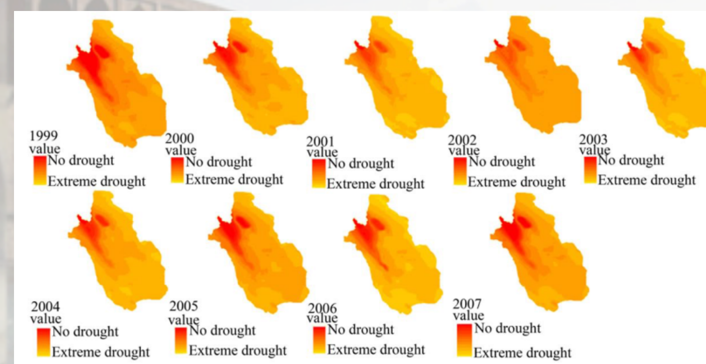


(a)



(b)

Fars Province: Visual spatial correlation between (a) SPI and (b) VHI during 1999 – 2007
(c) Drought Severity Classes map



(c)

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Section 3. Space Technology Products and Services by Iranian Agencies

3.2 Drought Modeling and Prediction

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to information with which to plan response and mitigation measures. The main objectives of a drought early warning system are:

- To provide early warning information about the onset of drought and its effect on food security to trigger timely responses
- To provide information on food availability during drought and plan timely and well-targeted responses to drought
- To build a reliable database of baseline information that can be utilized for local development planning

Effective drought early warning systems must integrate climatic parameters such as precipitation, stream flow, snow pack, groundwater levels, reservoir and lake levels, and soil moisture and remote sensing-based data. The remotely sensed data most frequently used for drought early warning include MODIS, AVHRR, Landsat, SPOT and IRS.

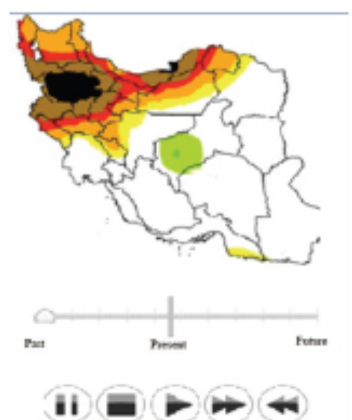
While monitoring has been carried out for decades, forecasting drought is still in its infancy. One challenge to drought prediction is that it does not have an obvious beginning or end. Researchers are currently developing methods of drought prediction using satellite data from meteorological, oceanographic and hydrological observations. These observations, combined with near real-time remotely sensed data, allow early prediction of drought that countries can use to develop strategies for agriculture, fisheries and the distribution of goods.

This is a blend of science and art as is carried out a national scale at the NOAA Climate Prediction Center in Maryland. The meteorologists there periodically produce a US seasonal drought outlook to predict conditions related to drought three months in advance.

Drought modeling using satellite data and artificial neural networks (ANNs) is also being carried out by the ISA. Drought prediction helps to better manage available resources and decrease damage from drought. The SPI is the measure most often used of those that quantify the severity of drought. It takes into account the precipitation index normalized for a period of 30 years. A major challenge for modeling drought using SPI is a lack of measuring stations in many places; this makes it impossible to monitor drought conditions for those regions. NOAA-AVHRR images are freely available and provide useful information on parameters such as land cover and vegetation.

Current research uses satellite images to forecast drought in Iran. Intelligent models have been considered and trained based on the time-series obtained for the period of 1978-2008. The proposed model used a number of satellite based features (NDVI based indices, Vegetation Condition Index and Temperature Condition Index) as input and the output was the drought condition characterized by SPI. The experimental results showed that the model successfully forecast drought with an accuracy of up to 90%. The TCI resulted in the best performance of the indices.

A web-based application was created to visualize the results and produce nation-wide forecast maps of drought conditions. The aim was to find the best satellite-based vegetation index for modeling drought, which was determined to be the TCI.



Web-based application for visualizing the results of drought prediction by Using ANNs

3.2 Drought Modeling and Prediction

Example Case from Iranian Space Agency

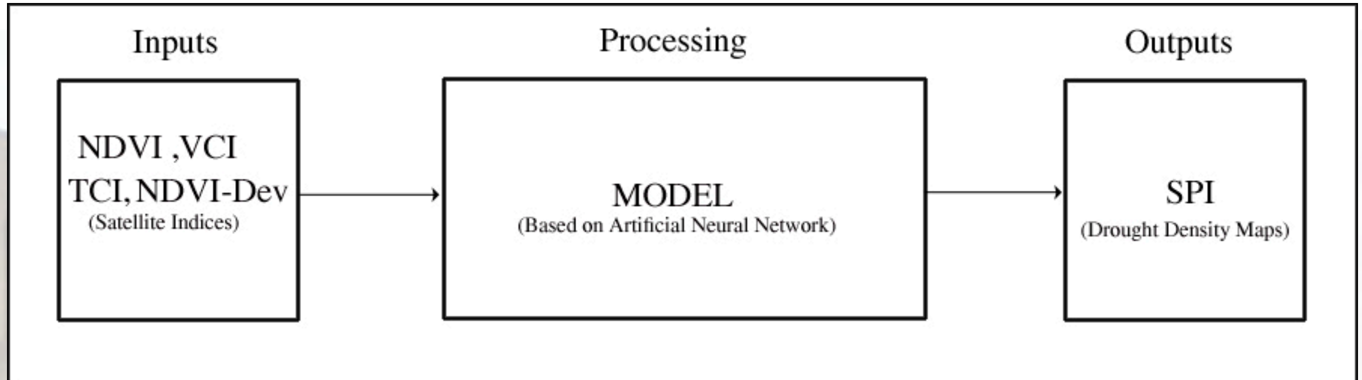


Figure (1)- schematic diagram of the model

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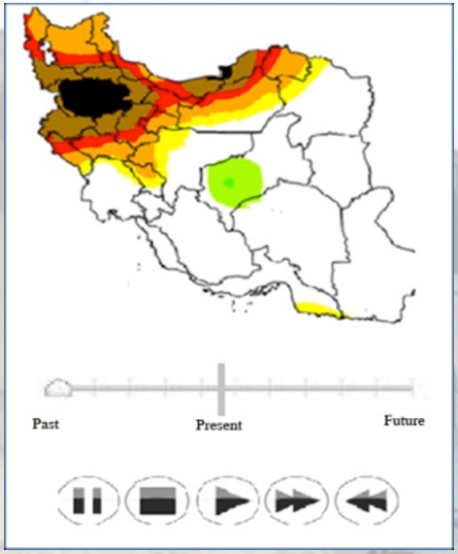

Web-based application for visualizing the results of drought prediction by Using ANNs

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3.3 Drought Assessment

Hazard and Impact Assessment

Drought hazard is expressed in terms of the probability of a drought event occurring in a given place during a given period of time. The availability of spatial-temporal datasets of drought indicators that allow the development of a historical catalogue of drought events is a major requirement for drought hazard assessment. Time-series of drought characteristics on different time scales should be obtained and analyzed to define the probability of drought given the characteristics of a specific region.

The effects of drought include the damage expected as a consequence of drought, which is better expressed in terms of the cost of damage to vulnerable systems such as water resources and crops. Remote sensing-based indicators are more efficient in terms of time and cost to assess the effect of drought. For example, high temporal resolution images such as those from MODIS and the advanced very high resolution radiometer (AVHRR) provide data for daily measurement of the vegetation index. The maps based on this type of data are used to monitor climatic and environmental changes such as deforestation, desertification and drought. The effects of drought hazard are important factors in drought risk assessment. The relation between drought risk, hazard and impact can be expressed as:

$$\text{risk} = \text{hazard} \times \text{impact}$$

Vulnerability Assessment

Drought vulnerability is a measure of the inability of a society or an ecosystem to cope with drought and is the sum of the effect of different elements of the system (e.g., water resources, crops). Drought vulnerability is related to the degree of natural and social adaptation to drought in terms of resistance and resilience.

EO satellites provide data that is relevant for assessment of agricultural and environmental vulnerability to drought. Since it is not possible in advance to know which time-scale is most suitable for monitoring drought vegetation conditions, the response times of the different vegetation types to water shortage can differ. Complete spatial coverage, good availability, accessibility, low cost, and high temporal and spatial resolutions are the advantages of the use of EO data for analysis of drought vulnerability.

The Ministry of Agriculture has recently proposed an agricultural drought risk assessment plan. The plan will decrease or compensate for agricultural loss based on measures of drought severity and duration. Current damage (based on monitoring methods) or subsequent damage (based on forecasting methods) will be evaluated in the short term (one to several months) and long term (3-5 years).

As for other natural disasters such as flooding, drought management comprises four steps. The first step is reconnaissance to identify the most susceptible area for agricultural drought by monitoring and forecasting. The second step is drought impact assessment and loss estimation. This is based on the severity and length of drought. In the third step, the areas subjected to drought will be zoned based on the first two stages. In the final step, a loss compensation plan will be implemented based on the findings of the previous steps.

Satellite images are used to extract meteorological, agricultural, and hydrological indices to locate the areas that are most prone to drought. The severity and length of drought will be estimated for each region to predict damage to major agriculture products and natural resources. Risk zoning maps for agriculture products faced with varying levels of drought severity and lengths will be prepared. This will allow implementation of proper decision-making to decrease the impact of drought. This may include changing cultivation patterns, planting schedules, prioritizing areas for implementation of drought risk management plans and support programs.

Historical data and data on damage from the Forestry and Watershed Management Organization, Soil Conservation and Watershed Research Institute and the Ministry of the Interior (Crisis Management Organization) are being

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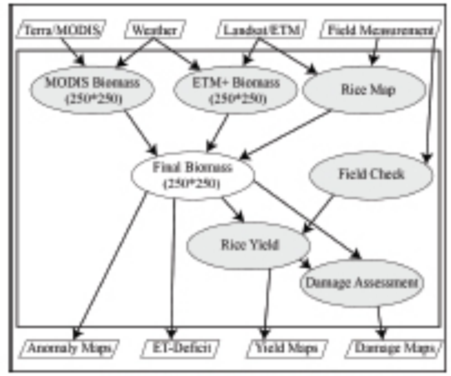
used in addition to satellite images for analysis. Meteorological and hydrological data were analyzed to extract drought indices and prepare meteorological and hydrological drought maps in cooperation with the Ministry of Power and the Meteorological Organization. Drought risk maps were prepared based on 10 years of satellite data provided by the ISA and other relevant organizations.

Crop Damage Assessment

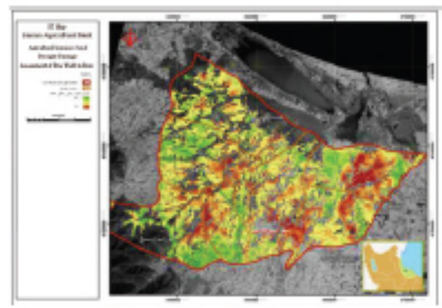
"Rice Damage Assessment caused by Drought using Remote Sensing Technology – a case study in Sumea Sara, Iran"

Agricultural insurance is one policy that has been carefully considered by the Iranian government. In the past, agricultural damage caused by natural disasters have been estimated based on periodic revisits by insurance adjusters and dialogue between the insurer and insured. Damage estimation showed several weak points; high expenses and lack of requirements and sufficient technical justification that resulted in unequal estimates and provided means to abuse the system. A more precise approach has been the use of periodic satellite data acquired during the growing season to estimate agricultural damage using simulation models and ground truth data with acceptable accuracy. Estimating loss from natural disasters using satellite data is now routinely used by the agriculture insurance bureau.

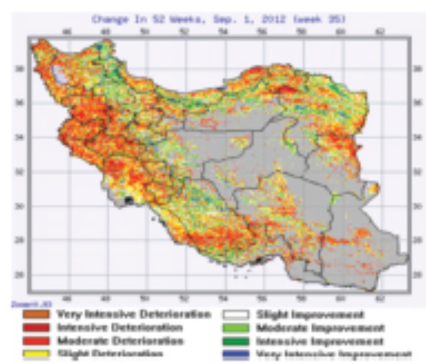
An example of the use of satellite data is to estimate damage to rice crops using satellite and meteorological data, agrobiologic models, and physiologic and phonologic data. The satellite data used for damage estimates was from AQUA/MODIS 250 m every 10 days and Landsat/ETM 30 m. Meteorological data is obtained from synoptic stations belonging to the Meteorological Organization and the Ministry of Power on a daily basis. Data on the physiology and phenology of rice was collected by ground sampling (224 samples) and analyzed in cooperation with the Rice Research Center in Rasht, Iran. The center is in charge of rice damage estimates



Damage Assessment Schematic Model
Source: Agricultural Insurance Fund



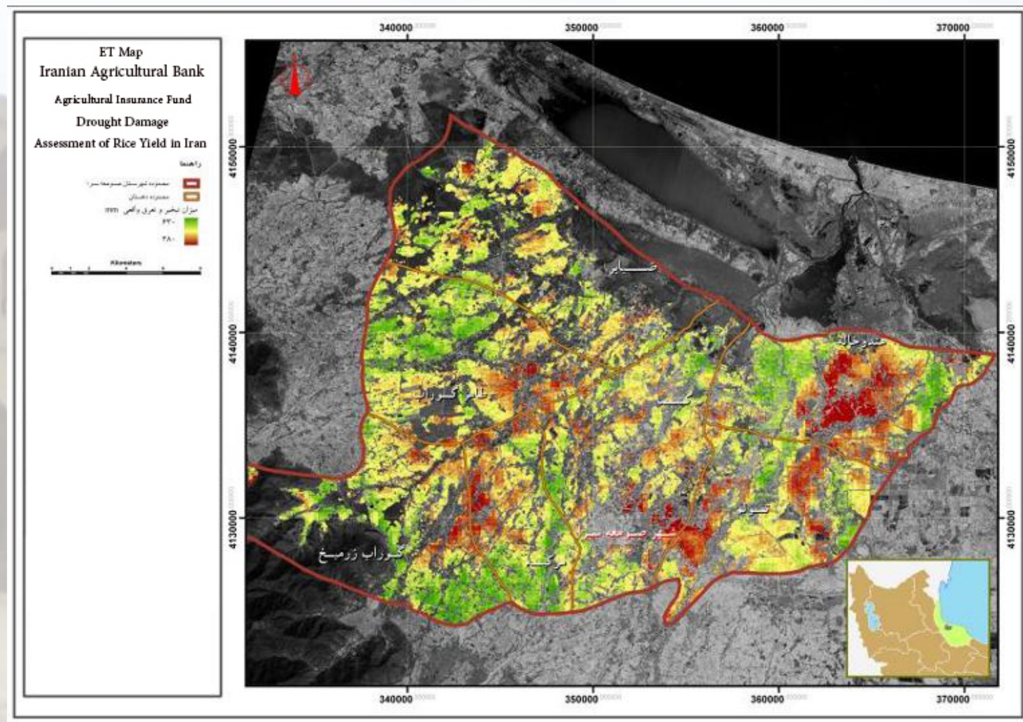
Rice ET Map for Damage Assessment
Source: Iranian Insurance Fund



Drought change map Sep 2011 to Sep 2012 based on VHI, VCI and TCI.
Source: IRIMO Report

3.2 Crop Damage Assessment

"A case study for Rice Damage Assessment caused by Drought using Remote Sensing Technology –a case study in Sumea Sara, Iran"



The satellite data used for damage estimates was from AQUA/MODIS 250 m every 10 days and Landsat/ETM 30 m. The red parts of this map denote areas with high ET deficits that are under water stress.

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Section4. International Cooperation

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caused by natural disasters such as drought, frost and flooding.

The system monitors the growing process from planting stage to harvest and prepares a biomass map every 10 days showing major influence parameters. The system calculates biomass yield, rough rice yield and yield gap. The map showing damage to area prone to natural disaster are prepared by compiling the yield map, yield gap, and vegetation cover anomaly coefficients during the growing season. Sufficient information is produced (~800 map layers) for specialized applications or in combination with other map layers. Actual evapotranspiration (ET), potential ET, ET deficit and soil moisture are major parameters needed for water resources management. The damage estimate model for rice is composed of 4 major modules:

- Biomass measurement module using remote sensing technology on a periodic basis
- Rice cover map module prepared using satellite data
- Rice yield map module
- Data analysis and loss estimate module

The output maps help managers and decision-makers discriminate between damaged and undamaged areas. The ET deficit can be predicted from ET maps using remote sensing data. The red parts of this map denote areas with high ET deficits that are under water stress. IRIMO has recently completed projects on drought monitoring system in Iran. The system is based on drought indices, including SPI-, PDSI- and GIS-RS-based drought indices (NDVI, brightness temperature - BT, VCI, TCI and VHI).

4. International Cooperation

4.1 Economic Cooperation Organization

A three-day workshop on Drought Management for the Economic Cooperation Organization (ECO) Region was held on 21-23 December, 2003 in the ECO Secretariat, Tehran, Islamic Republic of Iran. Food and Agriculture Organization of the United Nations (FAO), Islamic Republic of Iran Ministry of Agriculture and the Economic Cooperation Organization (ECO) jointly organized the workshop.

Recurrent severe drought in some parts of the ECO region has negatively affected agricultural production and trade of agro-products. The ECO ministerial meeting on Agriculture held in Islamabad in 2002 identified drought management as a priority for cooperation between the ECO countries and Iran was selected as the coordinating country for ECO cooperation in this regard.

A set of recommendations was adopted and proposals for an ECO Plan of Action were formulated during the workshop. The participants of the workshop recommended that member countries initiate strategies and plans of action for drought management and preparedness planning, enact appropriate laws and legislation for drought mitigation, ensures coordination and collaboration between governmental institutions and more intense cooperation with international organizations.

The recommendations for the plan of action included an exchange of students/experts for training purposes, the exchange of information and data on drought mitigation practices, monitoring and evaluation and technical support for member countries. The development of FAO technical cooperation programs for the ECO region was recommended to enhance the capacity of countries for drought management. This includes drought early warning systems and preparation of "bankable project documents" to be addressed to donors.

In June 2010, the Islamic Republic of Iran Meteorological Organization (IRIMO) and ECO signed a treaty in the service of human security. The Regional Risk Management body was founded

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In June 2010, the Islamic Republic of Iran Meteorological Organization (IRIMO) and ECO signed a treaty in the service of human security. The Regional Risk Management body was founded to facilitate international cooperation in the fields of weather, climate, water and related sciences. IRIMO and ECO agreed that ECO would contribute $50'000 for the Regional Risk Management Center in Mashhad, Iran. A general purpose fund was allocated as seed money to support the activities and programs of this ECO Regional Center for Risk Management (ECO-RCRM).

The main goal of ECO-RCRM is to provide facilities for collaborative research in risk management of natural disasters, especially drought, between universities and relevant institutions in ECO countries and to assist the national meteorological researchers to apply risk management to natural disasters to meet the needs of their countries. This includes initiation of programs of by the center, data collection and distribution, experience sharing and training and project development.

Drought Assessment and Monitoring for the ECO Region Using Satellite Data

MODIS satellites are used to drive long-term mean and temporal values for the NDVI and VCI.

Expected Outcomes

- Establish a real-time drought monitoring system based on NDVI and other indices
- Produce maps using well-known remote sensing indices, such as NDVI and VI
- Produce normal climatological maps based on NDVI and VI
- Fill in gaps in drought monitoring for the region that result from measurement-related problems for precipitation and other meteorological parameters
- Establish a website for drought monitoring maps and related discussions

Planned Activities

The study will investigate historical patterns of droughts in the region using monthly time-step AVHRR satellite data. Recent drought patterns will be studied using 8-day time-interval MODIS to facilitate international cooperation in the fields of weather, climate, water and related sciences. IRIMO and ECO agreed that ECO would contribute $50'000 for the Regional Risk Management Center in Mashhad, Iran. A general purpose fund was allocated as seed money to support the activities and programs of this ECO Regional Center for Risk Management (ECO-RCRM).

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Drought Assessment and Monitoring for the ECO Region Using Satellite Data

A near real-time drought monitoring system is currently being developed by I.R. of Iranian Meteorological Organization (IRIMO) using drought-related characteristics (indices) derived from remote-sensing data. The indices include a deviation from the NDVI from its long-term mean and a VCI. Data from the NOAA-AVHRR and MODIS satellites are used to drive long-term mean and temporal values for the NDVI and VCI.

Expected Outcomes

- Establish a real-time drought monitoring system based on NDVI and other indices
- Produce maps using well-known remote sensing indices, such as NDVI and VI
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- Fill in gaps in drought monitoring for the region that result from measurement-related problems for precipitation and other meteorological parameters
- Establish a website for drought monitoring maps and related discussions

Planned Activities

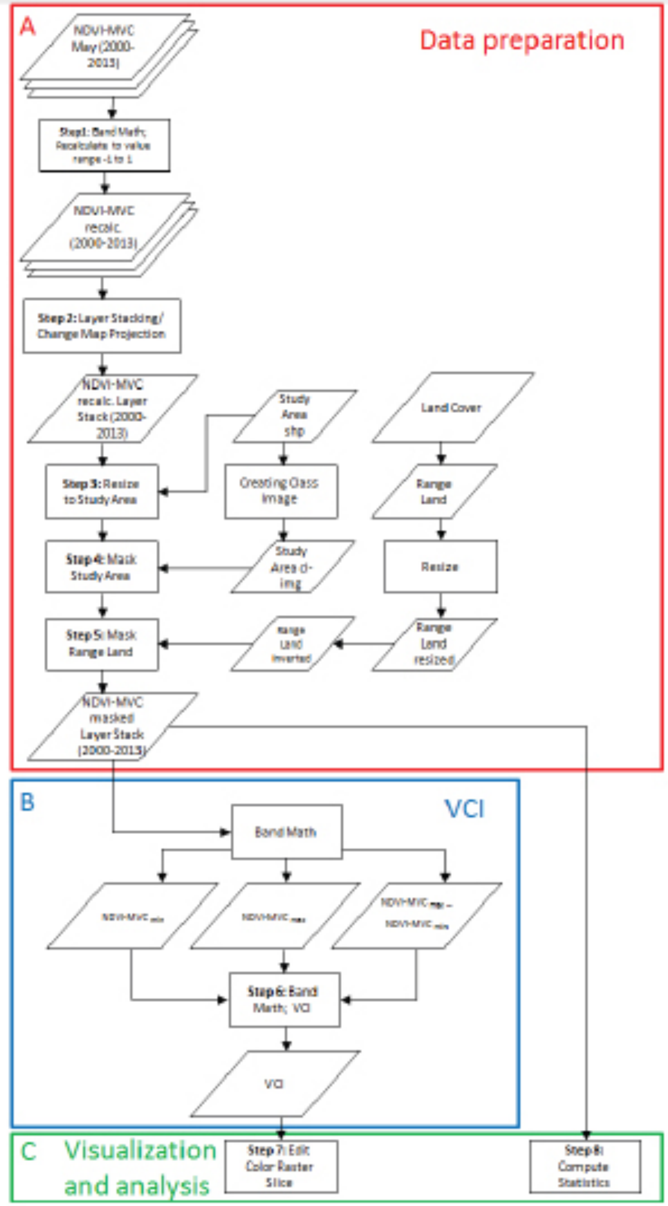
The study will investigate historical patterns of droughts in the region using monthly time-step AVHRR satellite data. Recent drought patterns will be studied using 8-day time-interval MODIS satellite images available from 2000 onwards. Regression relationships will be developed between drought-related indices obtained from MODIS and AVHRR data, which have different pixel resolutions and optical characteristics. These relationships will be established for each month of the year and for data pooled from all

Digging wells and feeding irrigation canals (Khuzestan Province, Iran)

4.3 UN SPIDER Regional Support Office

The UN-SPIDER regional support office (RSO) in Iran is hosted by the ISA. The RSO was established in 2009 by agreement between the ISA and the United Nations Office for Outer Space Affairs (UNOOSA). ISA is the national focal point for all space research and activities in Iran, as well as remote sensing and telemedicine. With the support of the ISA, the RSO has held several national and international workshops, training courses and exhibitions. The Iranian RSO has implemented projects in the field of disaster management and emergency response, especially in drought monitoring and forecasting, earthquake damage assessment, fault movement and forest fire detection. Development of a GeoPortal is an ongoing project of the RSO.

The ISA and UN-SPIDER are currently developing a recommended practice for the use of space-based information for drought monitoring and risk assessment. This practice explains how to monitor the effect of drought on natural vegetation (rain-fed, rangeland and forests). The main criteria considered to define the methodology are the availability of input, simplicity of methodology, free-of-charge data, and good research literature. The results can be used for the development of a regional drought monitoring and risk assessment system. Considering the spread and frequency of drought in the region and the lack of ground climate observation posts and technical capacity in the countries of the region for dealing with drought, a system that uses archived satellite imagery could play an invaluable role in drought preparedness.



Drought Practice Workflow, prepared by ISA

UNITED NATIONS
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UN-SPIDER KNOWLEDGE PORTAL

Space-based information for Disaster Management and Emergency Response

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Network

- IWG-SEM
- National Focal Points
- Regional Support Offices
- Post-2015 Disaster Risk Reduction

Islamic Republic of Iran Regional Support Office

Expert Meeting on Flood and Drought Risk Reduction concluded

At a glance:

The UN-SPIDER Regional Support Office (RSO) in Iran is hosted by the Iranian Space Agency (ISA). The RSO was established in 2009 under a cooperation agreement between ISA and the United Nations Office for Outer Space Affairs (UNOOSA). ISA is the national focal point for all space research and activities in Iran, as well as remote sensing and tele-medicine. With the support of ISA, the RSO in the past has held several national and international workshops, training courses and exhibitions. The Iranian RSO has implemented several projects in the field of disaster management and emergency response especially in drought monitoring and forecasting, earthquake damage assessment and fault movement and also forest fire detection. Developing a GeoPortal is an ongoing project of the RSO.

Capacity Building:

- Fundamental of Remote Sensing and Digital Image Processing
- Advanced Remote Sensing

Get in touch

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4.1 Economic Cooperation Organization (ECO)

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Drought Assessment and Monitoring for the ECO Region Using Satellite Data

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support drought resilience and reduce vulnerability; enhance institutional coordination mechanisms for drought management; and develop national capacity for drought planning, mitigation, and response.

As of the writing of this booklet, the national drought preparedness strategy was in the process of being introduced to the parliament for official approval. When approved, the policy calls for the development of a National Drought Management Centre that would serve as the drought mitigation hub of Iran. Eventually, it is envisioned that the Centre could also serve as the regional hub for the ECO region (a regional division of about ten countries).

5.1 Development of the Iranian National Strategy and Action Plan

Step 1: Creating Political Momentum and Authority

Drought conditions in Iran from 1999 to 2001 demonstrated the significant environmental, social, and economic effects of drought within the country. Similar effects experienced across the Near East Region provided the impetus for national meetings and regional conferences to better understand and develop strategies to reduce the risk of similar drought events in the future. As a result of these events, awareness increased about the need for a more comprehensive and proactive strategy for mitigating and responding to drought events in Iran.

The drought event created the "policy window" and, in this case, international agencies (such as FAO) played a critical role in placing drought on the international agenda within the Near East Region. FAO discussed the need for proactive drought planning at several regional conferences from 2000 to 2004, and adopted "drought mitigation" as a priority area for interdisciplinary action (PAIA).

Similarly, Iranian government representatives recognized the need for additional drought planning and requested that FAO provide technical and financial assistance to establish a national drought strategy. This assistance was provided by FAO under a Technical Cooperation Programme (TCP) project. The project, "A National Strategy and Action Plan on Drought Preparedness Management and Mitigation in the Agricultural Sector", was initiated in December 2004.

Overall, a combination of internal and external pressures and opportunities provided enough impetus to carry the project from the agenda setting to the implementation phase.

Step 2: Strategic Planning and Coordination

The drought planning project was officially executed by the Ministry of Jihad-e-Agriculture (Department of Agronomy), in collaboration with the Ministry of Interior (Bureau of Research and Coordination of Safety and Rehabilitation Activities – BRCSRA) and the Ministry of Road and Transportation (Islamic Republic of Iran Meteorological Organization – IRIMO). To help organize the project, a National Project Coordinator from the Iranian Department of Agronomy was appointed to work with an FAO consultant in leading the planning project. Eventually, a Project National Steering Committee was also established. Members of the committee are organizations dealing with drought management at the national, provincial, and district levels.

To help carry out the project, FAO provided technical advisory and supervisory services, and funding for an international drought mitigation consultant and 15 national drought management consultants. In addition to providing technical support, the FAO TCP project was instrumental in providing an incentive for the coordination of drought-related stakeholders and programs in the country.

The project team members also provided the leadership necessary to keep the project moving forward. For example, to initiate the project, FAO's drought management consultant met with representatives of the Iranian agen-

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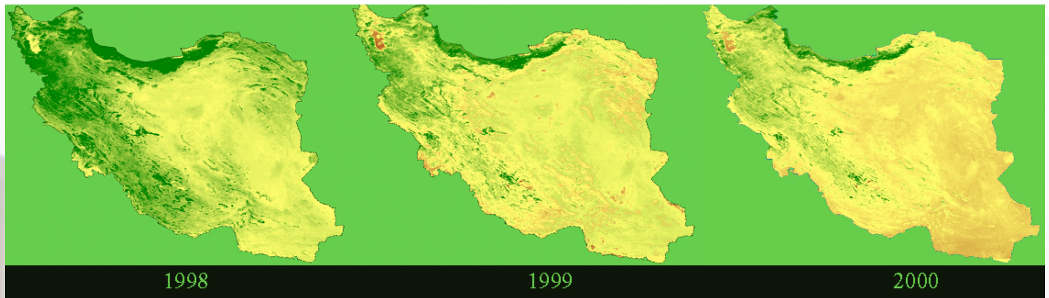
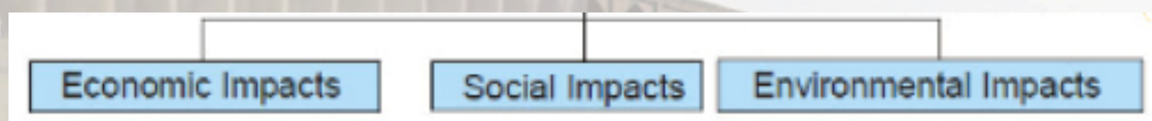
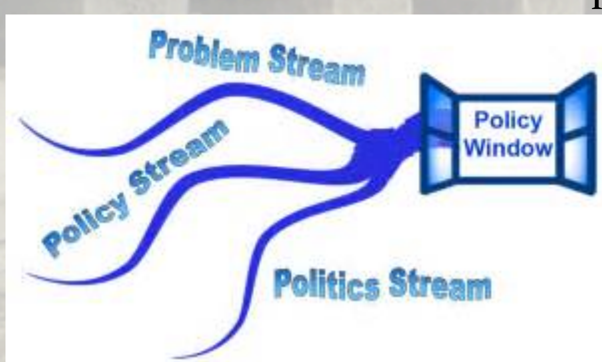
Section5:Implementation of Strategy and Action Plan

Development of the Iranian National Strategy and Action Plan





comprehensive and proactive strategy for mitigating and responding to drought events in Iran.



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Section5:Implementation of Strategy and Action Plan

Development of the Iranian National Strategy and Action Plan

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Section5:Implementation of Strategy and Action Plan

Development of the Iranian National Strategy and Action Plan

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Technical Cooperation Program

executed

the Ministry of Agriculture (Department of Agronomy)

the Ministry of Interior

the Ministry of Road and Transportation (Islamic Republic of Iranian Meteo-rological Organization)

FAO

provided

technical advisory and supervisory services

Funding for

International & National Consultants

draft of national drought preparedness strategy

Section5:Implementation of Strategy and Action Plan

5.1 Development of the Iranian National Strategy and Action Plan

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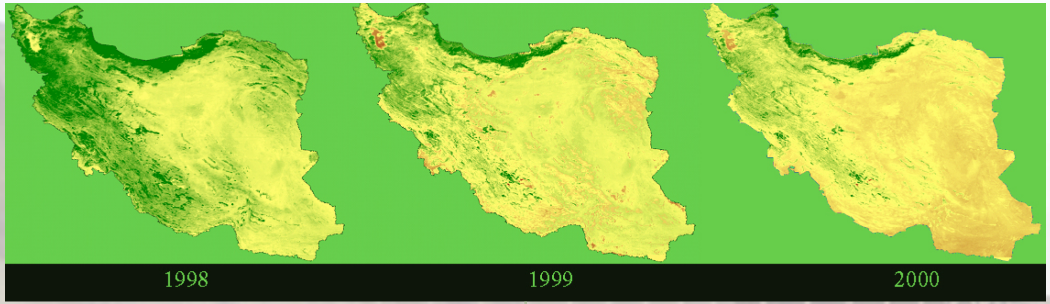

Established relations between governments & International Organizations (such as FAO)

draft of national drought preparedness strategy

Section5:Implementation of Strategy and Action Plan

Development of the Iranian National Strategy and Action Plan

Seminars & training Courses with the participants from different organizations

Visits of Universities

Result: The first review of the drought strategy and action plan

Wrap-up Workshop

Final draft

Under Assessment by the Iranian Parliament

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Step 6: Implementing the National Drought Strategy and Action Plan

The national drought preparedness strategy is in the process of being introduced to the parliament for official approval.

Meanwhile, an external study tour to FAO Rome for a group of three professional experts of the National Disaster Task Force was organized in 2006. The study tour to FAO/Global Information and Early Warning Service (GIEWS) and the visit to the Technical Divisions in Rome also contributed to improving the national capacity-building in database management and drought information delivery, and in drought early warning, monitoring, mitigation, and response.

These types of activities continue to enhance national drought risk reduction capacities and are required to fully implement the task identified in the national drought preparedness strategy, whether or not it is passed by the Iranian parliament.

6. Challenges for the Future

Lack of Inter-Ministerial Cooperation

In countries such as Iran, the nonexistence or deficit of inter-ministerial cooperation is a challenge to drought management. It is clear that effective drought management requires intensive cooperation and accurate programming in different divisions. Drought management requires cooperation between ministries and between organizations.

An established service network that encompasses all stakeholders allows data and information to be easily transferred from one to another without unnecessary obstacles. It may be a challenge to implement such a network, but it is necessary to achieving the sought-after synergies. The service network must be able to easily exchange and provide information required by the different stakeholders, from meteorological organizations to space agencies to disaster management authorities to users at the community level. The information must also be relevant and useful at each level.

Lack of High Resolution Data

The most important restriction facing space-based input is unavailability of actual time-series with appropriate local cover. With the emergence of remotely-sensed satellite data, this problem has decreased considerably (especially in industrial and developed countries). The lack of access to high resolution satellite data remains a problem for many developing countries. This creates problems for drought assessment at regional scale. For example, the drought early warning system faces numerous challenges in Iran. Data and information on climate and the water supply, including seasonal forecasts, must first be integrated to provide decision-makers with a comprehensive representation of current and future conditions.

Large Amounts of Data

Another obstacle to the use of satellites for drought monitoring and early warning in Iran has been the collection and transfer of large amounts of data. In areas identified as high-risk, several months' worth of relevant high-resolution satellite data and ground-based data could run into terabytes of information that require storage and processing. Resources must be allocated to meet these increased requirements so that the infrastructure will not be under-scaled in the struggle to cope with the additional load. This may create a bottleneck to effective drought monitoring and early warning.

Section 6. Challenges for the Future

Challenge 1

Lack of Inter-Ministerial Cooperation

An established service network that encompasses all stakeholders allows data and information to be easily transferred from one to another without unnecessary obstacles.

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Issues Regarding Data

Lack of High Resolution Data

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Issues Regarding Data

Large Amounts of Data

Issues Regarding Data

Lack of Sufficient and Accurate Ground Data

Lack of Expertise in Drought Management

establishment of disaster management studies establishment of disaster management stud-ies at universities and development of training courses to promote the advantages of satellite data in drought monitoring and modeling.

Solutions

One solution to all these problems is greater coordination between meteorological, hydrological, and agricultural services. In addition, improved delivery systems must be developed to get information into the hands of decision-makers in a timely manner. This requires better understanding of user needs and preferences about how this information should be presented. Websites provide the most cost-effective and timely mechanisms for information delivery, but this technology is not widely available in Iran. Appropriate delivery systems must be employed. Potential users of climate information must also be educated on how information can be applied to reduce the risks associated with extreme climatic events such as drought. Improved com-

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Solutions

Some solutions for general problems which most developing countries are faced in drought risk reduction

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Solutions:

Coordination

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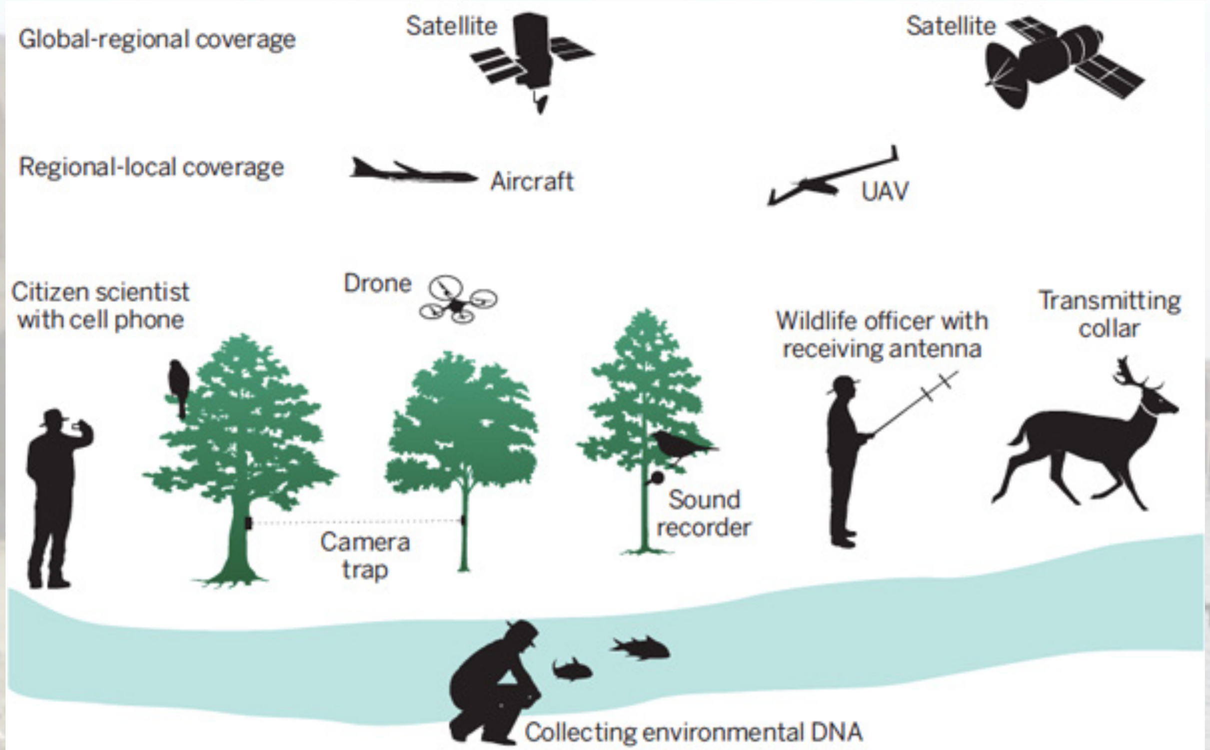
Improved Delivery System



Sensor power. Networking satellite and airborne remote sensing with in situ sensing will allow changes in many elements of biodiversity to be tracked over time.

Better Understanding of User Preferences

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Solutions:

Train Potential Users

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Thank You!