One of the first laws adopted under Berdimuhammadov's presidency offered a state guarantee of equality for women, in December 2007. Some 16% of parliamentarians are women but there are no data on women researchers. A group of women scientists have formed a club to encourage women to choose a career in science and increase the participation of women in state S&T programmes and in decision-making circles. The current chair is Edzhegul Hodzhamadova, Senior Researcher at the Institute of History of the Academy of Sciences. Club members meet with students, deliver lectures and give interviews to the media. The club is endorsed by the Women's Union of Turkmenistan, which has organized an annual meeting of more than 100 women scientists on National Science Day (12 June) ever since the day was instituted in 2009.

## UZBEKISTAN

### A fledgling innovation system

The anti-crisis package covering 2009–2012 helped Uzbekistan weather the financial crisis by injecting funds into strategic economic sectors. As specified by presidential decree in December 2010, these sectors were, for 2011–2015: energy, oil and gas; the chemical, textile and automobile industries; non-ferrous metals; engineering; pharmaceuticals; high-quality processing of agricultural products ; and construction materials. These sectors tend to involve large companies equipped with design bureaux and laboratories. There are, however, also specialized state institutions which actively promote innovation. These include the: the Agency for Technology Transfer (since 2008), focusing on technology transfer to the regions; the Scientific and Technical Information State Unitary Enterprise, placed under the Committee for the Co-ordination of Science and Technology Development (since 2009); and the Intellectual Property Agency of Uzbekistan (since 2011).

The government has also decreed free industrial zones (FIZ) to foster the modernization of all economic sectors. The Navoi region became the first FIZ in December 2008. It was followed by Angren in the Tashkent region in April 2012 and Djizak in the Sirdary region in March 2013. The enterprises established in these FIZ have already produced some inventions and are involved in public–private partnerships through which they co-finance projects in innovation with the Fund for the Reconstruction and Development of Uzbekistan, set up in May 2006. The national innovation system in Uzbekistan is still in its formative years, however. There is at best a tenuous relationship between science and industry and almost no commercialization of research results.

In 2012, the Committee for the Co-ordination of Science and Technology Development formulated eight priorities for R&D to 2020, based on the needs of industry (CCSTD, 2013):

- Constructing an innovative economy by strengthening the rule of law;
- Energy and resource savings;
- Development of renewable energy use;
- Development of ICTs;
- Agriculture, biotechnology, ecology and environmental protection;
- Medicine and pharmacology;
- Chemical technologies and nanotechnologies; and
- Earth sciences: geology, geophysics, seismology and raw mineral processing.

The first of the eight R&D priorities merits greater explanation. The ultimate goal of the ongoing legal reform in Uzbekistan is to harness innovation to solving socio-economic problems and enhancing economic competitiveness. Innovation is perceived as a means of democratizing society. The contours of the draft law on innovation and innovative activity were first outlined in the presidential decree of January 2011 devoted to deepening democratic reforms, including by strengthening the status of local representatives. This draft bill also sets out to create an effective mechanism for the testing, deployment and commercial development of promising scientific work. It outlines additional incentives and rewards for enterprises developing innovative projects, especially in high-tech industries. In 2014, the draft law was subjected to public scrutiny to encourage debate.

In Uzbekistan, state support (financial, material and technical) for innovation is provided directly to specific programmes and projects, rather than to the individual research institutions and hierarchical structures. One of the most effective elements of this scheme is the principle of equity financing, which allows for a flexible combination of budgetary funds with funding from industry and the regions. This ensures that there is a demand for the research being undertaken and that the results will lead to products and processes. It also creates bridges between the public research sector and industrial enterprises. Researchers and industrialists can also discuss ideas at the country's annual innovation fairs (see photo, p. 364). Between 2008 and 2014:

- 26% of the proposals vetted concerned biotechnologies, 19% new materials, 16% medicine, 15% oil and gas, 12% chemical technologies and 13% energy and metallurgy;
- more than 2 300 agreements were signed for experimental development for more than 85 billion Uzbek soms (UZS), equivalent to US$ 37 million;
- based on these contracts, 60 new technologies were introduced and 22 product types went into production;

Table 14.4: **Uzbekistan's most active research organizations, 2014**

| Physics and Astronomy | Energy |
|---|---|
| Institute of Nuclear Physics | Institute of Energy and Automation |
| RT-70 Observatory | Tashkent State Technical University |
| SPU Physical–Technical Institute (Physics–Sun) | Fergana Polytechnic Institute |
| Institute of Polymers, Chemistry and Physics | Karshi Engineering Economic Institute |
| Institute of Applied Physics, National University of Uzbekistan | Biochemistry, genetics and molecular biology |
| **Chemical Sciences** | **Biochemistry, Genetics and Molecular Biology** |
| Institute of Bio-organic Chemistry *(named after Academician Sadykov)* | Centre of Genomics and Bioinformatics |
| Institute of General and Inorganic Chemistry | Institute of Plant and Animal Genofund |
| Institute of Chemistry and Plant Substances | Institute of Genetics and Plant Experimental Biology |
| Institute of Polymers, Chemistry and Physics | Institute of Microbiology |

*Source:* compiled by author

- the new products generated UZS 680 billion (almost US$ 300 million), providing US$ 7.8 million in import substitution.

## Securing a new generation of researchers

In 2011, three-quarters of Uzbek researchers were employed in higher education and just 6% in the business enterprise sector (Figure 14.5). With most university researchers nearing retirement, this imbalance imperils Uzbekistan's research future. Almost all holders of a Candidate of Science, Doctor of Science or PhD are more than 40 years old and half are aged over 60; nearly one in four researchers (38.4%) holds a PhD degree, or its equivalent, the remainder holding a bachelor's or master's degree (60.2%).

In July 2012, a presidential decree abolished the system of Candidate of Science and Doctor of Science degrees inherited from the Soviet system,[18] replacing it with the three-tier degree system comprised of bachelor's, master's and PhD degrees. Whereas those with a bachelor's degree used to be barred from postgraduate studies in the old system, they will now be able apply for a course leading to a master's degree. This should incite young people to study science.

In December 2012, a second presidential decree focused on improving proficiency in foreign languages, beginning with the 2013/2014 academic year. English teaching, in particular, will be introduced into secondary schools and certain university courses will be taught in English, especially engineering and specialized areas, such as law and finance, in order to foster international information exchange and scientific co-operation. Students from remote rural areas will be able to specialize in foreign language teaching at university on the recommendation of local public authorities. Television and radio programmes designed to teach children and teenagers foreign languages will be broadcast widely. Universities will be given greater access to international multimedia resources, specialized literature, newspapers and magazines.

Inha University in Tashkent opened its doors to students in October 2014. Specializing in ICTs, this new university is the result of collaboration with Inha University in the Republic of Korea and will adopt similar academic programmes. Initially, 70 students are being selected for the Department of Information and Communication Engineering and a further 80 for the Department of Computer Science and Engineering. All lectures are given in English.

In order to improve training, the first cross-sectorial youth laboratories were created by the Academy of Sciences in 2010, in promising fields such as genetics and biotechnology; advanced materials; alternative energy and sustainable energy; modern information technology; drug design; and technology, equipment and product design for the oil and gas and chemical industries. These fields were chosen by the academy to reflect the strengths of Uzbek science (Figure 14.6 and Tables 14.2 and 14.4). The Academy of Sciences has also revived the Council of Young Scientists.

## More problem-solving research

In order to re-orient academic research towards problem-solving and ensure continuity between basic and applied research, the Cabinet of Ministers issued a decree in February 2012 re-organizing more than 10 institutions of the Academy of Sciences. For example, the Mathematics and Information Technology Research Institute was subsumed under the National University of Uzbekistan and the Institute for Comprehensive Research on Regional Problems of Samarkand was transformed into a problem-solving laboratory on environmental issues within Samarkand State University. Some have remained attached to the Academy of Sciences, such as the Centre of Genomics and Bioinformatics (Table 14.4 and Box 14.5).

**18**. For an explanation of the Soviet system of higher education, see Figure 14.3 on p. 220 of the *UNESCO Science Report* 2010.

### Box 14.5: **Uzbek and US scientists add economic value to cotton fibre**

A recent study could potentially have a multibillion-dollar impact on the global cotton industry and help cotton farmers fend off increasing competition from synthetic fibres.

Published in January 2014 in *Nature Communications*, the study is the result of collaboration between biologists at the Uzbek Centre of Genomics and Bioinformatics, the Texas A&M University (USA) and the US Department of Agriculture's Office of International Research Programs, which provided most of the funding.

'Sustainability and biosecurity of cotton production are pivotal for the Uzbek economy because agriculture accounts for [19%] of the country's GDP', says lead author Prof. Ibrokhim Abdurakhmonov, who received his master's degree in plant breeding from Texas A&M University in 2001 and is now director of the Centre of Genomics and Bioinformatics at the Academy of Sciences in his native Uzbekistan.

The overwhelming majority of cotton harvested worldwide is upland cotton *(Gossypium hirsutum)*. A cotton called *Gossypium barbadense* is more desirable because of its longer fibres and greater strength but it is late-maturing, low-yielding and more difficult to grow because it requires a dry climate and is less resistant to pathogens and pests.

'For a long time, cotton breeders have been trying to develop upland cotton with the fibre qualities of *G. barbadense* cotton,' says Alan Pepper, an associate professor in the Texas A&M Department of Biology and a co-author of the paper. 'Globally, everybody is trying to do it. Economically, it is a huge deal because every millimetre you add to fibre length adds that much to the price of cotton when the farmer sells it.'

The researchers' method increased the length of the fibre by at least 5 mm, or 17%, compared to the control plants in their experiment. 'This was pure basic science – kind of a shot-in-the-dark experiment,' says Pepper.

He acknowledges that the results of the research are, technically, genetically modified organisms (GMOs). But he makes a key distinction. A major criticism of GMOs, Pepper notes, focuses on cases where genes from other species – even bacterial ones – have been added to an organism to achieve a desired trait. 'What we are doing is a little different. We are not actually adding a gene from another species. We are just taking the genes that are there and we are knocking down the effect of one of those genes that is already in the plant.'

'The increased value of longer and stronger lint would be at least US$ 100 per acre more income,' says Abdurakhmonov. 'Our anticipation of possible improvement of resistance to abiotic stresses [such as high winds or drought] further adds to its commercial potential.'

In December 2013, Prof. Abdurakhmonov was named 'researcher of the year' by the International Cotton Advisory Committee for this 'gene knockout technology,' which is being patented in Uzbekistan, the USA and elsewhere. Research is being conducted in order to apply this technology to other crops.

Uzbekistan accounts for about 10% of global cotton fibre exports, behind the USA, India, China and Brazil. It is currently using revenue from cotton-growing to diversify its economy.

*Source:* www.bio.tamu.edu (press release); see also http://genomics.uz

In March 2013, two research institutes were created by presidential decree to foster the development of alternative energy sources, with funding from the Asian Development Bank and other institutions: the SPU Physical–Technical Institute (Physics Sun Institute) and the International Solar Energy Institute.

## CONCLUSION

**Progress hampered by low investment in R&D**

Most of the Central Asian republics have managed to maintain stable economic growth throughout the global financial crisis and even some of the highest annual growth rates in the world. They are still in the process of transition to a market economy, however. Progress is being hampered by the low level of investment in R&D and, in Kyrgyzstan and Turkmenistan in particular, by very low levels of internet access.

The republics are all adopting structural and administrative reforms to reinforce the rule of law, modernize traditional sectors of the economy, introduce new technologies, strengthen related skills and create an environment more conducive to innovation, such as by strengthening intellectual property protection and providing incentives for innovative enterprises. Increasingly, government policies are opting for a more sustainable development path, including for extractive industries.

In order to attain the objectives outlined in their respective development plans, governments in Central Asia need to:

- strengthen co-operation – which is vital for sharing R&D results – by developing a common regional network for scientific and technical information, and creating a database in priority research areas: renewable energy, biotechnology, new materials, etc.;

- establish a support centre for STI using a common methodological approach to ensure unified legislative frameworks and the development of standard tools to assess STI policy implementation;
- provide one another with foreign direct investment, in order to diversify sources of R&D funding and foster intraregional co-operation in areas of common interest, including renewable energy, biotechnology, biodiversity conservation and medicine;
- develop more infrastructure to foster innovation: science and technology parks, special industrial zones, business incubators for start-ups and spin-offs, etc.; and
- co-operate in training highly qualified specialists for the knowledge economy: managers and engineers for innovative projects; intellectual property lawyers, including as concerns international law, patent marketers and so on.

***KEY TARGETS FOR CENTRAL ASIA***

- Raise Kazahkstan's GERD/GDP ratio to 1% by 2015;
- Raise the share of innovative activity in Kazakh enterprises to 10% by 2015 and 20% by 2020;
- Carry the weight of the Kazakh manufacturing sector to 12.5% of GDP by 2020;
- Reduce the share of the Kazakh population living below the poverty line to 8% by 2020;
- Cultivate 15% of the acreage in Kazakhstan with water-saving technologies and develop drought-resistant genetically modified crops by 2030;
- Place Kyrgyzstan among the top 30 countries for doing business by 2017 and the 50 least corrupt by 2017;
- Ensure that all Kyrgyz faculty members hold at least a master's degree and 10% a PhD or Doctor of Science degree by 2020;
- Privatize 30% of Tajik pre-schools, vocational schools and universities by 2015;
- Equip 50% of Tajik schools with internet access by 2015;
- Ensure that 50% of Tajik scientific projects are in applied fields by 2015.

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