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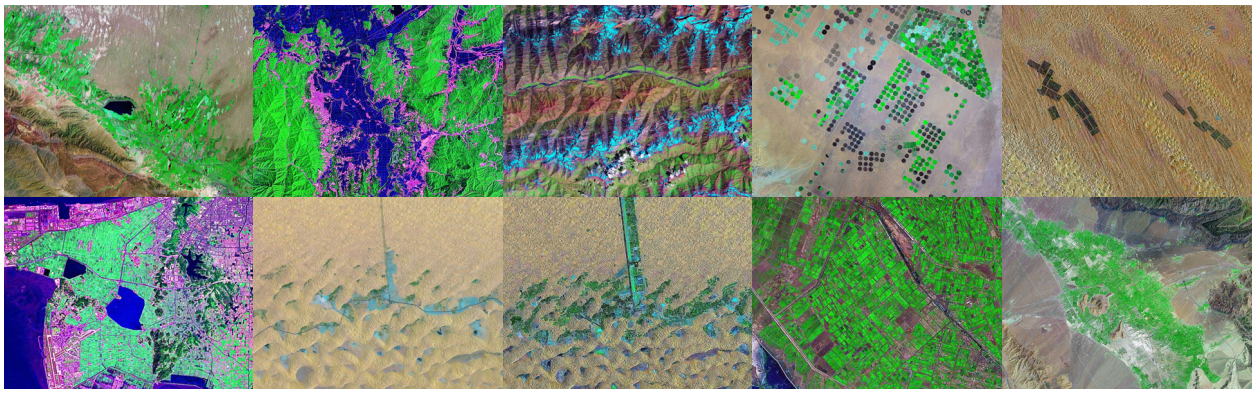
A Digital Global Map of Irrigated Areas

An Update for Asia



DOCUMENTATION

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Frankfurt Hydrology Paper

Land and Water development division

JOHANN WOLFGANG GOETHE UNIVERSITÄT FRANKFURT AM MAIN

Digital Global Map of Irrigated Areas

An update for Asia

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Frankfurt Hydrology Paper 1
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The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Contents

Preface

Agriculture is by far the largest water-use sector, accounting for about 70 percent of all water withdrawn worldwide from rivers and aquifers for agricultural, domestic and industrial purposes. In several developing countries, irrigation represents up to 95 percent of all water withdrawn, and it plays a major role in food production and food security. The agriculture development strategies of most of these countries depend on the possibility of maintaining, improving and expanding irrigated agriculture. However, as the pressure on water resources increases, irrigation is facing growing competition from other water-use sectors and becoming a threat to the environment in an increasing number of regions.

In the last decade, the international community has made major efforts to assess the different elements of the water balance and to predict current and future water needs for the different use sectors. However, considerable uncertainty remains concerning the extent and distribution of irrigated land in the world and on agricultural water use, therefore, making it difficult to monitor the irrigation sector adequately. Coverage of irrigated areas in the world, available in a geographical information system (GIS), is the single most important item of information needed to improve future global studies on water and food.

The first version of the Digital Global Map of Irrigated Areas was published in 1999 (see table). It consisted of a raster map with a resolution of 0.5 ° by 0.5 ° containing the percentage of the area that was equipped for irrigation around 1995, the so-called irrigation density. To further develop and improve the global GIS coverage of areas equipped for irrigation and to make it available to users in the international community, cooperation was established between the Johann Wolfgang Goethe University in Frankfurt am Main, Germany, and the Land and Water Development Division of the Food and Agriculture Organization of the United Nations (FAO).

Through this cooperation, the mapping project has been linked closely to the FAO global information system on water and agriculture, Aquastat. The Aquastat programme collects and disseminates data and information by country and by region. Its aim is to provide users interested in global, regional and national analysis (e.g. policy-makers, decision-makers and researchers) with the most accurate, reliable, consistent and up-to-date information available on water resources and agricultural water management. In order to make thorough analyses, the Aquastat programme collects data from many different sources including national water resources and irrigation master plans, statistics and yearbooks, FAO technical reports, and national and international surveys and reports made available by national and international research centres.

The data collected through the Aquastat programme have served as the main source for improving the overall quality and resolution of the Digital Global Map of Irrigated Areas. In addition, the methodology for producing the map has been improved substantially. This has made it possible to increase the spatial resolution of the map to 5 minutes, thus justifying the publication of an improved second version of the Digital Global Map of Irrigated Areas. For Version 2, updated maps of Latin America, Europe, Africa and Oceania have been published. The next step in improving the dataset is the inclusion of the continent of Asia, which is presented in this document. For the update of the map of Asia, an inventory of subnational irrigation statistics for the continent was compiled. Irrigation maps were derived from project reports, irrigation subsector studies and books related to irrigation and drainage and were compared with satellite images in many regions. The reference year for the update of the map is 2000.

Brief history of the Digital Global Map of Irrigated Areas

1999	Version 1	Digital Global Map of Irrigated Areas Version 1 published (resolution: 0.5 ° × 0.5 °). **Döll, P. & Siebert, S.** 1999. *A digital global map of irrigated areas*. Germany, Center for Environmental Systems Research, University of Kassel.
2001	Version 2	Cooperation was established between the project team of the Global Map of Irrigated Areas and the FAO Aquastat programme. As a result of this cooperation, the map-generation methodology was improved and an update of the continents of Latin America and Europe was made. The global grid resolution was increased to a grid of 5 arc-minutes and the map was made available to the general public as Version 2. **Siebert, S. & Döll, P.** 2001. *A digital global map of irrigated areas - an update for Latin America and Europe*. Germany, Center for Environmental Systems Research, University of Kassel.
2002	Version 2.1	Update of Africa and Oceania using the improved map-generation methodology described in Siebert & Döll (2001). **Siebert, S., Döll, P. & Hoogeveen, J.** 2002. *A digital global map of irrigated areas - an update for Africa and Oceania*. Germany, Center for Environmental Systems Research, University of Kassel, and Rome, FAO (available at http://www.fao.org/ag/agl/aglw/aquastat/irrigationmap/index.stm).
2004		The Global Map of Irrigated Areas project team at the University of Kassel moved to the Johann Wolfgang Goethe University in Frankfurt am Main, Germany.
2005	Version 2.2	Update of the continent of Asia using the map-generation methodology described in Siebert & Döll (2001). **Siebert, S., Feick, S. & Hoogeveen, J.** 2005. *A digital global map of irrigated areas - an update for Asia*. Frankfurt am Main, Germany, Johann Wolfgang Goethe University, and Rome, FAO (this publication).
The complete documentation of the Digital Global Map of Irrigated Areas is always available at: http://www.fao.org/ag/agl/aglw/aquastat/irrigationmap/index.stm. From this address, the map can also be downloaded.		

Acknowledgements

This report was prepared by Stefan Siebert and Sebastian Feick of the Hydrology Group of the Institute of Physical Geography at the University of Frankfurt am Main, Germany, with contributions from Jippe Hoogeveen of the Land and Water Development Division of the Food and Agriculture Organization of the United Nations (FAO). The International Institute for Applied Systems Analysis in Laxenburg, Austria, and the United Nations Environment Programme in Sioux Falls, the United States of America, provided valuable data relating to irrigation in the China, the Democratic People's Republic of Korea, and the Russian Federation. The Asiacover project of the Environment and Natural Resources Service, FAO, contributed important spatial information for the countries in the lower Mekong River Basin as well as for Afghanistan and Pakistan. The Land and Water Documentation Centre, FAO, provided useful paper maps for most countries. The authors wish to acknowledge the assistance and support for the irrigation-mapping project provided by Petra Döll of the University of Frankfurt, and Karen Frenken and Jean-Marc Faurès of FAO. The publication was edited by Julian Plummer.

Summary

The Land and Water Development Division of the Food and Agriculture Organization of the United Nations and the Johann Wolfgang Goethe University, Frankfurt am Main, Germany, are cooperating in the development of a global irrigation-mapping facility. This report describes an update of the Digital Global Map of Irrigated Areas for the continent of Asia. For this update, an inventory of subnational irrigation statistics for the continent was compiled. The reference year for the statistics is 2000. Adding up the irrigated areas per country as documented in the report gives a total of 188.5 million ha for the entire continent. The total number of subnational units used in the inventory is 4 428. In order to distribute the irrigation statistics per subnational unit, digital spatial data layers and printed maps were used. Irrigation maps were derived from project reports, irrigation subsector studies, and books related to irrigation and drainage. These maps were digitized and compared with satellite images of many regions. In areas without spatial information on irrigated areas, additional information was used to locate areas where irrigation is likely, such as land-cover and land-use maps that indicate agricultural areas or areas with crops that are usually grown under irrigation.

Documentation

Generation of a map of administrative units compatible with statistics used to update the Digital Global Map of Irrigated Areas in Asia

WORKING REPORT I

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INTRODUCTION

This report describes the generation of a digital map of administrative units compatible with statistical data collected to update the Digital Global Irrigation Map for the Asian continent (Figure 1). As documented in Working Report II, the collected irrigation statistics for subnational units refer to the situation in different years. The map of administrative units has to be compatible with the administrative setting in the year of the statistics. Therefore, the base year for the mapping of the administrative setting also differs from country to country and even within some (larger) countries.

The map of administrative units is based on a digital map produced by the United Nations Environment Programme (UNEP) to map population densities in the Russian Federation and in Asia (available at http://www.grid.unep.ch). However, because the administrative setting changes in many countries year by year, the map has had to be adjusted in many parts to fit to the collected statistics of irrigated areas. This process is documented in the following sections.

BASE PROCESSING OF THE UNEP MAP OF ADMINISTRATIVE UNITS

The first step was to download the Asia and Russia population database (available at http://www.grid.unep.ch). The second step was to convert e_asia.e00, sc_asia.e00, se_asia.e00, w_asia.e00 and russia.e00 to ArcView shapefile format. The final step was to delete all columns in the data table except: name1, name2, name3 and country.

MODIFICATIONS OF THE ADMINISTRATIVE UNIT MAP (BY COUNTRY IN ALPHABETICAL ORDER)

Afghanistan

District and province boundaries were used as provided by the Afghanistan Information Management Service (AIMS). The organization provides the boundaries as polygon- or polyline-shapefile in the present 32-province system (available at http://www.aims.org.af/). The country boundary was used as given by the UNEP shapefile.

Armenia

Union of all existing administrative units and digitizing of 39 districts using a map published in [AM01].

Azerbaijan

Union of all administrative units in Azerbaijan mainland. As a result, the map consists of seven administrative units in Azerbaijan (Nagorno Karabakh, Azerbaijan mainland and five districts in the Nakhichevan area).

Bahrain

Digitizing of nine regions using a political map provided by the Cartographic Section of the United Nations (available at http://www.un.org/Depts/Cartographic).

Bangladesh

Union of 699 districts (third-level administrative units) to 64 zilas (second-level administrative units).

Bhutan

The boundaries of 20 districts (dzongkhags) were digitized from an atlas at the scale 1:250 000 [BT01], while the country boundary was left unchanged.

Brunei Darussalam

Union of all existing administrative unit polygons. As a result, no subdivision of the country was made.

Cambodia

Union of 204 third-level administrative units to 21 second-level administrative units (provinces).

China (including China Hong Kong SAR and China Macao SAR)
Administrative units had to be changed to be compatible with the dataset of irrigation statistics on the county level. The procedure was to use the county boundaries as provided by the irrigation statistics dataset but to keep the country boundary as it is in the UNEP dataset. This consisted of the following steps:

1. Preparing the county map:
   - download of dataset "China county-level data on population (census) and agriculture, keyed to 1:1 m GIS map" (available at http://sedac.ciesin.columbia.edu) including the related county shapefile (my901.e00),
   - converting my901.e00 to ArcView – shapefile format;
   - deleting all columns in county shapefile except columns GBCENMQ (census ID) and NMFULL (county name),
   - changing projection of county shapefile from Lambert Conformal Conic Projection to Latitude–Longitude, WGS84;
   - linking chinaag1.dbf to county shapefile,
   - creating column irriarea and copying content of related database column A616 to column irriarea,
   - renaming column NMFULL to name1,
   - removing link between county shapefile and data table chinaag1.dbf,
   - deleting column GBCENMQ;
2. Merging administrative unit maps:
   - deleting all administrative units belonging to China, China Hong Kong SAR and China Macao SAR in the UNEP file admindata.shp,
   - creating a new shapefile (temp.shp) by a spatial merge of shapefiles admindata.shp and china.shp,
   - copying all polygons of the merged file temp.shp that have their origin alone from file china.shp to file admindata.shp => clipping of China – administrative units along the border with other countries,
   - filling of the gaps along the Chinese border by extending the related Chinese counties.

As a result, China has been divided into 30 provinces, 2 416 counties, China Hong Kong SAR and China Macao SAR.

China Macao SAR
See China.

Cyprus
The administrative-unit polygons were split using a map published in [CY01] along the boundary between the territory under government control and the occupied northern part of the island. Therefore, Cyprus has been divided into 5 districts under government control and 4 occupied districts.

Democratic People's Republic of Korea
Union of all subnational units to one polygon representing the entire country.

East Timor
See Indonesia (no subdivision of East Timor below the country level).

Georgia
Union of all administrative units (as result no subdivision of Georgia below the country level).

India

Andaman and Nicobar Islands
Union of all the single-island polygons to create one multipart polygon representing Andaman and Nicobar Islands.

Andhra Pradesh
No modifications (the state is divided into 23 districts).

Arunachal Pradesh
Lower Subansiri District was split into the districts of Lower Subansiri and Papumpare; West Siang and East Siang Districts were merged and split to form the districts of West Siang, Upper Siang and East Siang using a district map of Arunachal Pradesh as provided by the Public Health Engineering Department (available at http://www.arunachalphed.nic.in). In total, there are 13 districts in Arunachal Pradesh. The administrative setting used here is representative for the situation in the late 1990s.

Assam
Union of Karbi Anglong and Karbi Anglong (Diphu) Districts to Karbi Anglong District. No other modifications (the state is divided into 23 districts).

Bihar
On 15 November 2000, the state of Jharkhand was formed from the southern districts of Bihar. Therefore, the southern districts of the former state territory were assigned to Jharkhand. In the remaining northern part of the former Bihar territory, the boundaries of the districts were changed to create the new districts of Sheikhpura, Luckeesarai, Jamui, Sheohar, Banka, Supaul, Buxar and Bhabhua by using a district map downloaded from http://www.mapsofindia.com. Thereby, the state of Bihar was divided into 37 districts.

Chandigarh
No modifications (the state is not divided into districts).

Chhatisgarh
Chhatisgarh State was formed on 1 November 2000 from the eastern districts of Madhya Pradesh. The districts of Bastar, Bilaspur, Dantewada, Dhamtari, Durg, Janjgeer-Champa, Jashpur, Kanker, Kawardha, Korba, Koriya, Mahasamund, Raigarh, Raipur, Rajnandgawn and Surguja were defined using a district map downloaded from http://www.mapsofindia.com.

Dadra and Nagar Haveli
Union of Dadra and Nagar Haveli to one multipart polygon.

Daman and Diu
Union of Daman and Nagar Diu to one multipart polygon.

Delhi
No modifications (the state is not divided into districts).

Goa
Union of two islands belonging to North Goa with the landlocked part of the district. The state consists of two districts (North Goa and South Goa).

Gujarat
No modifications (the state is divided into 19 districts).

Haryana
Using a district map of Haryana downloaded from http://www.mapsofindia.com, Hisar District was split into the districts of Hisar and Fatehabad; Rohtak District was split into the districts of Rohtak and Jhajjar; and the districts of Yamunanagar, Ambala and Panchkula were created in the area previously covered by the districts of Yamunanagar and Ambala. Therefore, the state is now divided into 19 districts.

Himachal Pradesh
No modifications (the state is divided into 12 districts).

Jammu and Kashmir
No modifications (the state is divided into 14 districts).

Jharkhand
On 15 November 2000, the state of Jharkhand was formed from the southern districts of Bihar. Therefore, the southern districts of the former Bihar state territory were assigned to Jharkhand. Using a district map downloaded from http://www.thebharat.com, Hazaribag was split into the districts of Koderma, Chatra and Hazaribag; Giridih District was split into the districts of Giridih and Bokaro; and Palamu District was split into the districts of Palamu and Garhwa. The state is divided into 18 districts.

Karnataka
Using a district map downloaded from http://www.thebharat.com, Bijapur District was split into the districts of Bagalkot and Bijapur; Dharwad District was split into the districts of Gadag, Haveri and Dharwad; Raichur District was split into the districts of Koppal and Raichur; Dakshin Kannada District was split into the districts of Uduki and Dakshin Kannada; and Mysore District was split into the districts of Chamaraja Nagar and Mysore. In addition, the boundaries of the central districts of Shimoga, Davangere and Chitradurga were adjusted to the new administrative setting. As a result of this procedure, the state is now divided into 27 districts.

Kerala
No modifications (the state is divided into 14 districts).

Lakshadweep
Union of all the single-islands polygons to create one multipart polygon representing the Lakshadweep Islands.

Madhya Pradesh
On 1 November 2000, Chhatisgarh State was formed from the eastern districts of Madhya Pradesh. Therefore, using a district map downloaded from http://www.thebharat.com, the eastern districts of the former Madhya Pradesh state territory were assigned to Chhatisgarh. In addition, Jabalpur District was split into the districts of Katni and Jabalpur; Mandla District was split into the districts of Dindori and Mandla; Shahdol District was split into the districts of Umaria and Shahdol; Hoshangabad District was split into the districts of Harda and Hoshangabad; Mandsaur District was split into the districts of Neemach and Mandsaur; Morena District was split into the districts of Sheopur Kalan and Morena; and West Nimar District was split into the districts of Badwani and West Nimar. Therefore, the state of Madhya Pradesh is now divided into 45 districts.

Maharashtra
No modifications (the state is divided into 30 districts).

Manipur
Union of the two districts Imphal East and Imphal West to the district of Imphal. Thereafter, the state is still divided into eight districts.

Meghalaya
No modifications (the state is divided into five districts).

Mizoram
Union of the three districts to one polygon representing the state of Mizoram.

Nagaland
No modifications (the state is divided into seven districts).

Orissa
Using a district map downloaded from http://www.thebharat.com, Baleshwar District was split into the districts of Balasore and Bhadrak; Cuttack District was split into the districts of Kendrapara, Jajpur, Jagatsinghpur and Cuttack; Dhenkanal District was split into the districts of Angul and Dhenkanal; Sambalpur District was split into the districts of Deogarh, Jharsuguda, Bagarh and Dhenkanal; Bolangir District was split into the districts of Sonepur and Bolangir; Phulbani District was split into the districts of Boudh and Phulbani; Puri District was split into the districts of Khurda, Nayagarh and Puri; Ganjam District was split into the districts of Gajapati and Ganjam; Kalahandi District was split into the districts of Nawapara and Kalahandi; and Koraput District was split into the districts of Nawrangpur, Rayagada, Malkangiri and Koraput. Thus, the state is divided into 30 districts.

Pondicherry
No modifications (the union territory is divided into four districts).

Punjab
Using a district map downloaded from http://www.mapsofindia.com, Bathinda District was split into the districts of Mansa and Bathinda; and the districts of Fairdkot and Firozpur were split into the districts of Moga, Muktsar, Fairdkot and Firozpur. The state is divided into 17 districts.

Rajasthan
By using a district map downloaded from http://www.mapsofindia.com, Kota District was split into the districts of Baran and Kota; Gangangarh District was split into the districts of Hanumangarh and Gangangarh; Udaipur District was split into the districts of Rajsamand and Udaipur; and the districts of Jaipur and Sawai Madhopur were split into the districts of Karauli, Dausa, Jaipur and Sawai Madhopur. The state is now divided into 32 districts.

Sikkim
Union of North, West, South and East Sikkim into one polygon representing the state of Sikkim.

Tamil Nadu
Using a district map downloaded from http://www.mapsofindia.com, Chengaianna District was split into the districts of Tiruvallur and Kancheepuram; South Arcot District was split into the districts of Villupuram and Cuddalore; Salem District was split into the districts of Namakkal and Salem; Tiruchchirappalli District was split into the districts of Perambalur, Karur and Tiruchchirappalli; Thanjavur District was split into the districts of Nagapattinam, Thiruvarur and Thanjavur; and Madurai District was split into the districts of Theni and Madurai. The state is now divided into 29 districts.

Tripura
Union of the three districts North, West and South Tripura into one polygon representing the state of Tripura.

Uttaranchal
On 9 November 2000, the state of Uttaranchal was formed from the districts of Almora, Bageshwar, Chamoli, Champawat, Dehradun, Haridwar, Nainital, Pauri Garhwal, Pithoragarh, Rudra Prayag, Tehri Garhwal, Udhamsingh Nagar, and Uttarkashi of Uttar Pradesh. Therefore, the 13 districts of the former Uttar Pradesh territory were assigned to Uttaranchal.

Uttar Pradesh
On 9 November 2000, the state of Uttaranchal was formed from the districts of Almora, Bageshwar, Chamoli, Champawat, Dehradun, Haridwar, Nainital, Pauri Garhwal, Pithoragarh, Rudra Prayag, Tehri Garhwal, Udhamsingh Nagar, and Uttarkashi of Uttar Pradesh. Therefore, the 13 districts of the former Uttar Pradesh territory were assigned to Uttaranchal. In addition, the boundaries of the districts of Uttar Pradesh were adjusted to meet the administrative setup as taken from a district map of Uttar Pradesh downloaded from http://www.mapsofindia.com. The state of Uttar Pradesh is now divided into 69 districts.

West Bengal
West Dinajpur District was split into the districts of North Dinajpur and South Dinajpur. The state is divided into 18 districts.

Indonesia and East Timor
Union of all administrative units of Indonesia and East Timor and digitizing of 89 watersheds for Indonesia and 1 watershed for East Timor using a basin map published in [ID01].

Iraq
No modifications (the country is divided into 18 governorates).

Islamic Republic of Iran
Using a political map of the Islamic Republic of Iran provided by the Cartographic Section of the United Nations (available at http://www.un.org/Depts/Cartographic), the ostan of East Azarbayejan was split into the ostans of East Azarbayejan and Ardebil. As a result, the country is divided into 25 ostans.

Israel
Using a map provided by the Central Bureau of Statistics [IS01], the existing 5 districts of the UNEP dataset were split into 14 subdistricts and 33 natural regions.

Japan
No modifications (the country is divided into 10 provinces and 47 prefectures).

Jordan
No modifications (the country is divided into 8 governorates).

Kazakhstan
Using a political map published in [KZ01], the oblast of Guryev was split into the oblasts of Mangistau and Atyrau; and the oblast of Kustanay was split into the oblasts of Kostanai and Torgai. As result, the country is divided into 19 oblasts.

Kuwait
The country was split into six regions using a map from the online map collection of the University of Texas (available at http://www.lib.utexas.edu).

Kyrgyzstan
Union of administrative units existing in the UNEP map and digitizing of the boundaries of 7 regions and 41 districts using a map provided by GRID-Arendal (available at http://www.grida.no).

Lao People's Democratic Republic
Union of second-level administrative units into first-level administrative units. The country is so divided into 18 provinces.

Lebanon
Digitizing of 5 regions (mohafaza) and 26 districts (caza) using a map downloaded from an online collection of materials related to the Near East region (available at http://almashriq.hiof.no).

Malaysia
No modifications (the country is divided into 14 states).

Maldives
Union of all the single-island polygons into one multipart polygon representing the country of the Maldives.

Mongolia
No modifications (the country is divided into 18 aimags).

Myanmar
Union of second-level administrative units into first-level administrative units. The country is so divided into 14 states.

Nepal
No modifications (the country is divided into 75 districts).

Oman
Union of 63 districts (welayat) into 8 regions.

Pakistan
Union of 70 districts into 4 provinces and digitizing of the boundaries of 107 districts using the maps indicated in references [PK01] – [PK04] for the provinces of Punjab, Balochistan, Sindh and North-West Frontier Province. The boundaries of the five districts of the Northern Territories along the border with China and India were digitized using a map downloaded from http://www.northernareas.org.pk.

Palestinian Authority
Digitizing of the boundaries of 11 governorates in the West Bank and 5 governorates in the Gaza area using a map as indicated in reference [PL01].

Papua New Guinea
Union of all subnational units into one polygon representing the country of Papua New Guinea.

Philippines
Union of the administrative units into 12 multipart polygons representing the regions of the country.

Qatar
No modifications (the country is not divided into subnational units).

Republic of Korea
No modifications (the country is divided into 15 provinces).

Russian Federation
All rayons in the European part of the Russian Federation were deleted. In the Asian part of the map, the second-level administrative units (rayons) were aggregated to 33 first-level administrative units (oblasts).

Saudi Arabia
Union of the provinces of Al Jawf and Al Qurayyat. The boundary to Yemen was changed in the regions of Najran and Eastern Province according to a map used as the reference for Yemen (see section on Yemen). The country is divided into 13 regions.

Singapore
Union of all polygons into one multipart polygon representing the country of Singapore.

Sri Lanka
The boundaries of the Uda Walawe System, which covers parts of the provinces of Hambantola, Ratnapura and Moneragala, were digitized using a map published in [SL01]. The province boundaries of Jaffna were digitized using a map downloaded from http://www.statistics.gov.lk. Thus, Sri Lanka is now divided into 26 subnational units.

Syrian Arab Republic
No modifications (the country is divided into 13 regions).

Taiwan Province of China
Union of the counties of Raoping and Penghu. Taiwan Province of China consists of 23 counties.

Tajikistan
Union of all administrative units and splitting of the country into two watersheds (Amu Darya Basin and Syr Darya Basin) using a map provided by GRID Arendal (available at http://www.grida.no).

Thailand
Using a map published in [TH01], Udon Thani District was split into the districts of Nong Bua Lam Phu and Udon Thani; the district of Nakhon Phanom and Mukdahan was split into the district of Nakhon Phanom and the district of Mukdahan; the districts of Ubon Ratchathani and Yasothon were split into the districts of Amnat Charoen, Ubon Ratchathani and Yasothon; and Prachin Buri District was split into the districts of Sa Kaeo and Prachin Buri. Thailand is divided into 76 provinces.

Turkey
No modifications (the country is divided into 73 provinces).

Turkmenistan
Using a map provided by the Cartographic Section of the United Nations (available at http://www.un.org/Depts/Cartographic), the velayat of Turkmenistan Territories was split into the velayats of Balkan and Akhal. The country is divided into five velayats.

United Arab Emirates
No modifications (the country is divided into 7 emirates).

Uzbekistan
Using a map provided by the Cartographic Section of the United Nations (available at http://www.un.org/Depts/Cartographic), the welayat of Samarkand was split into the welayats of Nawoiy and Samarqand; and the welayat of Syrdarya was split into the welayats of Jizzakh and Sirdaryo. The country is divided into 13 welayats.

Viet Nam
Union of districts into provinces as shown in Figure 2 in [VN01] with exception of the districts located in the Mekong Delta. Union of all districts located in the Mekong Delta into one polygon representing the entire delta. Therefore, the country is divided into 30 districts, the Mekong Delta and one polygon representing islands south of continental Viet Nam.

Yemen
Union of all administrative units existing in the UNEP map and digitizing of the boundaries of 19 governorates using a map from the online map collection of the University of Texas (available at http://www.lib.utexas.edu). The boundary to Saudi Arabia was also changed to fit this map.

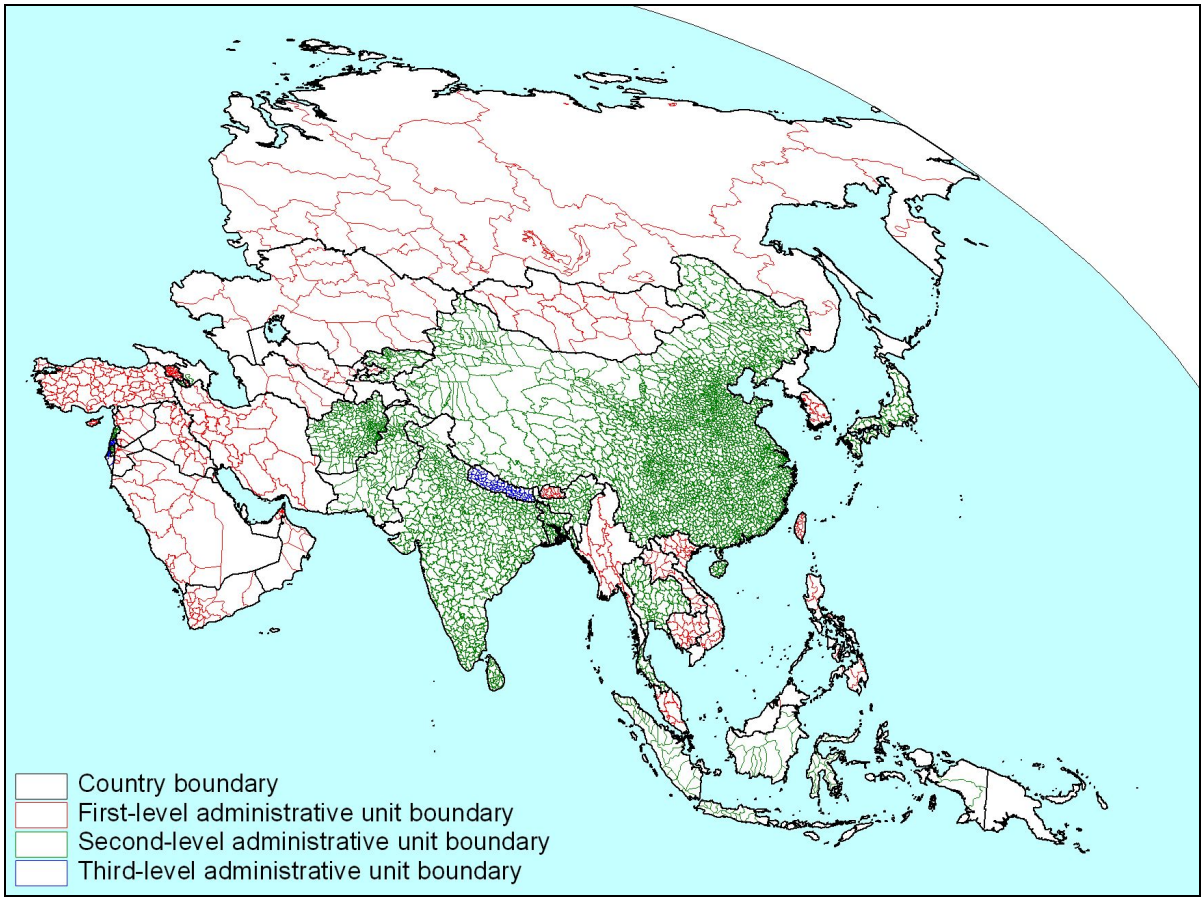

FIGURE 1
Map of administrative units (Robinson projection) consistent with collected subnational irrigation statistics used to update the Global Map of Irrigated Areas (subnational boundaries shown where irrigation statistics available at that level)

REFERENCES

[AM01] **Republic of Armenia.** 1993. *Irrigation subsector review and project identification*. Report to FAO. Report No.: 79/93 CP – ARM2.

[BT01] **Ministry of Agriculture.** 1997. *Atlas of Bhutan 1:250,000, land cover & area statistics of 20 Dzongkhags*. Land Use Planning Project. Thimphu.

[CY01] **Savvides, L., Dörflinger, G. & Alexandrou, K.** 2001: *The assessment of water demand of Cyprus*. TCP/CYP/8921, Report 1.5.1. Nicosia, Ministry of Agriculture, Natural Resources and Environment.

[ID01] **Elshof, A.J.** 1990. *Irrigated sawah and swamp - development potential and use.* Ministry of Public Works, Jakarta.

[IS01] **Central Bureau of Statistics.** 2004. *Statistical abstract of Israel 2003 No. 54*. State of Israel - Maps (available at http://gis.cbs.gov.il).

[KZ01] **World Bank.** 1996. *Irrigation and drainage improvement project.* Staff appraisal report. Report No. 15379-KZ.

[PK01] **Government of Punjab.** 2004. *Punjab districts* (available at http://www.punjab.gov.pk).

[PK02] **Government of Balochistan.** 2004. *District database – map of Balochistan* (available at http://www.bdd.sdnpk.org).

[PK03] **Government of Sindh.** 2004. *Integrated social & environmental assessment [ISEA] for a proposed Sindh on-farm water management [SOFWM] project* (available at http://www.sindh.gov.pk).

[PK04] **Election Commission of Pakistan.** 2004. *District map of N.W.F.P. and F.A.T.A.* (available at http://www.khyber.org).

[PL01] **Applied Research Institute.** 2004. *West Bank and Gaza governorates according to Palestinian administration 1995* (available at http://www.poica.org).

[SL01] **Droogers, P.** 2004. *Water, climate, food, and environment in the Walawe Basin, contribution to the project Adaptation strategies to changing environments (ADAPT)* (available at http://www.geo.vu.nl).

[TH01] **Ministry of Agriculture and Cooperatives.** 2004. *Agricultural statistics of Thailand – crop year 2002/2003*. Office of Agricultural Economics (available at http://oae.go.th).

[VN01] **FAO.** 1986. *Investigation of lands with declining and stagnating productivity, country report Viet Nam*, by S. Western. AG: GCP/RAS/107/JPN, Field Document No. 9. Bangkok.

Documentation

The inventory of subnational irrigation statistics for the Asian part of the Digital Global Map of Irrigated Areas

WORKING REPORT II

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INTRODUCTION

This report describes how the inventory of subnational irrigation statistics for the Asian continent was compiled and gives references to the data sources. The setting of the subnational units used in this inventory is consistent with the representation of subnational unit boundaries in the polygon shapefile produced as described in Working Report I. The methodology used to produce the global irrigation map (see Working Report III) ensured that the sum total of irrigated area in the final map was equal to the irrigated area per subnational unit as given by this inventory. The base year for the statistics was 2000. Statistics closest to this base year were used where irrigation statistics for more than one year were available.

The irrigated area per country is as documented in Table A1 and totals 188.5 million ha for the entire continent. The total number of subnational units used in this inventory is 4 428. Subnational irrigation statistics were available for all countries except Brunei Darussalam, Democratic People's Republic of Korea, East Timor, Georgia and Qatar. The area equipped for irrigation as a percentage of the total surface area is shown in map form in Annex B (Figure B1).

Although the incorporation of this inventory of subnational irrigation statistics has led to a major improvement in the global irrigation map, uncertainties still remain mainly because of the use of different definitions for irrigated lands. In some countries, there are only statistics available on the irrigated area actually used in the year of statistics while in other countries the area equipped for irrigation is given. Moreover, in some countries, the official figures include types of wild flooding and spate irrigation. It also appears in some cases that statistics from different sources disagree on the area of irrigated lands. These indicators of uncertainty are also mentioned in the following documentation. The list of references at the end of this report is followed by a comprehensive annex of tables showing the irrigated area per subnational unit.

DOCUMENTATION PER COUNTRY (IN ALPHABETICAL ORDER)

Afghanistan

The last available census-based inventory of irrigated areas dates back to 1967, giving a total of 2 385 290 ha [AF01]. However, land-cover maps, recently produced through the collaborative efforts of FAO, the United Nations Development Programme (UNDP) and the Afghan Geodesy and Cartography Office (Kabul), indicate that the extent of irrigated areas has not changed much in the last 35 years. Therefore, about 190 000 ha are classified as intensively irrigated (two crops, rice–wheat), about 1 370 000 ha as cropped and irrigated at least once a year, and about 1 650 000 ha as irrigated occasionally (every two or three years) [AF02]. Table A2 provides a comparison of the 1967-reported irrigated areas with the results of the land-cover mapping at province level. The large discrepancies in the provinces of Kunduz and Takhar may be a result of the uncertain position of the province boundary. A large irrigation scheme is located in Takhar when using the UNEP province boundaries, but in Kunduz when using the boundary as given by the AIMS shapefile.

Based on these findings, the area equipped for irrigation was computed on a district level based on the recently produced land-cover map as the sum of areas classified as intensively or occasionally irrigated. The estimates are shown in Table A3 and total 3 199 070 ha. However, the area actually irrigated may be significantly lower. Following statistics recently published by the Central Statistics Office, the extent of paddy cultivation has been 121 000–180 000 ha in the last ten years, and the extent of wheat has been 1 600 000–2 050 000 ha [AF03]. About 46 percent of the harvested wheat area was irrigated in 2003 [AF04].

Armenia

The area equipped for irrigation per district as shown in Table A4 totals 286 027 ha at the country level [AM01]. The figures are for 1992. The same document reported the total area of irrigation schemes under construction to be 27 341 ha. About 34 000 ha of the 320 000 ha irrigated in 1990 were out of operation. This area depended mainly on runoff from snowmelt, so no irrigation water was available in the summer season.

Azerbaijan
The total area equipped for irrigation was reported to be 1 453 318 ha, which was about 90 percent of the arable land resources of the country. However, the area actually irrigated was about 1 100 000 ha in the 2001 cropping season [AZ01]. The irrigated area in the five rayons of Nakhichevan as taken from report [AZ02] refers to 2000, while the irrigated area in Nagorno-Karabakh was obtained from report [AZ01]. The difference from the total irrigated area of the country was assumed to be located in Azerbaijan mainland. The irrigated area per subnational units is shown in Table A5.

Bahrain
The cultivable area in Bahrain was estimated to be 11 000 ha. The cultivated area increased between 1993 and 2000 from 3 160 ha to more than 4 000 ha [BN01] and it is completely equipped for irrigation. The irrigated area per region is shown in Table A6. The figures refer to 2001 [BN02].

Bangladesh
The area equipped for irrigation is 3 751 045 ha [BG01]. The figures refer to 1995. However, statistics at zila and division level were available for 1998, and they gave a total of 3 360 265 ha [BG02]. Most probably, these statistics refer to the area actually irrigated and not to the area equipped for irrigation. Therefore, it was decided to scale the irrigated area per zila so that the total at the country level was consistent with the area reported as equipped for irrigation in the Aquastat report. The resulting irrigated area per zila and division is shown in Table A7.

Bhutan
The irrigated area is reported to be 38 733.6 ha [BT01]. The figures were published in 1995 and originate from the classification of satellite imagery (base year 1989–90) and groundtruthing carried out in 1993–94 [BT02]. Irrigated area per dzongkhag is shown in Table A8.

Brunei Darussalam
The irrigated area in Brunei Darussalam is reported to be about 1 000 ha [BR01]. The figures refer to 1995. No subnational statistics were available.

Cambodia
A recent inventory reported 802 irrigation systems in 15 provinces, covering a total area of 282 072 ha [CB01]. However, 125 schemes were reported as no longer operational and, therefore, their project area was not included in the total area. The figures refer to the situation in 2001. The irrigated area of the six provinces not included in the inventory (Preah Vihear, Stung Treng, Ratana Kiri, Mondul Kiri, Koh Kong and Tonle Sap) was reported to be about 2 100 ha in 1990 [CB02], so that the total irrigated area of the country is about 284 172 ha. Irrigated area per province is shown in Table A9.

China
The irrigated area was reported to be 53 820 300 ha in the 2000 cropping season [CH01]. The figures given by the report are limited to the provinces in China mainland and are based on census results.

The farm area for China Hong Kong SAR was reported to be 6 960 ha in the 2000 cropping season, while the area actually cropped was 2 710 ha [CH02]. Based on these statistics, the irrigated area in China Hong Kong SAR was estimated to be 2 000 ha.

Irrigated area per province is shown in Table A10. However, there are large uncertainties regarding the irrigated area in China. Inventories based on remote sensing reported a much larger extent of areas under irrigation. Therefore, the irrigated area has been estimated at 78 million ha for the 1992–93 cropping season [CH03].

The irrigated area per county was available for 1990 [CH04] and totalled about 46 million ha. The inventory is based on the agricultural census undertaken in the same year. In addition, irrigated areas were digitized from a 1:1 000 000 land-use atlas [CH05]. The atlas was published in 1990 and is based on satellite images and large-scale aerial photographs taken in

the 1980s. Irrigated areas and paddy areas derived from the land-use map totalled about 68 million ha. The large discrepancy between the results of the agricultural census and the results of the land-use mapping also appears for total cropland, which was reported as 95 million ha (census) and 130 million ha (land-use atlas). This shows again the considerable uncertainty relating to land use in China.

TABLE 1
Computed limits of irrigated area in Chinese provinces compared with irrigated area as reported by the Statistical Yearbook for 2000

Province	Irrigated area in 2000 Statistical Yearbook	Computed lower limit	Computed upper limit
		(ha)	
Anhui	3 197 200	2 393 380	4 659 509
Beijing & Tianjin	681 400	699 623	1 119 617
Chongqing	624 600	544 546	1 582 604
Fujian	940 200	883 723	2 090 074
Gansu	981 500	795 407	2 154 860
Guangdong	1 478 500	1 746 674	3 825 079
Guangxi	1 501 600	1 442 889	2 657 885
Guizhou	653 400	513 849	1 728 516
Hainan	179 800	138 826	618 077
Hebei	4 482 300	3 189 292	4 303 022
Heilongjiang	2 032 000	468 484	1 115 970
Henan	4 725 300	3 154 604	4 914 514
Hubei	2 072 500	1 999 137	2 689 678
Hunan	2 677 500	2 320 441	2 877 443
Inner Mongolia	2 371 700	1 091 745	2 642 936
Jiangsu	3 900 900	3 990 628	5 886 979
Jiangxi	1 903 400	1 808 576	3 182 925
Jilin	1 315 100	306 773	901 794
Liaoning	1 440 700	714 772	1 442 271
Ningxia	398 800	237 468	507 354
Qinghai	211 400	161 386	422 612
Shaanxi	1 308 000	1 173 319	2 325 451
Shandong	4 824 900	4 150 802	5 748 701
Shanghai	285 900	237 610	352 009
Shanxi	1 105 000	979 825	1 873 721
Sichuan	2 469 000	1 969 102	3 943 761
Tibet	157 000	94 809	383 604
Xinjiang	3 094 800	1 916 242	5 386 233
Yunnan	1 403 400	907 885	1 968 769
Zhejiang	1 403 200	1 453 018	2 868 969
China mainland total	53 821 000	41 484 838	76 174 938

In order to estimate irrigated area per county in the 2000 cropping season, three inventories were combined. Irrigated area per province was assumed to be as given in [CH01]. The downscaling to county values was achieved by combining the census results for the county level in 1990 [CH04] and the irrigated area per county as taken from the land-use atlas [CH05]. First, the upper and lower limits of irrigated area per province were computed by calculating the sum of minimum and maximum irrigated areas per county as taken from the two inventories (Table 1). It was assumed that the irrigated area per county was at least as high as the minimum of irrigated area taken from the two inventories plus the difference from the maximum value

scaled by a coefficient *s*. The coefficient *s* was constant for all counties within the same province and was chosen so that the sum of the irrigated area in all counties equalled the irrigated area per province. It was possible to use this method for 23 of the 30 provinces in China mainland. In the provinces of Beijing and Tianjin, Guangdong, Jiangsu, and Zheijang, the computed lower limits of irrigated area were higher than the irrigated area reported for the provinces in 2000 (Table 1). This indicates either an overestimation of irrigated area in both inventories or a strong decline in irrigated areas between 1990 and 2000 in these provinces. Irrigated area per county was computed here by scaling the minimum of the irrigated area as reported by the two inventories. In contrast, the computed upper limit of irrigated area was lower than the irrigated area reported for 2000 in the provinces of Hebei, Heilongjiang and Jilin (Table 1). This indicates either an underestimation of irrigated areas in both inventories or a considerable increase in irrigated areas in these provinces between 1990 and 2000. Irrigated area per county was computed here as a maximum of the two inventories plus the rainfed agricultural land scaled by a coefficient so that the sum of the computed irrigated areas per county equalled the irrigated area per province in 2000. The percentage of the total land of the counties that was irrigated is shown for 1990 and 2000 in Figure B2.

China Macao SAR
The total land area of China Macao SAR is about 2 680 ha, of which 577 ha are classified as green area. The green area contains about 67 ha of gardens, parks and squares, 3 ha are classified as nurseries [MC01]. However, no information was available on agricultural land use and irrigation. Therefore, it was assumed that there is no irrigated area in China Macao SAR.

Cyprus
The extent of irrigable lands in the part of Cyprus under government control has been reported as being 45 452 ha in 2003, while the area actually irrigated was reported to be 35 931 ha [CP01]. The irrigated area in the Turkish-occupied northern part of the island was estimated by digitizing a land-use map [CP02] and by calculating the sum of the digitized area. Irrigated area per province is shown in Table A11. Thus, the area equipped for irrigation for the entire island was estimated to be 55 813 ha.

Democratic People's Republic of Korea
The irrigated area in the Democratic People's Republic of Korea was reported to be 1 460 000 ha in 1995 [KN01]. According to statistics provided by FAOSTAT (available at http://faostat.fao.org), there had been no change in the extent of irrigated area by 2002. No subnational irrigation statistics were available.

East Timor
The total irrigated area of the country was estimated to be about 14 000 ha. The figures have their origin in a study by the Indonesian Ministry of Public Works and relate to 1990 [ID01]. No more recent statistics on a subnational level were available.

Georgia
In the Soviet period, infrastructure was built to irrigate 469 000 ha of agricultural land, mainly located in the more arid east of the country [GG01]. In the 1990s, civil strife, war, vandalism and theft, as well as problems associated with land reform, the transition to a market economy, and the loss of markets with traditional trading partners, contributed to a significant reduction in the irrigated area. It has been reported that only about 160 000 ha were irrigated during the severe drought in 2000. Almost all pumping schemes (about 143 000 ha) were out of order. Therefore, a rehabilitation programme was started by Georgia's State Department of Amelioration and Water Economy to renew the infrastructure of existing irrigation and drainage schemes and to establish amelioration service cooperatives. About 255 000 ha are covered by this programme [GG02]. Based on these reports, the area equipped for irrigation was reduced to 300 000 ha. Irrigation statistics in subnational units were not available.

India

The following sections present subnational irrigation statistics for each of the federal states or union territories of India. The data were collected from various sources and they refer to the so-called "net area irrigated", because the "area equipped for irrigation" was not available. The term "net area irrigated" means all areas that were irrigated at least one time in the year of the statistics. For example, it does not include areas that were completely fallow in the year of statistics. Other common terms, such as "irrigation potential created" and "irrigation potential utilized", could not be used because they are cumulative. They allow for the potential created or used in all the years before the year of the statistics and, therefore, may lead to a doublecounting of rehabilitation areas. The term "gross area irrigated", which is also present in the statistics, has more the meaning of the area harvested and, therefore, leads to doublecounting of areas cropped more than once.

Because the data were from different sources, there were also different base years for the statistics. Where data for more than one year were available, the data closest to 2000 were used. The irrigated area of all the subnational units as presented here totals 57 286 407 ha. Irrigated area per federal state or union territory is shown in Table A12.

Andaman and Nicobar Islands

The area equipped for irrigation in the Andaman and Nicobar Islands in the 1993–94 cropping season was 1 093 ha, which was about 8 percent of the cultivable area and 12 percent of the net sown area [IN01]. Most of the cultivated area is located in valleys on the larger islands of the Andaman district.

Andhra Pradesh

The net irrigated area in Andhra Pradesh was 4 384 124 ha in the 1999–2000 cropping season. Of this total, 1 361 759 ha were cropped more than once. The main irrigation sources are wells (1.9 million ha) and canals (1.63 million ha). The highest irrigation density is to be found on the coast in the districts of West Godavari, Krishna, Guntur, Srikakulam and East Godavari [IN02]. Distribution of irrigated area per district is shown in Table A13.

Arunachal Pradesh

About 2.4 percent of the total geographical area of the state is cultivable. The area equipped for irrigation is 39 043 ha, which is about 20 percent of the net area sown. The figures refer to 2000. The highest irrigation density is to be found in the district of East Siang. Irrigated area per district [IN03] is shown in Table A14.

Assam

The latest official irrigation statistics at state level (e.g. [IN04]) estimate irrigated area in Assam at 572 000 ha. These statistics refer to the 1953–54 cropping season. According to a more recent inventory, irrigated areas at district level total 458 071 ha. However, in the 1991–92 cropping season, 221 412 ha were utilized for irrigation, which was about 8 percent of the net area sown [IN05]. About one-third of the total irrigated area is located in the districts of Nagaon and Barpeta. Irrigated area per district is shown in Table A15.

Bihar

The irrigated area in Bihar and Jharkhand combined was 3 625 000 ha in 2000 [IN06]. The latest available statistics on net irrigated area per district are for the 1993–94 cropping season and, therefore, refer to the former Bihar state territory [IN07]. The irrigated area of all districts in this inventory totalled 3 453 000 ha and was scaled to fit the figures for 2000. In order to compute the irrigated area for the districts created post-1994, an inventory on gross irrigated area per district in the 1997–98 cropping season [IN08] was used. Net irrigated area was assigned to the newly created districts proportional to their gross irrigated area. The total irrigated area for the state of Bihar was calculated as 3 439 545 ha. Irrigated area per district is shown in Table A16.

Chandigarh
The irrigated area was about 2 000 ha in the 1999–2000 cropping season [IN06].

Chhatisgarh
The irrigated area in the 1999–2000 cropping season was 1 078 400 ha, which was about 22 percent of the net area sown. More than 70 percent of the total irrigated area was located in the four central districts of Raipur, Durg, Bilaspur and Janjgeer-Champa [IN09]. Irrigated area per district is shown in Table A17.

Dadra and Nagar Haveli
The irrigated area in this state between Maharashtra and Gujarat is about 6 000 ha, which is about 38 percent of the net area sown [IN06; IN01]. The figure relates to the 1999–2000 cropping season.

Daman and Diu
The irrigated area is about 1 000 ha [IN06], which is about 21 percent of the net area sown [IN05].

Delhi
The irrigated area was 39 070 ha in the 1998–99 cropping season [IN10].

Goa
The irrigated area was 22 372 ha in the 1999–2000 cropping season. There were two medium-sized irrigation projects: Salaulim (2 700 ha) and Anjuna (1 415 ha). The remaining area was irrigated by minor irrigation projects [IN11]. The irrigated area in South Goa was reported to be 8 992 ha in 1994 [IN05]; the difference from the total irrigated area of the state (13 380 ha) was assigned to North Goa.

Gujarat
The irrigated area was 3 092 400 ha in the 1998–99 cropping season, which was about 32 percent of the net area sown. The cropping intensity on irrigated fields was 125 percent [IN12]. Irrigated area per district is shown in Table A18.

Haryana
The irrigated area is 2 888 000 ha. This is 82 percent of the net area sown, and in some districts (Kurukshetra, Panipat, Kaithal and Karnal) almost all the cultivated area is irrigated. The cropping intensity in the irrigated areas is reported to be about 177 percent. The figures refer to the 1999–2000 growing season [IN13]. Irrigated area per district is shown in Table A19.

Himachal Pradesh
The irrigated area was 101 897 ha in the 1999–2000 cropping season, which was about 18 percent of the net area sown. More than 32 000 ha of the irrigated area were located in the district of Kangra. The highest irrigation density is to be found in districts along the boundary with the state of Punjab. The cropping intensity on irrigated fields was about 175 percent [IN14]. Irrigated area per district is shown in Table A20.

Jammu and Kashmir
A total of 315 870 ha were irrigated in the 2000–01 growing season. This was 42 percent of the net area sown. The cropping intensity on irrigated fields was about 144 percent. Most of the irrigated areas were located in the more humid parts of the state (Anantnang, Jammu and Baramulla) while the irrigated fraction of the net sown area was highest in the arid districts (Leh and Kargil) [IN15]. Irrigated area per district is shown in Table A21.

Jharkhand
The irrigated area in Bihar and Jharkhand combined was 3 625 000 ha in 2000 [IN06]. The latest available statistics on net irrigated area per district are for the 1993–94 cropping season and, therefore, refer to the former Bihar state territory [IN07]. The irrigated area of all districts in this inventory totalled 3 453 000 ha and was scaled to fit the figures for 2000. In order to

compute the irrigated area for the districts created post-1994, an inventory on gross irrigated area per district in the 1997–98 cropping season [IN16] was used. Net irrigated area was assigned to the newly created districts proportional to their gross irrigated areas. The total irrigated area for the state of Jharkhand was computed to be 185 455 ha. About 61 000 ha of irrigated area were located in the districts of Palamu and Garhwa. Irrigated area per district is shown in Table A22.

Karnataka

The irrigated area was 2 491 871 ha in the 1998–99 cropping season, which was about 24 percent of the net area sown. The cropping intensity on irrigated fields was about 125 percent. In the districts of Bagalkot, Bellary, Mandya, Davangere and Belgaum, the irrigation density was relatively high, while the irrigation density in the districts of Uttara Kannada and Chikmagalur was very low [IN17]. Irrigated area per district is shown in Table A23.

Kerala

The irrigated area was 380 043 ha in the 1999–2000 cropping season, which was about 17 percent of the net area sown. The cropping intensity on irrigated fields was about 124 percent. More than 60 percent of the total irrigated area was located in the districts of Thrissur, Palakkhad, Kasaragod and Alappuzha [IN18]. Irrigated area per district is shown in Table A24.

Lakshadweep

The irrigated area has been reported to be about 1 000 ha [IN06]. The net area sown is 2 755 ha [IN19]. The whole of the cultivated area is cropped with coconuts. In parts of the cultivated area, other crops are grown in intercropping systems. Irrigation water is usually provided by wells. However, because of the limited availability of this resource, the extraction of irrigation water by using motor pumps has been banned [IN20].

Madhya Pradesh

The irrigated area was 5 514 979 ha in the 1998–99 cropping season, which was about 36 percent of the net area sown. The cropping intensity on irrigated fields is about 103 percent. High densities of irrigated areas are to be found in the north and west of the state while irrigation density in the east of the state is generally low [IN21]. Irrigated area per district is shown in Table A25.

Maharashtra

The irrigated area was 3 140 200 ha in the 1997–98 cropping season, which was about 18 percent of the net area sown. The cropping intensity on irrigated fields is about 118 percent. The highest irrigation density is to be found in Pune Division, which consists of the districts of Pune, Solapur and Ahmadnagar [IN22]. Irrigated area per district is shown in Table A26.

Manipur

Statistics on the total extent of irrigated areas on a district level were not available. Therefore, the irrigated area per district was estimated using an inventory on gross irrigated-rice areas per district in the period 1994–2000 [IN23]. For each district, the maximum annual value within this period was selected. These district values gave a total of 92 860 ha for the entire state and were then scaled down to fit to the net irrigated area per state, which was reported to be about 65 000 ha [IN06]. About 40 percent of the net area sown was assumed to be irrigated. According to the estimates, most of the irrigated area is located in the central districts of Bishnupur and Imphal. The estimates of irrigated area per district are shown in Table A27.

Meghalaya

The irrigated area on the district level totalled 45 045 ha in the 1991–92 cropping season [IN24], which was about 22 percent of the net area sown. The net irrigated area in the 1999–2000 season was reported to be 48 000 ha [IN06]. However, these figures in the all-India

inventory have their origin in the 1984-85 growing season. Therefore, the district values, shown in Table A28, were not scaled to meet the figures given for 2000.

Mizoram
The irrigated area in the 1999–2000 growing season was 9 000 ha, which was about 10 percent of the net area sown [IN06]. Related figures for the three districts of Mizoram were not available.

Nagaland
The irrigated area in the 1999–2000 cropping season was 63 000 ha, which was about 24 percent of the net area sown [IN06]. The irrigated areas per district were available for the 1991–92 season and yielded a total of 58 900 ha [IN25]. Therefore, the district-level irrigated area was scaled so that the sum met the statistics for 2000. These estimated irrigated areas per district in the 1999–2000 cropping season are shown in Table A29.

Orissa
The irrigated area in the 1999–2000 cropping season was estimated to be 2 090 000 ha. This was about 34 percent of the net area sown [IN06]. However, the figures for Orissa in the all-India inventory refer to 1989–90, because more recent statistics on net irrigated area were not available. In order to estimate irrigated area per district, an inventory of the created irrigation potential on the district level was used [IN26]. The inventory refers to the 1999–2000 season and distinguishes the kharif and rabi cropping seasons. In all districts, the available potential for kharif crops is higher than the potential for rabi crops. Therefore, it was used to estimate the area equipped for irrigation. The potential in the districts totalled 2 380 740 ha and was scaled to fit the figures for the net irrigation area as given by the all-India inventory. The estimates of irrigated area per district are shown in Table A30.

Pondicherry
The irrigated area was 21 390 ha in the 2000–01 cropping season. This was about 88 percent of the net sown area. The cropping intensity on irrigated fields was about 160 percent [IN27]. Irrigated area per district is shown in Table A31.

Punjab
The irrigated area was 4 020 700 ha in the 2000–01 cropping season. This was about 94 percent of the net area sown and about 80 percent of the total geographical area of the state of Punjab. The cropping intensity on irrigated fields was about 190 percent. In the district of Ludhiana, all the cultivated area was irrigated, and more than 98 percent of the area sown was irrigated in 12 of the 17 districts [IN28]. Therefore, Punjab can be seen as one of the most intensive agricultural and irrigated areas in the world. Irrigated area per district is shown in Table A32.

Rajasthan
The irrigated area was 5 611 874 ha in the 1999–2000 cropping season, which was about 36 percent of the net area sown. The cropping intensity on irrigated fields was about 123 percent. The density of irrigated areas tends to be higher in the northern districts of the state (Gangangar, Hanumangarh, Alwar, Baratpur and Dausa). Irrigated area per district is shown in Table A33 [IN29].

Sikkim
The irrigated area was 16 000 ha in the 1985–86 cropping season. This was about 17 percent of the net are sown, and these are the most recent statistics available [IN06]. Data for irrigated area on the district level were not available.

Tamil Nadu
The irrigated area was 3 018 839 ha in the 1998–99 cropping season. This was about 54 percent of the net area sown. The cropping intensity on irrigated fields was about 120 percent. With the exception of the districts of Nilgiris, Chennai and Toothukudi, the fraction of irrigated net sown

area exceeded 30 percent in all districts [IN30]. The density of irrigated areas was high, in particular in the northeast of the state. Irrigated area per district is shown in Table A34.

Tripura

The irrigated area in the state of Tripura was about 35 000 ha, which was about 13 percent of the net area sown. The figures refer to the 1992–93 season [IN06]. Irrigation statistics on the district level were not available.

Uttaranchal

Irrigation statistics for the state of Uttaranchal are not available yet. Therefore, irrigation statistics for the districts of the former Uttar Pradesh territory for the period before the existence of Uttaranchal (1996–97 growing season) were used in order to estimate irrigated area in Uttaranchal [IN31]. For districts formed post-1997, more recent statistics available in the district profiles provided by the National Informatics Centre were also used (available at http://districts.nic.in). Irrigated area per district was estimated as shown in Table A35. The areas totalled 332 502 ha. More than 60 percent of the total irrigated area of the state is located in the districts of Hardwar and Udhamsingh Nagar.

Uttar Pradesh

The irrigated area in the 1999–2000 cropping season was 12 469 624 ha [IN32]. This was about 74 percent of the net area sown and 51 percent of the total geographical area of the state. The cropping intensity on irrigated fields was about 141 percent. In particular, in Meerut Division (districts of Meerut, Bagpat, Ghaziabad, Bulandshahar and Gautam Budh Nagar), the cultivated area is completely irrigated. Irrigated area per district is shown in Table A36 [IN32].

West Bengal

The irrigated area in the 1987–88 cropping season was 1 911 000 ha, which was about 35 percent of the net area sown. More recent statistics on net irrigated area were not available for West Bengal [IN06]. Gross irrigated area in the 1997–98 cropping season was reported to be 4 570 000 ha [IN33]. In order to estimate the area equipped for irrigation on a district level, the gross area irrigated was divided by the district-specific cropping intensity [IN34]. Because separate cropping intensities for irrigated and rainfed land were not available, the irrigated areas so computed totalled 2 484 952 ha and were scaled to fit the total area as given by the statistics (1 911 000 ha). The resulting figures for irrigated area per district are shown in Table A37.

Indonesia

The irrigated area of 88 basins of the country totals 4 459 000 ha [ID01] and is shown in Table A38. The figures refer to 1990 but they are in good agreement with the area equipped for irrigation (4 427 922 ha) as reported in the Aquastat database (available at http://www.fao.org) for 1996. About 65 percent of the irrigated area is located on the island of Java.

Iraq

The area equipped for irrigation is reported to be 3 525 000 ha [IQ01]. The figures refer to 1990. A large part of this area is not irrigated. Because of waterlogging and salinity, the area irrigated in 1993 was about 1 936 000 ha [IQ02] and this had decreased to 1 775 750 ha in 2001 [IQ03]. However, the three Kurdish provinces in the north of the country (Dahoak, Arbil and Sulaimania) are not included in these figures. The largest decrease in irrigated area is to be found in the downstream provinces where agriculture depends completely on irrigation. In the provinces located more upstream of the Tigris River (Salah Eldin, Tameem and Nineweh), where also rainfed agriculture is practised, the irrigated area increased between 1993 and 2001. No official statistics were available for the mountainous, Kurdish northern provinces. Therefore, statistics originating from a land survey in 1992 and provided by the Kurdistan Democratic Party [IQ04] were used for these provinces.

Statistics on the area equipped for irrigation were not available on a province level. Therefore, it was estimated by combining areas computed from digitized land-use maps [IQ05], tactical pilot charts [IQ06] and satellite imagery [IQ07] with province-level statistics of the area

actually irrigated in 1993 [IQ02] and 2001 [IQ03]. It was assumed that the area equipped for irrigation was as least as high as the maximum of the area actually irrigated in 1993 and 2001. In order to estimate the area of the irrigated areas not in use, the land-use maps, pilot charts and satellite imagery were used for the downstream provinces of Muthannia, Qadisiya, Najaf, Babil, Baghdad, Thegar, Diala, Misan and Wasit. The estimates for the northern provinces of Dahoak, Arbil and Sulaimania are as reported in the land survey. The estimates of the area equipped for irrigation per province are shown in Table A39.

Islamic Republic of Iran
The figures for the irrigated area per ostan as reported in Table A40 total 6 913 800 ha [IR01]. The figures refer to 1994. However, because the data were published in the Statistical Yearbook 2003, it can be assumed that more recent statistics are not available.

Israel
The irrigated area in Israel reached its maximum extent in the mid-1980s at about 230 000 ha and then declined to 186 600 ha in 2000 [IS01]. An irrigated area of about 3 200 ha is located in enclosed settlements in the West Bank and Gaza territories. Irrigated area per natural region as shown in Table A41 was computed using statistics on cultivated crops [IS02] under the assumptions that the flower and garden-plant area was completely irrigated, that citrus plantations were completely irrigated, that 91.88 percent of the vegetable area was irrigated, and that 74.08 percent of the other plantations (except citrus) was irrigated. These coefficients were computed from inventories on the national scale ([IS03]; [IS04]). The extent of irrigated field crops per natural region was given by [IS02].

Japan
Figures on area equipped for irrigation were available for 1993 on a province level and totalled 3 129 000 ha [JP01]. In Japan, paddy-fields are almost completely irrigated, while only about 10 percent of the upland fields are irrigated [JP02]. In addition, statistics on the extent of paddy- and upland fields per prefecture [JP03] were used in order to estimate the irrigated area within the prefectures. These figures refer to 1995. It was assumed that all the paddy-field areas were irrigated and that the fraction of irrigated upland fields was constant for all prefectures within the same province. The resulting figures for extent of irrigated area per prefecture are shown in Table A42.

Jordan
The area equipped for irrigation increased from 64 300 ha in 1990 [JO01] to 76 912 ha in 2000 [JO02]. However, other inventories reported irrigated areas of 84 130 ha in 1993 [JO03] and 95 005 ha in 2000 [JO04]. Irrigated area per governorate was estimated on the basis of the values reported in [JO01] in order to be consistent with the Aquastat country report. The changes post-1990 were estimated based on the differences from inventory [JO03]. The more recent inventory published in 2003 [JO04] could not be used for this purpose because the administrative setting of the country has changed in the meantime. The resulting figures for irrigated area per governorate are shown in Table A43.

Kazakhstan
The area equipped for irrigation was 2 313 100 ha in 1993. In addition, there existed 138 700 ha of equipped wetland and inland valley bottoms [KZ01]. However, it has been estimated that about 680 000 ha of the land were out of use in the 1994 cropping season because of soil salinization, waterlogging, broken or incomplete distribution systems or because of other reasons [KZ02]. The irrigated areas in 2002 consisted of 1 220 000 ha of regular irrigation and 580 600 ha of so-called “engineering-liman irrigation and inundated hay lands” [KZ03]. Irrigated area per oblast was available for 1993 [KZ02]. The oblast values give a total of 1 855 200 ha and are shown in Table A44.

Kuwait
The cultivated area in Kuwait increased from 4 770 ha in 1994 to 6 968 ha in 2000 [KU01]. Because of the climate conditions, all the cultivated area is irrigated. Irrigated area per governorate is shown in Table A45.

Kyrgyzstan
In 1994, 1 075 040 ha were equipped for irrigation [KY01]. Irrigated area per oblast and per raion is shown in Table A46.

Lao People's Democratic Republic
The area equipped for irrigation almost doubled in the period 1995–2000. Most of the increase was based on the establishment of pumping schemes, which covered 46 150 ha in 1997 and 153 330 ha of agricultural land in 2000. Irrigated areas per province, as shown in Table A47, totalled 295 535 ha in the wet season and 197 100 ha in the dry season [LA01].

Lebanon
The irrigated areas per mohafaza and caza, as shown in Table A48, totalled 117 113 ha. This was about 40 percent of the cultivated area [LE01]. The figures refer to 1997.

Malaysia
The area equipped for irrigation is about 362 600 ha [ML01]. The figures refer to 1994. Irrigated area per state was available for 1993 and totalled 321 696 ha [ML02]. Therefore, irrigated area per state was scaled so that the sum was equal to the value given by the Aquastat report for the entire country. The resulting figures for irrigated area per state are shown in Table A49.

Maldives
The cultivated area was estimated to be about 3 000 ha, but there is no irrigation in the Maldives [MD01].

Mongolia
The area equipped for irrigation is about 57 300 ha, of which 43 400 ha under highly mechanized sprinkler systems and about 13 900 ha covered by surface-irrigation systems. However, only 16 674 ha of the sprinkler-irrigation area was operational in 1994 [MG01]. An inventory of the irrigated area per aimag (district) was only available for the sprinkler-irrigation schemes [MG02]. Most of the sprinkler-irrigated area is located in the west and the north of the country. It was also reported that about 80 percent of the surface-irrigation schemes are located in the west of the country [MG01]. Therefore, in order to estimate the total area equipped for irrigation at aimag level, the sprinkler-irrigated area per aimag was scaled so that the sum of the irrigated areas was 57 300 ha. The resulting estimated areas equipped for irrigation per aimag are shown in Table A50.

Myanmar
The irrigated area in Myanmar increased from about 1 000 000 ha in the 1991–92 cropping season to 1 841 320 ha in the 1999–2000 cropping season [MY01]. Subnational statistics were available for the 1994–95 cropping season [MY02]. Irrigated area per state totalled 1 555 361 ha in 1995 and was scaled so that the sum of the irrigated areas per state fitted the total irrigated area of the country reported for the 1999–2000 season. The resulting estimates for irrigated area per state are shown in Table A51.

Nepal
The area equipped for irrigation in Nepal is 1 168 349 ha [NP01]. The figure refers to the 2001–02 cropping season. Irrigated area per district and development region is shown in Table A52.

Oman

The cultivated area in the sultanate of Oman was 72 714 ha in 2000 [OM01]. Because of the arid climate, the cultivated area is completely irrigated [OM02]. Irrigated area per region, as documented in Table A53, was available for 2001 and totalled 72 630 ha [OM03].

Pakistan

The following sections present district-level subnational irrigation statistics for each of the federal states. The area equipped for irrigation per federal state, as documented in Table A54, was taken from the Aquastat country report [PK01] because the national statistics usually report the gross or net area actually irrigated in the year of the statistics. As defined at the beginning of this report, irrigated area includes "full or partial control irrigation" and "equipped wetland and inland valley bottoms", but excludes spate irrigation. The figures refer to 1990 and give a total of 14 327 000 ha. The net area irrigated in 2000 was reported to be 12 030 983 ha. In addition, there were 432 825 ha with spate irrigation. The gross area irrigated was 19 505 416 ha in the same year; 9 074 329 ha were cropped with kharif crops, 10 069 697 ha were cropped with rabi crops, and 361 388 ha with irrigated orchards [PK02].

The cultivated area in the districts of the Northern Territories along the border with India and China was assumed to be completely irrigated and totalled 90 464 ha [PK03]. The figures have their origin in the 1990 agricultural census. The total area equipped for irrigation in the country is 14 417 464 ha.

Balochistan

The irrigated area per district by irrigation-water source was derived from a recent inventory [PK04]. In most of the districts, the figures refer to 1995. For each of the districts, area irrigated by canals, tubewells, wells, springs and karezes was included, while irrigated area classified as flood irrigation or rainfed was not taken into consideration. The resulting area equipped for irrigation totalled 807 335 ha and the figures were then scaled so that the sum of the irrigated area of all districts was 767 120 ha. Almost 30 percent of the irrigated area of the state is located in the district of Jaffarabad. More than 90 percent of this district located in the Indus plain is equipped for irrigation. Irrigated area per district is shown in Table A55.

Northern Territories

Irrigated area per district, as documented in Table A56, totals 90 464 ha. It was assumed that all the cultivated area as reported by the 1990 agricultural census [PK03] was irrigated. However, other studies indicate that the irrigated area in this very remote, mountainous region might be even larger than that reported by the census [PK05].

North-West Frontier Province

Irrigated area per district totalled 804 282 ha in North-West Frontier Province [PK06] and 88 074 ha in the Federally Administered Tribal Areas [PK07]. Only areas irrigated by canals, tanks, tubewells, wells and pumps were considered because areas irrigated by other sources most probably indicate spate-irrigation areas. The figures refer to the 1999–2000 cropping season. Irrigated area per district was scaled so that the total was equal to the area equipped for irrigation as reported in the Aquastat database (719 152 ha). The resulting figures for irrigated area per district are shown in Table A57.

Punjab

The area equipped for irrigation is 10 325 678 ha [PK01]. The cultivated area was reported to be 12 350 000 ha in the 1999–2000 cropping season, of which 1 330 000 ha were current fallow [PK08]; 6 872 204 ha were reported cropped in the kharif season, 8 839 377 ha in the rabi season, and 173 086 ha were classified as orchard. Of the area sown, 13 395 904 ha were irrigated [PK02]. Therefore, about 84 percent of the cultivated area was equipped for irrigation and about 84 percent of the sown crops were growing on irrigated fields.

The area equipped for irrigation was not available at district level. Therefore, it was estimated by computing first the fraction of area sown that was irrigated [PK09], and then by

multiplying this fraction by the cultivated area per district [PK10]. The resulting area equipped for irrigation gave a total of 10 178 276 ha for the entire Punjab state territory. Therefore, the area equipped for irrigation per district was scaled so that the total area corresponded with the figures in the Aquastat report. Area equipped for irrigation per district is shown in Table A58.

Sindh

The area equipped for irrigation was reported to be 2 515 050 ha [PK01]. The net area sown in the 1997–98 cropping season was 3 040 000 ha; 906 000 ha were sown more than once. In addition, 2 645 000 ha of the cultivated area were fallow land in the same season [PK11]. Area equipped for irrigation was not available at district level. Therefore, it was estimated as follows:

- Area equipped for irrigation should be at least as high as the maximum value of irrigated areas per district in the 1997–98 rabi season [PK12] and the 1998 kharif-season [PK13]. The resulting figures for irrigated area per district gave a total of 2 073100 ha.
- District-based statistics on net area sown [PK14] and the proportion of irrigated to rainfed crops [PK15] were used to estimate the additional areas given by the difference from the Aquastat figures for the entire state.

The resulting estimates for area equipped for irrigation per district are shown in Table A59.

Palestinian Authority

The irrigated area decreased from 17 247 ha in 1982 to 16 990 ha in 1990 [PL01] and to 16 222 ha in 2001 [PL02]. Of the irrigated area, 6 990 ha were located in the West Bank and 9 220 ha in the Gaza Strip [PL02]. In addition, 12.2 ha under drip irrigation were reported to be in Jerusalem [PL03]. Based on the methodology described in the section on Israel, the irrigated area located in Israeli settlements was estimated to be 3 244 ha. Irrigated area per governorate is shown in Table A60.

Papua New Guinea

There are no areas equipped for irrigation in Papua New Guinea. Some types of flood irrigation are reported [PG01]. However, these types of irrigation do not meet the criteria for full or partially equipped irrigation.

Philippines

The area equipped for irrigation per region, as documented in Table A61 totals 1 550 000 ha [PH01]. The figures refer to 1993. The area actually irrigated was reported to be 1 470 691 ha in that year.

Qatar

The area equipped for irrigation was estimated at 12 520 ha in 1993 [QT01], while the area actually irrigated in 2000 was reported to be 9 762 ha [QT02]. Subnational-level statistics were not available.

Republic of Korea

The irrigated areas per province total 880 365 ha and are shown in Table A62. The figures refer to irrigated paddy lands in the 2002 cropping season. In addition, 258 043 ha of paddy lands are classified in the same inventory as "partially irrigated" [KS01].

Russian Federation

Irrigated area per oblast, as documented in Table A63, totals 897 000 ha in the Asian part of the country. The figures refer to 1997 [RU01].

Saudi Arabia

The cultivable area was estimated at 4 987 000 ha in 2000 [SA01], but only 1 119 750 ha were used in that year [SA02]. Another inventory reported 1 620 983 ha as being used in the 1992 cropping season [SA03]. All agriculture is irrigated, and the extent of cultivation depends mainly on the availability of irrigation water as a limiting factor [SA04]. The area equipped for irrigation on the regional level, as documented in Table A64, was estimated by using the maximum value of the cultivated areas in the 1992 and 2000 cropping seasons as reported by

the inventories [SA03] and [SA02]. The resulting estimated total irrigated area was 1 730 767 ha.

Singapore
Agrotechnology parks, which are agriculture estates developed with the necessary infrastructure for farming, cover about 1 465 ha. Of this total, 937 ha were used for farming in 2000 [SI01]. However, there are no records that would indicate irrigation in Singapore.

Sri Lanka
The area equipped for irrigation in 1995 was about 570 000 ha [SL01]. Area equipped for irrigation was not available at district level. It was estimated by using an inventory of irrigated paddy-fields in the 2001–02 cropping season [SL02] and an inventory of other irrigated field crops in the 1990–1991 cropping season [SL03]. Irrigated paddy area totalled 335 026 ha in major schemes and 177 433 ha in minor schemes while the area of other irrigated crops totalled 61 351 ha. The resulting total irrigated area was 573 810 ha. Irrigated area per district was then scaled so that the total irrigated area within the country matched the value of 570 000 ha given in the Aquastat report. Irrigated area per district is shown in Table A65.

Syrian Arab Republic
The irrigated area in the Syrian Arab Republic increased from 670 134 ha in 1989 to 1 088 891 ha in 1995 [SY01] and to 1 266 900 ha in 2001 [SY02]. Irrigated area per governorate in the 2001 growing season is shown in Table A66.

Taiwan Province of China
The cultivated area decreased from 667 602 ha in 1990 to 656 676 ha in 1995 [TW01] and to 627 160 ha in 2000 [TW02]. In contrast, the irrigated area increased from 510 500 ha in 1990 to 525 528 ha in 1995 [TW03]. No information was available on the extent of irrigated area per county or irrigated area in 2000. Therefore, irrigated area per county was estimated by using statistics related to irrigated area per region in 1995 [TW03] as well as paddy area per county and other cultivated area per county in 1995 [TW04]. It was assumed that all the paddy area was irrigated and that the fraction of irrigated other fields was constant in all counties within the same region. The resulting estimates for irrigated area per county in 1995 are shown in Table A67.

Tajikistan
The area equipped for irrigation has been reported to be 719 200 ha, with 240 200 ha of the irrigated area located in the Syr Darya River Basin and 479 000 ha in the Amu Darya River Basin [TJ01]. The figures refer to 1994, but more recent reports indicate that there had been no change by 2002 [TJ02]. No subnational statistics were available.

Thailand
The irrigated area per province and region, as documented in Table A68, totals 4 985 708 ha [TH01]. The figures refer to 2000.

Turkey
The area equipped for irrigation was 4 185 910 ha in 1994 [TK01]. The area actually irrigated was 3 093 545 ha in 1991 [TK02] and 3 143 000 ha in 1994 [TK03]. At province level, only area actually irrigated was available. Therefore, the area equipped for irrigation was estimated by choosing the maximum value of the areas reported as irrigated in the inventories [TK02] and [TK03]. The resulting total for irrigated areas was 3 756 555 ha and the figures were then scaled so that the total irrigated area of the country matched the value reported in the Aquastat database [TK01]. Irrigated area per district is shown in Table A69.

Turkmenistan
The area equipped for irrigation is 1 744 100 ha [TM01]. The figures refer to 1994. Irrigated area per welayat in 1996 totalled 1 711 800 ha [TM02] and was scaled so that the total irrigated

area of the country was equal to the area equipped for irrigation as reported in the Aquastat database [TM01]. Irrigated area per welayat is shown in Table A70.

United Arab Emirates
The cultivated area increased from 68 877 ha in 1992 to 111 356 ha in 1998 [UE01] and 280 341 ha in 2001 [UE02]. About 82 percent of the irrigated area is located in the emirate of Abu Dhabi. Of the total figure, 213 530 ha are equipped with modern irrigation systems, mainly drip irrigation [UE03]. The most important irrigated crops are palm trees (185 329 ha), field crops (43 253 ha) and vegetables (9 683 ha) [UE02]. Irrigated area per emirate in the 2000–01 cropping season is shown in Table A71.

Uzbekistan
The irrigated area per oblast, as documented in Table A72, totalled 4 223 000 ha in 1996 [UZ01]. The highest irrigation densities are to be found in the oblasts of Andijon, Sirdarjo and Farghona, where more than 50 percent of the oblast area is equipped for irrigation.

Viet Nam
The area equipped for irrigation in Viet Nam is about 3 000 000 ha. About 2 000 000 ha are used while about 1 000 000 ha are within the design command area but currently not being irrigated. The area harvested on irrigated fields is about 5 400 000 ha, which indicates a very high cropping intensity [VN01]. The area equipped for irrigation per district, as documented in Table A73, was taken from an inventory of design capacities per district [VN02], an inventory on irrigable land per basin [VN03], and an inventory of irrigated areas in the Mekong River Basin [VN04].

Yemen
The area equipped for irrigation was 388 000 ha in 1996. In addition, there were about 100 000 ha of spate irrigation [YE01], mainly located in the governorates along the coast (Taiz, Hodeidah, Laheg, Abyan, Shabwa, Haja and Hadramout) [YE02]. Irrigated area per governorate totalled 576 570 ha in 2001 [YE03]. The irrigated area of the governorates was first reduced by 100 000 ha to remove the spate irrigation areas, and then scaled so that the total for the irrigated areas of the country was equal to the value reported for equipped irrigation in [YE01]. The resulting estimates for irrigated area per governorate are shown in Table A74.

REFERENCES

[AF01] **Ministry of Water and Power.** 1967. *Irrigated areas per province and per source*. Table available in the Aquastat library.

[AF02] **Afghanistan Information Management Service (AIMS), FAO.** 2003. *Land cover of Afghanistan (1993).* Dataset and documentation available at http://www.fao.org and http://www.aims.org.af.

[AF03] **Central Statistics Office of Afghanistan.** 2004. *Cultivated land area, crop (hectare)* (available at http://www.aims.org.af).

[AF04] **Central Statistics Office of Afghanistan.** 2004. *Wheat: area, yield and production by province* (available at http://www.aims.org.af).

[AM01] **Republic of Armenia.** 1993. *Irrigation subsector review and project identification*. Report to FAO. Report no. 79/93 CP – ARM2, Annex 1, Table 3.

[AZ01] **World Bank.** 2003. *Irrigation distribution system and management improvement project.* Project appraisal document. Environmentally and Socially Sustainable Development Sector Unit, Europe and Central Asia Region, Report No. 25755-AZ (available at http://www.worldbank.org).

[AZ02] **State Amelioration and Irrigation Committee of the Republic of Azerbaijan.** 2003. *Irrigation distribution system and management improvement project – environmental assessment.* Report to the World Bank (available at http://www.worldbank.org).

[BG01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 52. Rome.

[BG02] **Bangladesh Bureau of Statistics.** 2004. *NDB Statistics*, *Zila Profile* (available at http://www.bbsgov.org).

[BN01] **Government of Bahrain.** 2004. *Statistical abstracts 2002.* Table S20B (available at http://www.bahrain.gov.bh).

[BN02] **Arab Organization for Agricultural Development.** 2003. *Arab Agricultural Statistics Yearbook 2002.* Agricultural Information, Documentation and Statistics Center (also available at http://www.aoad.org).

[BR01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 68. Rome.

[BT01] **Land Use Planning Project.** 1995. *Land cover figures for Bhutan.* Thimphu.

[BT02] **Ministry of Agriculture.** 2004. Homepage of the Land Use and Statistics Section of the Policy and Planning Division (available at http://www.moa.gov.bt).

[CB01] **Mekong River Commission.** 2003. *People and environment atlas of the lower Mekong Basin.* Phnom Penh, Mekong River Commission Secretariat (available at http://www.mrcmekong.org).

[CB02] **FAO.** 1994. *Agricultural development options review (phase I).* Rome.

[CH01] **National Bureau of Statistics.** 2001. *China statistical yearbook 2001* (available at http://chinadatacenter.org).

[CH02] **Agriculture, Fisheries and Conservation Department.** 2002. *Department annual report 2001/02* (available at http://www.afcd.gov.hk).

[CH03] **Frolking, S., Xianming, X., Yahui Z., Salas, W. & Li, C.** 1999. Agricultural land-use in China: a comparison of area estimates from ground-based census and satellite-borne remote sensing. *Glob. Ecol. Biogeog.,* 8: 407-416.

[CH04] **Skinner, G.W.** 1997. *China county-level data on population (census) and agriculture, keyed to 1:1M GIS map.* Center for International Earth Science Information Network (CIESIN), (available at http://sedac.ciesin.columbia.edu).

[CH05] **Wu, C., ed.** 1990. *Land-use map of China (1:1 000 000 scale)*. Beijing, Science Press.

[CP01] **Republic of Cyprus.** 2004. *Census of agriculture 2003 – preliminary results.* Statistical Service, Republic of Cyprus (available at http://www.mof.gov.cy).

[CP02] **Savvides, L.** 1975. *Land use map of Cyprus – Scale 1:250 000.* Nicosia.

[GG01] **FAO.** 1997. *Irrigation in the countries of the former Soviet Union in Figures*, p. 102. Rome.

[GG02] **World Bank.** 2001. *Irrigation and drainage community development project*. Project appraisal document. Report No. 22042-GE (available at http://www.worldbank.org).

[ID01] **Elshof, A.J.** 1990. *Irrigated sawah and swamp - development potential and use*. Jakarta, Ministry of Public Works.

[IN01] **Government of India.** 2001. *Report on census of minor irrigation schemes 1993–94.* Ministry of Water Resources (available at http://164.100.8.59/census/startcon.htm).

[IN02] **Government of Andhra Pradesh, Department of Agriculture.** *District-wise net area irrigation by various sources in Andhra Pradesh (1999–2000)*, (available at http://www.indiaagristat.com).

[IN03] **Government of Arunachal Pradesh.** 2001. *Statistical abstract of Arunachal Pradesh 2000*, Directorate of Economics and Statistics (available at http://www.indiaagristat.com).

[IN04] **Government of India.** *Land use classification and irrigated area (1997-98 & 1998–99)*. Ministry of Agriculture (available at http://www.indiaagristat.com).

[IN05] **Government of India.** 2004. *District profiles*. National Informatics Centre, Ministry of Communications and IT (available at http://gist.ap.nic.in/).

[IN06] **Government of India.** 2003. State-wise net area under irrigation by sources in India (1999–2000). *In* Ministry of Statistics & Programme Implementation, *Statistical Abstract 2002* (available at http://www.indiaagristat.com).

[IN07] **Government of Bihar.** *District-wise net area irrigated by other sources and total net area irrigated in Bihar (1991-92 to 1993–94)*. Agricultural Department (available at http://www.indiaagristat.com).

[IN08] **Fertilizer Association of India.** 2002. District/source-wise gross irrigated area in Bihar – part II (1997-98). *In: Fertiliser and agriculture statistics, Eastern Region* (available at http://www.indiaagristat.com).

[IN09] **Government of Chhatisgarh.** 2001. District-wise net area sown/area irrigated in Chhatisgarh (1999–2000). *In: Chhatisgarh in charts and graphs 2001*. Directorate of Economics and Statistics (available at http://www.indiaagristat.com).

[IN10] **Government of Delhi.** 2002. Area irrigated by different sources in Delhi (1994–95 to 1998–99). *In: Economy survey of Delhi 2001-02*. Department of Planning (available at http://www.indiaagristat.com).

[IN11] **Government of Goa.** *Irrigated area and irrigation by different source in Goa (during 1999–2000)*. Directorate of Agriculture (available at http://www.indiaagristat.com).

[IN12] **Government of Gujarat.** *District/source-wise area irrigated in Gujarat (1998–99)*. Department of Agriculture (available at http://www.indiaagristat.com).

[IN13] **Government of Haryana.** 2002. District-wise net area under irrigation in Haryana (1999–2000). *In: Statistical Abstract of Haryana (2000–01)*. Economic and Statistical Organisation, Planning Department (available at http://www.indiaagristat.com).

[IN14] **Government of Himachal Pradesh.** District-wise irrigation intensity in Himachal Pradesh (1998–99 & 1999–2000). *In: Annual season and crop report 1999–2000* (available at http://www.indiaagristat.com).

[IN15] **Fertilizer Association of India.** 2002. District/source-wise irrigated area in Jammu and Kashmir (2000–01). *In: Fertiliser and agriculture statistics, Northern Region, 2001–2002* (available at http://www.indiaagristat.com).

[IN16] **Fertilizer Association of India.** 2002. District/source-wise gross irrigated area in Jharkhand – part II (1997-98). *In: Fertiliser and agriculture statistics, Eastern Region* (available at http://www.indiaagristat.com).

[IN17] **Government of Karnataka.** 2002. District-wise net area irrigated by various sources in Karnataka (1998–99). *In: Karnataka at a glance 2000–01*. Directorate of Economics and Statistics (available at http://www.indiaagristat.com).

[IN18] **Government of Kerala.** *District/source-wise net area irrigated in Kerala (1999–2000)*. Directorate of Economics and Statistics (available at http://www.indiaagristat.com).

[IN19] **Government of India.** Area under crops in Lakshadweep – part VI (1991-92). *In: Indian agricultural statistics 1991-92*. Ministry of Agriculture (available at http://www.indiaagristat.com).

[IN20] **Government of Lakshadweep.** *Lakshadweep – land, soil, climate*. Department of Agriculture (available at http://lakshadweep.nic.in).

[IN21] **Government of Madhya Pradesh.** District/source-wise net irrigated area in Madhya Pradesh (1998–99). *In: Agricultural statistics 2000*. Directorate of Agriculture (available at http://www.indiaagristat.com).

[IN22] **Government of Maharashtra.** District-wise sources of water supply and area irrigated in Maharashtra – part IV (1997-98). *In: Season and crop report 1997-98* (available at http://www.indiaagristat.com).

[IN23] **Government of Manipur.** 2002. District-wise estimated area under rice by different types of irrigation in Manipur – part III (1993–94 to 1999–2000). *In: Statistical abstract of Manipur 2001*. Directorate of Economics and Statistics (available at http://www.indiaagristat.com).
[IN24] **Government of India.** 1992. District-wise area irrigated and crops irrigated of Meghalaya (1991-92), part I. *In: Indian agricultural statistics*. Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture (available at http://www.indiaagristat.com).
[IN25] **Government of India.** 1992. District-wise area irrigated and crops irrigated of Nagaland (1991-92), part I. *In: Indian agricultural statistics 1991-92*. Ministry of Agriculture (available at http://www.indiaagristat.com).
[IN26] **Fertilizer Association of India.** District/source-wise gross area irrigated in Orissa (1999–2000). *In: Fertiliser and agriculture statistics, Eastern Region, 2001-02* (available at http://www.indiaagristat.com).
[IN27] **Fertilizer Association of India.** District-wise land utilization (area cropped / area irrigated) in Pondicherry (2000–2001). *In: Fertiliser and agriculture statistics, Southern Region, 2001-02* (available at http://www.indiaagristat.com).
[IN28] **Fertilizer Association of India.** District/source-wise irrigated area in Punjab (2000–2001). *In: Fertiliser and agriculture statistics, Northern Region, 2001-02* (available at http://www.indiaagristat.com).
[IN29] **Government of Rajasthan.** District-wise net area irrigated by sources in Rajasthan – part II (1999–2000). *In: Agricultural statistics 1999–2000*. Directorate of Economics and Statistics (available at http://www.indiaagristat.com).
[IN30] **Government of Tamil Nadu.** *District-wise area sown & irrigated in Tamil Nadu (during 1998–99)*. Directorate of Agriculture (available at http://www.indiaagristat.com).
[IN31] **Government of Uttar Pradesh.** *Commissionery/district-wise irrigated area, tubewells and canals in Uttar Pradesh (1996-97)*. Irrigation Department (available at http://www.indiaagristat.com).
[IN32] **Fertilizer Association of India.** District/source-wise irrigated area in Uttar Pradesh (1999-00). *In: Fertiliser and agriculture statistics, Northern Region, 2001-02* (available at http://www.indiaagristat.com).
[IN33] **Fertilizer Association of India.** District/source-wise gross area irrigated in West Bengal (1997-98). *In: Fertiliser and agriculture statistics, Eastern Region, 2001-02* (available at http://www.indiaagristat.com).
[IN34] **Government of West Bengal.** *District-wise cultivable area, net cropped area, gross cropped area and cropping intensity of West Bengal (1999–2000)*. Evaluation Wing Directorate of Agriculture (available at http://www.indiaagristat.com).
[IQ01] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 105. Rome.
[IQ02] **Arab Organization for Agricultural Development.** 1994. *Arab agricultural statistics yearbook*. Volume No. 14, Table 18. Khartoum.
[IQ03] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*. Agricultural Information, Documentation and Statistics Center (available at http://www.aoad.org).
[IQ04] **Kurdistan Democratic Party.** 2004. *Agriculture in Kurdistan* (available at http://www.kdp-ankara.org.tr).
[IQ05] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients*, Plate AX04. Tübingen, Germany.
[IQ06] **Humanitarian Information Centre for Iraq.** 2004. *Tactical pilotage charts at the 1:500.000*, (available at http://www.hiciraq.org).
[IQ07] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, Tiles 071-287, 071-288, 071-298, 071-299, 071-300, 071-310 and 071-311. Sioux Falls, USA, USGS (also available at http://glcfapp.umiacs.umd.edu:8080).
[IR01] **Statistical Centre of Iran.** 2004. *Iran statistical yearbook 1381*, Table 4.2 (available at http://eamar.sci.org.ir).
[IS01] **Central Bureau of Statistics.** 2003. *Statistical abstract of Israel 2002*, Table 19.1 (available at http://www.cbs.gov.il).
[IS02] **Central Bureau of Statistics.** 2003. *Statistical abstract of Israel 2002*, Table 19.2 (available at http://www.cbs.gov.il).

[IS03] **Central Bureau of Statistics.** 2003. *Statistical abstract of Israel 2002*, Table 19.4 (available at http://www.cbs.gov.il).
[IS04] **Central Bureau of Statistics.** 2003. *Statistical abstract of Israel 2002*, Table 19.6 (available at http://www.cbs.gov.il).
[JO01] **Department of Statistics.** 1991. *Statistical yearbook 1991*. Amman.
[JO02] **Department of Statistics.** 2004. *Irrigated and non-irrigated areas under tree crops, field crops and vegetables in 2000*, table (available at http://www.dos.gov.jo).
[JO03] **Arab Organization for Agricultural Development.** 1994. *Arab agricultural statistics yearbook*, Volume No. 14, Table 9. Khartoum.
[JO04] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*, Part 1, Table 3. Agricultural Information, Documentation and Statistics Center (available at http://www.aoad.org).
[JP01] **Ministry of Agriculture, Forestry and Fisheries.** 1994. *Status of agricultural land use in Japan*. Agricultural Structure Improvement Bureau (available in the Aquastat library).
[JP02] **Japanese Society of Irrigation, Drainage and Reclamation Engineering.** 1995. *Irrigation and drainage in Japan*. Third Edition. Tokyo.
[JP03] **Government of Japan.** 1998. *Japan statistical yearbook 1997*, Table 6-12. Tokyo, Management and Coordination Agency, Statistics Bureau.
[KN01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 128. Rome.
[KS01] **Ministry of Agriculture and Forestry.** 2003. *Agricultural and forestry statistical yearbook 2003*, Table B2, p. 41. Seoul, Agricultural Information and Statistics Bureau (also available at http://www.maf.go.kr/).
[KU01] **Ministry of Planning, Statistics and Information Sector.** 2002. *Annual statistical abstract 2001*, p. 102 (available at http://www.mop.gov.kw).
[KY01] **Asian Development Bank.** 1995. *Agriculture sector program loan to the government of the Kyrgyz Republic*. Project Preparation Technical Assistance, Annex 4 – Irrigation, report prepared by S. Gardiner, ULG Consultants Ltd, available in the Aquastat library.
[KZ01] **FAO.** 1997. *Irrigation in the countries of the former Soviet Union in figures*, p. 112. Rome.
[KZ02] **World Bank.** 1996. *Kazakhstan, irrigation and drainage improvement project*. Staff appraisal report. Report No. 15379-KZ. Washington, DC.
[KZ03] **UNDP.** 2004. *Water resources of Kazakhstan in the new millennium*. Report No. UNDPKAZ 07. Almaty (also available at http://www.cagateway.org).
[LA01] **Ministry of Agriculture and Forestry.** 2002. *Agricultural statistics yearbook 2002*. Vientiane, Department of Planning (also available at http://www.agrostat-moa.gov.la).
[LE01] **Economic and Social Commission for Western Asia (ESCWA).** 1999. *Evaluation of agricultural policies in selected ESCWA member countries: a case-study of Lebanon (Policy Analysis Matrix Approach, PAM)*, Table 9. New York, United Nations.
[MC01] **Statistics and Census Service.** 2004. *Environment statistics 2002* (available at http://www.dsec.gov.mo).
[MD01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 157. Rome.
[MG01] **FAO.** 1995. *Irrigation rehabilitation project*. Working Paper 3. Rome.
[MG02] **FAO.** 1994. *Irrigation rehabilitation project*, Working Paper 1. Rome.
[ML01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 150. Rome.
[ML02] **Azhari Ghazalli, M.** 2002. Water for food and rural development. In *Proc. workshop Towards releasing the National Water Vision*, 23–24 May 2000. Kuala Lumpur.
[MY01] **Ministry of Agriculture and Irrigation.** 2004. *Myanmar agriculture* (available at http://www.myanmar.com).
[MY02] **Ministry of Agriculture, Water Resources Utilization Department.** 1995. *Net irrigated area by state and division in 1994/95*, table available in the Aquastat library.
[NP01] **Central Bureau of Statistics.** 2004. *National sample census of agriculture 2001/02*, Table 4. Kathmandu (available at http://www.cbs.gov.np).
[OM01] **Ministry of National Economy.** 2003. *Statistical year book*, Table 2.6 (available at http://www.moneoman.gov.om).
[OM02] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 180. Rome.
[OM03] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*. Agricultural Information, Documentation and Statistics Center (available at http://www.aoad.org).

[PK01] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 188. Rome.
[PK02] **Government of Pakistan, Statistics Division.** 2003. *Agricultural census 2000 – Pakistan report*. Lahore, Pakistan (available at http://www.statpak.gov.pk).
[PK03] **Shafiullah, A.A.H.** 2003. *Northern areas strategy for sustainable development*. Background paper agriculture and food security, IUCN, Karachi, Pakistan (available at http://www.northernareas.org.pk).
[PK04] **Government of Balochistan.** 2004. *District database* (available at http://bdd.sdnpk.org).
[PK05] Ahmed, S. & Joyia, M.F. 2003. *Northern Areas strategy for sustainable development*. Background paper water, IUCN, Karachi, Pakistan (available at http://www.northernareas.org.pk).
[PK06] **Government of NWFP, Planning and Development Department, Bureau of Statistics.** 2004. *N-W.F.P. development statistics* (available at http://www.nwfpbos.sdnpk.org).
[PK07] **Government of NWFP, Planning and Development Department, Bureau of Statistics.** 2004. *FATA development statistics* (available at http://www.nwfpbos.sdnpk.org).
[PK08] **Government of Pakistan, Ministry of Food, Agriculture and Livestock.** 2004. *Agricultural statistics of Pakistan 2000–2001*, Table 61 (available at http://www.pakistan.gov.pk).
[PK09] **Government of the Punjab.** 2004. *Punjab statistics*, Table 43 (available at http://www.punjab.gov.pk).
[PK10] **Government of the Punjab.** 2004. *Punjab statistics*, Table 2 (available at http://www.punjab.gov.pk).
[PK11] **Sindh Bureau of Statistics.** 2002. *Development statistics of Sindh*, Table 4.16. Karachi, Pakistan (also available at http://sbos.sdnpk.org).
[PK12] **Sindh Bureau of Statistics.** 2002. *Development statistics of Sindh*, Table 4.55. Karachi, Pakistan (also available at http://sbos.sdnpk.org).
[PK13] **Sindh Bureau of Statistics.** 2002. *Development statistics of Sindh*, Table 4.46. Karachi, Pakistan (also available at http://sbos.sdnpk.org).
[PK14] **Sindh Bureau of Statistics.** 2002. *Development statistics of Sindh*, Table 4.17. Karachi, Pakistan (also available at http://sbos.sdnpk.org).
[PK15] **Sindh Bureau of Statistics.** 2002. *Development statistics of Sindh*, Table 4.40. Karachi, Pakistan (also available at http://sbos.sdnpk.org).
[PL01] **World Bank.** 1994. *Water conservation in the occupied territories*. Washington, DC.
[PL02] **Palestinian Central Bureau of Statistics.** 2003. *Statistical abstract of Palestine (4)*, Table 3.2.1 (available at http://www.pcbs.org).
[PL03] **Palestinian Central Bureau of Statistics.** 2000. *Jerusalem statistical yearbook No. 2*. Ramallah, Palestinian Authority (also available at http://www.pcbs.org).
[PG01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 186. Rome.
[PH01] **National Irrigation Administration.** 1993. *Corporate plan 1993–2002*. Quezon City, Philippines.
[QT01] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 199. Rome.
[QT02] **State of Qatar, Planning Council.** 2002. *Annual abstract – 2002*, Table 158 (available at http://www.planning.gov.qa).
[RU01] **Goscomstat.** 1998. *Environment protection in Russia*. Moscow.
[SA01] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*, Table 3. Agricultural Information, Documentation and Statistics Center (also available at http://www.aoad.org).
[SA02] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*, Table 14. Agricultural Information, Documentation and Statistics Center (also available at http://www.aoad.org).
[SA03] **Dabbagh, A.E. & Abderrahman, W.A.** 1997. Management of groundwater resources under various irrigation water use scenarios in Saudi Arabia. *Arab. J. Sci. Eng.*, 22.
[SA04] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 209. Rome.
[SI01] **Agri – Food & Veterinary Authority of Singapore.** 2004. *More information – statistics, tables* (available at http://www.ava.gov.sg).
[SL01] **FAO.** 1999. *Irrigation in Asia in figures*, p. 202. Rome.

[SL02] **Department of Census and Statistics, Sri Lanka.** 2004. *Statistical abstract 2003*, Table 5.6. Colombo (also available at http://www.statistics.gov.lk).

[SL03] **Jayewardene, J., Jayasinghe, A. & Dayaratne, P.W.C.** 1991. Promoting crop diversification in rice-based irrigation systems. In S.M. Miranda & A.R. Maglinao, eds. *Proc. second progress review and coordination workshop of the Research Network on Irrigation Management for Crop Diversification in Rice-Based Systems (IMCD) held in Yogyakarta, Indonesia from 09 to 12 September 1991*.

[SY01] **World Bank.** 2001. *Syrian Arab Republic - irrigation sector report*. Rural Development, Water, and Environment Group, Middle East and North Africa Region. Report No. 22602-SYR (available at http://www-wds.worldbank.org).

[SY02] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*, Table 16. Agricultural Information, Documentation and Statistics Center (also available at http://www.aoad.org).

[TJ01] **FAO.** 1997. *Irrigation in the countries of the former Soviet Union in figures*, p. 184. Rome.

[TJ02] **USAID.** 2002. *Irrigation improvements in Tajikistan. An overview of USAID activities in Central Asia* (available at http://www.cagateway.org).

[TH01] **Office of Agricultural Economics.** 2004. *Agricultural statistics of Thailand, crop year 2002/03*, Table 128 (available at http://oae.go.th).

[TK01] **FAO.** 1997. *Irrigation in the Near East region in figures*, p. 255. Rome.

[TK02] **State Institute of Statistics.** 2004. *Main economic and social indicators*, Table 8.11 (available at http://www.die.gov.tr).

[TK03] **State Hydraulics Works.** 1995. *Yili Program Bütce Toplantisi Takdim Raporu*. Report cited in Aquastat country questionnaire.

[TM01] **FAO.** 1997. *Irrigation in the countries of the former Soviet Union in figures*, p. 194. Rome.

[TM02] **Mihailovich, S.M. & Bayramklichevich, S.U.** 1996. Increasing of desalinization watering effect in conditions increasing deficiency of water resources. *In:* ICID: *6th drainage workshop on drainage and the environment in Ljubljana, Slovenia, April 1996, post workshop proc.*, pp. 173-182.

[TW01] **Directorate-General of Budget, Accounting and Statistics.** 1997. *1995 Agricultural, forestry, fishery and husbandry survey,* p. 24. General Report. Taipei, Taiwan Province of China (also available at http://www.dgbas.gov.tw).

[TW02] **Directorate-General of Budget, Accounting and Statistics.** 2002. *2000 Agricultural, forestry, fishery and husbandry survey*, p. 29. General Report. Taipei, Taiwan Province of China (available at http://www.dgbas.gov.tw).

[TW03] **Directorate-General of Budget, Accounting and Statistics.** 1997. *1995 Agricultural, forestry, fishery and husbandry survey*, Table 16. General Report. Taipei, Taiwan Province of China (available at http://www.dgbas.gov.tw).

[TW04] **Directorate-General of Budget, Accounting and Statistics.** 1997. *1995 Agricultural, forestry, fishery and husbandry survey.* Taipei, Taiwan Province of China (available at http://www.dgbas.gov.tw).

[UE01] **Ministry of Agriculture and Fisheries.** 2004. *MAF statistics* (available at http://uae.gov.ae).

[UE02] **Ministry of Planning.** 2003. *Statistical abstract 2001*, Table 6.1 (available at http://www.uae.gov.ae).

[UE03] **Ministry of Planning.** 2004. *Statistical abstract 2003*, Table 6.11 (available at http://www.uae.gov.ae).

[UZ01] **European Commission, Directorate General.** 1996. *Water resources management and agricultural production in the Central Asian Republics – Warmap Project*. Vol. 4: Irrigated crop production systems, Table 4.5. Tashkent.

[VN01] **World Bank.** 1996. *Vietnam – water resources sector review*. Agriculture and Environment Division, Country Department I, East Asia and Pacific Region, Report No. 15041-V, p. 22.

[VN02] **FAO.** 1986. *Investigation of lands with declining and stagnating productivity, Viet Nam*. Country report. Report No. AG:GCP/RAS/107/JPN, Field Document 9. Bangkok.

[VN03] **World Bank.** 1996. *Vietnam – water resources sector review*. Agriculture and Environment Division, Country Department I, East Asia and Pacific Region, Report No. 15041-V, Annex 1, Table D.

[VN04] **Mekong River Commission Secretariat.** 2003. *People and environment atlas of the Lower Mekong Basin*. CD-Rom. Phnom Penh, MRC.

[YE01] **World Bank.** 1999. *Republic of Yemen - agricultural strategy note*. Rural Development, Water and Environment Department, Middle East and North Africa Region, Report No. 17973-YEM, Table 1 (available at http://www-wds.worldbank.org).

[YE02] **World Bank.** 2000. *Irrigation improvement project*. Project appraisal document. Rural Development, Water and Environment Department, Middle East and North Africa Region, Report No. 20720-YEM (available at http://www-wds.worldbank.org).

[YE03] **Arab Organization for Agricultural Development.** 2003. *Arab agricultural statistics yearbook 2002*, Table 28. Agricultural Information, Documentation and Statistics Center (also available at http://www.aoad.org).

Annex A
Tables

TABLE A1
Irrigated area per country in Asia as used in this report

Country	Irrigated area (ha)	Country	Irrigated area (ha)
Afghanistan	3 199 070	Lebanon	117 113
Azerbaijan	1 453 318	Malaysia	362 600
Armenia	286 027	Mongolia	57 300
Bahrain	11 000	Myanmar	1 841 320
Bangladesh	3 751 045	Nepal	1 168 349
Bhutan	38 734	Oman	72 714
Brunei Darussalam	1 000	Pakistan	14 417 464
Cambodia	284 172	Palestinian Authority (Gaza, West Bank)	16 222
China (excl. Taiwan)	53 822 300	Philippines	1 550 000
Cyprus	55 813	Qatar	12 520
Democratic People's Republic of Korea	1 460 000	Republic of Korea	880 365
East Timor	14 000	Russian Federation (Asian part)	897 000
Georgia	300 000	Saudi Arabia	1 730 767
India	57 286 407	Sri Lanka	570 000
Indonesia	4 459 000	Syrian Arab Republic	1 266 900
Iraq	3 525 000	Taiwan Province of China	525 528
Islamic Republic of Iran	6 913 800	Tajikistan	719 200
Israel	186 600	Thailand	4 985 708
Japan	3 129 000	Turkey	4 185 910
Jordan	76 912	Turkmenistan	1 744 100
Kazakhstan	1 855 200	United Arab Emirates	280 341
Kuwait	6 968	Uzbekistan	4 223 000
Kyrgyzstan	1 075 040	Viet Nam	3 000 000
Lao People's Democratic Republic	295 535	Yemen	388 000
		Asia total	188 503 362

TABLE A2
Comparison of irrigated areas in Afghanistan in surveys 1967 and 1990–93

Province	Irrigated area 1967 (ha)	Irrigated area two seasons 1990–93 (ha)	Irrigated area one season 1990–93 (ha)	Irrigated area occasionally 1990–93 (ha)
Badakhshan	61 760	3 122	30 964	17 720
Badghis	33 300	416	19 802	30 756
Baghlan	80 180	14 356	58 224	17 098
Balkh	224 500	5 369	85 790	145 596
Bamyan	23 150	0	18 921	31 645
Farah	125 730	23	45 937	176 232
Faryab	121 600	0	53 894	83 581
Ghazni	117 490	88	129 347	160 452
Ghor	72 860	0	29 575	36 676
Helmand	162 720	13 462	104 959	119 444
Herat	163 700	394	123 324	64 090
Jawzjan	184 600	0	99 207	131 264
Kabul	57 600	30	39 327	20 762
Kandahar	117 920	441	51 365	203 560
Kapisa & Parwan	75 140	1 704	69 335	9 583
Kunar	23 320	2 684	9 373	12 979

Province	Irrigated area 1967 (ha)	Irrigated area two seasons 1990–93 (ha)	Irrigated area one season 1990–93 (ha)	Irrigated area occasionally 1990–93 (ha)
Kunduz	209 590	66 910	58 856	6 426
Laghman	23 580	13 482	5 659	4 212
Logar	26 650	0	22 649	12 931
Nangarhar	42 340	26 143	40 847	29 414
Nimroz	60 300	0	0	76 778
Oruzgan	126 580	0	65 988	57 689
Paktya	56 350	665	62 760	54 977
Samangan	44 330	201	21 442	37 003
Takhar	61 860	39 086	68 278	2 077
Wardak	25 600	0	30 838	26 568
Zabul	62 540	74	22 367	72 326
Afghanistan total	2 385 290	188 651	1 369 027	1 641 841

TABLE A3
Irrigated area per district and province in Afghanistan

District	Province	Irrigated area (ha)
Baharak	Badakhshan	11 494
Darwaz	Badakhshan	1 647
Fayz Abad	Badakhshan	5 901
Ishkashim	Badakhshan	4 192
Jurm	Badakhshan	8 662
Khwahan	Badakhshan	344
Kishim	Badakhshan	7 232
Kuran Wa Mun	Badakhshan	2 308
Ragh	Badakhshan	1 120
Shahri Buzur	Badakhshan	332
Shighnan	Badakhshan	2 783
Wakhan	Badakhshan	4 656
Zebak	Badakhshan	715
	Badakhshan	51 387
Ab Kamari	Badghis	572
Ghormach	Badghis	12 640
Jawand	Badghis	3 098
Muqur	Badghis	4 135
Murghab	Badghis	14 406
Qadis	Badghis	10 023
Qalay-I- Naw	Badghis	2 307
	Badghis	47 180
Andarab	Baghlan	9 696
Baghlan	Baghlan	15 952
Baghlani Jad	Baghlan	10 593
Burka	Baghlan	10 249
Dahana-I- Gh	Baghlan	1 009
Dushi	Baghlan	4 978
Kahmard	Baghlan	7 277
Khinjan	Baghlan	3 905
Khost Wa Fir	Baghlan	12 609
Nahrin	Baghlan	9 441
Puli Khumri	Baghlan	17 971
Tala Wa Barf	Baghlan	4 335
	Baghlan	108 015
Balkh	Balkh	33 326
Chahar Bolak	Balkh	40 802
Chahar Kint	Balkh	343
Chimtal	Balkh	15 213
Dawlat Abad	Balkh	73 957
Dihdadi	Balkh	14 134
Kaldar	Balkh	5 507
Khulm	Balkh	32 389
Kishindih	Balkh	4 044
Marmul	Balkh	245
Mazari Shari	Balkh	1 712
Nahri Shahi	Balkh	37 404
Sholgara	Balkh	7 629
Shortepa	Balkh	8 579
	Balkh	275 285
Bamyan	Bamyan	8 968
Panjab	Bamyan	6 749
Shibar	Bamyan	3 141
Waras	Bamyan	9 554
Yakawlang	Bamyan	6 633
	Bamyan	35 044
Anar Dara	Farah	6 414
Bakwa	Farah	12 983
Bala Buluk	Farah	19 925
Farah	Farah	23 990

District	Province	Irrigated area (ha)
Gulistan	Farah	5 371
Khaki Safed	Farah	14 423
Lash Wa Juwa	Farah	16 410
Pur Chaman	Farah	9 754
Pusht Rod	Farah	36 006
Qalay-I-Kah	Farah	13 625
Shib Koh	Farah	9 364
	Farah	168 265
Almar	Faryab	19 182
Andkhoy	Faryab	9 413
Bilchiragh	Faryab	7 954
Dawlat Abad	Faryab	8 247
Khani Chahar	Faryab	16 376
Khwaja Sabz	Faryab	13 010
Kohistan	Faryab	2 843
Maymana	Faryab	1 976
Pashtun Kot	Faryab	1 972
Qaramqol	Faryab	13 339
Qaysar	Faryab	29 791
Shirin Tagab	Faryab	9 706
	Faryab	133 809
Ab Band	Ghazni	15 704
Ajristan	Ghazni	7 561
Andar	Ghazni	35 242
Bahrami Shah	Ghazni	14 895
Dih Yak	Ghazni	7 509
Gelan	Ghazni	25 339
Ghazni	Ghazni	8 915
Giro	Ghazni	14 878
Jaghatu	Ghazni	10 247
Jaghuri	Ghazni	18 555
Malistan	Ghazni	6 451
Muqur	Ghazni	15 471
Nawa	Ghazni	19 384
Nawur	Ghazni	17 886
Qarabagh	Ghazni	26 309
Zana Khan	Ghazni	1 486
	Ghazni	245 831
Chaghcharan	Ghor	14 094
Lal Wa Sarja	Ghor	6 300
Pasaband	Ghor	11 922
Saghar	Ghor	2 703
Shahrak	Ghor	16 212
Taywara	Ghor	12 617
Tulak	Ghor	7 128
	Ghor	70 977
Baghran	Hilmand	11 164
Dishu	Hilmand	6 499

District	Province	Irrigated area (ha)
Garmser	Hilmand	25 458
Kajaki	Hilmand	22 141
Lashkar Gah	Hilmand	14 226
Musa Qala	Hilmand	15 752
Nad Ali	Hilmand	24 941
Nahri Sarraj	Hilmand	30 910
Naw Zad	Hilmand	28 482
Naway i Bara	Hilmand	26 786
Reg	Hilmand	16 855
Sangin	Hilmand	8 208
Washer	Hilmand	5 288
	Hilmand	236 709
Adraskan	Hirat	10 713
Chishti Shar	Hirat	4 557
Farsi	Hirat	12 023
Ghoryan	Hirat	24 395
Gulran	Hirat	2 375
Guzara	Hirat	25 157
Hirat	Hirat	1 739
Injil	Hirat	41 644
Karukh	Hirat	13 023
Kohsan	Hirat	7 732
Kushk	Hirat	5 241
Kushki Kuhna	Hirat	1 689
Obe	Hirat	14 202
Pashtun Zarg	Hirat	26 061
Shindand	Hirat	44 051
Zinda Jan	Hirat	13 974
	Hirat	248 577
Aqcha	Jawzjan	21 193
Darzab	Jawzjan	3 502
Fayz Abad	Jawzjan	35 087
Khamyab	Jawzjan	258
Khwaja Du Ko	Jawzjan	16 705
Mardyan	Jawzjan	25 797
Mingajik	Jawzjan	27 808
Qarqin	Jawzjan	2 821
Shibirghan	Jawzjan	50 404
	Jawzjan	183 573
Bagrami	Kabul	6 457
Chahar Asyab	Kabul	2 531
Dih Sabz	Kabul	6 820
Guldara	Kabul	3 069
Istalif	Kabul	1 268
Kabul	Kabul	4 552
Kalakan	Kabul	2 103
Khaki Jabbar	Kabul	1 219
Mir Bacha Ko	Kabul	5 144

District	Province	Irrigated area (ha)
Musayi	Kabul	1 999
Paghman	Kabul	10 526
Qarabagh	Kabul	5 766
Shakardara	Kabul	8 794
Surobi	Kabul	2 231
	Kabul	62 480
Arghandab	Kandahar	2 297
Arghistan	Kandahar	12 768
Daman	Kandahar	34 437
Ghorak	Kandahar	4 493
Kandahar	Kandahar	30 475
Khakrez	Kandahar	12 563
Maruf	Kandahar	7 645
Maywand	Kandahar	12 813
Panjwayi	Kandahar	28 798
Reg	Kandahar	3 526
Shah Wali Ko	Kandahar	20 628
Shorabak	Kandahar	43 983
Spin Boldak	Kandahar	34 253
	Kandahar	248 678
Alasay	Kapisa	1 233
Koh Band	Kapisa	1 241
Kohistan	Kapisa	7 714
Mahmud Raqi	Kapisa	3 157
Nijrab	Kapisa	3 392
Tagab	Kapisa	328
	Kapisa	17 064
Bak	Khost	1 517
Gurbuz	Khost	2 445
Jaji Maydan	Khost	421
Khost(Matun)	Khost	10 299
Mando Zayi	Khost	6 196
Musa Khel	Khost	379
Nadir Shah K	Khost	1 981
Qalandar	Khost	333
Sabari	Khost	3 710
Spera	Khost	391
Tani	Khost	786
Tere Zayi	Khost	6 514
	Khost	34 971
Asad Abad	Kunar	2 539
Bar Kunar	Kunar	859
Chapa Dara	Kunar	1 577
Chawkay	Kunar	2 230
Dangam	Kunar	1 520
Khas Kunar	Kunar	2 871
Marawara	Kunar	798
Narang	Kunar	2 253

District	Province	Irrigated area (ha)
Nari	Kunar	707
Nurgal	Kunar	1 810
Pech	Kunar	2 177
Sirkanay	Kunar	2 650
	Kunar	21 994
Ali Abad	Kunduz	3 675
Archi	Kunduz	23 105
Chahar Dara	Kunduz	17 316
Imam Sahib	Kunduz	46 877
Khan Abad	Kunduz	19 110
Kunduz	Kunduz	32 212
Qalay-I- Zal	Kunduz	14 673
	Kunduz	156 969
Alingar	Laghman	5 344
Alishing	Laghman	3 569
Dawlat Shah	Laghman	2 011
Mihtarlam	Laghman	5 527
Qarghayi	Laghman	4 588
	Laghman	21 038
Baraki Barak	Logar	8 990
Charkh	Logar	6 150
Khushi	Logar	1 697
Muhammad Agh	Logar	6 114
Puli Alam	Logar	10 984
	Logar	33 935
Achin	Nangarhar	5 869
Bati Kot	Nangarhar	9 530
Chaparhar	Nangarhar	4 105
Dara-I-Nur	Nangarhar	2 635
Dih Bala	Nangarhar	3 229
Dur Baba	Nangarhar	295
Goshta	Nangarhar	1 730
Hisarak	Nangarhar	4 027
Jalal Abad	Nangarhar	4 106
Kama	Nangarhar	5 281
Khogyani	Nangarhar	9 012
Kuz Kunar	Nangarhar	2 823
Lal Pur	Nangarhar	995
Muhmand Dara	Nangarhar	3 365
Nazyan	Nangarhar	566
Pachir Wa A	Nangarhar	2 587
Rodat	Nangarhar	14 866
Sherzad	Nangarhar	8 056
Shinwar	Nangarhar	3 921
Surkh Rod	Nangarhar	8 990
	Nangarhar	95 988
Chahar Burja	Nimroz	13 199
Chakhansur	Nimroz	15 909

District	Province	Irrigated area (ha)
Kang	Nimroz	2 326
Khash Rod	Nimroz	31 338
Zaranj	Nimroz	10 310
	Nimroz	73 082
Bargi Matal	Nuristan	1 497
Kamdesh	Nuristan	223
Mandol	Nuristan	1 775
Nuristan	Nuristan	829
Wama	Nuristan	1 349
Waygal	Nuristan	89
	Nuristan	5 762
Barmal	Paktika	4 841
Dila	Paktika	11 302
Gayan	Paktika	383
Gomal	Paktika	657
Mata Khan	Paktika	2 519
Nika	Paktika	450
Omna	Paktika	1 433
Sar Hawza	Paktika	882
Sarobi	Paktika	2 086
Sharan	Paktika	10 652
Urgun	Paktika	3 940
Waza Khwa	Paktika	3 050
Wor Mamay	Paktika	3 282
Zarghun Shah	Paktika	17 599
Ziruk	Paktika	492
	Paktika	63 571
Azra	Paktya	1 379
Chamkani	Paktya	1 868
Dand Wa Pata	Paktya	1 338
Gardez	Paktya	15 923
Jadran	Paktya	1 086
Jaji	Paktya	4 077
Jani Khel	Paktya	889
Lija Mangal	Paktya	1 260
Sayid Karam	Paktya	12 442
Shamal	Paktya	202
Shwak	Paktya	288
Zurmat	Paktya	27 993
	Paktya	68 745
Bagram	Parwan	15 525
Chaharikar	Parwan	10 928
Ghorband	Parwan	7 016
Hisa-I-Awali	Parwan	2 898
Hisa-I-Duwum	Parwan	1 584
Jabalussaraj	Parwan	5 680
Kohi Safi	Parwan	1 651
Panjsher	Parwan	2 803
Salang	Parwan	2 156
Shekh Ali	Parwan	3 353
Shinwari	Parwan	1 878
Surkhi Parsa	Parwan	4 627
	Parwan	60 099
Aybak	Samangan	5 426
Dara-I- Suf	Samangan	4 149
Hazrati Sult	Samangan	6 884
Khuram Wa Sa	Samangan	1 733
Ruyi Du Ab	Samangan	3 049
	Samangan	21 242
Balkhab	Sari Pul	6 253
Kohistanat	Sari Pul	12 505
Sangcharak	Sari Pul	11 269
Sari Pul	Sari Pul	13 779
Sayyad	Sari Pul	881
Sozma Qala	Sari Pul	3 980
	Sari Pul	48 667
Bangi	Takhar	3 615
Chah Ab	Takhar	354
Chal	Takhar	114
Darqad	Takhar	6 978
Farkhar	Takhar	3 199
Ishkamish	Takhar	6 123
Kalafgan	Takhar	1 561
Khwaja Ghar	Takhar	6 543
Rustaq	Takhar	2 522
Taluqan	Takhar	21 304
Warsaj	Takhar	4 372
Yangi Qala	Takhar	15 835
	Takhar	72 520
Chora	Uruzgan	12 908
Day Kundi	Uruzgan	20 683
Dihrawud	Uruzgan	8 205
Gizab	Uruzgan	8 620
Khas Uruzgan	Uruzgan	12 972
Kijran	Uruzgan	9 117
Nesh	Uruzgan	15 729
Shahidi Hass	Uruzgan	9 448
Shahristan	Uruzgan	14 860
Tirin Kot	Uruzgan	12 363
	Uruzgan	124 906
Chaki Wardak	Wardak	6 685
Day Mirdad	Wardak	4 054
Hisa-I- Awal	Wardak	6 541
Jalrez	Wardak	3 589
Markazi Bihs	Wardak	18 369
Maydan Shahr	Wardak	2 477

District	Province	Irrigated area (ha)
Nirkh	Wardak	9 764
Sayd Abad	Wardak	10 850
	Wardak	62 329
Arghandab	Zabul	12 367
Atghar	Zabul	4 379
Daychopan	Zabul	19 173
Mizan	Zabul	9 211
Qalat	Zabul	14 693
Shahjoy	Zabul	16 848
Shamulzayi	Zabul	7 249
Shinkay	Zabul	7 321
Tarnak Wa Ja	Zabul	9 138
	Zabul	100 379
Afghanistan total		3 199 070

TABLE A4
Irrigated area per district in Armenia

District	Irrigated area (ha)
Akhurian	17 148
Amasia	4 230
Ani	2 299
Aparan	6 601
Aragats	2 011
Ararat	16 255
Armavir	23 851
Artashat	13 671
Artik	3 482
Ashotsk	2 490
Ashtarak	16 768
Bagramian	11 040
Echmiadzin	20 007
Egegnadzor	7 824
Goris	6 289
Gugark	1 871
Hrazdan	5 592
Ijevan	6 369
Kamo	3 118
Kapan	1 831
Kotaik	10 670
Krasnoselsk	982
Lake Sevan	0
Martuni	9 012
Masis	9 304
Megri	1 557
Nairi	10 251
Novemberian	11 112
Sevan	1 566
Sisian	7 036
Spitak	4 420
Stepanavan	2 686
Talin	9 048
Tashir	713
Taush	6 305
Tumanian	6 862
Vaik	3 609
Vardenis	9 153
Yerevan	8 994
Armenia total	286 027

TABLE A5
Irrigated area in Azerbaijan

Region	Region / District	Irrigated area (ha)
Azerbaijan mainland	Azerbaydzhan mainland	1 397 118
Nakhichevan	Sharur	24 500
Nakhichevan	Babek	19 300
Nakhichevan	Shahbuz	2 600
Nakhichevan	Julfa	4 900
Nakhichevan	Ordubad	4 900
Azerbaijan total		1 453 318

TABLE A6
Irrigated area per region in Bahrain

Region	Irrigated area (ha)
Northern	1 220
Jidhafs	590
Sitra	120
Isa Town	0
Central	310
Western	1 410
Riffa & Southern	0
Muharraq	190
Manama	220
Bahrain total	4 060

TABLE A7
Irrigated area per zila and division in Bangladesh

Zila	Division	Irrigated area (ha)
Barguna	Barisal	2 221
Barisal	Barisal	29 274
Bhola	Barisal	18 023
Jhalakati	Barisal	5 787
Patuakhali	Barisal	6 229
Pirojpur	Barisal	5 456
	Barisal	66 990
Bandarban	Chittagong	4 067
Brahmanbaria	Chittagong	81 078
Chandpur	Chittagong	63 991
Chittagong	Chittagong	93 664
Comilla	Chittagong	125 364
Cox Bazar	Chittagong	48 486
Feni	Chittagong	30 568
Habiganj	Chittagong	73 593
Khagrachhari	Chittagong	6 308
Lakshmipur	Chittagong	23 418
Maulvibazar	Chittagong	26 969
Noakhali	Chittagong	17 431
Rangamati	Chittagong	8 147
Sunamganj	Chittagong	95 444
Sylhet	Chittagong	35 898
	Chittagong	734 425
Dhakala	Dhaka	40 993
Faridpur	Dhaka	45 398
Gazipur	Dhaka	45 590
Gopalganj	Dhaka	24 791
Jamalpur	Dhaka	86 238
Kishoreganj	Dhaka	142 890
Madaripur	Dhaka	29 389
Manikganj	Dhaka	28 373
Munshiganj	Dhaka	18 195
Mymensingh	Dhaka	136 930
Narayanganj	Dhaka	26 891
Narsingdi	Dhaka	47 365
Netrokona	Dhaka	96 775
Rajbari	Dhaka	29 042
Shariatpur	Dhaka	18 474
Sherpur	Dhaka	58 467
Tangail	Dhaka	129 161
	Dhaka	1 004 962
Bagerhat	Khulna	8 993
Chuadanga	Khulna	57 264
Jessore	Khulna	125 474
Jhenaidaha	Khulna	86 347
Khulna	Khulna	9 234
Kushtia	Khulna	73 299
Magura	Khulna	15 020
Meherpur	Khulna	44 458
Narail	Khulna	16 357
Satkhira	Khulna	59 400
	Khulna	495 845
Bogra	Rajshahi	227 185
Dinajpur	Rajshahi	167 048
Gaibandha	Rajshahi	96 302
Joypurhat	Rajshahi	63 036
Kurigram	Rajshahi	56 324
Lalmonirhat	Rajshahi	43 153
Naogaon	Rajshahi	180 656
Natore	Rajshahi	67 923
Nawabganj	Rajshahi	32 961
Nilphamari	Rajshahi	66 719
Pabna	Rajshahi	47 508
Panchagarh	Rajshahi	13 623

Zila	Division	Irrigated area (ha)
Rajshahi	Rajshahi	99 376
Rangpur	Rajshahi	118 831
Sirajganj	Rajshahi	115 973
Thakurgaon	Rajshahi	52 206

Zila	Division	Irrigated area (ha)
	Rajshahi	1 448 823
Bangladesh total		3 751 045

TABLE A8
Irrigated area per dzongkhag in Bhutan

Dzongkhag	Irrigated area (ha)
Bumthang	75
Chukha	1 538
Dagana	2 115
Gasa	148
Ha	101
Lhuentse	944
Mongar	627
Paro	2 351
Pemagatshel	0
Punakha	3 247
Samdrup - Jongkha	2 187

Dzongkhag	Irrigated area (ha)
Samtse	6 254
Sarpang	4 527
Thimphu	1 615
Trashi Yangtse	2 021
Trashigang	1 659
Trongsa	1 965
Tsirang	2 292
Wangdue - Phodrang	3 952
Zhemgang	1 115
Bhutan total	38 734

TABLE A9
Irrigated area per provinces in Cambodia

Province	Irrigated area (ha)
Banteay Meanchey	4 975
Battambang	23 990
Kampong Cham	16 870
Kampong Chhnang	9 622
Kampong Speu	21 360
Kampong Thom	27 731
Kampot	3 000
Kandal	34 768
Koh Kong	600
Kratie	5 703
Mondul Kiri	200
Phnom Penh	2 770

Province	Irrigated area (ha)
Preah Vihear	300
Prey Veng	25 360
Pursat	5 329
Ratana Kiri	200
Siem Reap	48 195
Stung Treng	800
Svay Rieng	3 683
Takeo	48 716
Tonle Sap	0
Cambodia total	284 172

TABLE A10
Irrigated area per province in China

Province	Irrigated area (ha)
Anhui	3 197 200
Beijing	681 400
Chongqing	624 600
Fujian	940 200
Gansu	981 500
Guangdong	1 478 500
Guangxi	1 501 600
Guizhou	653 400

Province	Irrigated area (ha)
Hainan	179 800
Hebei	4 482 300
Heilongjiang	2 032 000
Henan	4 725 300
Hong Kong SAR	2 000
Hubei	2 072 500
Hunan	2 677 500
Inner Mongolia	2 371 700

Province	Irrigated area (ha)
Jiangsu	3 900 900
Jiangxi	1 903 400
Jilin	1 315 100
Liaoning	1 440 700
Ningxia	398 800
Qinghai	211 400
Shaanxi	1 308 000
Shandong	4 824 900
Shanghai	285 900
Shanxi	1 105 000
Sichuan	2 469 000
Tibet	157 000
Xinjiang	3 094 800
Yunnan	1 403 400
Zhejiang	1 403 200
China total	53 823 000

TABLE A11
Irrigated area per district in Cyprus

District	Irrigated area (ha)
Ammochostos	11 500
Keryneia	1 400
Larnaka	9 117
Lefkosia	18 000
Lemesos	7 383
Pafos	8 413
Cyprus total	55 813

TABLE A12
Irrigated area per federal state and union territory in India

Federal state or union territory	Irrigated area (ha)
Andaman & Nicobar	1 093
Andhra Pradesh	4 384 124
Arunachal Pradesh	39 043
Assam	458 071
Bihar	3 439 545
Chandigarh	2 000
Chhatisgarh	1 078 400
Dadra & Nagar Haveli	6 000
Daman & Diu	1 000
Delhi	39 070
Goa	22 372
Gujarat	3 092 400
Haryana	2 888 000
Himachal Pradesh	101 897
Jammu & Kashmir	310 870
Jharkhand	185 455
Karnataka	2 491 871
Kerala	380 043
Lakshadweep	1 000
Madhya Pradesh	5 514 979
Maharashtra	3 140 200
Manipur	65 000
Meghalaya	45 045
Mizoram	9 000
Nagaland	63 000
Orissa	2 090 000
Pondicherry	21 390
Punjab	4 020 700
Rajasthan	5 611 874
Sikkim	16 000
Tamil Nadu	3 018 839
Tripura	35 000
Uttar Pradesh	12 469 624
Uttaranchal	332 502
West Bengal	1 911 000
India total	57 286 407

TABLE A13
Irrigated area per district in Andhra Pradesh (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Adilabad	77 024	Nalgonda	211 687
Anantapur	138 405	Nellore	231 849
Chittoor	172 648	Nizamabad	169 805
Cuddapah	133 104	Prakasam	184 162
East Godavari	282 408	Rangareddi	75 866
Guntur	372 503	Srikakulam	181 538
Hyderabad	172	Vishakhapatnam	112 621
Karimnagar	256 184	Vizianagaram	143 599
Khammam	196 092	Warangal	287 163
Krishna	324 531	West Godavari	368 068
Kurnool	168 374	Andhra Pradesh total	4 384 124
Mahbubnagar	157 186		
Medak	139 135		

TABLE A14
Irrigated area per district in Arunachal Pradesh (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Changlang	2 972	Tirap	1 352
Dibang Valley	2 951	Upper Siang	2 247
East Kameng	1 418	Upper Subansiri	2 324
East Siang	8 610	West Kameng	1 086
Lohit	3 263	West Siang	3 197
Lower Subansiri	5 718	Arunachal Pradesh total	39 043
Papumpare	2 431		
Tawang	1 474		

TABLE A15
Irrigated area per district in Assam (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Barpeta	56 068	Karimganj	5 021
Bongaigaon	6 136	Kokrajhar	24 233
Cachar	4 836	Lakhimpur	6 878
Darrang	43 339	Marigaon	14 993
Dhemaji	8 158	Nagaon	82 790
Dhubri	13 744	Nalbari	16 080
Dibrugarh	11 453	North Cacha Hills	4 687
Goalpara	10 973	Sibsagar	15 648
Golaghat	11 245	Sonitpur	50 306
Hajlakandi	3 521	Tinsukia	4 879
Jorhat	10 041	Assam total	458 071
Kamrup	32 776		
Karbi Anglong	20 266		

TABLE A16
Irrigated area per district in Bihar (India)

District	Irrigated area (ha)
Araria	65 272
Aurangabad	169 914
Banka	98 426
Begusarai	96 354
Bhabhua	123 291
Bhagalpur	41 443
Bhojpur	164 734
Buxar	129 508
Darbhanga	63 200
Gaya	150 229
Gopalganj	109 823
Jahanabad	91 174
Jamui	20 203
Katihar	87 029
Khagaria	68 380
Kishanganj	21 757
Luckeesarai	37 505
Madhepura	73 560
Madhubani	108 787
Munger	30 771
Muzaffarpur	91 174
Nalanda	118 111
Nawada	76 669
Paschim (West) Champaran	105 678
Patna	126 400
Purbi (East) Champaran	166 806
Purnia	102 570
Rhotas	269 376
Saharsa	53 875
Samastipur	104 642
Saran	110 859
Sheikhpura	34 812
Sheohar	11 915
Sitamadhi	44 033
Siwan	120 000
Supaul	76 669
Vaishali	74 597
Bihar total	3 439 545

TABLE A17
Irrigated area per district in Chhatisgarh (India)

District	Irrigated area (ha)
Bastar	5 200
Bilaspur	128 200
Dantewada	5 000
Dhamtari	95 900
Durg	194 400
Janjgeer-Champa	120 000
Jashpur	7 300
Kanker	16 300
Kawardha	28 300
Korba	5 600
Koriya	5 600
Mahasamund	57 600
Raigarh	35 000
Raipur	286 300
Rajnandgawn	59 000
Surguja	28 700
Chhatisgarh total	1 078 400

TABLE A18
Irrigated area per district in Gujarat (India)

District	Irrigated area (ha)
Ahmadabad	173 400
Amreli	82 300
Banaskantha	361 700
Bharuch	91 700
Bhavnagar	165 100
Gandhinagar	29 600
Jamnagar	85 500
Junagadh	152 400
Kachchh	127 700
Kheda	308 300
Mahesana	398 100
Panchmahals	120 700
Rajkot	148 500
Sabarkantha	191 500
Surat	210 900
Surendranagar	127 300

District	Irrigated area (ha)
The Dangs	400
Vadodara	188 100
Valsad	129 200
Gujarat total	3 092 400

TABLE A19
Irrigated area per district in Haryana (India)

District	Irrigated area (ha)
Ambala	95 000
Bhiwani	208 000
Faridabad	116 000
Fatehabad	208 000
Gurgaon	76 000
Hisar	271 000
Jhajjar	111 000
Jind	220 000
Kaithal	196 000
Karnal	207 000
Kurukshetra	147 000
Mahendragarh	119 000
Panchkula	13 000
Panipat	97 000
Rewari	84 000
Rohtak	110 000
Sirsa	333 000
Sonipat	174 000
Yamunanagar	103 000
Haryana total	2 888 000

TABLE A20
Irrigated area per district in Himachal Pradesh (India)

District	Irrigated area (ha)
Bilaspur	3 164
Chamba	6 165
Hamirpur	1 790
Kangra	32 194
Kinnaur	4 690
Kullu	2 510
Lahul & Spiti	3 386
Mandi	13 138
Shimla	3 086
Sirmaur	14 405
Solan	9 530
Una	7 839
Himachal Pradesh total	101 897

TABLE A21
Irrigated area per district in Jammu and Kashmir (India)

District	Irrigated area (ha)
Anantnag	49 620
Bagdam	31 760
Baramula	40 150
Doda	7 410
Jammu	54 900
Kargil	9 470
Kathua	21 980
Kupwara	19 260
Leh	8 480
Mirpur	5 000
Poonch	3 840
Pulwama	34 120
Rajouri	7 320
Srinagar	17 210
Udhampur	5 350
Jammu & Kashmir total	315 870

TABLE A22
Irrigated area per district in Jharkhand (India)

District	Irrigated area (ha)
Bokaro	2 072
Chatra	5 180
Deoghar	7 252
Dhanbad	1 036

District	Irrigated area (ha)
Dumka	12 433
Garhwa	21 757
Giridih	8 289
Godda	9 325
Gumla	7 252
Hazaribag	17 613
Kodarma	2 072
Lohardagga	2 072
Pakur	12 433
Palamu	39 370
Pashchimi (West) Singhbhum	10 361
Purbi (East) Singhbhum	2 072
Ranchi	19 685
Sahibganj	5 180
Jharkhand total	185 455

TABLE A23
Irrigated area per district in Karnataka (India)

District	Irrigated area (ha)
Bagalkot	189 609
Bangalore Rural	57 888
Bangalore Urban	20 044
Belgaum	326 225
Bellary	151 796
Bidar	37 155
Bijapur	121 238
Chamaraja Nagar	44 017
Chikmagalur	26 140
Chitradurga	54 182
Dakshina Kannada	66 015
Davangere	128 815
Dharwad	39 652
Gadag	65 764
Gulbarga	165 813
Hassan	77 847
Haveri	73 699
Kodagu	3 094
Kolar	81 887
Koppal	97 368
Mandya	116 901
Mysore	120 620
Raichur	125 790
Shimoga	128 733
Tumkur	112 235
Udupi	34 250
Uttara Kannada	25 094
Karnataka total	2 491 871

TABLE A24
Irrigated area per district in Kerala (India)

District	Irrigated area (ha)
Alappuzha	42 275
Ernakulam	34 195
Idukki	12 635
Kannur	24 550
Kasaragod	43 813
Kollam	1 350
Kottayam	15 653
Kozhikode	5 997
Malappuram	33 468
Palakkad	65 057
Pathanamthitta	6 849
Thiruvananthapuram	3 833
Thrissur	86 728
Wayanad	3 640
Kerala total	380 043

TABLE A25
Irrigated area per district in Madhya Pradesh (India)

District	Irrigated area (ha)
Badwani	77 993
Balaghat	121 442
Betul	104 503
Bhind	125 382
Bhopal	71 900
Chhatrapur	169 515

District	Irrigated area (ha)
Chindwara	120 046
Damoh	81 336
Datia	81 391
Dewas	158 405
Dhar	232 642
Dindori	951
East Nimar	151 434
Guna	154 156
Gwalior	123 940
Harda	127 238
Hoshangabad	232 517
Indore	160 059
Jabalpur	92 731
Jhabua	80 835
Katni	45 736
Mandla	13 591
Mandsaur	155 833
Morena	156 170
Narsimhapur	157 860
Neemach	73 071
Panna	50 319
Raisen	147 732
Rajgarh	169 280
Ratlam	145 549
Rewa	87 306
Sagar	168 439
Satna	106 516
Sehore	171 530
Seoni	73 316
Shahdol	17 871
Shajapur	215 922
Sheopur Kalan	98 385
Shivpuri	166 756
Sidhi	50 189
Tikamgarh	177 972
Ujjain	261 259
Umaria	16 301
Vidisha	143 913
West Nimar	175 747
Madhya Pradesh total	5 514 979

TABLE A26
Irrigated area per district in Maharashtra (India)

District	Irrigated area (ha)
Ahmadnagar	305 300
Akola	29 200
Amravati	63 300
Aurangabad	152 500
Beed	210 500
Bhandara	193 500
Buldana	39 500
Chandrapur	106 300
Dhule	96 900
Garhchiroli	55 000
Jalgaon	155 400
Jalna	72 700
Kolhapur	115 700
Latur	38 700
Mumbai	0
Nagpur	112 800
Nanded	60 000
Nasik	195 400
Osmanabad	107 200
Parbhani	90 100
Pune	255 100
Raigad	12 100
Ratnagiri	2 500
Sangli	132 800
Satara	176 500
Sindhudurg	36 100
Solapur	232 000
Thane	16 700
Wardha	25 700
Yavatmal	50 700
Maharashtra total	3 140 200

TABLE A27
Irrigated area per district in Manipur (India)

District	Irrigated area (ha)
Bishnupur	12 271
Chandel	3 010
Churachandpur	1 561
Imphal	24 821
Senapati	8 827
Tamenglong	980

District	Irrigated area (ha)
Thoubal	6 454
Ukhrul	7 077
Manipur total	65 000

TABLE A28
Irrigated area per district in Meghalaya (India)

District	Irrigated area (ha)
East Garo Hills	6 931
East Khasi Hills	8 261
Jaintia Hills	8 760
West Garo Hills	15 542
West Khasi Hills	5 551
Meghalaya total	45 045

TABLE A29
Irrigated area per district in Nagaland (India)

District	Irrigated area (ha)
Kohima	15 852
Mokokchung	5 230
Mon	4 257
Phek	15 274
Tuesang	10 076
Wokha	9 466
Zunheboto	2 845
Nagaland total	63 000

TABLE A30
Irrigated area per district in Orissa (India)

District	Irrigated area (ha)
Angul	49 425
Balasore	85 426
Bargarh	127 521
Bhadrak	100 148
Bolangir	61 048
Boudh	33 298
Cuttack	125 308
Deogarh	14 134
Dhenkanal	49 916
Gajapati	27 925
Ganjam	234 069
Jagatsinghpur	39 548
Jajpur	92 186
Jharsuguda	11 351
Kalahandi	101 448
Kendrapara	92 107
Keonjhar	73 540
Khurda	70 617
Koraput	81 739
Malkangiri	63 471
Mayurbhanj	81 730
Nawapara	33 482
Nawrangpur	21 455
Nayagarh	45 202
Phulbani	20 595
Puri	119 146
Rayagada	46 844
Sambalpur	53 884
Sonepur	65 648
Sundargarh	67 790
Orissa total	2 090 000

TABLE A31
Irrigated area per district in Pondicherry (India)

District	Irrigated area (ha)
Karaikal	7 847
Mahe	45
Pondicherry	13 135

Yanam	363
Pondicherry total	21 390

TABLE A32
Irrigated area per district in Punjab (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Amritsar	439 500	Mansa	199 000
Bathinda	294 900	Moga	197 400
Fairdkot	128 800	Muktsar	217 500
Fatehgarh Sahib	102 600	Nawanshahr	83 400
Firozpur	470 900	Patiala	289 700
Gurdaspur	217 500	Rupnagar	93 100
Hoshiarpur	188 300	Sangrur	422 500
Jalandhar	236 700	Punjab total	4 020 700
Kapurthala	134 700		
Ludhiana	304 200		

TABLE A33
Irrigated area per district in Rajasthan (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Ajmer	84 470	Jaisalmer	70 927
Alwar	401 196	Jalor	226 842
Banswara	74 074	Jhalawar	180 666
Baran	225 601	Jhunjhunun	213 194
Barmer	103 615	Jodhpur	142 485
Bharatpur	234 963	Karauli	93 154
Bhilwara	113 432	Kota	211 831
Bikaner	175 562	Nagaur	259 170
Bundi	187 053	Pali	156 296
Chittaurgarh	162 491	Rajsamand	20 666
Churu	60 410	Sawai Madhopur	155 614
Daulpur	94 483	Sikar	219 204
Dausa	158 700	Sirohi	48 542
Dungarpur	21 654	Tonk	189 189
Gangangar	579 583	Udaipur	47 944
Hanumangarh	339 631	Rajasthan total	5 611 874
Jaipur	359 232		

TABLE A34
Irrigated area per district in Tamil Nadu (India)

District	Irrigated area (ha)	District	Irrigated area (ha)
Chennai	0	Kanniyakumari	29 071
Coimbatore	163 615	Karur	48 451
Cuddalore	146 407	Madurai	108 067
Dharamapuri	130 303	Nagapattinam	127 128
Dindigul	106 622	Namakkal	65 511
Erode	164 155	Nilgiris	462
Kancheepuram	147 946	Perambalur	67 166

District	Irrigated area (ha)
Pudukkottai	103 215
Ramanathapuram	72 779
Salem	111 566
Sivagangai	92 157
Thanjavur	173 161
Theni	58 485
Tiruchirappalli	102 186
Tirunelveli	114 797
Tiruvallur	120 356
Tiruvannamalai	162 266
Tiruvarur	145 176
Toothukudi	42 516
Vellore	125 275
Villupuram	225 885
Virudhunagar	64 115
Tamil Nadu total	3 018 839

TABLE A35
Irrigated area per district in Uttaranchal (India)

District	Irrigated area (ha)
Almora	8 000
Bageshwar	4 000
Chamoli	3 000
Champawat	2 000
Dehra Dun	34 000
Hardwar	101 000
Nainital	36 000
Pauri	7 502
Pithoragarh	2 000
Rudra Prayag	5 000
Tehri-Garhwal	9 000
Udhamsingh Nagar	115 000
Uttarkashi	6 000
Uttaranchal total	332 502

TABLE A36
Irrigated area per district in Uttar Pradesh (India)

District	Irrigated area (ha)
Agra	233 632
Aligarh	278 568
Allahabad	266 096
Ambedkar Nagar	162 893
Auraiya	117 465
Azamgarh	271 858
Baghpat	104 550
Bahraich	87 669
Ballia	160 901
Balrampur	80 813
Banda	124 716
Barabanki	213 078
Bareilly	302 050
Basti	131 597
Bijnor	285 189
Budaun	377 752
Bulandshahar	256 787
Chandauli	123 117
Chitrakut	41 117
Deoria	156 352
Etah	278 259
Etawah	117 529
Faizabad	145 318
Farrukhabad	126 126
Fatehpur	178 291
Firozabad	163 846
Gautam Budh Nagar	124 908
Gazipur	211 648
Ghaziabad	140 682
Gonda	169 876
Gorakhpur	195 049
Hamirpur	98 998
Hardoi	322 767
Hathras	142 587
Jalaun	155 658
Jaunpur	251 540
Jhansi	183 437
Jyotiba Phule Nagar	106 506
Kanauj	129 224
Kandur Nagar (Urban)	142 433
Kanpur Dehat (Rural)	149 222
Kaushambi	71 465
Kheri	341 251
Kushinagar	150 981
Lalitpur	184 773
Lucknow	121 844

District	Irrigated area (ha)
Maharajganj	158 513
Mahoba	94 279
Mainpuri	175 802
Mathura	259 707
Mau	115 936
Meerut	188 042
Mirzapur	134 462
Moradabad	233 940
Muzaffarnagar	299 547
Partapgarh	176 460
Pilibhit	190 836
Raibareli	239 203
Rampur	170 670
Saharanpur	251 374
Saint Kabir Nagar	91 537
Sant Ravidas Nagar	57 687
Shahjahanpur	327 279
Shravasti	71 370
Siddharthnagar	138 350
Sitapur	294 640
Sondbhadra	49 211
Sultanpur	219 600
Unnao	260 967
Varanasi	89 794
Uttar Pradesh total	12 469 624

TABLE A37
Irrigated area per district in West Bengal (India)

District	Irrigated area (ha)
Bankura	210 750
Birbhum	103 321
Burdwan	239 107
Calcutta	0
Coochbehar	24 109
Darjiling	10 148
Hooghly	144 661
Howrah	48 270
Jalpaiguri	50 208
Malda	136 557
Midnapur	293 320
Murshidabad	197 666
Nadia	162 500
North 24 Panganas	98 233
North Dinajpur	64 833
Purulia	35 473
South 24 Panganas	34 850
South Dinajpur	56 993
West Bengal total	1 911 000

TABLE A38
Irrigated areas per river basin in Indonesia

Basin	Island	Irrigated area (ha)
Bali	Bali	87 000
Flores	Flores	10 000
Digul – Bikuma	Irian Jaya	1 000
Eilanden – Edera	Irian Jaya	2 000
Memberamo	Irian Jaya	1 000
Wasi – Kais – Omba	Irian Jaya	1 000
Bengawan – Solo	Java	376 000
Cimanuk	Java	264 000
Cisadane – Cillwung	Java	160 000
Cisadeg – Cikuningan	Java	90 000
Citanduy	Java	121 000
Citarum	Java	415 000
Ciujung – Ciliman	Java	66 000
Ciwulan	Java	50 000
Iratun – Seluna	Java	286 000
K. Brantas	Java	265 000
Madura	Java	81 000
Pekalen – Sampean	Java	354 000
Pemail – Comal	Java	93 000
Progo – Opak – Oyo	Java	113 000
Serayu	Java	173 000
Barito	Kalimantan	16 000
Berau – Kelai	Kalimantan	3 000
Cengal – Batulicin	Kalimantan	7 000
Kahayan	Kalimantan	1 000
Kapuas	Kalimantan	6 000
Karangan	Kalimantan	4 000
Kayan	Kalimantan	4 000
Mahakam	Kalimantan	6 000
Mempawah – Sambas	Kalimantan	3 000
Mendawai	Kalimantan	1 000
Pawan	Kalimantan	3 000

Basin	Island	Irrigated area (ha)
Pembuang	Kalimantan	1 000
Sampit	Kalimantan	0
Sesayao	Kalimantan	4 000
Lombok	Lombok	90 000
Halmahera	Maluku	5 000
Seram – Buru – Sula	Maluku	7 000
Wetar – Aru	Maluku	3 000
Bolango – Bone	Sulawesi	17 000
Bongka – Malik	Sulawesi	11 000
Jeneberang	Sulawesi	36 000
Kaluku – Karama	Sulawesi	41 000
Laa – Tambalako	Sulawesi	11 000
Lambunu – Bual	Sulawesi	14 000
Lasolo – Sampara	Sulawesi	14 000
Lombok – Mantawa	Sulawesi	9 000
Paguyaman – Randangan	Sulawesi	21 000
Paleang – Roraya	Sulawesi	8 000
Palu – Lariang	Sulawesi	19 000
Parigi – Poso	Sulawesi	10 000
Pompangan – Kalaena – Laron	Sulawesi	67 000
Ranowangko – Tondano	Sulawesi	25 000
Sadang	Sulawesi	35 000
Towari – Susua	Sulawesi	6 000
Walanae – Cenrane	Sulawesi	32 000
Asahan	Sumatra	35 000
Bahbolon	Sumatra	11 000
Barumun – Kualuh	Sumatra	50 000
Batangari	Sumatra	57 000
Baturusa – Cerucut	Sumatra	13 000
Belawan – Belumai – Ular	Sumatra	19 000
Bt. Gladis Bt. Toru – Natas	Sumatra	28 000
Indragki	Sumatra	35 000
Ipuh – Teramang – Majunto	Sumatra	13 000
Jambu Aye	Sumatra	23 000
Kampar	Sumatra	27 000
Kanal – Alas – Talo	Sumatra	22 000
Krueng Aceh	Sumatra	11 000
Lais – Bintunan – Ketahun	Sumatra	18 000
Mesuji – Tl. Bawang	Sumatra	74 000
Meureudu – Ureun	Sumatra	4 000
Musi	Sumatra	33 000
Pase Peusangan	Sumatra	7 000
Rokan	Sumatra	28 000
Semangka	Sumatra	32 000
Seputih – Sekampung	Sumatra	70 000
Siak	Sumatra	5 000
Silaul	Sumatra	47 000
Singkil	Sumatra	51 000
Sinkulat – Tripa	Sumatra	29 000
Sugihan	Sumatra	8 000
Tamiyamg – Langsa	Sumatra	12 000
Wampu – Besitang	Sumatra	26 000
Woyla – Lambesi	Sumatra	14 000
Sumba	Sumba	11 000
Sumbawa	Sumbawa	80 000
Timor Barat	Timor	17 000
Indonesia total		4 459 000

TABLE A39
Irrigated area per governorate in Iraq

Province	Irrigated area (ha)
Al-Anbar	102 750
Al-Basrah	59 250
Al-Muthanna	100 731
Al-Qadisiyah	355 622
An-Najaf	111 869
Arbil	5 119
At-Tameem	176 500
Babil	387 190
Baghdad	262 032
Thegar	348 463
Dahoak	14 123
Diala	420 701
Kerbala	31 500
Misan	238 489
Nineweh	71 250
Salah Eldin	189 750
Sulaimania	35 002
Wasit	614 658
Iraq total	3 525 000

TABLE A40
Irrigated area per ostan in the Islamic Republic of Iran

Ostan	Irrigated area (ha)	Ostan	Irrigated area (ha)
Ardebil	228 900	Kohgiluyeh & Boyer Ahmad	48 200
Bushehr	40 800	Kordestan	143 100
Chaharmahal & Bakhtiar	104 400	Lorestan	188 600
East Azarbayejan	425 700	Markazi	275 400
Esfahan	310 400	Mazandaran	390 400
Fars	641 100	Semnan	111 700
Gilan	169 800	Sistan & Baluchestan	187 800
Hamadan	289 000	Tehran	198 400
Horasan	1 144 600	West Azarbayejan	418 400
Hormozgan	72 300	Yazd	85 300
Ilam	39 800	Zanjan	350 800
Kerman	355 700	Islamic Republic of Iran total	6 913 800
Kermanshah	119 800		
Khuzestan	573 400		

TABLE A41
Irrigated area per natural region, subdistrict and district in Israel

Natural region	Subdistrict	District	Irrigated area (ha)
Petah Tiqwa Region	Petah Tiqwa	Central	2 867
Southern Sharon	Petah Tiqwa	Central	4 460
Lod Region	Ramla	Central	6 363
Rehovot Region	Rehovot	Central	7 427
Eastern Sharon	Sharon	Central	3 456
Western Sharon	Sharon	Central	8 646
Rishon Le Ziyyon & Tel Aviv Regions	Rehovot & Tel Aviv	Central & Tel Aviv	3 362
Carmel Coast	Hadera	Haifa	1 417
Hadera Region	Hadera	Haifa	5 182
Zikhron Ya'akov, Haifa & Alexander Mountain Reg.	Haifa & Hadera	Haifa	5 729
Judean Foothills	Jerusalem	Jerusalem	3 821
Judean Mountains	Jerusalem	Jerusalem	667
Nahariyya & Akko Regions	Akko	Northern	4 993
Shefar'am & Karmi'el Regions	Akko	Northern	5 785
Yehi'am & Elon Regions	Akko	Northern	3 044
Golan	Golan	Northern	7 198
Kinnerot	Kinneret	Northern	3 578
Sea of Galilee	Kinneret	Northern	0
Eastern Lower Galilee & Kokhav Plateau Regions	Kinneret & Zefat	Northern	6 608
Bet Shean Basin & Harod Valley	Zefat	Northern	11 255
Eastern Upper Galilee	Zefat	Northern	2 133
Hula Basin & Hazor Regions	Zefat	Northern	10 537
Menashe Plateau	Zefat	Northern	702
Nazareth-Tir'an Mountains	Zefat	Northern	2 909
Yizre'el & Yoqne'am Regions	Zefat	Northern	11 030
Ashdod & Ashqelon Regions	Ashqelon	Southern	10 678
Lakhish Region	Ashqelon	Southern	4 558
Mal'akhi Region	Ashqelon	Southern	13 242

Natural region	Subdistrict	District	Irrigated area (ha)
Arava, Dead Sea & Southern Negev Mts. Regions	Be'er Sheva	Southern	3 688
Be'er Sheva & Northern Negev Mountain Regions	Be'er Sheva	Southern	2 941
Besor Region	Be'er Sheva	Southern	17 581
Dead Sea	Be'er Sheva	Southern	0
Gerar Region	Be'er Sheva	Southern	7 550
Settlements West Bank			2 912
Settlements Gaza Strip			280
Israel total			186 600

TABLE A42
Irrigated area per province and prefecture in Japan

Prefecture	Province	Irrigated area (ha)
Hiroshima	Chugoku	56 480
Okajama	Chugoku	68 605
Shimane	Chugoku	38 537
Tottori	Chugoku	31 012
Yamaguchi	Chugoku	50 366
	Chugoku	245 000
Hokkaido	**Hokkaido**	354 000
Fukui	Hokuriku	42 566
Ishikawa	Hokuriku	44 549
Niigata	Hokuriku	175 986
Toyama	Hokuriku	62 899
	Hokuriku	326 000
Gifu	Kanto	51 073
Gumma	Kanto	41 316
Ibaraki	Kanto	120 369
Kanagawa	Kanto	8 015
Nagano	Kanto	74 719
Saitama	Kanto	60 430
Tochigi	Kanto	111 371
Tokyo	Kanto	1 919
Tshiba	Kanto	93 907
Yamanashi	Kanto	12 881
	Kanto	576 000
Hyogo	Kinki	79 389
Kyoto	Kinki	30 053
Nara	Kinki	20 844
Osaka	Kinki	13 813
Shiga	Kinki	54 813
Wakayama	Kinki	21 088
	Kinki	220 000
Fukuoka	Kyushu	81 357
Kagoshima	Kyushu	63 364
Kumamoto	Kyushu	89 771
Miyazaki	Kyushu	47 250
Nagasaki	Kyushu	33 186
Oita	Kyushu	50 293
Saga	Kyushu	49 779
	Kyushu	415 000
Okinawa	**Okinawa**	7 000
Ehime	Shikoku	41 062
Kagawa	Shikoku	32 158
Kochi	Shikoku	28 418
Tokushima	Shikoku	27 362
	Shikoku	129 000
Akita	Tohoku	135 561
Aomori	Tohoku	94 391
Fukushima	Tohoku	117 221
Iwate	Tohoku	104 345
Miyagi	Tohoku	118 924
Yamagata	Tohoku	105 558
	Tohoku	676 000
Aichi	Tokai	67 965
Mie	Tokai	60 236
Shizuoka	Tokai	52 799
	Tokai	181 000
Japan total		3 129 000

TABLE A43
Irrigated area per governorate in Jordan

Governorate	Irrigated area (ha)
Amman	8 708
Irbid	18 200
Karak	6 821

Governorate	Irrigated area (ha)
Ma-an	9 178
Mafraq	10 535
Balqa	14 771
Tafila	1 193
Zarqa	7 506
Jordan total	76 912

TABLE A44
Irrigated area per oblast in Kazakhstan

Oblast	Irrigated area (ha)
Akmola	30 370
Aktobe	35 710
Almaty	260 030
Atyrau	25 690
East Kazakhstan	80 910
Karaganda	66 550
Kokshetau	5 600
Kostanai	21 590
Kzyl-Orda	240 730
Mangistau	210
North Kazakhstan	13 740
Pavlodar	70 030
Semei	101 360
South Kazakhstan	395 280
Taldy Korgan	246 200
Torgai	3 170
West Kazakhstan	46 470
Zhambyl	199 120
Zhezkazgan	12 440
Kazakhstan total	1 855 200

TABLE A45
Irrigated area per governorate in Kuwait

Governorate	Irrigated area (ha)
Ahmadi	2 911.4
Farwaniya	0.0
Hawalli	0.4
Jhara	4 056.3
Kuwait City	0.0
Kuwait total	6 968.1

TABLE A46
Irrigated area per raion and oblast in Kyrgyzstan

Raion	Oblast	Irrigated area (ha)
Batken	Batken Region	14 846
Kadamjai	Batken Region	26 997
Lailak	Batken Region	13 639
	Batken Region	55 482
Alamüdün	Chui Region	34 618
Chui	Chui Region	33 769
Jaiyl	Chui Region	42 658
Kemin	Chui Region	28 438
Moskovsky	Chui Region	44 426
Panfilov	Chui Region	31 731
Sokuluk	Chui Region	59 906
Ysyk-Ata	Chui Region	55 589
	Chui Region	331 135
Aksyi	Jalal-Abad Region	12 357
Ala-Buka	Jalal-Abad Region	16 218
Bazar-Korgon	Jalal-Abad Region	18 652
Chatkal	Jalal-Abad Region	8 765
Nooken	Jalal-Abad Region	22 868
Suzak	Jalal-Abad Region	45 001
Togus-Toro	Jalal-Abad Region	4 072
Toktogul	Jalal-Abad Region	14 013
	Jalal-Abad Region	141 946
Ak-Talaa	Naryn Region	15 962

Raion	Oblast	Irrigated area (ha)
At-Bashi	Naryn Region	32 330
Jumgal	Naryn Region	19 223
Kochkor	Naryn Region	24 785
Tien-Shan	Naryn Region	27 505
	Naryn Region	119 805
Alai	Osh Region	6 755
Aravan	Osh Region	22 517
Chong-Alay	Osh Region	14 179
Kara-Kuldja	Osh Region	7 275
Kara-Suu	Osh Region	42 930
Nookat	Osh Region	26 328
Uzgen	Osh Region	22 181
	Osh Region	142 165
Bakai-Ata	Talas Region	27 690
Kara-Buura	Talas Region	30 468
Manas	Talas Region	18 214
Talas	Talas Region	38 743
	Talas Region	115 115
Ak-Suu	Ysyk-Köl Region	41 342
Djety-Oguz	Ysyk-Köl Region	42 956
Ton	Ysyk-Köl Region	25 937
Tyup	Ysyk-Köl Region	24 826
Ysyk-Köl	Ysyk-Köl Region	34 331
Ysyk-Köl Lake	Ysyk-Köl Region	0
	Ysyk-Köl Region	169 392
Kyrgyzstan total		1 075 040

TABLE A47
Irrigated area per province in Lao People's Democratic Republic

Province	Irrigated area (ha)
Attapeu	4 310
Bokeo	7 728
Borikhamxay	19 875
Champasack	29 979
Huaphanh	10 597
Khammuane	23 637
Luangnamtha	7 874
Luangprabang	9 561
Oudomxay	8 400
Phongsaly	5 230
Saravane	14 985
Savannakhet	46 900
Sekong	3 249
Vientiane	32 172
Vientiane (Munic.)	38 852
Xayabury	16 669
Xaysomboon	3 277
Xiengkhuang	12 240
Lao People's Democratic Republic total	295 535

TABLE A48
Irrigated area per mohafaza and caza in Lebanon

Mohafaza	Caza	Irrigated area (ha)
Baalbeck	Bekaa	25 919
Hermel	Bekaa	4 734
Rachaiya	Bekaa	329
West Bekaa	Bekaa	10 566
Zahle	Bekaa	14 506
	Bekaa	56 054
Aley	Mount Lebanon	1 074
Baabda	Mount Lebanon	906
Beirut	Mount Lebanon	0
Chouf	Mount Lebanon	3 657
El Metn	Mount Lebanon	1 253
Jbail	Mount Lebanon	2 613
Keserouan	Mount Lebanon	1 285
	Mount Lebanon	10 788
Bent Jbail	Nabatiye	174
Hasbaya	Nabatiye	310
Marjaayoun	Nabatiye	319
Nabatiye	Nabatiye	1 429
	Nabatiye	2 232
Akkar	North Lebanon	21 611
Bcharre	North Lebanon	2 191
El Batroun	North Lebanon	441
El Minie	North Lebanon	6 619
Koura	North Lebanon	440
Tripoli	North Lebanon	166
Zgharta	North Lebanon	1 519

Mohafaza	Caza	Irrigated area (ha)
	North Lebanon	32 987
Jezzine	South Lebanon	1 252
Saida	South Lebanon	6 993
Sour	South Lebanon	6 807
	South Lebanon	15 052
Lebanon total		117 113

TABLE A49
Irrigated area per state in Malaysia

State	Irrigated area (ha)
Johor	3 443
Kedah	105 580
Kelantan	45 122
Kuala Lumpur	0
Melaka	6 969
Negeri Sembilan	9 784
Pahang	19 599
Perak	55 263
Perlis	24 841
Pulau Pinang	16 789
Sabah	19 345
Sarawak	17 061
Selangor	22 073
Terengganu	16 730
Malaysia total	362 600

TABLE A50
Irrigated area per aimag in Mongolia

Aimag	Irrigated area (ha)
Arhangay	1 217
Bayan-Olgiy	2 946
Bayanhongor	1 560
Bulgan & Erdenet	1 071
Dornod	2 339
Dornogovi	421
Dundgovi	137
Dzavhan	2 181
Govi-Altay	7 327
Hentiy	1 841
Hovd	7 209
Hovsgol	406
Omnogovi	618
Ovorhangay	4 933
Selenge & Darhan Uul	7 525
Suhbaatar	119
Tov & Ulaanbaatar	6 121
Uvs	9 329
Mongolia total	57 300

TABLE A51
Irrigated area per division in Myanmar

State / Division	Irrigated area (ha)
Ayeyarwady	563 445
Bago	130 210
Chin	9 352
Kachin	59 375
Kayah	19 127
Kayin	17 802
Magway	113 654
Mandalay	268 370
Mon	45 504
Rakhine	7 144
Sagaing	328 708
Shan	232 071
Tanintharyi	4 498
Yangon	42 059
Myanmar total	1 841 320

TABLE A52
Irrigated area per district and development region in Nepal

District	Development region	Irrigated area (ha)
Bhaktapur	Bagmati	2 588
Dhading	Bagmati	10 428
Kathmandu	Bagmati	5 004
Kavrepalanchok	Bagmati	11 406
Lalitpur	Bagmati	2 824
Nuwakot	Bagmati	11 447
Rasuwa	Bagmati	1 036
Sindhupalchok	Bagmati	10 030
	Bagmati	54 763
Dhanusha	Janakpur	39 118
Dolakha	Janakpur	6 810
Mahottari	Janakpur	30 425
Ramechhap	Janakpur	7 263
Sarlahi	Janakpur	58 323
Sindhuli	Janakpur	12 241
	Janakpur	154 180
Bara	Narayani	47 598
Chitwan	Narayani	28 442
Makwanpur	Narayani	9 131
Parsa	Narayani	38 306
Rautahat	Narayani	34 657
	Narayani	158 133
Bhojpur	Koshi	8 751
Dhankuta	Koshi	7 151
Morang	Koshi	82 835
Sankhuwasabha	Koshi	12 051
Sunsari	Koshi	65 766
Terhathum	Koshi	8 495
	Koshi	185 049
Ilam	Mechi	13 343
Jhapa	Mechi	59 643
Panchthar	Mechi	6 951
Taplejung	Mechi	8 040
	Mechi	87 977
Khotang	Sagarmath	8 209
Okhaldhunga	Sagarmath	4 107
Saptari	Sagarmath	37 021
Siraha	Sagarmath	26 737
Solukhumbu	Sagarmath	1 901
Udayapur	Sagarmath	14 883
	Sagarmath	92 858
Baitadi	Mahakali	5 399
Dadeldhura	Mahakali	3 882
Darchula	Mahakali	3 073
Kanchanpur	Mahakali	30 629
	Mahakali	42 982
Achham	Seti	6 678
Bajhang	Seti	4 700
Bajura	Seti	2 501
Doti	Seti	7 270
Kailali	Seti	43 316
	Seti	64 465
Banke	Bheri	6 055
Bardiya	Bheri	32 653
Dailekh	Bheri	7 932
Jajarkot	Bheri	3 468
Surkhet	Bheri	15 051
	Bheri	65 159
Dolpa	Karnali	363
Humla	Karnali	972
Jumla	Karnali	955
Kalikot	Karnali	7 478
Mugu	Karnali	947
	Karnali	10 715
Dang	Rapti	41 687
Pyuthan	Rapti	5 845
Rolpa	Rapti	7 701
Rukum	Rapti	5 062
Salyan	Rapti	7 216
	Rapti	67 512
Baglung	Dhawalagi	5 370
Mustang	Dhawalagi	1 004
Myagdi	Dhawalagi	3 703
Parbat	Dhawalagi	5 788
	Dhawalagi	15 865
Gorkha	Gandaki	10 764
Kaski	Gandaki	11 969
Lamjung	Gandaki	10 611
Manang	Gandaki	229
Syangja	Gandaki	10 041
Tanahu	Gandaki	9 124
	Gandaki	52 739
Arghakhanchi	Lumbini	4 060
Gulmi	Lumbini	5 382
Kapilvastu	Lumbini	16 234
Nawalparasi	Lumbini	36 797
Palpa	Lumbini	8 372
Rupandehi	Lumbini	45 108
	Lumbini	115 952
Nepal total		1 168 349

TABLE A53
Irrigated area per region in Oman

Region	Irrigated area (ha)
A Dakhliya	7 070
A Sharqiya	7 620
Al Batinah	40 800
Al Dhahira	9 810
Al Wusta	100
Dhofar	2 930
Musandam	900
Muscat	3 400
Oman total	72 630

TABLE A54
Irrigated area in Pakistan

Federal state, territory	Irrigated area (ha)
Balochistan	767 120
Northern Territories	90 464
North-West Frontier Province	719 152
Punjab	10 325 678
Sindh	2 515 050
Pakistan total	14 417 464

TABLE A55
Irrigated area per district in Balochistan (Pakistan)

District	Irrigated area (ha)
Awaran	6 117
Barkhan	14 581
Bolan	24 929
Chagai	12 408
Dera Bugti	4 239
Gwadar	2 569
Jaffarabad	226 477
Jhall Magsi	25 655
Kalat	30 722
Kech (Turbat)	40 223
Kharan	5 112
Khuzdar	30 996
Killa Abdullah	16 502
Killa Saifullah	19 232

District	Irrigated area (ha)
Kohlu	2 936
Lasbela	10 272
Loralai	26 406
Mastung	31 454
Musakhel	3 388
Nasirabad	126 495
Panjgur	14 443
Pishin	38 249
Quetta	11 436
Sibi	21 087
Zhob	17 702
Ziarat	3 490
Balochistan total	767 120

TABLE A56
Irrigated area per district in Northern Territories (Pakistan)

District	Irrigated area (ha)
Diamir	32 000
Gahkuch	11 636
Ghizar	7 896
Gilgit	18 073

District	Irrigated area (ha)
Skardu	20 859
Northern Territories total	90 464

TABLE A57
Irrigated area per district in North-West Frontier Province (Pakistan)

District	Irrigated area (ha)	District	Irrigated area (ha)
Abottabad	5 689	Lakki Marwat	37 813
Bajaur Agency	19 554	Malakand Agency	27 540
Bannu	40 529	Mansehra	16 254
Battagram	3 976	Mardan	63 372
Buner	10 329	Mohmand Agency	5 065
Charsadda	57 716	North Waziristan	8 083
Chitral	16 871	Nowshera	19 778
Dera Ismail Khan	97 736	Orakzai Agency	1 871
Dir	49 213	Peshawar	45 174
Hangu	5 734	Shangla	0
Haripur	26 412	South Waziristan	8 460
Karak	1 097	Swabi	27 064
Khyber Agency	8 611	Swat	56 041
Kohat	14 393	Tank	9 637
Kohistan	21 200	North-West Frontier Province total	719 152
Kurram Agency	13 942		

TABLE A58
Irrigated area per district in Punjab (Pakistan)

District	Irrigated area (ha)	District	Irrigated area (ha)
Attok	42 312	Mainwali	210 151
Bahawalnagar	587 000	Mandi Bahaud-Din	221 000
Bahawalpur	435 000	Multan	303 000
Bhakkar	333 727	Muzaffargarh	465 000
Chakwal	24 237	Narowal	119 163
Dera Ghazi Khan	412 504	Okara	350 000
Faisalabad	517 000	Pak Pattan	242 000
Gujarat	124 738	Rahim Yar Khan	628 000
Gujranwala	305 000	Rajanpur	337 000
Hafizabad	188 000	Rawalpindi	11 704
Islamabad	169	Sahiwal	261 000
Jhang	658 707	Sargodha	520 000
Jhelum	36 365	Sheikhupura	492 000
Kasur	306 000	Sialkot	245 211
Khanewal	364 000	Toba Tek Singh	257 000
Kushab	140 678	Vehari	392 000
Lahore	126 000	Punjab total	10 325 678
Layyah	412 010		
Lodhran	258 000		

TABLE A59
Irrigated area per district in Sindh (Pakistan)

District	Irrigated area (ha)	District	Irrigated area (ha)
Badin	200 000	Naushero Feroze	191 000
Dadu	109 550	Nawabshah	208 000
Ghotki	166 400	Sanghar	254 000
Hyderabad	262 000	Shikarpur	102 000
Jacobabad	135 100	Sukkur	98 000
Karachi	6 300	Tharparkar	24 700
Khaipur	223 000	Thatta	138 000
Larkana	174 000	Sindh total	2 515 050
Mirpurkhas & Umerkot	223 000		

TABLE A60
Irrigated area per district and region in the Palestinian Authority

Governorate	Region	Irrigated area (ha)
Deir Al-Balah	Gaza	1 370
Gaza	Gaza	1 920
Khan Yunis	Gaza	2 120
North Gaza	Gaza	2 120
Rafah	Gaza	1 690
	Gaza	9 220
Bethlehem	West Bank	180
Hebron	West Bank	220
Jenin	West Bank	1 080
Jericho	West Bank	1 910
Jerusalem	West Bank	12
Nablus	West Bank	590
Qualquiya	West Bank	720
Ramallah & Al-Bireh	West Bank	50
Salfit	West Bank	40
Tubas	West Bank	1 020
Tulkarm	West Bank	1 180
	West Bank	7 002
Palestinian Authority (excl. Israeli settlements)		16 222
Gaza	Gaza	285
Jericho & Tubas	West Bank	2 434
Nablus & Ramallah	West Bank	254
Bethlehem & Hebron	West Bank	271
Israeli settlements		3 244

TABLE A61
Irrigated area per region in the Philippines

Region	Irrigated area (ha)	Region	Irrigated area (ha)
Region 1	187 000	Region 5	91 000
Region 2	265 000	Region 6	111 000
Region 3	285 000	Region 7	24 000
Region 4	161 000	Region 8	57 000

Region	Irrigated area (ha)
Region 9	40 000
Region 10	81 000
Region 11	137 000
Region 12	111 000
Philippines total	1 550 000

TABLE A62
Irrigated area per province in the Republic of Korea

Province	Irrigated area (ha)
Busan	6 437
Chungbuk	49 821
Chungnam	144 976
Daegu	6 352
Daejeon	2 717
Gangwon	38 325
Gwangju	9 181
Gyeongbuk	133 372
Gyeonggi	87 218
Gyeongnam & Ulsan	108 753
Incheon	11 313
Jeju	117
Jeonbuk	126 267
Jeonnam	154 829
Seoul	687
Republic of Korea total	880 365

TABLE A63
Irrigated area per oblast in the Russian Federation (Asian part of the country)

Oblast	Irrigated area (ha)
Aginsky-Buryatsky okrug	2 000
Altaisky krai	109 000
Altay, Republic of	7 000
Amurskaya oblast	9 000
Buryatia, Republic of	150 000
Chelyabinskaya oblast	99 000
Chitinskaya oblast	15 000
Chukotsky national okrug	0
Evensky national okrug	0
Irkutskaya oblast	29 000
Jewish autonomous oblast	3 000
Kamchatskaya oblast	2 000
Kemerovskaya oblast	26 000
Khabarovsky krai	7 000
Khakasia, Republic of	52 000
Khanty-Mansiysky national okrug	0
Koryaksky national okrug	0
Krasnoyarsky krai	20 000
Kurganskaya oblast	19 000
Magadanskaya oblast	4 000
Nenetsky national okrug	0
not irrigated island or lake	0
Novosibirskaya oblast	39 000
Omskaya oblast	86 000
Primorsky krai	94 000
Sakha, Republic of	16 000
Sakhalinskaya oblast	0
Sverdlovskaya oblast	50 000
Taimyrski national okrug	0
Tomskaya oblast	5 000
Tumenskaya oblast	6 000
Tyva, Republic of	39 000
Ust-Ordynsky okrug	9 000
Russian Federation (Asian part) total	897 000

TABLE A64
Irrigated area per region in Saudi Arabia

Region	Irrigated area (ha)
Al Baha	9 021
Asier	38 220
Eastern Province	95 830
El Jouf	68 560
Hail	117 320
Jizan	262 329
Mecca	103 576
Medina	27 860

Region	Irrigated area (ha)
Najran	14 750
Northern Borders	170
Qaseem	329 509
Riyadh	608 592
Tabouk	55 030
Saudi Arabia total	1 730 767

TABLE A65
Irrigated area per district and region in Sri Lanka

District	Region	Irrigated area (ha)
Kandy	Central	11 565
Matale	Central	14 395
Nuwara Eliya	Central	6 470
	Central	32 429
Ampara	Eastern	64 465
Batticaloa	Eastern	26 922
Trincomalee	Eastern	25 249
	Eastern	116 637
Anuradhapura	North Central	100 731
Polonnaruwa	North Central	56 461
	North Central	157 192
Kurunegala	North Western	55 455
Puttalam	North Western	18 657
	North Western	74 112
Jaffna	Northern	4 320
Kilinochchi	Northern	13 017
Mannar	Northern	20 331
Mullaittivu	Northern	12 250
Vavuniya	Northern	21 597
	Northern	71 515
Kegalle	Sabaragamuwa	2 385
Ratnapura	Sabaragamuwa	11 632
	Sabaragamuwa	14 017
Galle	Southern	127
Hambantota	Southern	29 411
Matara	Southern	8 341
	Southern	37 879
Badulla	Uva	21 211
Moneragala	Uva	11 523
	Uva	32 734
Colombo	Western	1 835
Gampaha	Western	4 682
Kalutara	Western	2 268
	Western	8 784
Uda Walawe	**Uda Walawe**	24 700
Sri Lanka total		570 000

TABLE A66
Irrigated area per governorate in the Syrian Arab Republic

Governorate	Irrigated area (ha)
Al Hasake	430 520
Al Rakka	166 130
Aleppo	172 120
Damascus	65 160
Dier Elzzor	106 720
Diraa	28 250
Hama	140 390
Homs	45 440
Idleb	45 890
Kuneitra	4 270
Lattikia	34 980
Sweida	1 300
Tartous	25 730
Syrian Arab Republic total	1 266 900

TABLE A67
Paddy area, area of upland crops and irrigated area per county and region in Taiwan Province of China

County	Region	Paddy area (ha)	Upland fields (ha)	Irrigated area (ha)
Miaoli	Central	18 662	11 180	25 596
Nantou	Central	13 241	40 603	38 424
Taizhong	Central	23 163	21 213	36 320

County	Region	Paddy area (ha)	Upland fields (ha)	Irrigated area (ha)
Taizhong Shi	Central	2 389	1 431	3 277
Yunlin	Central	51 766	12 740	59 667
Zhanghua	Central	48 802	9 565	54 734
	Central	158 023	96 732	218 018
Hualia	East	12 309	17 059	19 156
Taidong	East	11 172	18 143	18 454
	East	23 481	35 202	37 610
Jinmen	Kinma	4	2 203	0
Lienkiang	Kinma	0	14	0
	Kinma	4	2 218	0
Jilong Shi	North	32	295	164
Taibei	North	8 631	9 912	13 066
Taibei Shi	North	862	2 243	1 865
Taoyuan	North	33 578	3 588	35 183
Xinzhu	North	15 931	9 195	20 044
Yilan	North	16 363	4 956	18 580
	North	75 396	30 189	88 902
Gaoxiong	South	13 634	21 955	26 760
Gaoxiong Shi	South	1 148	1 135	1 827
Jiayi	South	38 307	16 269	48 033
Penghu	South	0	1 515	906
Pingdong	South	28 473	20 603	40 791
Tainan	South	38 468	34 335	58 995
Tainan Shi	South	2 406	2 141	3 686
	South	122 436	97 953	180 998
Taiwan Province of China total		379 341	262 294	525 528

TABLE A68
Irrigated area per province and region in Thailand

Province	Region	Irrigated area (ha)
Bangkok	Bangkok	74 864
Ang Thong	Central	81 242
Chachoengsao	Central	150 100
Chainat	Central	142 025
Chanthaburi	Central	27 568
Chon Buri	Central	22 827
Kanchanaburi	Central	126 188
Lop Buri	Central	116 680
Nakhon Pathom	Central	183 382
Nakon Nayok	Central	95 407
Nonthaburi	Central	36 766
Pathum Thani	Central	110 958
Phetcha Buri	Central	83 494
Phranakhon Si Ayutthaya	Central	197 571
Prachin Buri	Central	57 185
Prachuap Khiri Khan	Central	51 341
Ratchaburi	Central	136 553
Rayong	Central	26 430
Sa Kaeo	Central	21 481
Samut Prakan	Central	60 528
Samut Sakhon	Central	37 696
Samut Songkhram	Central	8 736
Sara Buri	Central	59 355
Sing Buri	Central	67 840
Suphan Buri	Central	309 283
Trat	Central	18 445
	Central	2 229 083
Amnat Charoen	Northeastern	6 684
Buri Rum	Northeastern	57 677
Chaiyaphum	Northeastern	50 142
Kalasin	Northeastern	72 689
Khon Kaen	Northeastern	53 197
Loei	Northeastern	20 862

Province	Region	Irrigated area (ha)
Maha Sarakham	Northeastern	37 446
Mukdahan	Northeastern	13 407
Nakhon Phanom	Northeastern	17 925
Nakhon Ratchasima	Northeastern	150 251
Nong Bua Lam Phu	Northeastern	15 387
Nong Khai	Northeastern	25 494
Roi Et	Northeastern	60 781
Sakon Nakhon	Northeastern	85 493
Sisaket	Northeastern	38 585
Surin	Northeastern	40 915
Ubon Ratchathani	Northeastern	45 855
Udon Thani	Northeastern	33 856
Yasothon	Northeastern	13 096
	Northeastern	839 741
Chiang Mai	Northern	214 540
Chiang Rai	Northern	87 380
Kamphaeng Phet	Northern	78 746
Lampang	Northern	78 282
Lamphun	Northern	64 159
Mae Hong Son	Northern	12 129
Nakhon Sawan	Northern	155 077
Nan	Northern	40 407
Phayao	Northern	42 086
Phetchabun	Northern	43 757
Phichit	Northern	155 856
Phitsanulok	Northern	75 839
Phrae	Northern	69 600
Sukhothai	Northern	48 439
Tak	Northern	26 704
Uthai Thani	Northern	106 048
Uttaradit	Northern	22 179
	Northern	1 321 226
Chumphon	Southern	17 834
Krabi	Southern	9 098
Nakhon Thammarat	Southern	135 205
Narathiwat	Southern	76 482
Pattani	Southern	66 132
Phangnga	Southern	8 446
Phatthalung	Southern	68 123
Phuket	Southern	1 981
Ranong	Southern	3 138
Satun	Southern	14 308
Songkhla	Southern	55 538
Surat Thani	Southern	34 818
Trang	Southern	22 576
Yala	Southern	7 116
	Southern	520 794
Thailand total		4 985 708

TABLE A69
Irrigated area per province in Turkey

Province	Irrigated area (ha)
Adana	291 945
Adiyaman	21 172
Afyon	63 515
Agri	37 886
Aksaray	46 652
Amasya	76 886
Ankara	62 401
Antalya	142 630
Artvin	14 486
Aydin	103 766
Balikesir	38 120
Batman	20 757
Bayburt	19 523
Bilecik	21 172
Bingol	20 323
Bitlis	43 479
Bolu	43 458
Burdur	46 800
Bursa	91 476
Canakkale	30 647
Cankiri	27 857
Corum	36 489
Denizli	118 504
Diyarbakir	114 494
Edirne	37 941
Elazig	61 286
Erzincan	73 543
Erzurum	81 344
Eskisehir	110 315
Gaziantep	36 772
Giresun	4 457
Gumushane	16 714
Hakkari	12 611
Hatay	117 797
Icel	164 916
Isparta	78 001
Istanbul	12 271
Izmir	139 515

Province	Irrigated area (ha)
Kahramanmaras	95 093
Karaman	51 258
Kars	89 144
Kastamonu	26 743
Kayseri	90 258
Kinkkale	31 200
Kirklareli	14 072
Kirsehir	25 629
Kocaeli	10 029
Konya	261 731
Kutahya	31 200
Malatya	134 830
Manisa	134 830
Mardin	11 224
Mugla	60 114
Mus	40 115
Nevsehir	21 686
Nigde	43 265
Ordu	2 229
Rize	45
Sakarya	18 943
Samsun	56 432
Sanliurfa	49 029
Siirt	10 052
Sinop	21 637
Sirnak	48 289
Sivas	55 715
Tekirdag	23 400
Tokat	76 886
Trabzon	3 343
Tunceli	16 633
Usak	10 029
Van	84 948
Yozgat	46 800
Zinguldak	7 162
Turkey total	4 185 910

TABLE A70
Irrigated area per welayat in Turkmenistan

Welayat	Irrigated area (ha)
Akhal	499 130
Balkan	65 627
Dashkhovuz	409 861
Lebap	290 836
Mary	478 647
Turkmenistan total	1 744 100

TABLE A71
Irrigated area per emirate in the United Arab Emirates

Emirate	Irrigated area (ha)
Abu Dhabi	230 187
Ajman	2 078
Fujeira	6 071
Dubai	8 059
Ras Al Khaima	16 106
Sharjah	16 468
Umm Al Qiwayn	1 371
United Arab Emirates total	280 341

TABLE A72
Irrigated area per oblast in Uzbekistan

Oblast	Irrigated area (ha)
Andijon	282 000
Bukhara	264 000
Farghona	355 000
Jizzakh	288 000

Oblast	Irrigated area (ha)
Karakalpakstan	502 000
Khorazm	262 000
Namangan	273 000
Nawoiy	122 000
Qashqadaryo	490 000
Samarqand	369 000
Sirdaryo	300 000
Surkhondaryo	315 000
Tashkent Oblast	401 000
Uzbekistan total	4 223 000

TABLE A73
Irrigated area per province in Viet Nam

Province	Irrigated area (ha)
Bac Thai	33 100
Bia Lai Cong Tum	17 700
Bin Tri Tien	60 000
Cao Bang	7 550
Dac Lac	19 350
Dong Nai	13 000
Ha Bac	111 200
Ha Giang	14 850
Ha Nam Ninh	147 500
Ha Noi	55 600
Hai Hung	118 700
Hai Phong	54 400
Ho Chi Minh	23 000
Hoa Binh	74 100
Lai Chau	8 700
Lam Dong	8 600
Lang Son	18 000
Lao Cai	20 300
Mekong Delta	1 578 230
Nghe Tinh	143 000
Nghia Binh	47 800
Phu Khanh	53 100
Quang Nam-Da Nang	53 000
Quang Ninh	17 500
Son La	7 820
Song Be	9 800
Tay Ninh	7 500
Thai Binh	87 500
Thanh Hoa	107 600
Thuan Hai	34 200
Vinh Phu	47 300
Viet Nam total	3 000 000

TABLE A74
Irrigated area per governorate in Yemen

Governorate	Irrigated area (ha)
Abyan	8 674
Aden	671
Al Jawf	27 823
Albada	10 657
Amran	38 794
Dhammar	45 185
El Daleh	6 637
El Mahrah	595
Hadramaout	7 694
Haja	20 023
Hodeidah	72 248
Ibb	25 562
Laheg	5 446
Mahwaet	11 846
Mareb	14 693
Saadah	11 591
Sanaa	61 408

Governorate	Irrigated area (ha)
Shabwa	3 986
Taiz	14 466
Yemen total	388 000

Annex B
Figures

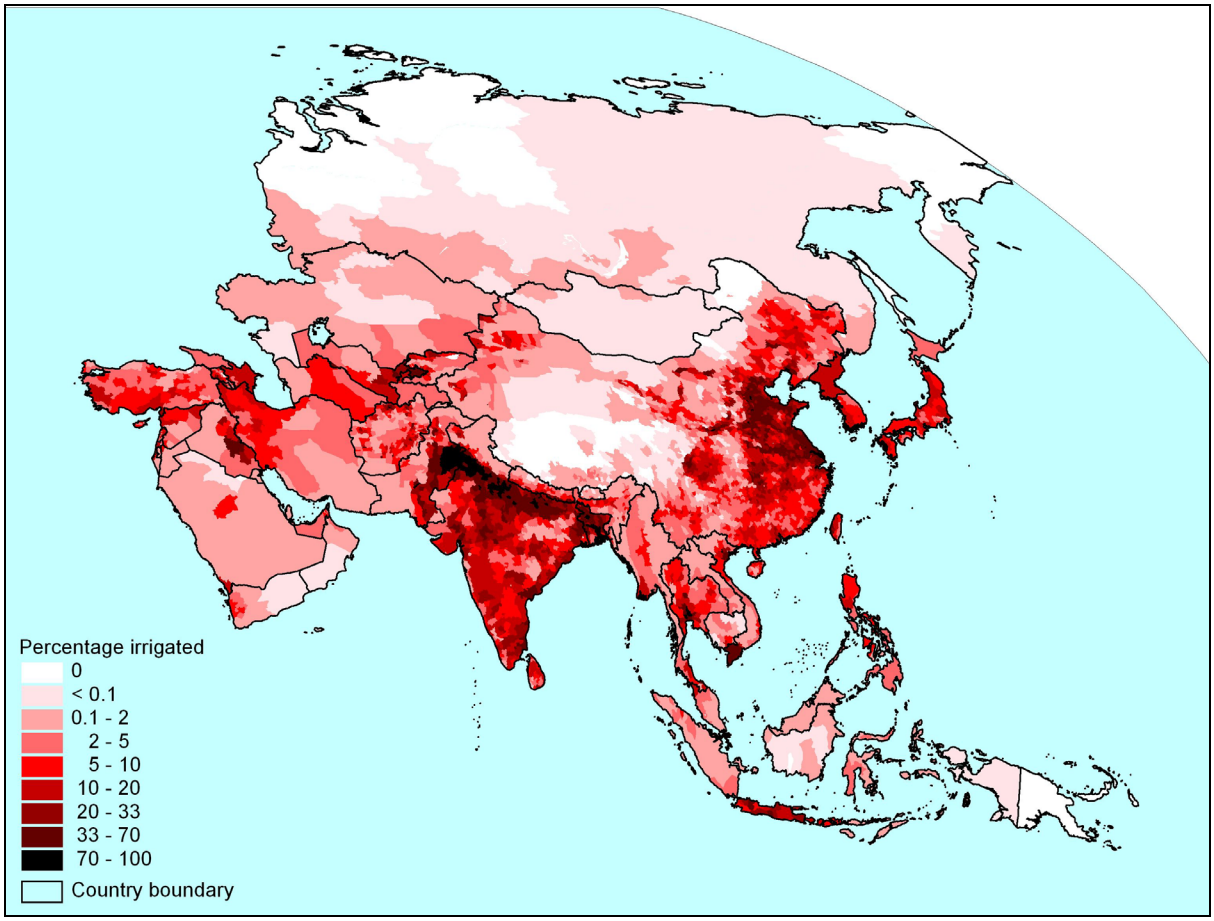

FIGURE B1
Irrigated area in subnational administrative units of Asia as a percentage of the surface area

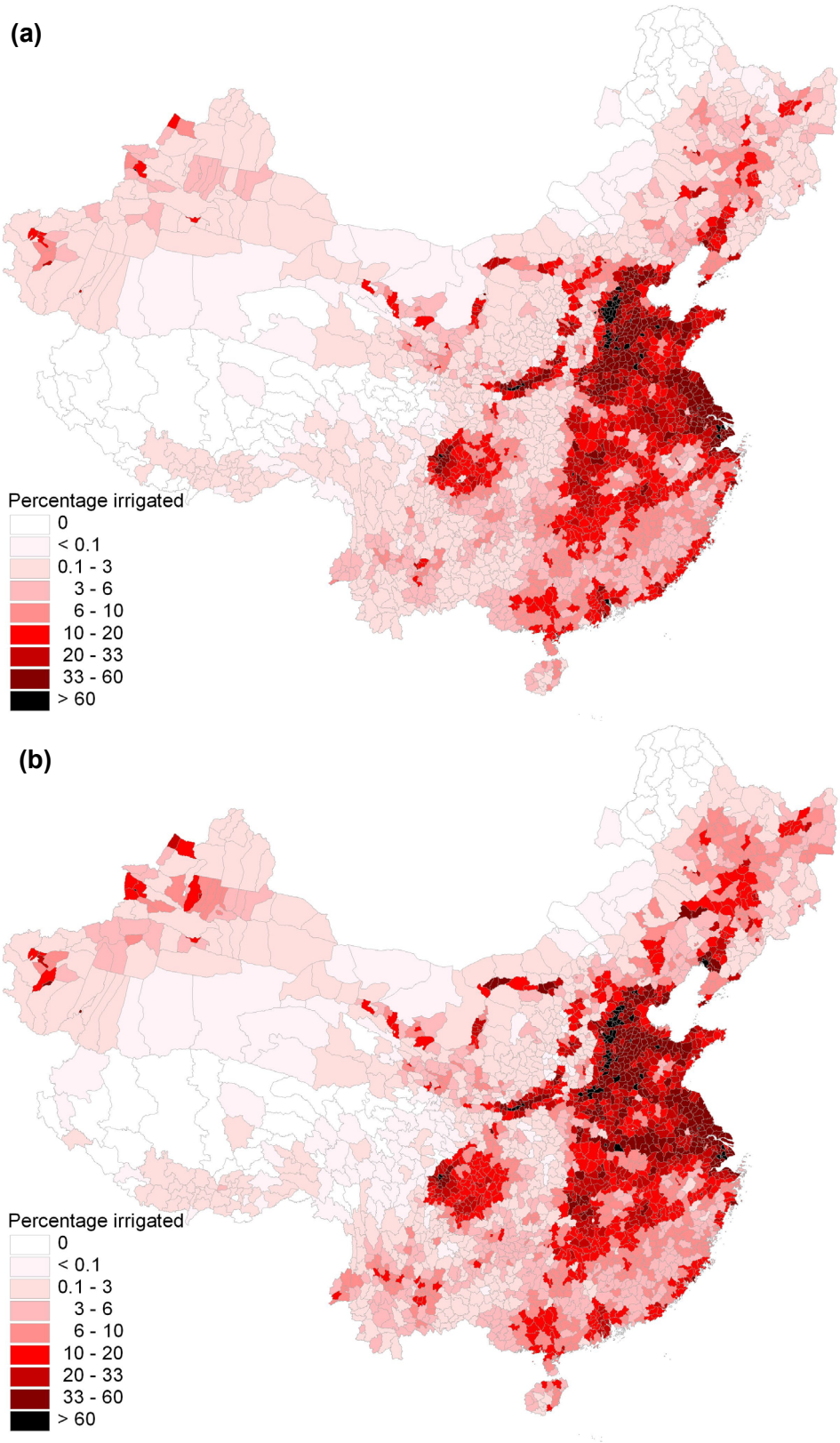

FIGURE B2
Irrigated area in China as a percentage of the county surface area: (a) as reported by Skinner for 1990 [CH04]; and (b) as estimated in this report for 2000

Documentation

Geospatial information used to locate irrigated areas within the subnational units in the Asian part of the Digital Global Map of Irrigated Areas

WORKING REPORT III

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INTRODUCTION

This report describes the digital spatial datasets and printed maps used to locate irrigated areas within the subnational administrative units. Irrigation maps were derived from publications such as project reports, irrigation subsector studies and books related to irrigation and drainage. After on-screen digitizing of the maps, the boundaries of the digitized irrigated areas were compared with satellite images in many regions. The shape and size of the digitized areas were then adjusted where necessary. However, for many subnational units, irrigation maps are not available. This is particularly the case in areas with a low irrigation density dominated by small-scale private schemes. In these cases, additional information was used to find areas were irrigation is probable (e.g. land-use maps that show where the main irrigated crops are growing). By assigning so-called priorities or weights to each digitized area, it was possible to control the distribution of irrigated areas within the subnational units. First, irrigated area was distributed only to areas having the highest priority, then to areas having the second-highest priority and so on. The distribution process was stopped where the sum of the distributed irrigated area was equal to or larger than the irrigated area of the subnational unit as taken from the statistics (see Working Report II). Where the distributed irrigated area was larger than the irrigated area as taken from the statistics (e.g. because the same priority was assigned to several irrigated areas digitized from the same map), the distributed irrigated area was downscaled. Therefore, this methodology, described in more detail in previous reports of the irrigation mapping project (e.g. update for Latin America and Europe), ensures that the sum of irrigated area per subnational unit is exactly as reported in the statistics.

The map resolution during the distribution process was 0.01 degrees. The map was aggregated subsequently to a resolution of 5 minutes (0.0833 degrees) and it is presented in the results section (Working Report IV). The following sections describe the maps and digital datasets used per country in alphabetical order.

Afghanistan

The irrigated areas were derived from land-cover maps, recently produced through the collaborative efforts of FAO, the United Nations Development Programme and the Afghan Geodesy and Cartography Office Kabul [AF01].

Armenia

Twelve major irrigation schemes were digitized from a map as shown in [AM01]. Because these large-scale schemes covered only 16 of the 39 districts, irrigation schemes under construction and potential irrigable areas were digitized from another map [AM02].

Azerbaijan

The irrigated areas were digitized from a map showing irrigation in the Caucasus region [AZ01]. The boundaries of the digitized irrigated areas were then adjusted using recent satellite imagery [AZ02].

Bahrain

The location of irrigated areas was detected using a land-use map [BN01] showing the cultivated areas of the country. The irrigated areas were then digitized in detail from Landsat satellite imagery [BN02].

Bangladesh

The irrigated areas were derived from a map showing irrigation accumulated in dot form [BG01]. Each dot represented 1 000 acres of irrigated area, and this also allowed the separation of areas with high and low irrigation density within the zilas.

Bhutan

The irrigated areas were digitized from a land-use atlas with a scale of 1:250 000 [BT01].

Brunei Darussalam
No map of irrigated areas was available. Therefore, arable land, mainly located in the north of the country, was digitized from satellite imagery [BR01].

Cambodia
Digital maps of irrigated areas (polygon dataset) and irrigation projects (point dataset) were used as compiled by the Mekong River Commission ([CB01]; [CB02]). In general, the point dataset was used for small schemes (fewer than 300 ha) while the polygon dataset was used for large schemes (more than 300 ha). Exceptions had to be made where schemes were available in only one of the two datasets – 278 000 ha of irrigated area were located this way in the country. The remainder of the irrigated area was distributed to paddy areas taken from a digital land-cover map [CB03].

China
The irrigated areas were derived from a land-use atlas published in 1990 (scale: 1:1 000 000). The atlas was available in a printed hardcover version [CH01] and in a digital version [CH02]. The digital version had a lower resolution and consisted of fewer classes than the printed version. Therefore, fields classified as irrigated or as paddy were digitized from the printed atlas version for 754 counties, covering about 67 percent of the country area. The digital version of the map was used for the other counties, which are mainly located in southeast China and usually very small.

It was assumed that all the paddy-fields were irrigated. However, in 287 counties, covering about 9 percent of the country area, the sum of irrigated and paddy areas as derived from the land-use map was smaller than the total irrigated area of the related county. In these cases, the difference from the irrigated area was distributed to rainfed agriculture fields digitized from the land-use map. The total amount of irrigated area distributed to fields classified as rainfed was 1.5 million ha for the entire country.

Cyprus
Eleven government schemes were digitized from a recent inventory [CP01]. In addition, a large number of other irrigated plots were derived from a land-use map produced in 1975 [CP02]. This map also shows irrigated areas outside the current government-controlled area.

Democratic People's Republic of Korea
No map of irrigated areas was available for the Democratic People's Republic of Korea. Therefore, a recent inventory of land form, land cover and crop-use intensity [KN01] was used. The map is based on remote sensing and distinguishes land forms (alluvial land, upland, hilly or steep land, and wetland), land uses (paddy rice, forest, rangeland or pasture, and urban) as well as five different classes of cultivation intensity. It was assumed that the paddy-fields (about 557 000 ha) were completely equipped for irrigation. It was further assumed that the fields assigned to other crops were also equipped for irrigation where they were located in the plains or river valleys with alluvial land (about 637 000 ha). The difference from the total area equipped for irrigation (about 266 000 ha) was distributed to fields cropped with upland crops.

East Timor
No map of irrigated areas in East Timor was available. Instead, paddy areas were derived from a digital land cover map (scale: 1:250 000) available from the FAO–UN Geo Network [ET01]. All records attributed as "irrigated and rainfed paddy land" were selected.

Georgia
The irrigated areas were digitized from an irrigation map published in a recent project report [GG01] and from a map showing irrigated areas in the Caucasus region [GG02]. The boundaries of the digitized areas were adjusted using Landsat satellite imagery [GG03].

India
The irrigated areas were digitized from an irrigation atlas published in 1987 [IN01] and from an irrigation map published in 1994 [IN02]. Both maps show the outlines of the large-scale irrigation schemes of the country and distinguish between existing schemes, schemes under construction and proposed schemes. In addition, the location of minor irrigation schemes is shown in the irrigation atlas in dot-map form, whereby each dot represents 4 000 ha of irrigated area outside the major irrigation schemes. These areas were digitized by enclosing areas closed by dots on the map. The outlines of some irrigation schemes located in the state of Arunachal Pradesh were derived from a Chinese land-use atlas [IN03].

Irrigated areas classified as "existing" and areas classified as "minor irrigation schemes" received the highest priority in the distribution process. Where the irrigated area per district was larger than the digitized existing irrigation schemes, then the irrigated area was also distributed to schemes classified as "under construction". Where the irrigated area on the map was still not sufficient, then the schemes classified as "proposed" were also incorporated. However, in several districts (mainly located in the centre and south of the country), the irrigated area per district as taken from the statistics was still larger than the digitized areas. In these cases, the irrigated area was also distributed to areas classified as "irrigated intensive agriculture" or "irrigated agriculture" in a recent remote-sensing-based land-cover inventory [IN04]. The outlines of the digitized irrigation schemes in the northeast (Arunachal Pradesh, Assam, Meghalaya, Mizoram, Manipur, Nagaland, Sikkim and Tripura) and northwest of India (Jammu and Kashmir, and Himachal Pradesh) were adjusted using satellite imagery [IN05].

Indonesia
No map of irrigated areas in Indonesia was available. Therefore, rice fields were digitized from a land-use map (scale: 1:2 500 000) [ID01]. In some basins, the area of digitized rice fields was smaller than the reported irrigated area. In these cases, areas classified as lowland cultivation and highland cultivation were also incorporated, and wet rice fields were digitized from another land-use map [ID02].

Iraq
The irrigated areas were located using a land-use map published in [IQ01]. The areas were then digitized in more detail from satellite imagery [IQ02] and tactical pilot charts [IQ03].

Islamic Republic of Iran
The irrigated areas in the west of the country were digitized from a land-use map [IR01]. Because the map covers only the west of the country, a large-scale land-use map [IR02] and two large-scale irrigation maps ([IR03]; [IR04]) were used to localize irrigated areas in the east of the country. In addition, satellite imagery [IR05] was used to find small irrigation schemes and to adjust the boundaries of the large schemes.

Israel
The irrigated areas were digitized from two irrigation maps ([IS01]; [IS02]). The outlines of the digitized areas were then adjusted using satellite imagery [IS03]. Some smaller irrigation schemes visible on the satellite images were also digitized and incorporated.

Japan
The irrigated areas were digitized from an irrigation map sent to FAO with the Aquastat country questionnaire [JP01].

Jordan
The irrigated areas were localized using an irrigation map of the Jordan Valley [JO01] and a map showing irrigated areas outside the Jordan Valley [JO02]. The irrigation schemes were then digitized using satellite imagery [JO03].

Kazakhstan
The irrigated areas were localized using a map of irrigation projects [KZ01] and two large-scale maps showing the outlines of the major irrigated areas of the country ([KZ02]; [KZ03]). By using Landsat satellite imagery [KZ04] and a map of irrigation areas in the Aral Sea Basin [KZ05], the outlines of the irrigated areas were then digitized in detail.

Kuwait
The irrigated areas were digitized from Landsat satellite images [KU01]. The digitized areas were in good agreement with areas shown as vegetated in recent governorate and municipality maps [KU02].

Kyrgyzstan
The irrigated areas were localized using a map of irrigation projects [KY01] and then digitized using satellite imagery [KY02] and a map of irrigated areas [KY03].

Lao People's Democratic Republic
Digital maps of irrigated areas (polygon dataset) and irrigation projects (point dataset) were used as compiled by the Mekong River Commission ([LA01]; [LA02]). In general, the point dataset was used for small schemes (fewer than 300 ha) while the polygon dataset was used for large schemes (more than 300 ha) – 265 000 ha of irrigated area was be located in this way. The remaining part of the irrigated area was distributed to paddy areas taken from a digital land-cover map [LA03].

Lebanon
The irrigated areas were digitized from a land-use map [LE01] and from satellite imagery [LE02].

Malaysia
The boundaries of nine large, government irrigation schemes, designated as granary schemes and totalling 196 284 ha, were digitized from maps provided by the Department of Irrigation and Drainage [ML01]. The remaining part of the irrigated area was assigned to a large number of small-scale irrigation schemes as digitized from another irrigation map [ML02].

Mongolia
The location of 156 sprinkler-irrigation schemes was derived from a recent inventory [MG01]. The total area equipped for irrigation in these schemes was reported as being 43 381 ha. Geographical coordinates of the schemes were missing in the inventory. However, the name of the project and the name of the closest village were given. Therefore, the geographical coordinates of the villages were detected by using the Geographical Names Server of the National Geospatial-Intelligence Agency (available at http://earth-info.nga.mil), and the related irrigated areas were assigned to these locations. However, the location of 13 schemes covering 2 060 ha in total could not be found in this way. In addition, the location of several unregistered schemes covering about 13 900 ha in total was unknown. Therefore, arable land was digitized from satellite imagery [MG02], and the irrigated area of the unregistered schemes as well as the irrigated area of the sprinkler schemes of unknown position was distributed to the digitized fields.

Myanmar
The location of 135 major irrigation works (dams, weirs and tanks) was digitized using three maps showing irrigation works constructed in the periods before independence, between 1969 and 1988, and post-1988 [MY01]. However, many projects are large and the irrigated fields may be located far from the major reservoir or weir belonging to the project. Therefore, irrigation maps ([MY02]; [MY03]; [MY04]) were also used to locate the main irrigation areas of the country. The location of known irrigated areas was in good agreement with the area classified as agricultural land in the GLC2000 land-cover dataset for Southeast Asia ([MY05]). Therefore, this dataset was used to distribute the irrigated areas in regions outside the main

irrigation schemes. Because several irrigation schemes were found in areas classified as "cultivated and managed, not irrigated (mixed)", this land-cover class was also considered as potentially irrigated. About 25 percent of the irrigated area of the subnational units was distributed to this class and about 75 percent to areas classified as "cultivated and managed, irrigated (flooded, rice, shrimp farms)".

Nepal
The irrigated areas were derived from the GLC2000 land-cover dataset for South Asia [NP01]. Areas classified as "irrigated intensive agriculture" or "irrigated agriculture" were in good agreement with irrigated areas as shown on maps published in an irrigation master plan [NP02]. Some additional projects were incorporated based on these maps and satellite imagery [NP03].

Oman
The cultivated area, which is completely irrigated in Oman, was digitized from Landsat satellite imagery [OM01].

Pakistan
The large-scale canal-irrigated area was digitized from a map showing the irrigation infrastructure and the irrigated areas of the country [PK01]. Satellite imagery [PK02] was used to incorporate the small-scale schemes and to adjust the outlines of the digitized canal-irrigated areas.

Palestinian Authority
The irrigated areas were digitized from a land-use map [PL01]. In addition, satellite imagery [PL02] was used to map schemes developed more recently.

Philippines
The irrigated areas were digitized from several irrigation maps ([PH01]; [PH02]; [PH03]; [PH04]). The outlines of the irrigated areas were then adjusted using satellite imagery [PH05].

Qatar
The location of the main irrigation schemes was shown on a land-use map [QT01]. The irrigated areas were digitized in detail from Landsat satellite imagery [QT02], using the land-use map for verification purposes.

Republic of Korea
The outlines of paddy areas were digitized from a land-use map provided by the Perry-Castañeda Library of the University of Texas [KS01]. Because this map dates back to the year 1973, the shape of the single paddy areas was then adjusted using Landsat satellite imagery [KS02].

Russian Federation
The irrigated areas and arable land were derived from a land-use map [RU01] and from an agricultural map [RU02], both provided by the International Institute for Applied Systems Analysis. In the Asian part of Russia, only a few areas are classified as irrigated. Therefore, irrigated areas were also distributed to other agricultural areas using the priorities as documented in Table 1. Irrigated area was first distributed only to cells with a priority of 7, then to cells with a priority of 6, and so on until the sum of the distributed irrigated area was equal to the irrigated area of the specific oblast as derived from the statistics.

TABLE 1
Priorities assigned to specific land uses to distribute irrigated areas within oblasts in the Asian part of Russia

Dataset	Attribute information	Priority
RU01	Irrigated cropland	7
RU01	Irrigated cropland (more than 50%) combined with multiyear plantation	7
RU01	Irrigated meadows	7

Dataset	Attribute information	Priority
RU01	Irrigated multiyear plantation	7
RU01	Irrigated multiyear plantation (more than 50%) combined with irrigated cropland	7
RU01	Cropland	6
RU01	Cropland (more than 50%) combined with forest	6
RU01	Cropland (more than 50%) combined with improved forage land, forest and bushes	6
RU01	Cropland (more than 50%) combined with multiyear plantation	6
RU01	Cropland (more than 50%) combined with natural and improved forage land	6
RU01	Cropland (more than 50%) combined with natural forage land	6
RU01	Cropland (more than 50%) combined with natural forage land and forest	6
RU01	Desert and semi-desert combined with cropland (up to 20%)	6
RU01	Improved forage land combined with cropland (up to 20%)	6
RU01	Multiyear plantation	6
RU01	Multiyear plantation (more than 50%) combined with cropland	6
RU01	Forest combined with cropland (up to 20%) and natural meadow forage land	5
RU01	Forest combined with natural forage land and cropland (up to 20%)	5
RU01	Meadow and meadow-steppe combined with cropland (up to 30%) and forest	5
RU01	Meadow and meadow-steppe combined with cropland (up to 30%), forest and bogs	5
RU01	Meadow and meadow-steppe combined with cropland (up to 30%), forest and solonchaks	5
RU01	Meadows combined with improved meadows, forest and cropland (up to 30%)	5
RU01	Natural forest forage land combined with cropland (up to 20%)	5
RU01	Natural meadow forage land combined with cropland (up to 20%) and forest	5
RU01	Park forest and bushes combined with cropland (up to 20%)	5
RU01	Park forest and bushes combined with cropland (up to 20%) and bogs	5
RU01	Sparse forest and open woodland combined with cropland (up to 20%)	5
RU01	Steppe combined with cropland (up to 20%)	5
RU02	Little used in agriculture	4

Saudi Arabia

The irrigated areas were digitized using Landsat satellite imagery [SA01], MODIS Vegetation Indices [SA02] and several large-scale irrigation maps ([SA03]; [SA04]; [SA05]). The approximate position and extent of the major irrigation schemes was detected based on the large-scale maps, and their more precise extent was derived by digitizing vegetated areas from the satellite imagery.

Sri Lanka

The locations of 308 major irrigation schemes (more than 40 ha) and 12 lift-irrigation schemes covering 246 700 ha in total were digitized from an irrigation map [SL01]. The rest of the irrigated area was assigned to paddy areas as digitized from a land-use map [SL02], from another map with a higher resolution but dating from 1972 [SL03], and from a map that was part of the 1976 Water Resources Development Plan [SL04].

Syrian Arab Republic

The irrigated areas were digitized from an irrigation map covering the west of the country [SY01] and from two land-use maps ([SY02]; [SY03]). In addition, satellite imagery [SY04] was used to locate recently developed schemes and to adjust the outlines of the digitized polygons.

Taiwan Province of China

Plain irrigated areas and paddy areas were digitized from a land-use atlas (scale: 1:1 000 000) [TW01]. For the island of Penghu, satellite imagery [TW02] was used in order to locate arable land.

Tajikistan

The irrigated areas were digitized from a map showing irrigated areas in the Aral Sea Basin [TJ01]. The shape of the boundaries of the irrigated areas was then adjusted using satellite imagery [TJ02].

Thailand

Digital maps of irrigated areas (polygon dataset) and irrigation projects (point dataset) were used as compiled by the Mekong River Commission ([TH01]; [TH02]). However, these inventories covered only the part of the country that belongs to the Mekong river watershed. In the other part of the country two similar datasets provided by the remote sensing department of FAO were used ([TH03]; [TH04]). In general, the point dataset was used for small schemes (fewer than 1 000 ha) while the polygon dataset was used for large schemes (more than 1 000 ha). Exceptions had to be made in cases where schemes were available only in the polygon dataset or only in the point dataset. In addition, irrigated area was assigned to agricultural land as taken from a digital land-cover map [TH05] using the priorities documented in Table 2.

TABLE 2
Priorities assigned to specific land uses to distribute irrigated areas within the provinces of Thailand

Attribute information	Priority
Broadcasted paddy-field	5
Paddy-field	5
Paddy-field 50%; broadcasted paddy-field 50%	5
Paddy-field 70%; broadcasted paddy-field 30%	5
Transplanted paddy-field	5
Broadcasted paddy-field 70%; bush and shrubs 30%	4
Coconut 50%; transplanted paddy-field 50%	4
Coconut 70%; paddy-field 30%	4
Coconut 70%; transplanted paddy-field 30%	4
Corn 70%; paddy-field 30%	4
Field crops 70%; paddy-field 30%	4
Mixed field crops 50%; paddy-field 50%	4
Mixed field crops 70%; paddy-field 30%	4
Mixed orchards 50%; transplanted paddy-field 50%	4
Mixed orchards 70%; transplanted paddy-field 30%	4
Mixed orchards 70%; paddy-field 30%	4
Mixed perennial crops 70%; broadcasted paddy-field 30%	4
Mixed perennial crops 70%; paddy-field 30%	4
Paddy-field 50%; bush and shrubs 50%	4
Paddy-field 50%; corn 50%	4
Paddy-field 50%; deciduous forest 50%	4
Paddy-field 50%; evergreen forest 50%	4
Paddy-field 50%; field crops 50%	4
Paddy-field 50%; mixed orchards 50%	4
Paddy-field 50%; para rubber 50%	4
Paddy-field 50%; perennial crops 50%	4
Paddy-field 50%; swidden cultivation 50%	4
Paddy-field 70%; bush and shrubs 30%	4
Paddy-field 70%; corn 30%	4
Paddy-field 70%; deciduous forest 30%	4
Paddy-field 70%; evergreen forest 30%	4

Attribute information	Priority
Paddy-field 70%; field crops 30%	4
Paddy-field 70%; mixed field crops 30%	4
Paddy-field 70%; mixed orchards 30%	4
Paddy-field 70%; mixed perennial crops 30%	4
Paddy-field 70%; sugar cane 30%	4
Paddy-field 70%; swidden cultivation 30%	4
Paddy-field 70%; disturbed deciduous forest 30%	4
Sugar cane 50%; paddy-field 50%	4
Transplanted paddy-field 50%; bush and shrubs 50%	4
Transplanted paddy-field 50%; para rubber 50%	4
Transplanted paddy-field 50%; wetland 50%	4
Transplanted paddy-field 70%; bush and shrubs 30%	4
Transplanted paddy-field 70%; coconut 30%	4
Transplanted paddy-field 70%; mixed field crops 30%	4
Transplanted paddy-field 70%; mixed orchards 30%	4
Transplanted paddy-field 70%; para rubber 30%	4
Village 70%; paddy-field 30%	4
Bush and shrubs 50%; paddy-field 50%	3
Bush and shrubs 70%; paddy-field 30%	3
Bush and shrubs 70%; transplanted paddy-field 30%	3
Deciduous forest 70%; paddy-field 30%	3
Disturbed deciduous forest 50%; paddy-field 50%	3
Disturbed deciduous forest 70%; paddy-field 30%	3
Disturbed evergreen forest 70%; paddy-field 30%	3
Disturbed tropical rain forest 70%; transplanted paddy-field	3
Marsh 50%; paddy-field 50%	3
Marsh 70%; paddy-field 30%	3
Para rubber 50%; transplanted paddy-field 50%	3
Para rubber 70%; transplanted paddy-field 30%	3
Swidden cultivation 70%; paddy-field 30%	3
Wetland 70%; transplanted paddy-field 30%	3
Beans and Peas 70%; sugar cane 30%	2
Cassava	2
Cassava 50%; coconut 50%	2
Cassava 50%; mixed orchards 50%	2
Cassava 50%; pineapple 50%	2
Cassava 70%; corn 30%	2
Cassava 70%; sugar cane 30%	2
Coconut	2
Coconut 50%; mixed orchards 50%	2
Coconut 50%; para rubber 50%	2
Coconut 70%; corn 30%	2
Coconut 70%; mixed field crops 30%	2
Coconut 70%; mixed orchards 30%	2
Coconut 70%; para rubber 30%	2
Coffee	2
Coffee 50%; para rubber 50%	2
Corn	2
Corn 50%; cassava 50%	2

Attribute information	Priority
Corn 50%; mixed orchards 50%	2
Corn 50%; sugar cane 50%	2
Corn 70%; beans and peas 30%	2
Corn 70%; cassava 30%	2
Corn 70%; mixed field crops 30%	2
Corn 70%; mixed orchards 30%	2
Corn 70%; sugar cane 30%	2
Field crops	2
Field crops 50%; orchard 50%	2
Field crops 50%; perennial crops 50%	2
Field crops 70%; orchard 30%	2
Mixed field crops	2
Mixed field crops 50%; mixed orchards 50%	2
Mixed field crops 70%; coconut 30%	2
Mixed field crops 70%; mixed horticulture 30%	2
Mixed field crops 70%; mixed orchards 30%	2
Mixed orchards 50%; coconut 50%	2
Mixed orchards 50%; mixed field crops 50%	2
Mixed orchards 50%; para rubber 50%	2
Mixed orchards 70%; coconut 30%	2
Mixed orchards 70%; corn 30%	2
Mixed orchards 70%; mixed field crops 30%	2
Mixed orchards 70%; para rubber 30%	2
Mixed orchards 70%; mixed horticulture 30%	2
Mixed perennial crops	2
Mixed perennial crops 50%; mixed field crops 50%	2
Mixed perennial crops 50%; mixed orchards 50%	2
Mixed perennial crops 70%; coconut 30%	2
Mixed perennial crops 70%; mixed orchards 30%	2
Perennial crops	2
Sugar cane	2
Sugar cane 50%; cassava 50%	2
Sugar cane 50%; corn 50%	2
Sugar cane 50%; mixed orchards 50%	2
Sugar cane 70%; cassava 30%	2
Sugar cane 70%; corn 30%	2
Sugar cane 70%; mixed horticulture 30%	2
Sugar cane 70%; mixed orchards 30%	2
Sugar cane 70%; pineapple 30%	2

Turkey

The irrigated areas were digitized from a land-use map [TK01] and from a map showing the actual development status of the Southeastern Anatolia Project in the southeast of the country [TK02]. In addition, satellite imagery [TK03] was used to locate irrigated areas developed after the publishing date of the maps in [TK01].

Turkmenistan

The irrigated areas were digitized from a map showing irrigated areas in the Aral Sea Basin [TM01]. The shape of the boundaries of the irrigated areas was then adjusted using satellite

imagery [TM02]. The location of the digitized irrigated areas was in good agreement with a map showing the irrigation infrastructure of the country [TM03].

United Arab Emirates
The cultivated area of the country, which is completely irrigated, was digitized from Landsat satellite imagery [UE01]. The digitized areas were in good agreement with areas classified as "agricultural areas and plantations" in a recently published atlas [UE02].

Uzbekistan
The irrigated areas were digitized from a map showing irrigated areas in the Aral Sea Basin [UZ01]. The shape of the boundaries of the irrigated areas was then adjusted using satellite imagery [UZ02].

Viet Nam
Digital maps of irrigated areas (polygon dataset) and irrigation projects (point dataset) were used as compiled by the Mekong River Commission ([VN01]; [VN02]). However, these inventories covered only the part of the country that belongs to the Mekong River watershed. In the other part of the country, irrigated area was distributed according to the GLC2000 land-cover map to areas classified as "cultivated and managed, irrigated (flooded, rice, shrimp farms)". These areas fitted well with areas indicated as irrigated by a large-scale irrigation map ([VN03]) and maps showing the irrigation infrastructure of the country ([VN04]).

Yemen
The irrigated areas were digitized using Landsat satellite imagery [YE01], MODIS Vegetation Indices [YE02] and several large-scale irrigation maps ([YE03]; [YE04]; [YE05]). The approximate position and extent of the major irrigation schemes was detected based on the large-scale maps, and their more precise extent was derived by digitizing vegetated areas from the satellite imagery.

REFERENCES

[AF01] **Afghanistan Information Management Service (AIMS) & FAO.** 2003. *Land cover of Afghanistan (1993)* (available at http://www.fao.org and at http://www.aims.org.af).

[AM01] **Republic of Armenia.** 1993. *Irrigation sub-sector review and project identification.* Report to FAO. Report No. 79/93 CP – ARM2.

[AM02] **Republic of Armenia.** 1993. *Irrigation sub-sector review and project identification.* Report to FAO. Report no. 79/93 CP – ARM2.

[AZ01] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 36. Stuttgart, Germany, Ulmer.

[AZ02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-300, 071-301, 071-312 and 071-313. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080/esdi/index.jsp).

[BG01] **Department of Agricultural Extension.** 1995. *1993–94 census of minor irrigation in Bangladesh, main report: national and regional summaries*, p. 16. Dhaka.

[BN01] **Statistisches Bundesamt.** 1991. *Länderbericht Bahrain 1991*. Wiesbaden, Germany.

[BN02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tile 071-310. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).

[BR01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-444 and 071-445. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).

[BT01] **Ministry of Agriculture.** 1997. *Atlas of Bhutan 1:250,000, land cover & area statistics of 20 Dzongkhags*. Thimphu, Land Use Planning Project.

[CB01] **Mekong River Commission Secretariat.** 2003. *People and the Environment Atlas of the Lower Mekong Basin.* CD–ROM, dataset b-irrarea01. Phnom Penh.

[CB02] **Mekong River Commission Secretariat.** 2003. *People and the Environment Atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrproj01. Phnom Penh.

[CB03] **FAO.** 2004. Dataset Landuse2000.zip provided by FAO ASIACOVER project (http://www.fao.org).

[CH01] **Wu, C. ed.** 1990. *Land-use map of China (1:1,000 000 scale)*. Beijing, Science Press.

[CH02] **Chinese Academy of Sciences.** 1994. *Digital land-cover map of China*. Beijing, Institute of Remote Sensing Applications

[CP01] **Savvides, L., Dörflinger, G. & Alexandrou, K.** 2001. *Reassessment of the island's water resources and demand – the assessment of water demand of Cyprus*, Figure 7. Nicosia, Ministry of Agriculture, Natural Resources and Environment, FAO.

[CP02] **Savvides, L.** 1975. *Land use map of Cyprus 1:250,000*. Nicosia.

[ET01] **Australian Local Government Information Service.** 2001. *Land cover of East Timor*. Digital map from FAO–UN GeoNetwork (available at http://www.fao.org).

[GG01] **World Bank.** 2001. *Irrigation and Drainage Community Development Project*. Project appraisal document. Report No. 22042-GE (available at http://www.worldbank.org).

[GG02] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 36. Stuttgart, Germany, Ulmer.

[GG03] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-289 and 071-301. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).

[ID01] **Republic of Indonesia, Land Resources Department.** 1990. *Map 10 – Land use and 1982 forest classification* (also available in the FAO–AGL library).

[ID02] **Unknown.** *Land use Java 1:1,000,000* (available in the FAO–AGL library).

[IN01] **Dutt, G.K. & Kundu, A.K., eds.** 1987. *Irrigation atlas of India*. Revised edition. Calcutta, India, National Atlas and Thematic Mapping Organisation, Department of Science and Technology.

[IN02] **Central Board of Irrigation and Power.** 1994. *Irrigation map of India 1994*. New Delhi.

[IN03] **Wu, C., ed.** 1990. *Land-use map of China (1:1,000 000 scale)*. Beijing, Science Press.

[IN04] **Roy, P.S., Agrawal, S., Joshi, P. & Shukla, Y.** 2003. *The land cover map for Southern Asia for the year 2000*. Version 3, GLC2000 database. European Commission Joint Research Centre (available at http://www.gvm.jrc.it/glc2000).

[IN05] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-354, 071-355, 071-359, 071-382, 071-390, 071-391, 071-393, 071-394 and 071-410. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).

[IQ01] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, plate AX4. Wiesbaden, Germany, Reichert.
[IQ02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-287, 071-288, 071-298, 071-299, 071-300, 071-310 and 071-311. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[IQ03] **Humanitarian Information Centre for Iraq.** 2004. *Tactical pilotage charts at the 1:500.000* (available at http://www.hiciraq.org).
[IR01] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, plate AX3. Wiesbaden, Germany, Reichert.
[IR02] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, plate AX1. Wiesbaden, Germany, Reichert.
[IR03] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 47. Stuttgart, Germany, Ulmer.
[IR04] **United States Agency for International Development.** 1993. *Water resources action plan for the Near East*, Figure 3. Washington, DC.
[IR05] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-298, 071-299, 071-300, 071-310, 071-311, 071-312, 071-320, 071-321, 071-322, 071-332, 071-333 and 071-334. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[IS01] **Eichenauer, H.** 1993. Die Bewässerungsgebiete Israels, Anmerkungen zu einer Karte 1:1 Million. *In* H. Popp & K. Rother, eds. *Die Bewässerungsgebiete im Mittelmeerraum*, pp. 135–141. Passau, Germany, Passavia Universitätsverlag.
[IS02] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, plate AX7. Wiesbaden, Germany, Reichert.
[IS03] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-271 and 071-272. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[JO01] **World Bank.** 1988. *Jordan water resources sector study*. Report No. 7099-JO. Washington, DC, Infrastructure Operations Division.
[JO02] **World Bank.** 1988. *Jordan water resources sector study*. Report No. 7099-JO. Washington, DC, Infrastructure Operations Division.
[JO03] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-271, 071-272, 071-286 and 071-287. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[JP01] **Unknown.** 1997. *Irrigation in Japan*. Map sent to FAO with the AQUASTAT country questionnaire.
[KN01] **United Nations Environment Programme.** 2004. *Land form, land cover and crop use intensity mapping for agriculture rehabilitation and food security in the Democratic People's Republic of Korea*. Sioux Falls, USA, USGS (available at http://grid2.cr.usgs.gov).
[KS01] **Unknown.** 1973. *Korea (South) – vegetation and land utilization* (available at http://www.lib.utexas.edu).
[KS02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-477 and 071-478. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[KU01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-309 and 071-310. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[KU02] **Kuwait Information Office.** 2004. Maps (available at http://www.kuwait-info.com).
[KY01] **World Bank.** 1998. *Kyrgyz Republic – Irrigation Rehabilitation Project*. Project appraisal document. Report No. 17531 KG (available at http://www-wds.worldbank.org).
[KY02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-344, 071-345, 071-360, 071-361 and 071-373. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[KY03] **Unknown.** *Aral Sea Basin 1:2,500 000 – administrative boundaries and irrigated areas*, map available in the FAO–AGL library.
[KZ01] **World Bank.** 1996. *Kazakhstan, irrigation and drainage improvement project*. Staff appraisal report. Report 15379-KZ. Washington, DC.

[KZ02] **UNEP.** 2004. *Environment State of the Aral Sea Basin* (available at http://www.grida.no).
[KZ03] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 36. Stuttgart, Germany, Ulmer.
[KZ04] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-302, 071-313, 071-314, 071-315, 071-323, 071-324, 071-325, 071-336, 071-337, 071-345, 071-346, 071-347, 071-348, 071-361, 071-362, 071-363, 071-364, 071-373, 071-374, 071-375, 071-386 and 071-387. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[KZ05] **Unknown.** *Aral Sea Basin 1:2,500 000 – administrative boundaries and irrigated areas*, map available in the FAO–AGL library.
[LA01] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrarea01. Phnom Penh.
[LA02] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrproj01. Phnom Penh.
[LA03] **FAO.** 2004. Dataset Landcover.zip provided by FAO ASIACOVER project (available at http://www.fao.org).
[LE01] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX6. Reichert, Germany, Wiesbaden.
[LE02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tile 071-272. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[MG01] **FAO.** 1994. *Irrigation rehabilitation project*. Working Paper 1. Rome.
[MG02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-386, 071-387, 071-397, 071-398, 071-399, 071-413, 071-414, 071-415, 071-424, 071-425, 071-426, 071-440, 071-441, 071-442, 071-452, 071-453, 071-454 and 071-469. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[ML01] **Department of Irrigation and Drainage.** 2004. *Granary areas in Malaysia* (available at http://agrolink.moa.my).
[ML02] **Wong, K.F., Shahrin, B.Y. & Adnan, M.N.M.** 1991. Management arrangements for diversifying rice irrigation systems in Malaysia, Figure 1. *In* S.M. Miranda & A.R. Maglinao, eds. *Management arrangements for accommodating non-rice crops rice-based irrigation systems*, pp. 53–66. Proc. first progress review and coordination workshop of the research network on irrigation management for crop diversification in rice based systems, Quezon City, the Philippines, 10–14 December 1990.
[MY01] **Ministry of Agriculture and Irrigation.** 1996. *Irrigation works in Myanmar*. Yangon.
[MY02] **Economic and Social Commission for Asia and the Pacific (ESCAP).** 1995. *Assessment of water resources and water demand by user sectors in Myanmar*, p. 48. New York, United Nations.
[MY03] **Framji, K.K., Garg, B.C. & Luthra, S.D.L.** 1981. *Irrigation and drainage in the world*. Third edition. Vol. I, p. 152. New Delhi, ICID.
[MY04] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 41. Stuttgart, Germany, Ulmer.
[MY05] **Stibig, H.J., Upik, R., Beuchle, R., Hildanus & Mubareka, S.** 2003. *The land cover map for South East Asia in the year 2000*. GLC2000 database. European Commission Joint Research Centre (available at http://www.gvm.jrc.it).
[NP01] **Roy, P.S., Agrawal, S., Joshi, P. & Shukla, Y.** 2003. *The land cover map for Southern Asia for the year 2000*. Version 3. GLC2000 database. European Commission Joint Research Centre (available at http://www.gvm.jrc.it/glc2000).
[NP02] **Ministry of Water and Power.** 1970. *Master plan of irrigation development in Nepal*. Kathmandu.
[NP03] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-370, 071-371 and 071-382. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[OM01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-308, 071-318, 071-319 and 071-320. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[PH01] **Department of Agriculture.** 1991. *Philippine land and soil management atlas for Mindanao*. Quezon City, the Philippines, Bureau of Soils and Water Management.

[PH02] **Framji, K.K., Garg, B.C. & Luthra, S.D.L.** 1981. *Irrigation and drainage in the world*. Third edition. Vol. II, p. 1097. New Delhi, ICID.
[PH03] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 54. Stuttgart, Germany, Ulmer.
[PH04] **World Bank.** 1996. *Philippines – water resources development project*. Staff appraisal report. Report No. 15297-PH. Washington DC.
[PH05] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-445, 071-446, 071-461, 071-462 and 071-463. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[PK01] **Ministry of Water and Power.** 1994. *Irrigation system of Pakistan*. Islamabad, Chief Engineering Adviser's Organisation.
[PK02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-332, 071-333, 071-341, 071-342, 071-343, 071-344, 071-358, 071-359, 071-360 and 071-370. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[PL01] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX7. Reichert, Germany, Wiesbaden.
[PL02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tile 071-272. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[QT01] **CIA.** 1993. *Atlas of the Middle East, Qatar – land use* (available at http://www.lib.utexas.edu).
[QT02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-309 and 071-310. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[RU01] **Stolbovoi, V. & McCallum, I.** 2002. *Land resources of Russia,* map 'Land Use'. Version 1.1. CD–ROM. Laxenburg, Austria, IIASA (available at http://www.iiasa.ac.at).
[RU02] **Stolbovoi, V. & McCallum, I.** 2002. *Land resources of Russia,* map 'Agriculture'. Version 1.1. CD–ROM. Laxenburg, Austria, IIASA (available at http://www.iiasa.ac.at).
[SA01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-271, 071-284, 071-285, 071-286, 071-287, 071-288, 071-296, 071-297, 071-298, 071-299, 071-308, 071-309, 071-310, 071-318 and 071-319. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[SA02] **NASA, Land Processes Distributed Active Archive Center.** 2004. *MOD13Q1: MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V004*. Enhanced Vegetation Indices (EVI) from 9 June 2000 and 17 January 2001 (available at (http://edcimswww.cr.usgs.gov).
[SA03] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX1. Reichert, Germany, Wiesbaden..
[SA04] **United States Agency for International Development.** 1993. *Water Resources Action Plan for the Near East*, Figure 3. Washington, DC.
[SA05] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 39. Stuttgart, Germany, Ulmer.
[SL01] **Survey Department.** 1988. *The national atlas of Sri Lanka*, map 'Irrigation schemes'. Colombo.
[SL02] **Survey Department.** 1988. *The national atlas of Sri Lanka*, map 'Paddy'. Colombo.
[SL03] **Unknown.** 1972. *Sri Lanka – land use, 1:1,000,000*, map available in the library of the Land and Water Development Division of FAO.
[SL04] **Unknown.** 1976. *Sri Lanka – water resources development plan*, map available in the library of the Land and Water Development Division of FAO.
[SY01] **Hopfinger, H.** 1993. Die syrische Bewässerungslandwirtschaft zwischen Staatseinfluß und freier Entfaltung privatwirtschaftlicher Tätigkeit. *In* H. Popp & K. Rother, eds. *Die Bewässerungsgebiete im Mittelmeerraum*, pp. 127–135. Passau, Germany, Passavia Universitätsverlag.
[SY02] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX4. Reichert, Germany, Wiesbaden.
[SY03] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX6. Reichert, Germany, Wiesbaden.

[SY04] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-272, 071-273, 071-287 and 071-288. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[TH01] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrarea01. Phnom Penh.
[TH02] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrproj01. Phnom Penh.
[TH03] **FAO.** 2004. Dataset irr-area provided by FAO ASIACOVER project (http://www.fao.org).
[TH04] **FAO.** 2004. Dataset irr-proj provided by FAO ASIACOVER project (http://www.fao.org).
[TH05] **FAO.** 2004. Dataset landuse provided by FAO ASIACOVER project (http://www.fao.org).
[TJ01] **Unknown.** *Aral Sea Basin 1:2,500 000 – administrative boundaries and irrigated areas*, map available in the FAO–AGL library.
[TJ02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-344, 071-345 and 071-360. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[TK01] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX2. Reichert, Germany, Wiesbaden.
[TK02] **General Directorate of State Hydraulic Works (DSI).** 2004. *GAP Project Development Plan* (available at http://www.dsi.gov.tr).
[TK03] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-261, 071-262, 071-273, 071-274, 071-288, 071-289, 071-300 and 071-301. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[TM01] **Unknown.** *Aral Sea Basin 1:2,500 000 – administrative boundaries and irrigated areas*, map available in the FAO–AGL library.
[TM02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-312, 071-313, 071-322, 071-323, 071-334 and 071-335. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[TM03] **FAO.** 1998. *Turkmenistan – FAO special programme for food security*. Exploratory mission report. Rome.
[TW01] **Wu, C., ed.** 1990. *1:1,000 000 land use map of China*. Beijing.
[TW02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tile 071-464. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[UE01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-309, 071-319 and 071-320. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[UE02] **United Arab Emirates University.** 1993. *The national atlas of the United Arab Emirates*. Al Ain.
[UZ01] **Unknown.** *Aral Sea Basin 1:2,500 000 – administrative boundaries and irrigated areas*, map available in the FAO–AGL library.
[UZ02] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-323, 071-324, 071-334, 071-335, 071-344 and 071-345. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[VN01] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrarea01. Phnom Penh.
[VN02] **Mekong River Commission Secretariat.** 2003. *People and the environment atlas of the Lower Mekong Basin*. CD–ROM, dataset b-irrproj01. Phnom Penh.
[VN03] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 44. Stuttgart, Germany, Ulmer.
[VN04] **World Bank.** 1996. *Vietnam – water resources sector review*. East Asia and Pacific Region, Report No. 15041-V. Agriculture and Environment Division, Country Department I.
[YE01] **Earth Satellite Corporation.** 2004. *Landsat GeoCover (2000/ETM+) Edition Mosaics*, tiles 071-295, 071-296, 071-307, 071-308 and 071-317. Sioux Falls, USA, USGS (available at http://glcfapp.umiacs.umd.edu:8080).
[YE02] **NASA, Land Processes Distributed Active Archive Center.** 2004. *MOD13Q1: MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V004*. Enhanced

Vegetation Indices (EVI) from 9 June 2000 and 17 January 2001 (available at http://edcimswww.cr.usgs.gov).

[YE03] **Universität Tübingen.** 1993. *Tübinger Atlas des Vorderen Orients (TAVO)*, Plate AX1. Reichert, Germany, Wiesbaden.

[YE04] **United States Agency for International Development.** 1993. *Water Resources Action Plan for the Near East*, Figure 3. Washington, DC.

[YE05] **Achtnich, W.** 1980. *Bewässerungslandbau*, p. 39. Stuttgart, Germany, Ulmer.

Documentation

Update of the Digital Global Map of Irrigated Areas in Asia
Results – Maps

WORKING REPORT IV

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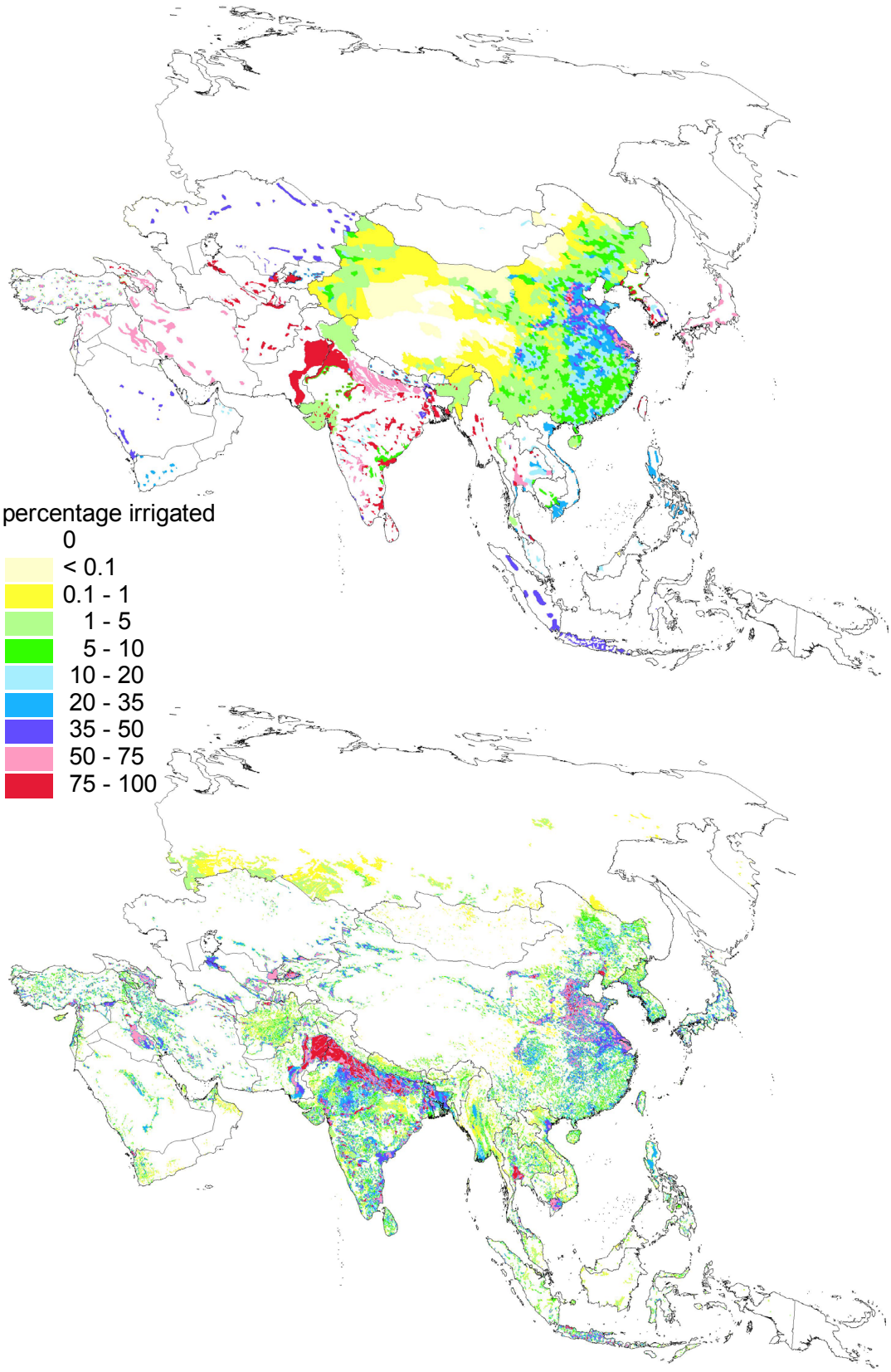
INTRODUCTION

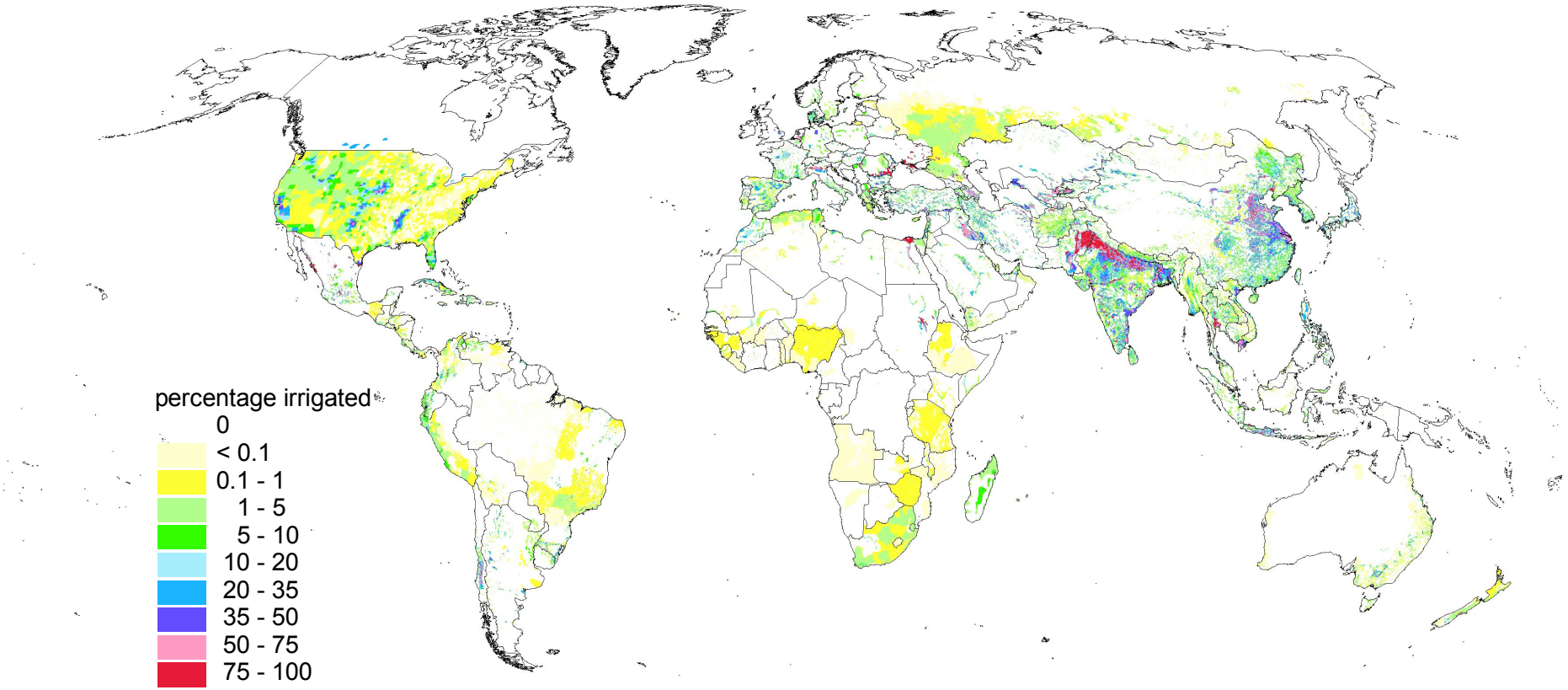
This report presents maps showing the percentage of the surface area equipped for irrigation in the new Version 2.2 of the Digital Global Map of Irrigated Areas. The map resolution is 5 minutes (0.0833 degrees), equivalent to about 9 × 9 km at the equator. Map 1 compares the new map version in the Asian part of the globe with the previous map version. Irrigation is much more widespread in the new map version and the resolution of the irrigation mapping has increased. Map 2 shows the updated global irrigation map, while Maps 3–12 show the irrigation maps for subregions of Asia. The colour scheme used in the maps is based on a paired-colour categorical scheme (as presented at http://geography.uoregon.edu). The colours can better be differentiated by colour-deficient and colour-blind users.

List of maps

Map no.	Map description
1	Percentage of surface area equipped for irrigation, Versions 2.1 and 2.2
2	Digital Global Map of Irrigated Areas showing percentage of surface area equipped for irrigation, Version 2.2
3	Position and extent of Maps 4–12 relative to the entire Asian continent
4	Percentage of surface area equipped for irrigation, East Asia (Bangladesh, Bhutan, China, Democratic People's Republic of Korea, Mongolia, Nepal, Republic of Korea, and Taiwan Province of China)
5	Percentage of surface area equipped for irrigation, South Asia (Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan)
6	Percentage of surface area equipped for irrigation, Russian Federation
7	Percentage of surface area equipped for irrigation, Southeast Asia (Brunei Darussalam, Cambodia, Lao People's Democratic Republic, Myanmar, Philippines, Thailand, Taiwan Province of China, and Viet Nam)
8	Percentage of surface area equipped for irrigation, Southeast Asia (Brunei Darussalam, East Timor, Indonesia and Malaysia)
9	Percentage of surface area equipped for irrigation, East Asia (Democratic People's Republic of Korea, Japan and Republic of Korea)
10	Percentage of surface area equipped for irrigation, Arabian Peninsula (Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen)
11	Percentage of surface area equipped for irrigation, Mediterranean and Mesopotamia (Cyprus, Iraq, Israel, Jordan, Lebanon, Palestinian Authority, Syrian Arab Republic, and Turkey)
12	Percentage of surface area equipped for irrigation, Near East and Central Asia (Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan)

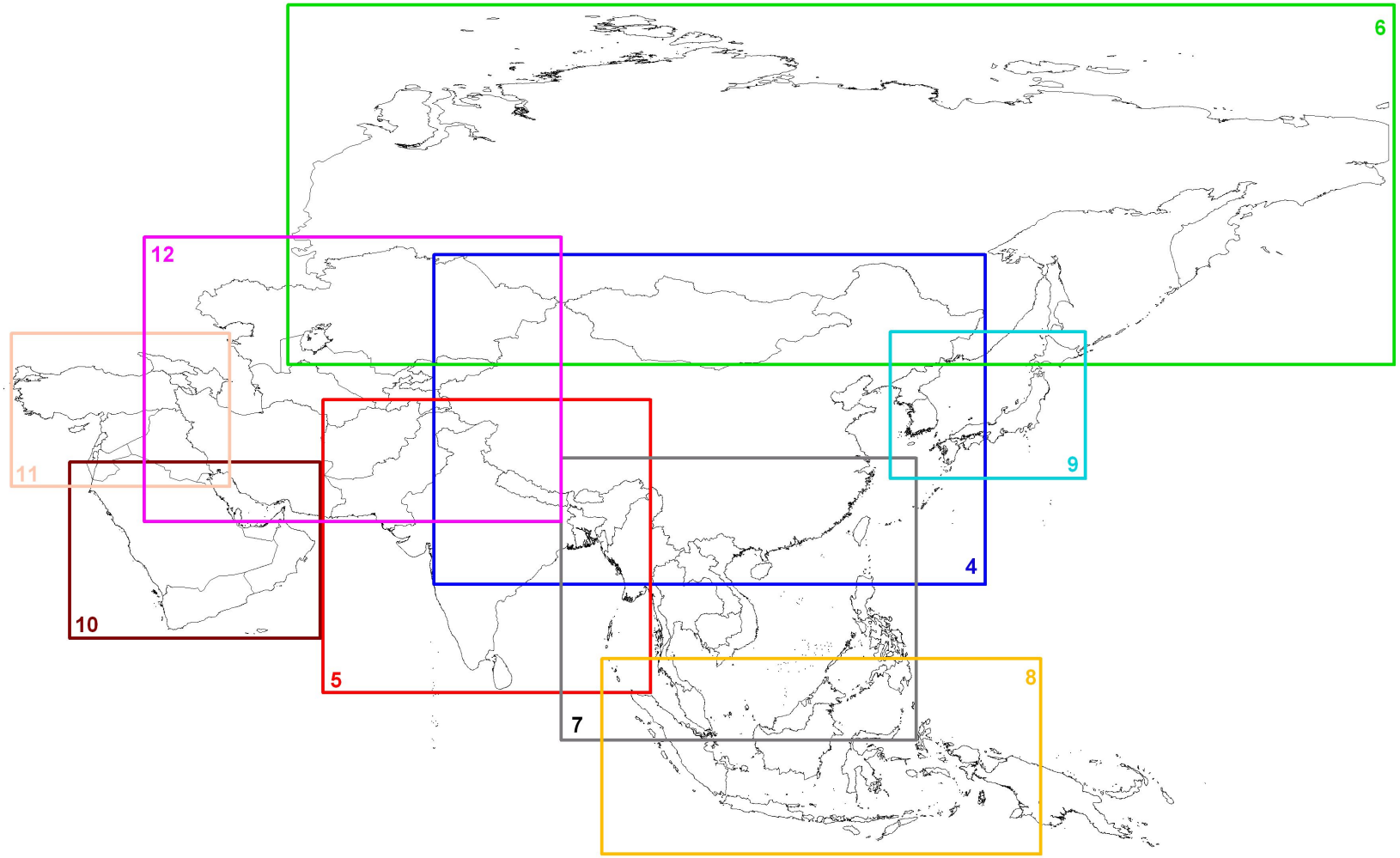


MAP 1
Percentage of surface area equipped for irrigation: (a) Asia – Version 2.1; and (b) Asia – Version 2.2

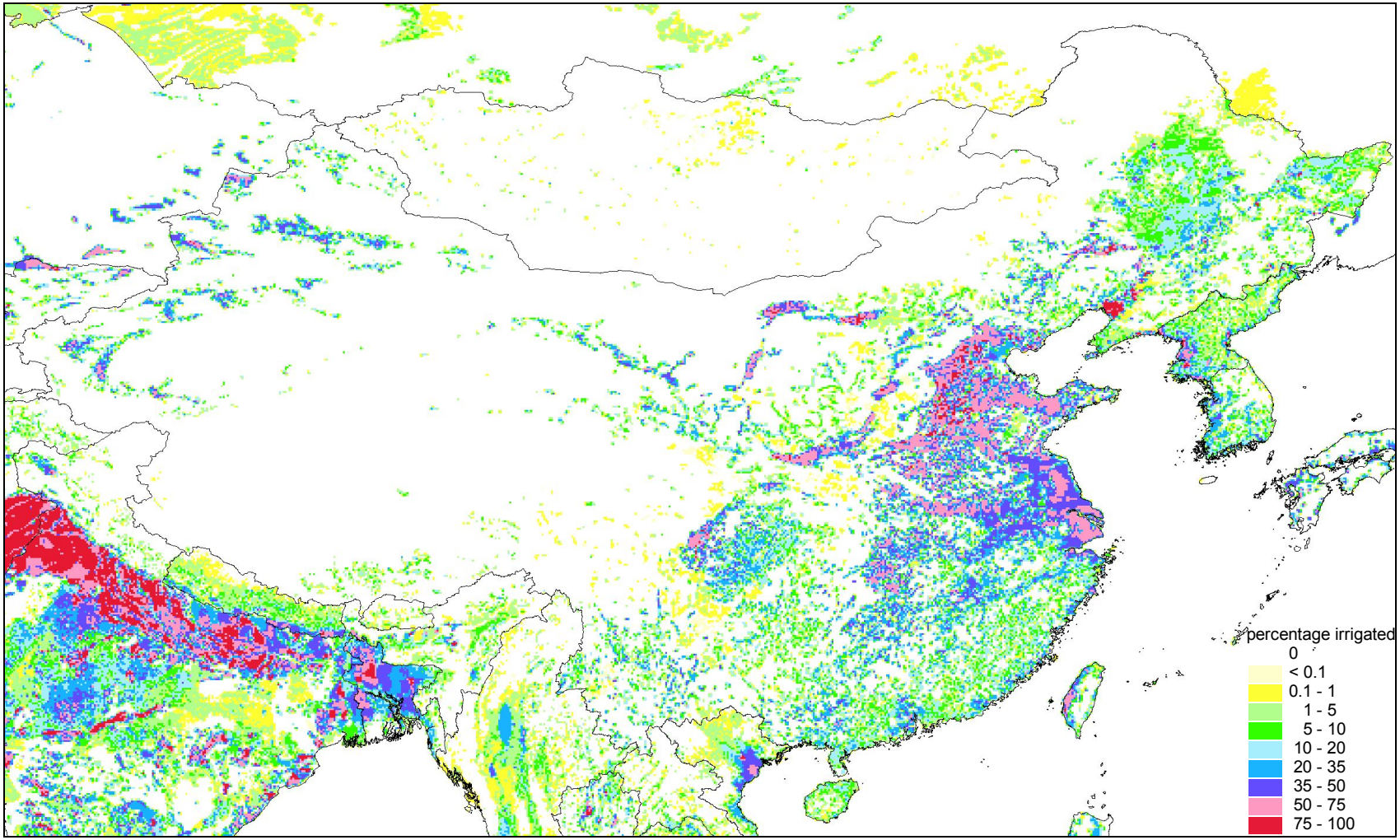


MAP 2

Digital Global Map of Irrigated Areas showing percentage of surface area equipped for irrigation, Version 2.2 (January 2005)

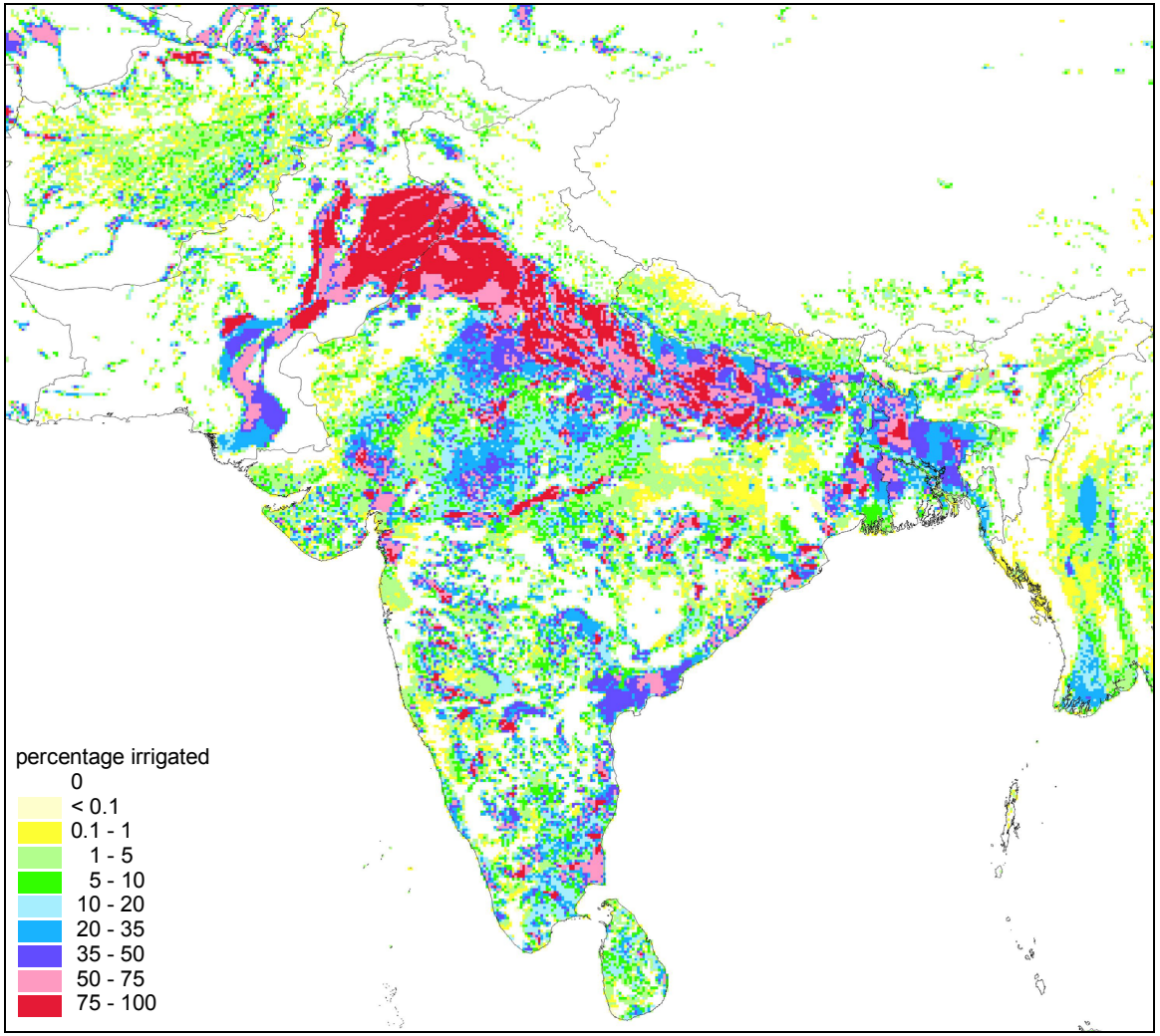


MAP 3
Position and extent of Maps 4–12 relative to the entire Asian continent

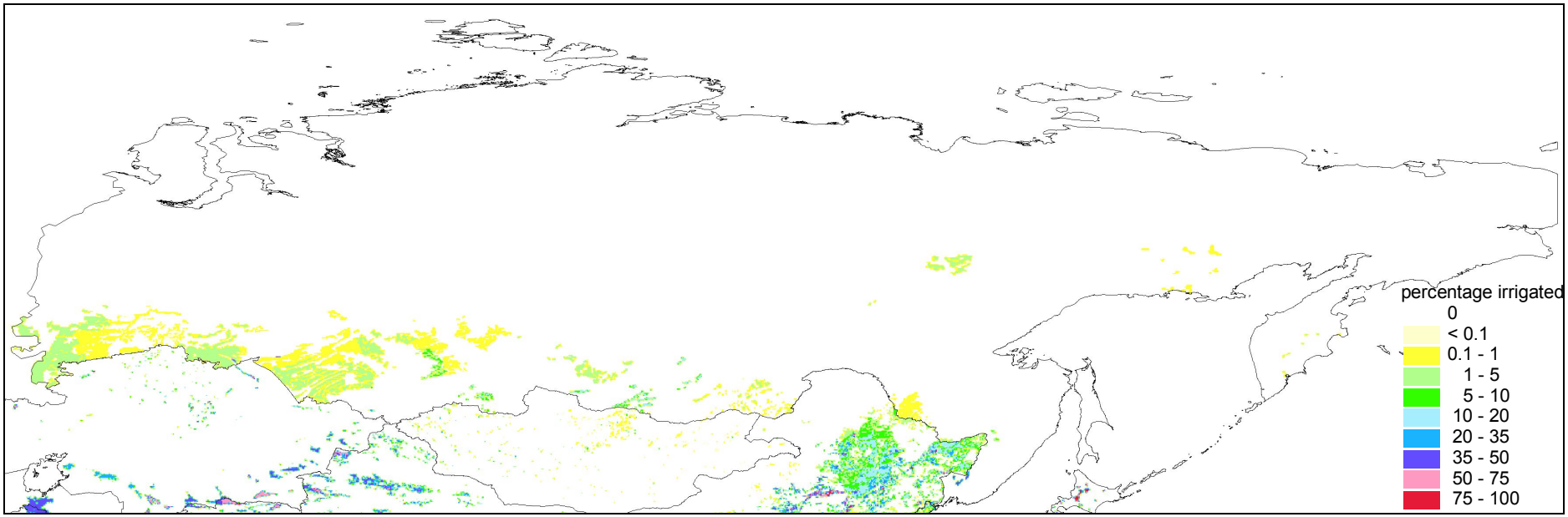


MAP 4

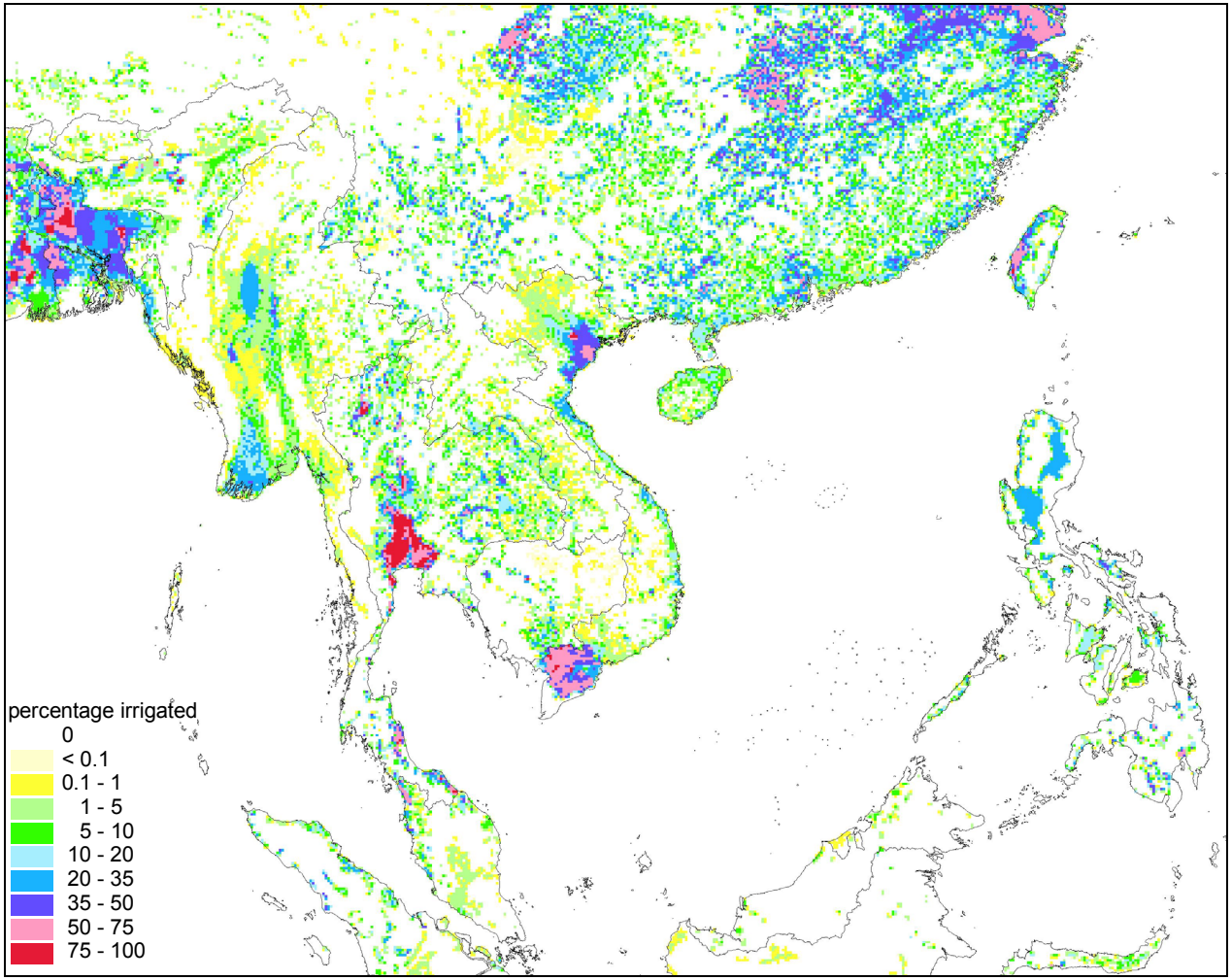
Percentage of surface area equipped for irrigation, East Asia (Bangladesh, Bhutan, China, Democratic People's Republic of Korea, Mongolia, Nepal, Republic of Korea, and Taiwan Province of China)



MAP 5
Percentage of surface area equipped for irrigation, South Asia (Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan)

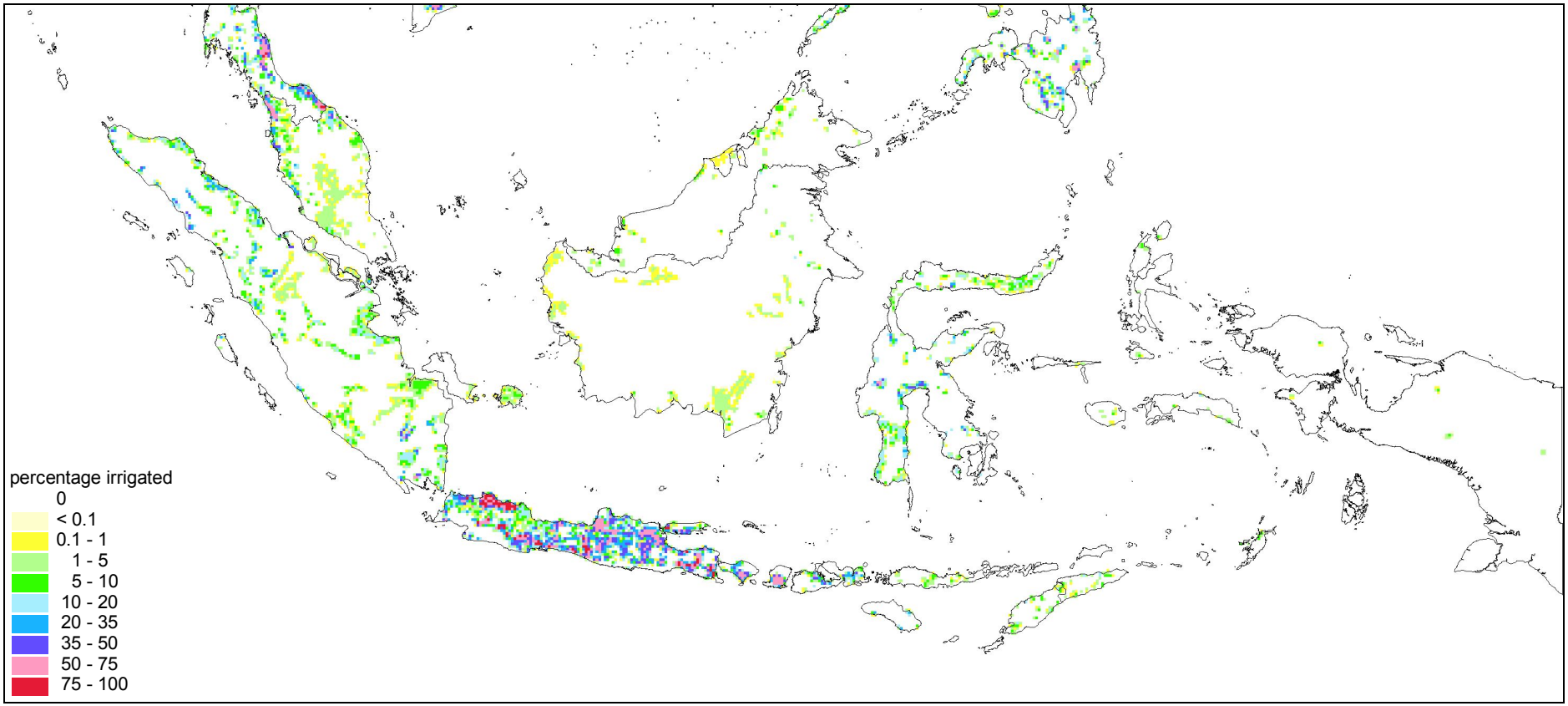


MAP 6
Percentage of surface area equipped for irrigation, Russian Federation



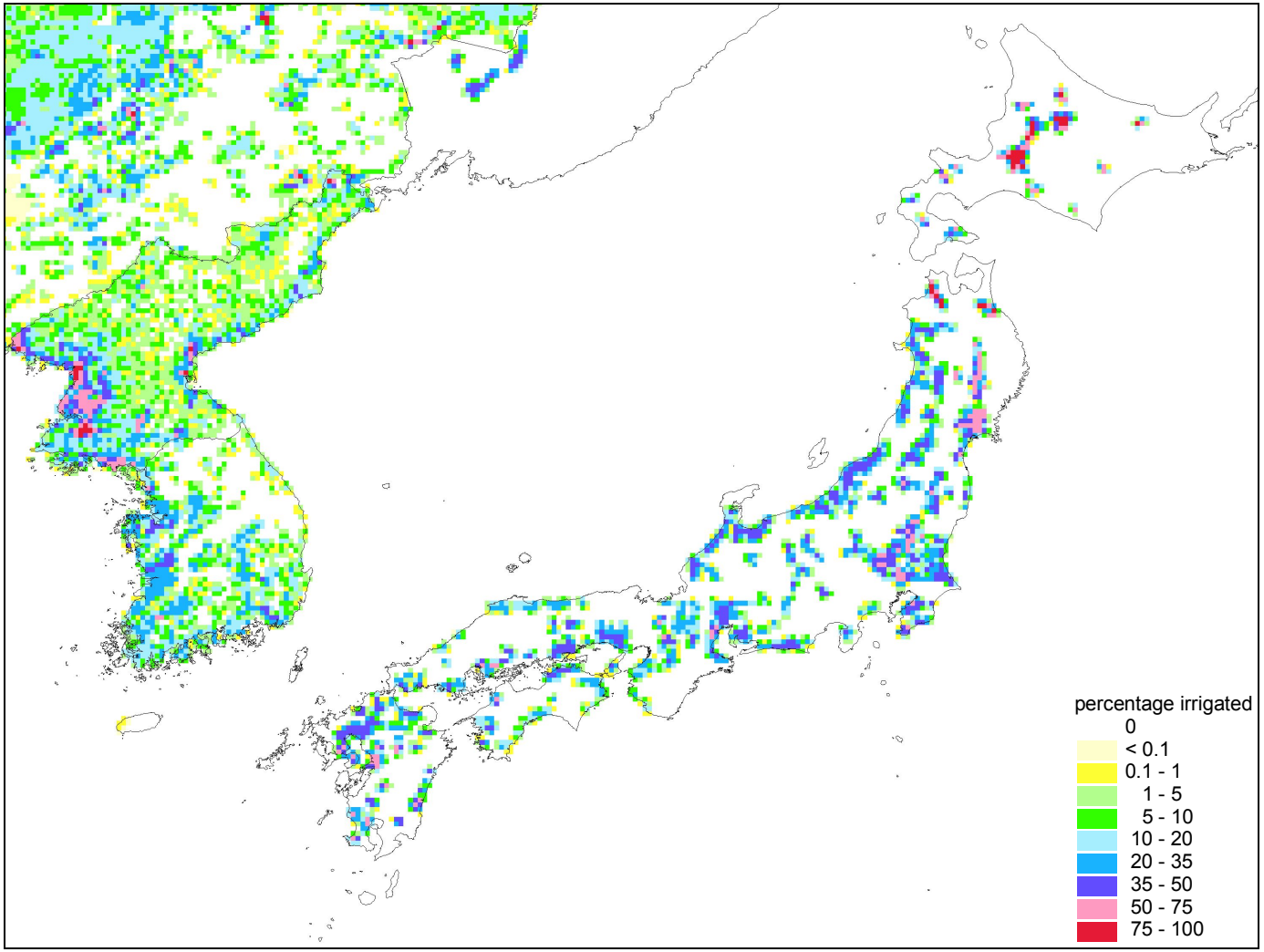
MAP 7

Percentage of surface area equipped for irrigation, Southeast Asia (Brunei Darussalam, Cambodia, Lao People's Democratic Republic, Myanmar, Philippines, Thailand, Taiwan Province of China, and Viet Nam)

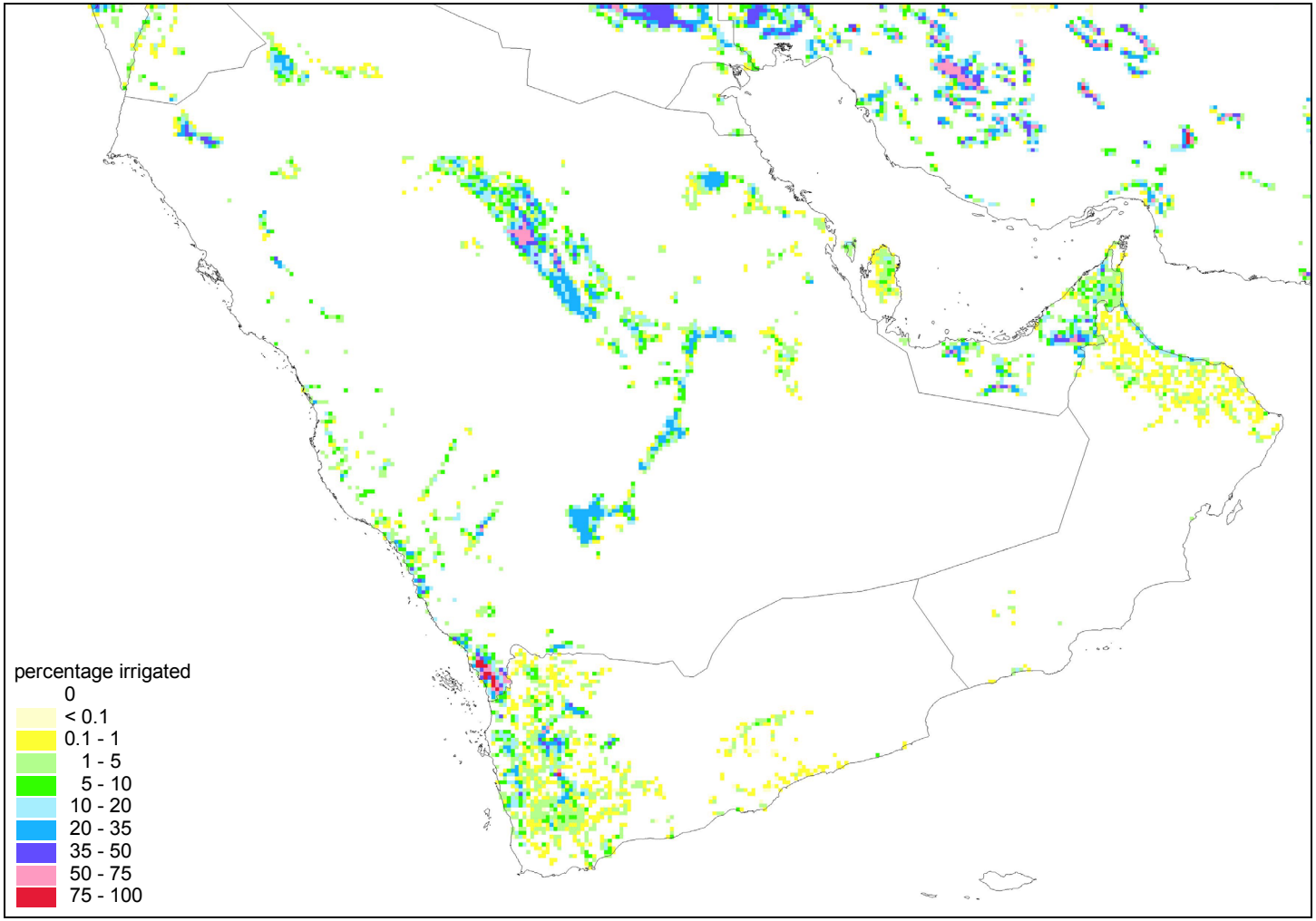


MAP 8

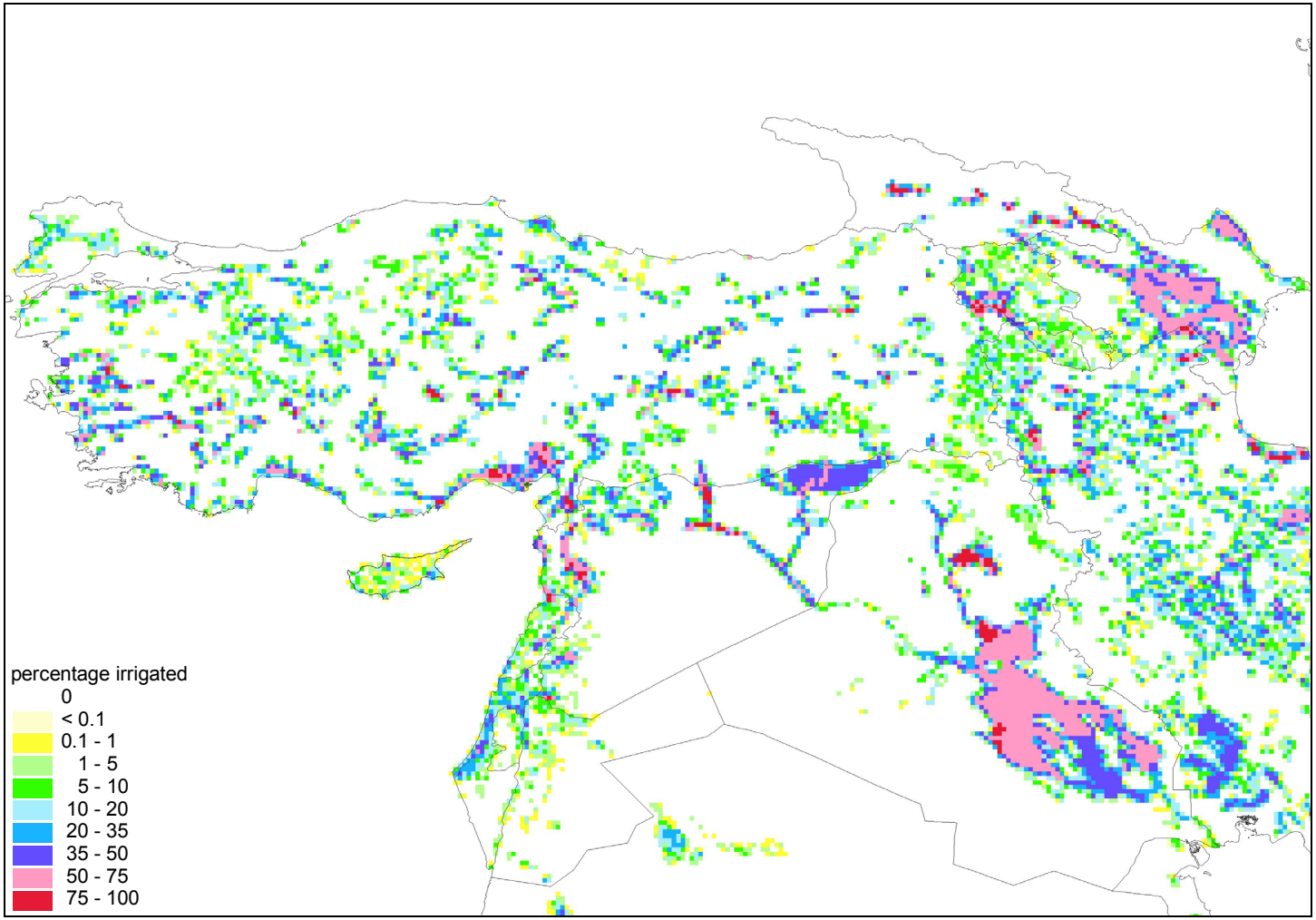
Percentage of surface area equipped for irrigation, Southeast Asia (Brunei Darussalam, East Timor, Indonesia and Malaysia)



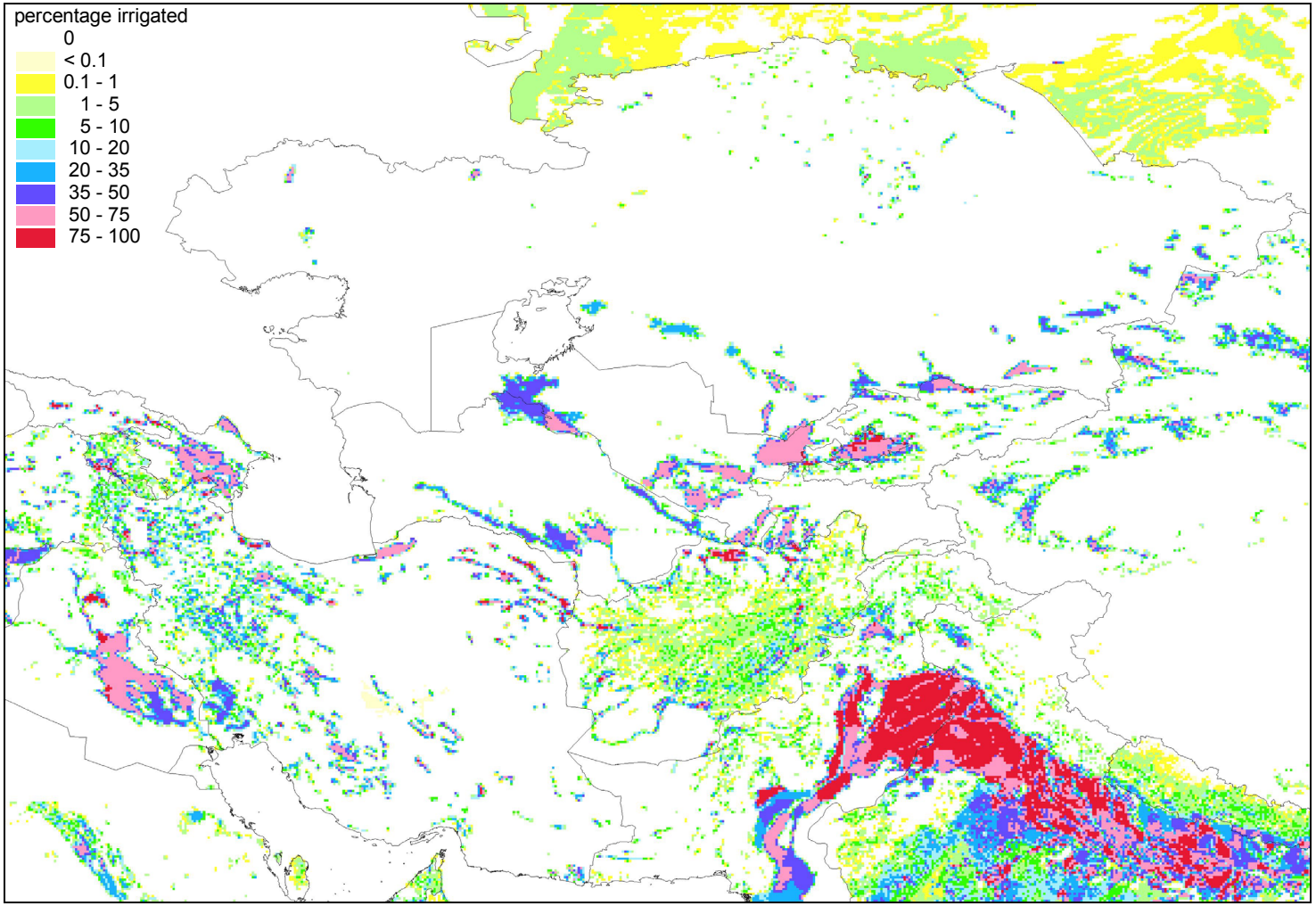
MAP 9
Percentage of surface area equipped for irrigation, East Asia (Democratic People's Republic of Korea, Japan and Republic of Korea)



MAP 10
Percentage of surface area equipped for irrigation, Arabian Peninsula (Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen)



MAP 11
Percentage of surface area equipped for irrigation, Mediterranean and Mesopotamia (Cyprus, Iraq, Israel, Jordan, Lebanon, Palestinian Authority, Syrian Arab Republic, and Turkey)



MAP 12
Percentage of surface area equipped for irrigation, Near East and Central Asia (Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan)

The Land and Water Development Division of the Food and Agriculture Organization of the United Nations and the Johann Wolfgang Goethe University, Frankfurt am Main, Germany, are cooperating in the development of a global irrigation-mapping facility. This report describes an update of the Digital Global Map of Irrigated Areas for the continent of Asia. For this update, an inventory of subnational irrigation statistics for the continent was compiled. The reference year for the statistics is 2000. Adding up the irrigated areas per country as documented in the report gives a total of 188.5 million ha for the entire continent. The total number of subnational units used in the inventory is 4 428. In order to distribute the irrigation statistics per subnational unit, digital spatial data layers and printed maps were used. Irrigation maps were derived from project reports, irrigation subsector studies, and books related to irrigation and drainage. These maps were digitized and compared with satellite images of many regions. In areas without spatial information on irrigated areas, additional information was used to locate areas where irrigation is likely, such as land-cover and land-use maps that indicate agricultural areas or areas with crops that are usually grown under irrigation.