



Water Resources Activities of the U.S. Geological Survey in Afghanistan From 2004 Through 2014

Safe and reliable supply of water, for irrigation and domestic consumption, is one of Afghanistan's critical needs for the country's growing population. Water is also needed for mining and mineral processing and the associated business and community development, all of which contribute to the country's economic growth and stability.

Beginning in 2004, U.S. Geological Survey scientists have aided efforts to rebuild Afghanistan's capacity to monitor water resources, working largely with scientists in the Afghanistan Geological Survey of the Ministry of Mines and Petroleum as well as with scientists in the Afghanistan Ministry of Energy and Water, the Afghanistan Ministry of Agriculture, Irrigation, and Livestock, and nongovernmental organizations in Afghanistan. Considerable efforts were undertaken by the U.S. Geological Survey to compile or recover hydrologic data on Afghanistan's water resources.

These collaborative efforts have assisted Afghan scientists in developing the data collection networks necessary for improved understanding, managing these resources, and monitoring critical changes that may affect future water supplies and conditions. The U.S. Geological Survey, together with Afghan scientists, developed a regional ground-water flow model to assist with water resource planning in the Kabul Basin. Afghan scientists are now independently developing the datasets and conducting studies needed to assess water resources in other population centers of Afghanistan.



Photograph by Robert E. Broshears, U.S. Geological Survey (retired)

Villagers lining up for water at a community well near Kabul, Afghanistan.

Background

Most hydrologic and climatic data collection activities ceased in about 1980 as a consequence of civil strife. Consequently, much of the institutional knowledge, scientific instrumentation, and skills of Afghan scientists had stagnated or were lost, making the task of meeting the need for supplies of water in Afghanistan challenging.

Reconstruction efforts were beginning in war-torn Afghanistan in 2002, at a time when much of the country was in disarray and lacked most technical capacity, infrastructure, and modern equipment necessary for effective hydrogeologic investigations. In 2004, the U.S. Geological Survey (USGS) and the Afghanistan Geological Survey (AGS) initiated plans to rebuild Afghanistan's capacity in geologic sciences. From 2004 through 2007, USGS and AGS activities were conducted under the auspices of the U.S. Agency for International Development (USAID), and since 2009, activities have been conducted under the auspices of the U.S. Department of Defense Task Force for Business and Stability Operations. The efforts of the USGS in Afghanistan have focused on building the capacity of Afghan scientists to monitor and assess the country's water resources. This rebuilding was accomplished by providing training in and application of modern techniques, including global positioning systems, field hydrology, and water-quality sampling, and by developing water-resource databases. To date [2014], more than 40 reports and maps on groundwater, water quality, and surface water have been produced as a result of USGS and AGS collaboration, including 24 geohydrologic assessments (fig. 1) at areas of interest for various minerals (Peters and others, 2011).



Photograph by Verne R. Schneider, U.S. Geological Survey

Aerial view of the Kajaki Dam and reservoir on the Helmand River in the Kajaki District, Afghanistan.

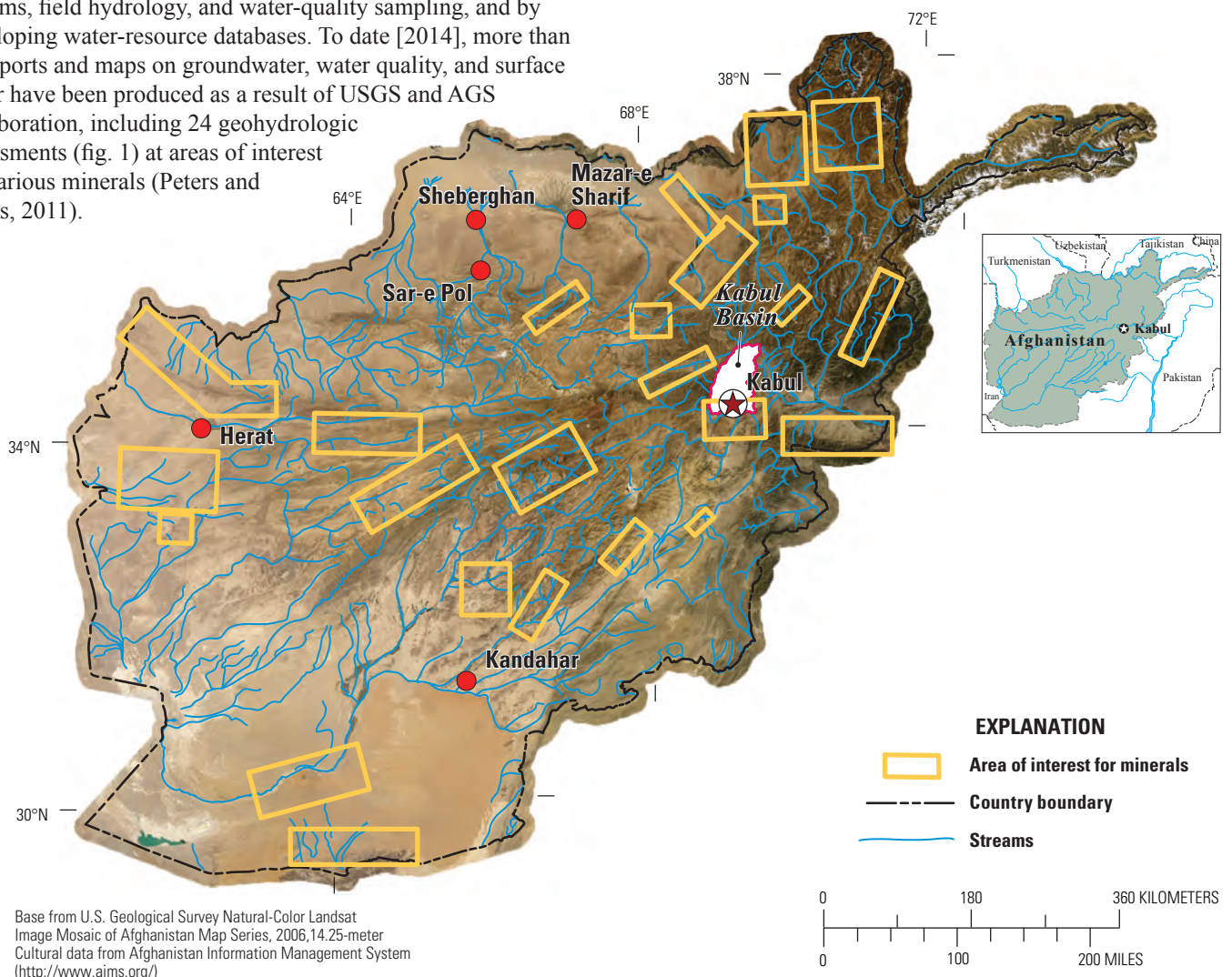
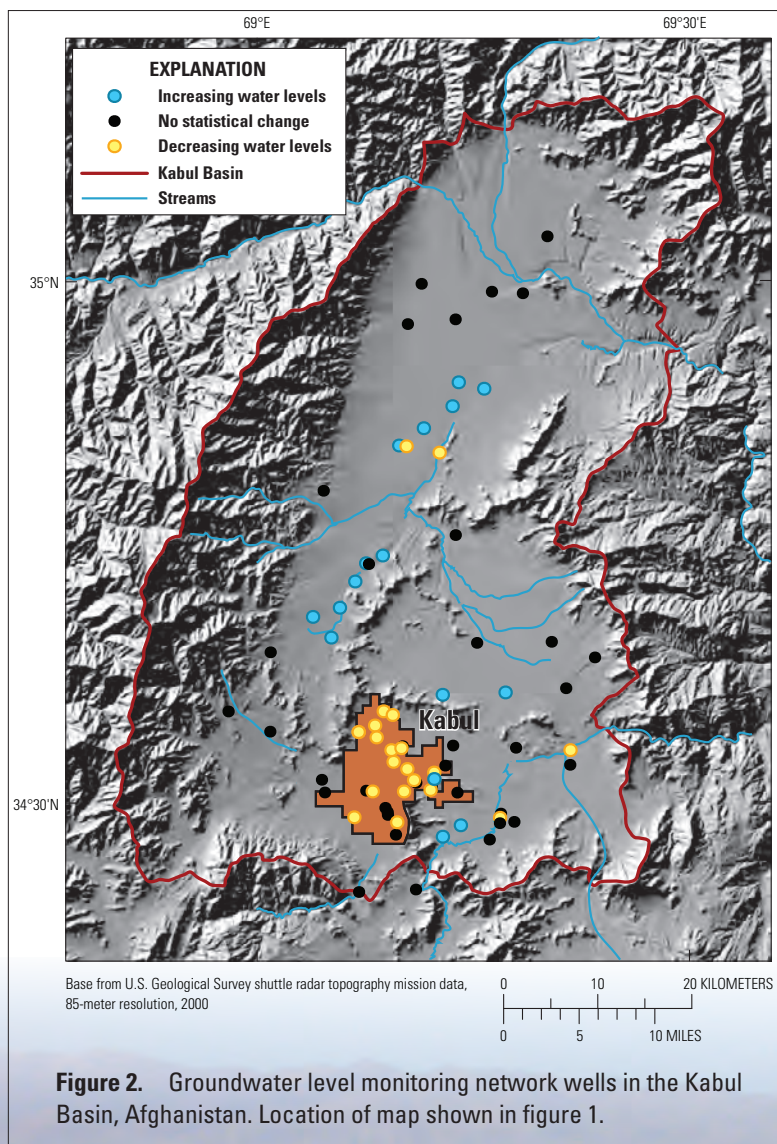


Figure 1. Major hydrologic features, areas of interest for minerals, and U.S. Geological Survey and Afghanistan Geological Survey water projects in Afghanistan.



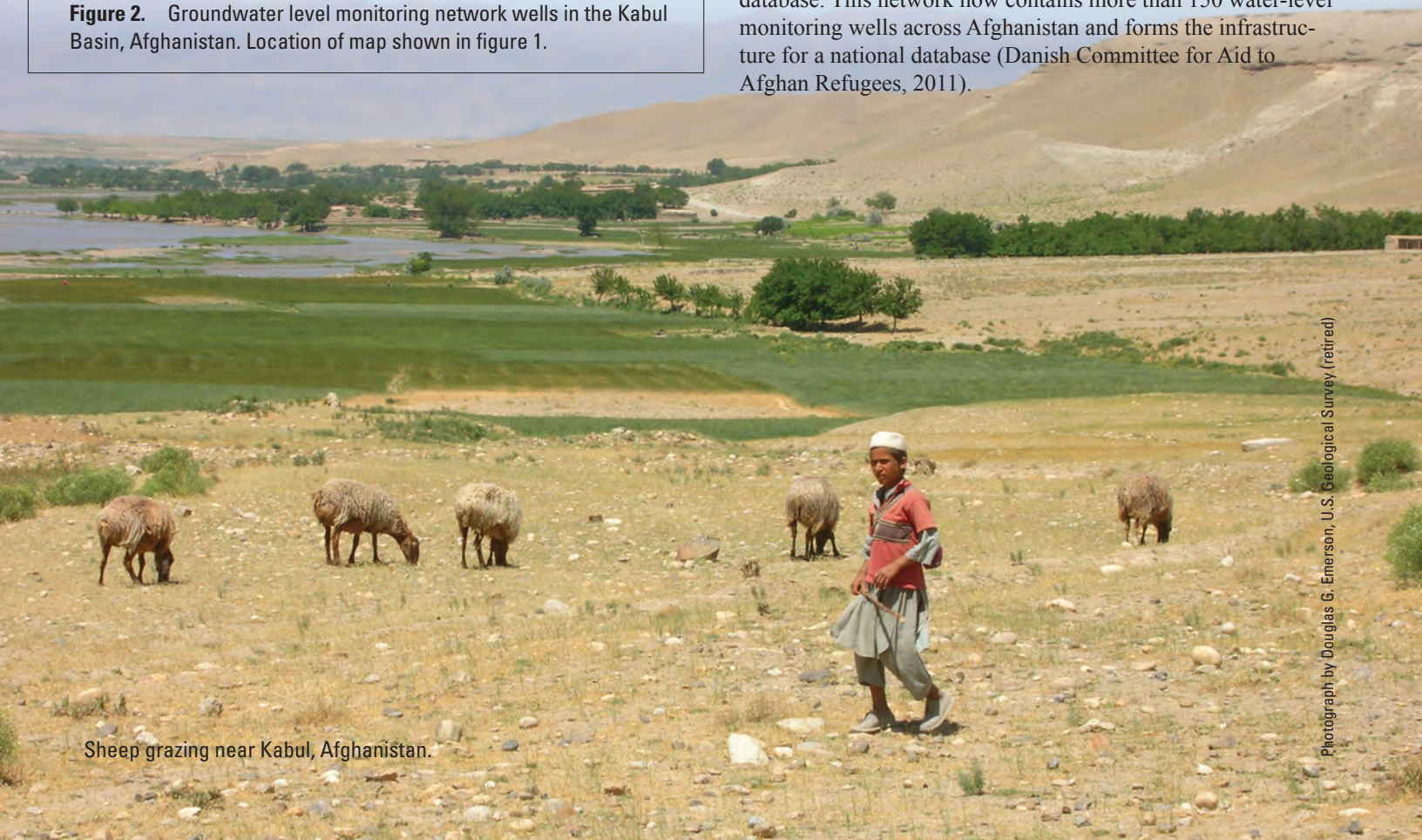
Groundwater Resources

The first cooperative efforts of the USGS in rebuilding Afghanistan's water resources capacity were with AGS engineers in compiling an inventory of water resources in the Kabul Basin. By the end of 2004, the AGS inventoried about 150 wells in the Kabul Basin. A subset of the wells inventoried between 2004 and 2012 is shown in figure 2; the inventoried wells indicate decreasing groundwater levels in the city of Kabul. Water samples collected and analyzed for physical, chemical, and microbiological properties formed the basis of the first USGS and AGS collaborative hydrologic investigation of the Kabul Basin (Broshears and others, 2005; Akbari and others, 2007). Further collaborative investigations with the AGS and the Afghanistan Ministry of Energy and Water (MEW) led to a detailed understanding of water availability and sustainability in the Kabul Basin (Mack and others, 2010).

The groundwater-level monitoring well network of the AGS in the Kabul Basin has been in operation for more than 10 years (Taher and others, 2014). Recent analysis of these data provides an improved understanding of the sustainability of groundwater resources in the basin (Mack and others, 2013).

AGS engineers have established similar groundwater monitoring networks and produced assessments of water resources in the cities of Mazar-e Sharif, Sheberghan, and Sar-e Pol (fig. 1). These networks and the related hydrologic assessments are critical for understanding current conditions and availability of water resources in some of the major population centers of Afghanistan.

In the mid-2000s, the USGS assisted the Danish Committee for Aid to Afghan Refugees (DACAAR), a Danish nongovernmental organization (NGO) staffed by Afghan scientists, in developing a national groundwater monitoring well network and database. This network now contains more than 150 water-level monitoring wells across Afghanistan and forms the infrastructure for a national database (Danish Committee for Aid to Afghan Refugees, 2011).



Sheep grazing near Kabul, Afghanistan.

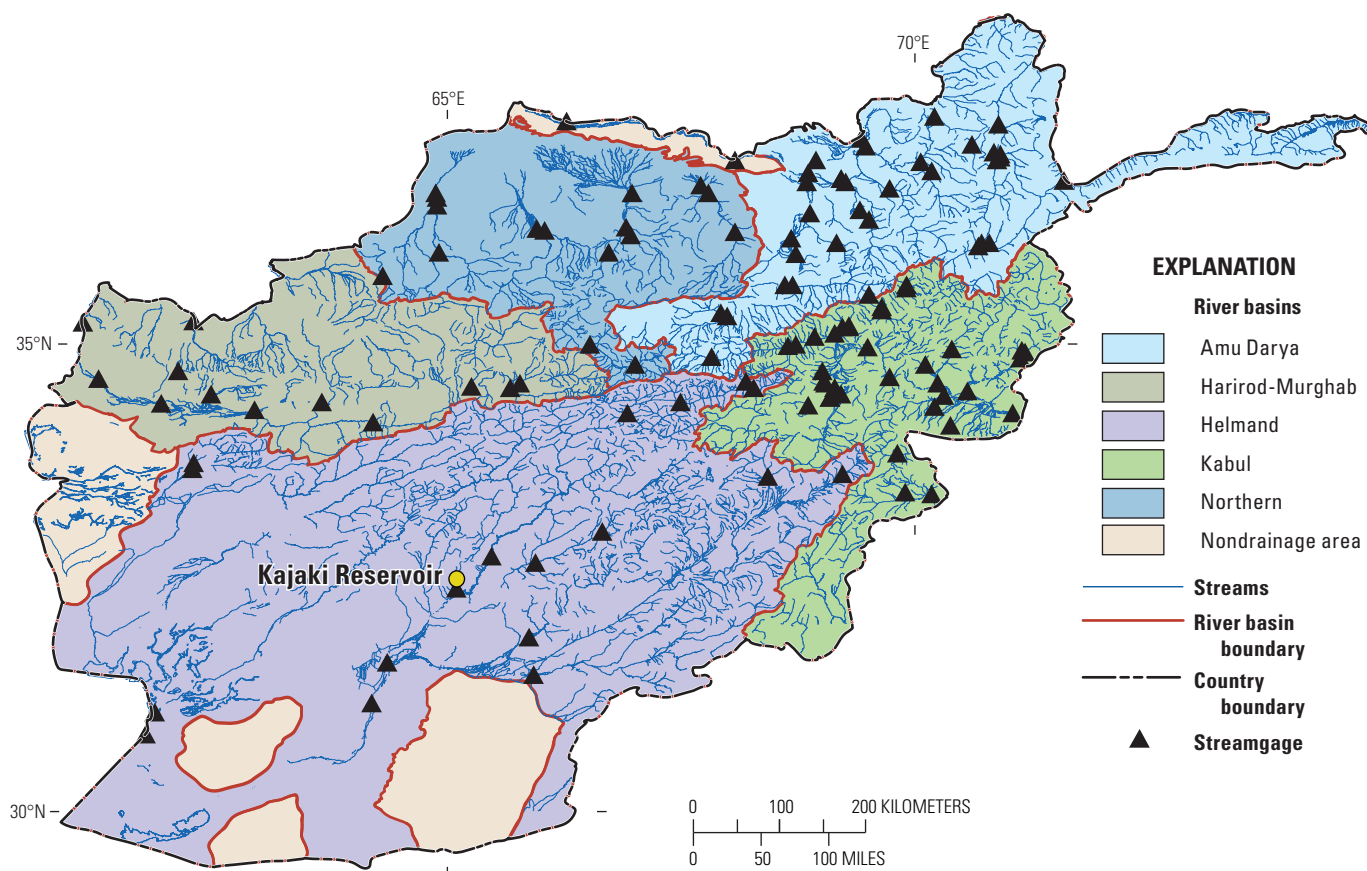


Figure 3. Major drainage basins, reinstalled streamgages (118), and the Kajaki Reservoir, Afghanistan.

Surface Water Resources

In the early 1950s, the USGS working in cooperation with a predecessor organization to USAID established a streamgaging program in the Helmand River Basin (Taylor, 1976, p. 62–65). By the late 1970s, Afghanistan had a functioning streamgaging and reservoir water-level gaging network that consisted of 169 streamgages distributed across the country (Favre and Kamal, 2004). This network operated until 1980 when most streamgages were destroyed or fell into disrepair and the original streamflow records and the database were lost. From 2006 to 2010, in cooperation with the MEW, the USGS recovered daily streamflow data from historical documents, converted those data into digital form, and loaded the data into the USGS National Water Information System for Afghanistan. Historical streamflow characteristics, including monthly and annual discharge, monthly and annual flow durations, annual peak discharges, and monthly and annual mean discharges, were published in Williams-Sether (2008), Olson and Williams-Sether (2010), and Vining (2010).

USGS scientists assessed surface-water resources of the Aynak area of investigation for minerals, near the city of Kabul, and at the Kajaki Reservoir in Helmand River Basin (fig. 3). The Kajaki Reservoir is a major source for hydropower and irrigation in the Helmand River Basin; the storage capacity at the reservoir has been reduced because of sedimentation and likely will be further reduced in the future because of continued problems with sedimentation (Vining and Vecchia, 2007).

From 2008 through 2011, approximately 127 historical streamgages were reestablished (fig. 3) and supplied with

modern equipment as part of a program by the USGS and the World Bank. The USGS continues to assist the MEW with the hydrologic network of Afghanistan, and programs are being developed to enhance capacity in surface-water monitoring and analysis techniques.



View of the Balkhab River looking upstream at Sar-e Pol, Afghanistan.

Photograph by Thomas J. Mack, U.S. Geological Survey

Climate

The Afghanistan Agrometeorology Program (Agromet) was established on January 1, 2004, to provide meteorological and crop data for internal food security assessments. USGS scientists assisted the Afghanistan Ministry of Agriculture, Irrigation, and Livestock with analyzing and reporting agricultural and meteorological data that provide valuable information on climate and food security for governmental and NGO aid decision makers.

By 2014, the Agromet Program had installed and was operating 102 stations to record precipitation amounts, snow cover, and other meteorological parameters. These parameters are crucial to the calibration and validation of remotely sensed models of Afghanistan, such as the snow cover extent shown in figure 4. Currently [2014], the Agromet Program has produced more than 150 monthly bulletins and seasonal reports in Dari and English (<http://afghanistan.cr.usgs.gov/agrometeorology-publications-maps>) and has trained more than 260 observers from government agencies and NGOs.

Summary

By the early 2000s, Afghanistan's hydrologic expertise was severely limited. The country's scientists had been isolated from the international scientific community and many of the technological advancements that had occurred in the field of water resources and climatology in the decades after 1980. Since 2004, the knowledge and understanding of Afghanistan's water resources has improved considerably as a result of capacity

developments at various Afghan ministries and nongovernmental organizations. Particular improvements have been made at the Afghanistan Geological Survey with technical support from the U.S. Geological Survey in cooperation with the U.S. Agency of International Development and the U.S. Department of Defense Task Force for Business and Stability Operations. Although the skills and experience developed are in the early stages, recent improvements in capacity have led directly to creation of local and national groundwater monitoring networks and a national climate monitoring network. The advances made aided Afghanistan's planners and managers in assessing current water resources and in monitoring changes that may affect future availability of water for drinking water supply, irrigation, and industrial uses.

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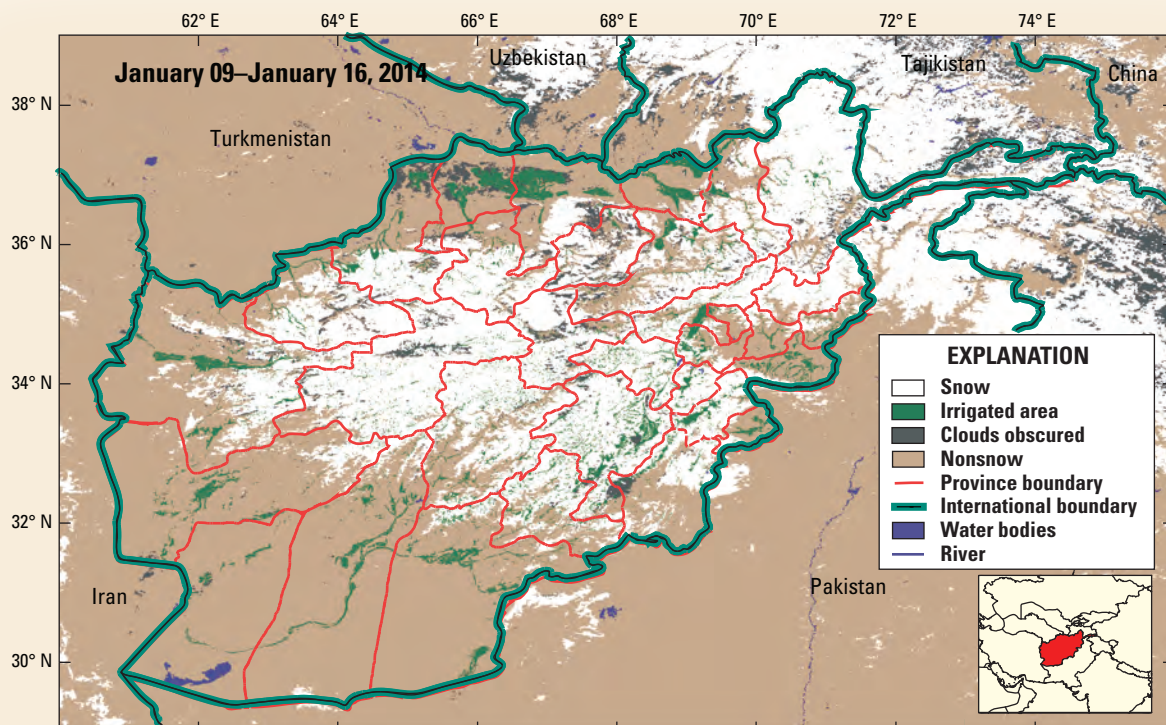


Figure 4. Snow cover extent in Afghanistan in December 2013; modified from U.S. Geological Survey [undated].

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View of the Balkhab River looking upstream at Sar-e Pol, Afghanistan.

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