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EQUITABLE ACCESS TO EDUCATION WITH GEOSPATIAL DATA: A CASE STUDY OF THE KYRGYZ REPUBLIC

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ABOUT THE LEARNING CYCLE ON EQUITABLE ACCESS TO EDUCATION WITH GEOSPATIAL DATA

This case study is a result of the KIX EAP Learning Cycle "Equitable access to education with geospatial data". Organised by NORRAG and the UNESCO International Institute for Educational Planning (IIEP), this professional development course ran from 15 June to 16 July 2021. Across 5 weeks, this Learning Cycle enabled participants to apply basic mapping techniques on a geographic information system (QGIS), understand the geospatial dimension of educational planning and management, and challenge the different aspects of equitable access to education by harnessing the power of geospatial data in their daily work. 10 national teams from Afghanistan, Bangladesh, Bhutan, Cambodia, Kyrgyz Republic, Maldives, Moldova, Pakistan, Papua New Guinea, and Sudan took part in this Learning Cycle.

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The KIX EAP Hub is supported by

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LIST OF ACRONYMS AND ABBREVIATIONS

DEP	Development Education Program
EMIS	Educational Management Information System
HDI	Human Development Index
HRDO	Human Development Report Office
KIX EAP	Knowledge and Innovation Exchange (KIX) Europe, Asia and the Pacific (EAP)
MoES	Ministry of Education and Science
NSC	National Statistical Committee
OECD	Organisation for Economic Cooperation and Development
PTR	Pupil-Teacher Ratio
SDGs	Sustainable Development Goals
SDR	Sustainable Development Report
UIS	Institute for Statistics
UNDP	United Nations Development Programme
UNICEF	The United Nations International Children's Emergency Fund
WBG	The World Bank Group
QGIS	Quantum Geographic Information System

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Special thanks to Amélie A. Gagnon, Senior Program Specialist at UNESCO-IIEP, Germán Vargas Mesa, Assistant Program Specialist at UNESCO-IIEP and the entire technical support team from NORRAG for a high level of training and professional approach in ensuring communication between the participants.

This GPE KIX EAP learning cycle specifically focused on the analysis of equitable access to education with the use of geospatial data; this was very important for us as it allowed us to take into account various local constraints. With the knowledge gained during the learning cycle, we were able to produce a case study on equal access to education in Kyrgyzstan using geospatial data at the school level.

The learning was of great interest and the skills acquired will definitely be reflected in educational policy planning processes or educational research. Special sincere thanks to Gita Steiner-Khamsi, Professor at the Graduate Institute of International and Development Studies (Switzerland) and Teachers College, Columbia University (USA), for her comprehensive support and dissemination of educational innovations.

COUNTRY CONTEXT

Total population	**6,672 million**[1] (NSC, 2015)
2021 Global Index Score:	**74.00/100** (Sachs *et al.*, 2021)
2021 Global Index Rank:	**44/165** (Sachs *et al.*, 2021)
SDG 4 Dashboard:	SDG achieved (Sachs *et al.*, 2021)
SDG 4 Trend:	On track or maintaining SDG achievement (Sachs *et al.*, 2021)
2019 HDI Value/Rank:	**0.697, 120 out of 189** (UNDP, 2020)
GNI per capita (PPP$):	**4,864** (UNDP, 2020)
Gini Index:	**29.69** (Statista, 2021)
Income Group:	Lower-middle income status (WBG, 2018)
Education Expenditure:	**5.73%** of GDP, **22.2%** of the total budget (NSC, 2015)
Secondary Net Enrolment:	Total: **85.2%** Female: **85%**; Male: **85.5%** (UNESCO, 2020)
Literacy Rate (15 years & older):	Total: **99.6%** Female: **99.5%**; Male: **99.7%** (UNESCO, 2020)
Out of School:	**2,645** children (7–17 years old) Female: **1,075**; Male: **1,570** (NSC, 2015)

Kyrgyzstan is a landlocked country in Central Asia, bordering Kazakhstan, China, Tajikistan and Uzbekistan. The mountainous region of the Tian Shan covers over 80 per cent of the country, with the remainder made up of valleys and river basins.

Kyrgyzstan is divided into seven regions, which are subdivided into 44 districts. The districts are further subdivided at the lowest level of administration (ayil okmotu or aimag), which include all rural settlements (villages and towns). Each ayil okmotu includes between 1 and 20 villages.

The cities of Bishkek (the capital) and Osh have "state level" status and do not belong to any region. Furthermore, there are 29 cities (13 cities at the "regional level" and 17 at the "district level").

The education system is multi-level in nature and consists of the following three main types of education programmes:

- Preparatory educational programmes for infant and preschool institutions;
- Public programmes for the development of general culture and individual intellect, the creation of a base for the successful attainment of professional qualifications;
- Professional programmes that provide gradual, professional-level growth and preparation for qualified specialists.

1 Kyrgyzstan's population is characterised as follows: 34% urban; 66% rural; 34.4% are under the age of 15 years old; and 6.2% are over 65.

1

WHAT IS EQUITY IN THE KYRGYZ REPUBLIC?

Educational equity means that the educational system gives each student what he or she needs in order to perform at an acceptable level. This means that everyone should be able to read, write and do simple arithmetic. As such, if some students need additional support to succeed, they should receive it.

According to the Organization for Economic Cooperation and Development (OECD), equity in education consists of two closely intertwined dimensions (OECD, 2018).

Fairness: This means making sure that personal and social circumstances are not obstacles to achieving educational potential. It also means prohibiting discrimination based on gender, ethnic origin or socioeconomic status.

Inclusion: This ensures a basic minimum standard of education for all.

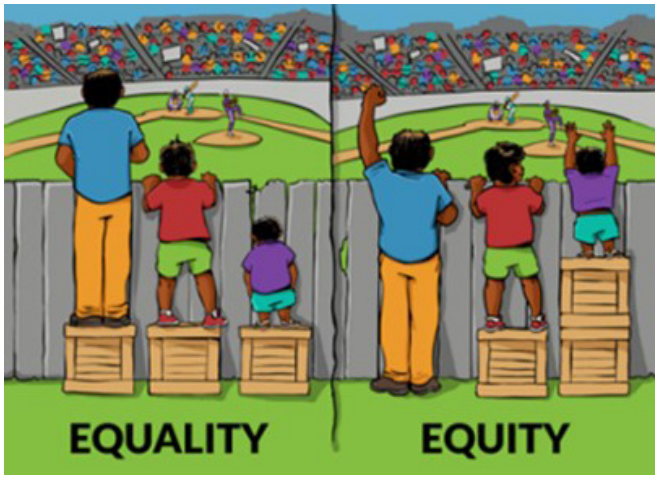


Image credit: Interaction Institute for Social Change (IISC)| Artist: Angus Maguire

The Constitution of the Kyrgyz Republic (2016) has enshrined into law the right to education, with everyone having the right to receive free preschool, basic general, secondary general and primary vocational education in state educational organisations. Article 3 of the Law on Education[2] expands the concept of equity in education and states that every citizen of Kyrgyzstan is guaranteed the right to education, regardless of gender, nationality, language, social and property status, health, type and nature of occupation, religion, political and religious beliefs, place of residence and other circumstances.[3]

Currently, the Development Education Program of the Kyrgyz Republic for the period 2021–2040 (DEP-2040) is the main document encapsulating the state's policies in the field of education (MoES, 2021). According to the DEP-2040, policy measures until the year 2040 will focus on three main objectives at all levels of education:

1) Ensuring equitable access
2) Ensuring the quality of education
3) Effective management and financing

Equitable access to education is achieved through the following priorities:

- Educational coverage at all levels of the education system
- Ensuring the inclusiveness of education and the introduction of multilingualism
- A safe and efficient learning environment

This case study presents an analysis of school-level data focusing on the following parameters:

- Distribution of schools by form of governance (state, municipal, private, mixed) in the context of country regions (supply)
- Population density of preschool education (3–6 years) (demand)
- Pupil–teacher ratios in the contexts of schools, districts and country regions (supply)
- Distribution of teachers by teaching experience (young teachers, those with less than 5 years of experience and those with more than 15 years of experience) within districts (supply)

2 Article 3 of the Law of the Kyrgyz Republic: On education. See also IBE-UNESCO. (2010). World Data on Education. http://www.ibe.unesco.org/sites/default/files/Kyrgyzstan.pdf

3 See footnote 2.

Although school enrolment (grades 1–11) has increased from 88.7 per cent in 2012 to 97.8 per cent in 2020 and the total number of schools has also increased, overcrowding in urban areas remains problematic due to internal migration (World Bank, 2020). Since 2012, the number of schools working under the three-shift system has doubled, and 37,000 children study in this system, which is strictly prohibited according to health-related and epidemiological rules and regulations. The state of the infrastructure in many schools threatens the life and health of students. Despite these threats, education and schooling have continued in the three-shift system due to the lack of appropriate buildings. About 245 school buildings are recognised as being in a state of emergency and, therefore, are in need of demolition and rebuilding. Furthermore, 457 schools in the country require rebuilding works to their roof, foundation and walls as well as the introduction of water supply and sewerage systems.

In the last nine years, the number of children aged 3 to 17 has increased by 1.7 per cent (34,200) (UNICEF, 2012). This is due to a stable demographic increase in the birth rate – the increase in children born alive in 2020 increased by 2.1 per cent compared to 2012. According to a forecast based on data from the UN Department of Economic and Social Affairs, in 2025, Kyrgyzstan will reach a population growth of 5.92 per cent, the maximum over the last 74 years (24.kg News Agency, 2019). Accordingly, from 2028, the maximum load will fall on kindergartens, and from 2032, it will fall on schools.

The constitution states that general education (9 grades) is mandatory for all citizens. However, this requirement has been changed, and from 2022, general secondary education (11 grades) will become compulsory. This transition to compulsory secondary general education and the demographic situation will put increasing pressure to develop and expand the educational infrastructure, which lags behind the increasing birth rates in the country. This will especially impact the situation in cities, which will also require a forward-looking policy of building social facilities for education. An increase in the number of pupils inevitably entails an increase in the workload of teachers. Thus, these challenges will require the adoption of policies to attract and train teachers not only in terms of increasing the supply of teachers (quantitative) but also with regards to ensuring quality education.

2

SCHOOL MAP REPRESENTING EDUCATIONAL LEVELS

The map below (Figure 1) shows general education schools classified by form of governance in country regions. As of 2021, there were 2,299 schools in operation in Kyrgyzstan, including 1,831 state schools, 309 municipal schools, 134 private schools and 25 mixed-form schools (see Table 1 for detailed information for each region). The mixed form of management means that the school is funded from a variety of sources.

The distribution of schools by region shows that most schools are located in the Osh, Jalal-Abad and Chui regions. The cities of Bishkek and Osh are not visible on the map, but if we draw large-scale maps by region, we can visually represent the location and quantitative ratio of schools by ownership form. There are fewer schools in the city of Osh and the Talas region; however, the compilation of such maps at the district level, and even at the level of aiyl-okmotu (aimag), would allow us to see the sufficiency and effectiveness of the location of schools in terms of making managerial decisions regarding the restructuring of management forms and the need to build new schools.

Specific forms of school governance are based on sources of funding, with the main budget items being wages, social expenditures and utility costs. According to data from the Educational Management Information System (EMIS), almost 80 per cent of schools are funded by the Kyrgyzstan Republic. The municipal budget is used to fund schools based mainly in the Chui, Issyk-Kul and Jalal-Abad regions, whereas most of the schools in Bishkek city are funded through the local mayoral budget. There are few schools with municipal

Figure 1: Form of school governance by region (2021)

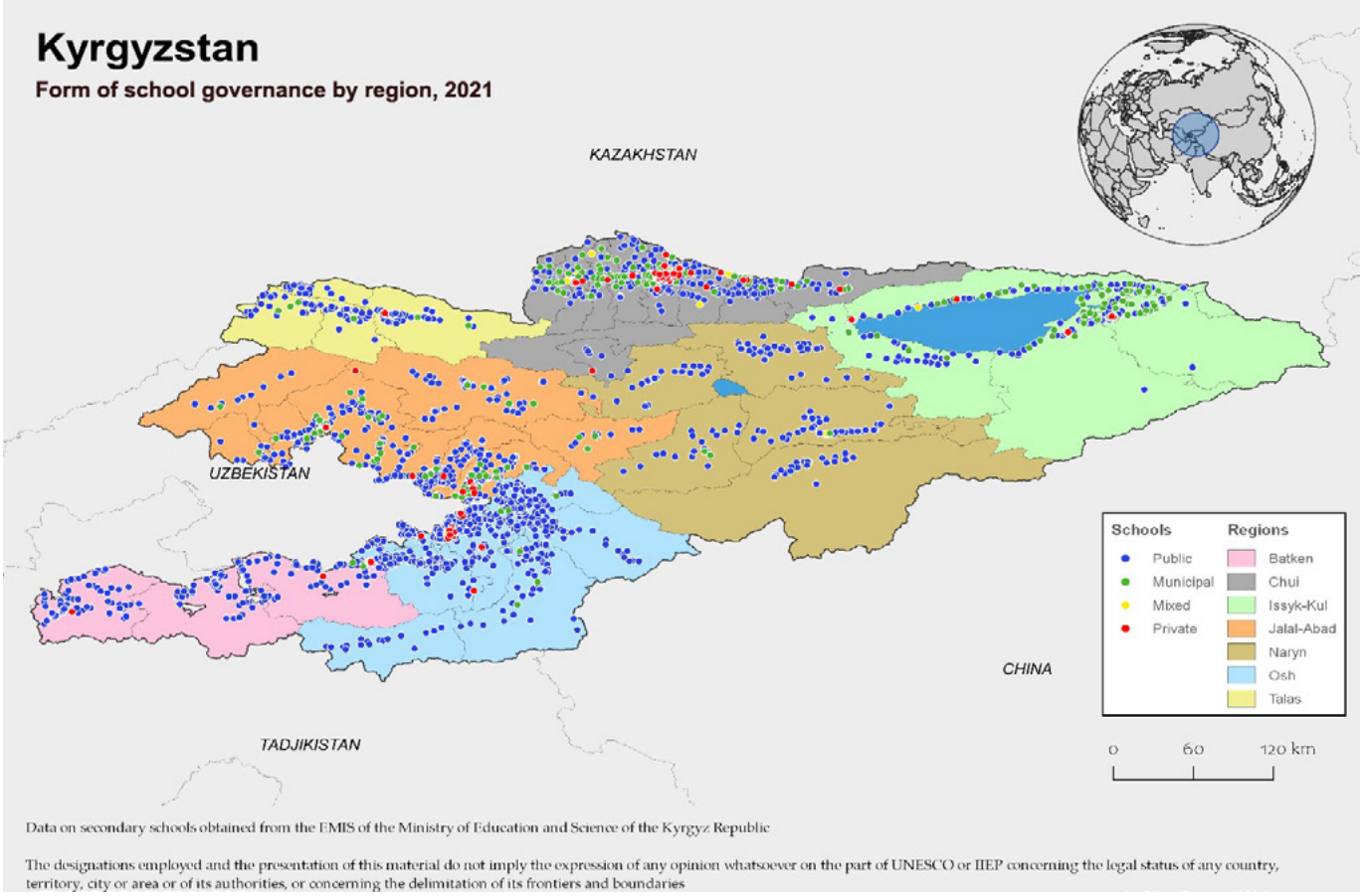


Table 1: Types of schools (state, municipal, private and mixed) in the various regions

Regions	Total no. of schools	No. of state schools	No. of municipal schools	No. of private schools	No. of mixed schools
Osh region	547	525	5	17	0
Jalal-Abad region	482	408	59	14	1
Chui region	331	215	82	21	13
Batken region	244	234	2	6	2
Issyk-Kul region	199	112	80	6	1
Bishkek city (capital)	163	38	70	52	3
Naryn region	141	137	3	0	1
Talas region	116	105	7	2	2
Osh city	76	57	1	16	2
TOTAL:	2,299	1,831	309	134	25

funding in the city of Osh and the Batken, Naryn, Osh and Talas regions. This means that most of the districts in these regions are subsidised, and therefore, schools cannot receive independent funding. It could be that the state budget management system does not take into account the viability of the local budget of the districts and aiyl-okmotu since the city of Osh and many districts of the Osh region have recently achieved impressive levels of economic development.

Indeed, there are mostly private schools in Bishkek city due to demands for better conditions and good quality education (the issue of the quality of education in all private schools remains controversial). In addition, entrepreneurship and solvency among the population in the capital are higher. It is noteworthy that there is a good growth trend in the number of private schools in Osh city and the Osh region as well as in the Chui and Jalal-Abad regions as there is economic development in these regions. A third of all private schools are located in rural areas (40 schools), indicating an increase in the solvency of the rural population. Nevertheless, there are also a few mixed schools in the country, mainly in the Chui region.

For this mapping exercise, the data on the schools were obtained from the EMIS of the Ministry of Education and Science of the Kyrgyz Republic (MoES). These data are continuously updated, and there are still data that need to be clarified. However, the data and the location of the schools allow us to generate maps for each district. Taking into account that the lowest levels of administrative management in the education system are the districts and city levels (cities at regional level), it is also possible to draw appropriate maps from the EMIS data for the education management bodies at these levels. However, it will probably be more useful for the MoES to see the location of schools at the level of villages and cities (district level) for decision-making at the local level.

The map of the country was obtained from the IIEP data source, which was made available during the Knowledge and Innovation Exchange (KIX) Europe, Asia and the Pacific (EAP) learning cycle course. In this map, the smallest geographical unit representing administrative borders is the *aiyl aimags*. Each *aiyl aimag* includes between 1 and 20 villages and settlements, and the distance between them is arguably quite large. It is advisable to use up-to-date data and provide separate details for each settlement. This allows researchers to conduct in-depth analyses and prepare sound proposals to solve educational problems at the local level. The data provided by the EMIS were at the district level, so it was not possible to distribute schools by *aimags* and conduct a more detailed analysis. Also, for a complete and diverse analysis, initial data from the National Statistical Committee (household survey) and other government departments, such as the transport department or social protection, are required, which were unavailable and may not be available at all. During this course, the team was not able to study the issue of data availability.

EMIS data on schools have a fairly wide list of indicators: administrative information about the organisation; the number of students by class, including separate data relating to gender and inclusion; data on employees and teachers, including their level of education and professional development; data on the material and technical base of all aspects such as equipment with textbooks, computers and the Internet; information on funding from various sources, including sponsors and parental contributions, and data on the students' educational results and achievements. During the preparation of the maps, we noticed that the data for some schools were incomplete (most often, these were private or created at universities). Also, much of the data for some schools are incomplete and require validation. In such situations, the national team was able to prepare this case study by utilising the data that were mostly complete and of high quality.

3

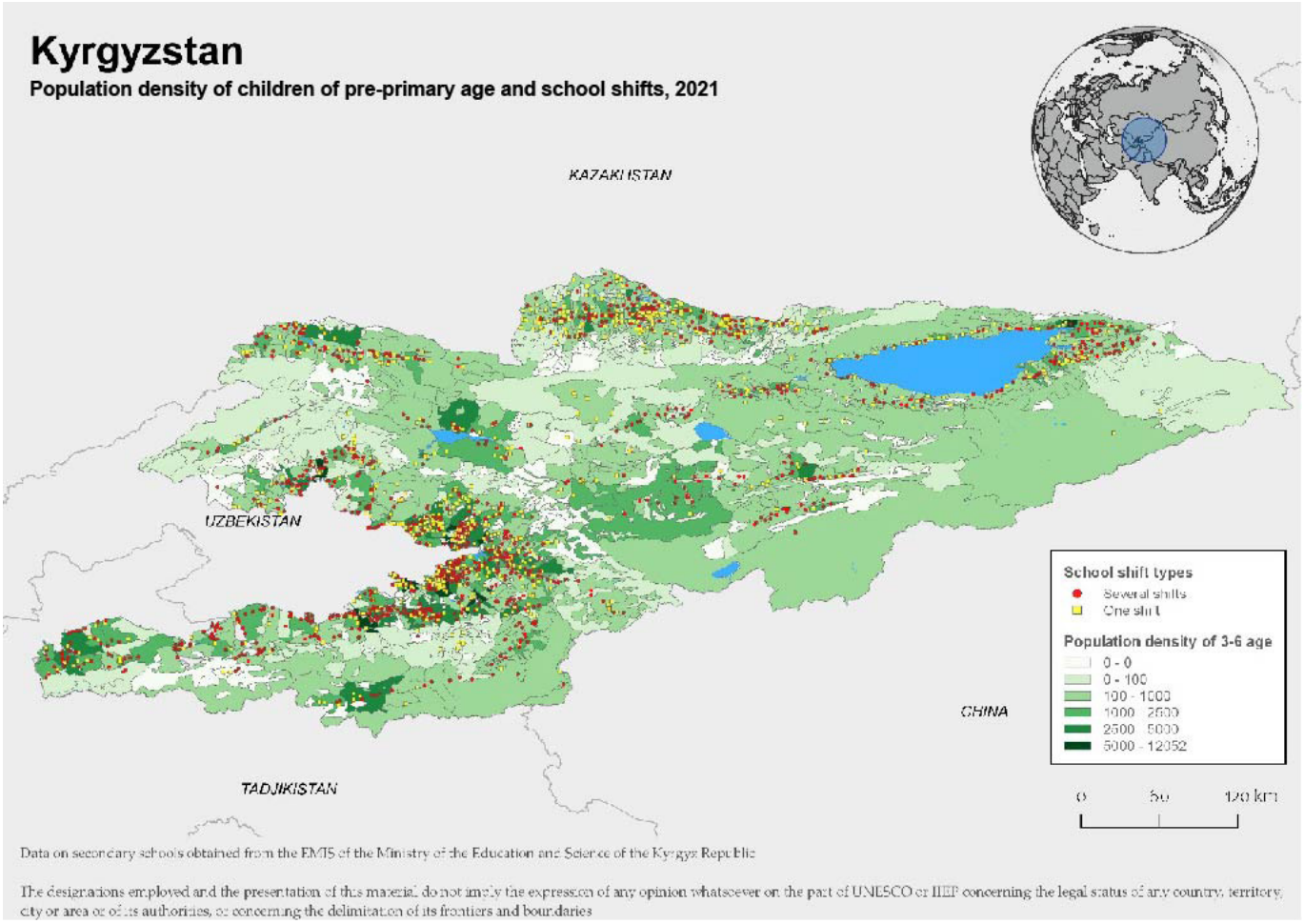
FACTORS AFFECTING THE DEMAND FOR EDUCATION

The demand for education is specific to the population – its numbers, wishes and needs. Second, the state determines which job profiles are needed for the development of the country and economy. Third, the demand for education comes from the labour market and economy as it depends on the level of production and services, the degree of technologization, the direction of development and the security of the country.

In this study, we mapped out two indicators (population density of preschool age children and number or school shifts) to understand how the interplay between these may affect the demand for education in particular *aimags*. The map below (Figure 2) shows the location of schools with one or more (2 or 3) training shifts and the population density of preschool age children (3–6 years) according to the *aiyl aimags* of the country. The map shows that most schools work in several shifts (57% or 1,307 schools) and are located in places with a high population density of preschool-age children.

However, the map also shows that there are some *aimags that operate using a two or three shift system even though the preschool age population density is quite low*. The reason for this is likely due to limited capacity in these schools which could be remediated with the construction of additional premises.

Figure 2: Population density of preschool age children and school shifts (2021)



Additionally, there are *aimags* that have a high population density of preschool age children in which schools are operating in single shifts. One possible explanation for this phenomenon is that parents in these *aimags* tend to choose better quality schools operating on multiple shifts that are outside of their immediate locality.

For a deeper analysis, we might consider each district and *aimag* separately, which would be possible using the QGIS programme[4]. However, to do this, it would be necessary to include the parameters of the distribution of schools by *aimags* (or based on the level of settlements, if necessary) in the EMIS. Also, the EMIS data would need to be more specific and valid in terms of number of schools shifts (1, 2, or 3), language(s) of instruction, school capacity, teacher age, and type of infrastructure. In addition, to determine the need to open schools for national minorities or introduce an additional language of instruction, it would be necessary to have data on the location of the population based on nationality. However, this may not be possible as confidentiality of this type of information is protected by law. In this case, it may be better to conduct surveys of the population, which would require sufficient funding.

4 QGIS is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing and analysis of geospatial data (Source: QGIS official website).

4

HOW EQUITABLE IS THE SUPPLY OF EDUCATION?

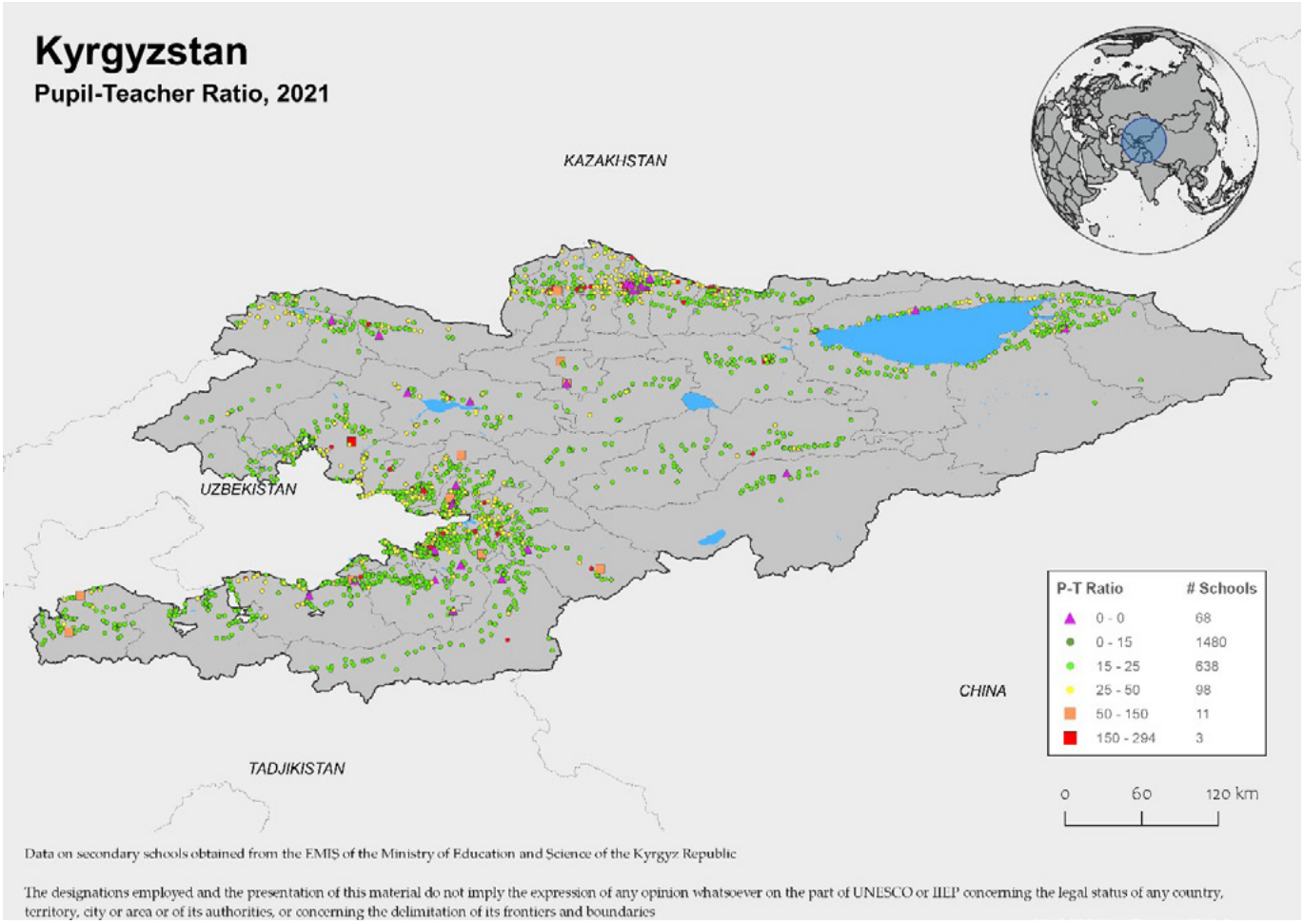
The national team set out to explore two indicators in relation to teachers in the supply of education: 1) the teacher–pupil ratio and 2) the distribution of teachers by teaching experience, that is, young and experienced teachers. Young teachers are those with up to five years of teaching experience, whereas experienced teachers have more than 15 years of experience. The study is looking at this indicator because it may help inform where urgent decision need to be made regarding teacher training due to recent growth in the number of pupils.

The map below (Figure 3) shows the pupil–teacher ratio (PTR) for each school. In most schools (64%), this PTR is 15:1. In 28% of the schools, the PTR ranges from 15 to 25 students per teacher.

In four per cent of the schools, the PTR was as high as 50:1, and in other cases, the PTR was not realistic, which may have been due to invalid data in the EMIS. In 68 of the schools, no PTR was calculated due to lack of necessary data on teacher or pupils.

In Kyrgyzstan's education policies, there is no set standard for PTR. However, various international studies have recommended a norm of 15:1. Although this standard is acceptable for large cities and densely populated regions, a single standard is meaningless for rural areas and areas with low population density. In this regard, in two-thirds of schools, the situation regarding the pupil–teacher ratio is within the recommended norm; in one- third of schools, it exceeds this

Figure 3: Pupil–teacher ratio (2021)



norm; and for the remaining schools, it is necessary to deal with and gather additional data, conduct an analysis for each school and possibly prepare a proposal to address the issue of teacher workload.

In order to present this data on PTR to the education authorities, we prepared maps (see Figure 4 below) for the various districts and regions. Three districts in the Chui region and one in the Naryn region recorded a maximum of up to 44 pupils per teacher. In eight districts (3 in Chui, 3 in Jalalabad, 1 in Osh and 1 in Talas), there were up to 20 pupils per teacher. In the remaining half of the districts, the average figure was normal for some and very low (up to 11 pupils per teacher) for others. These indicators could be distorted due to the invalidity of the data, or the number of unaccounted teachers.

A low PTR might be explained by the limited nature of work opportunities in rural areas. With the exception of state and social institutions, many teachers are employed in schools with a small academic load. For example, the PTR is lowest in the Naryn region (up to 12:1), in the cities of Bishkek and Osh, it is up to 17:1, and in the Chui region, the maximum is up to 19:1. In general, we can say that in the Naryn, Issyk-Kul and Osh regions, there is a problem with the distribution of teaching hours between teachers, which might contribute to low salaries.

As for the teaching experience of teachers, we considered the ratio of young teachers' with up to five years of experience and experienced teachers with more than 15 years of experience, both cohorts in district areas. According to the EMIS data, 53 per cent of young teachers and 30 per cent of experienced teachers make up the majority of the teaching staff. The remaining 17 per cent of the teachers have 5 to 15 years of experience. These teachers are the most stable and confident in their work because they have enough experience and can continue to develop professionally, as they are not close to retirement and will hold on to their jobs at school.

These findings point to specific management measures that could be taken. Young teachers might be retained through various measures to attract new teachers to remain in the profession and by providing them with professional development opportunities on new innovative teaching methods. Experienced teachers may warrant a different approach as many of them have strong pedagogical experience, and some are of retirement age and will need to prepare for a replacement. The EMIS does not collect data on retired teachers, so it is difficult to discuss policy measures to replace them. Nevertheless, there is a large percentage of

Figure 4: **Pupil–teacher ratio by district (2021)**

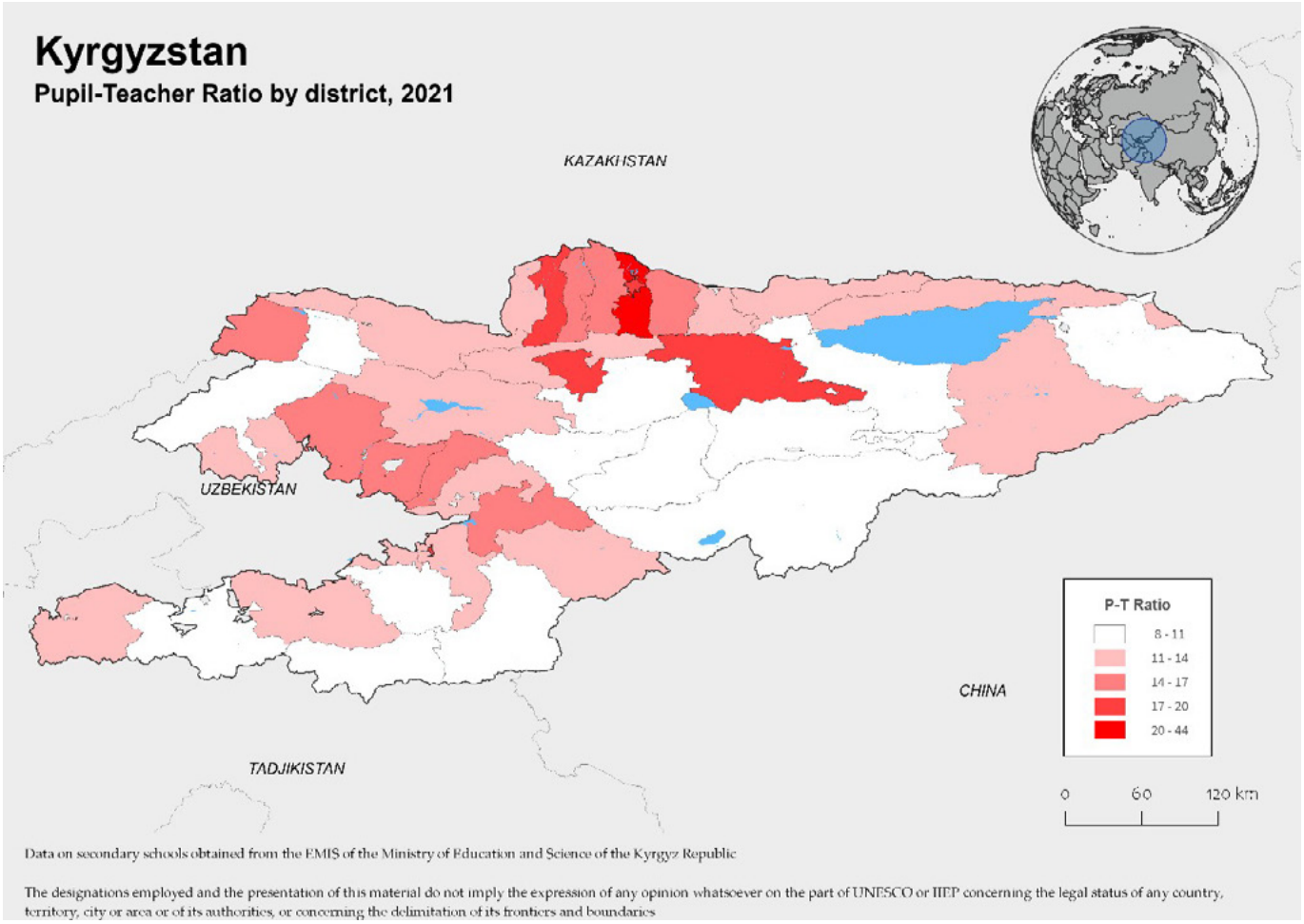
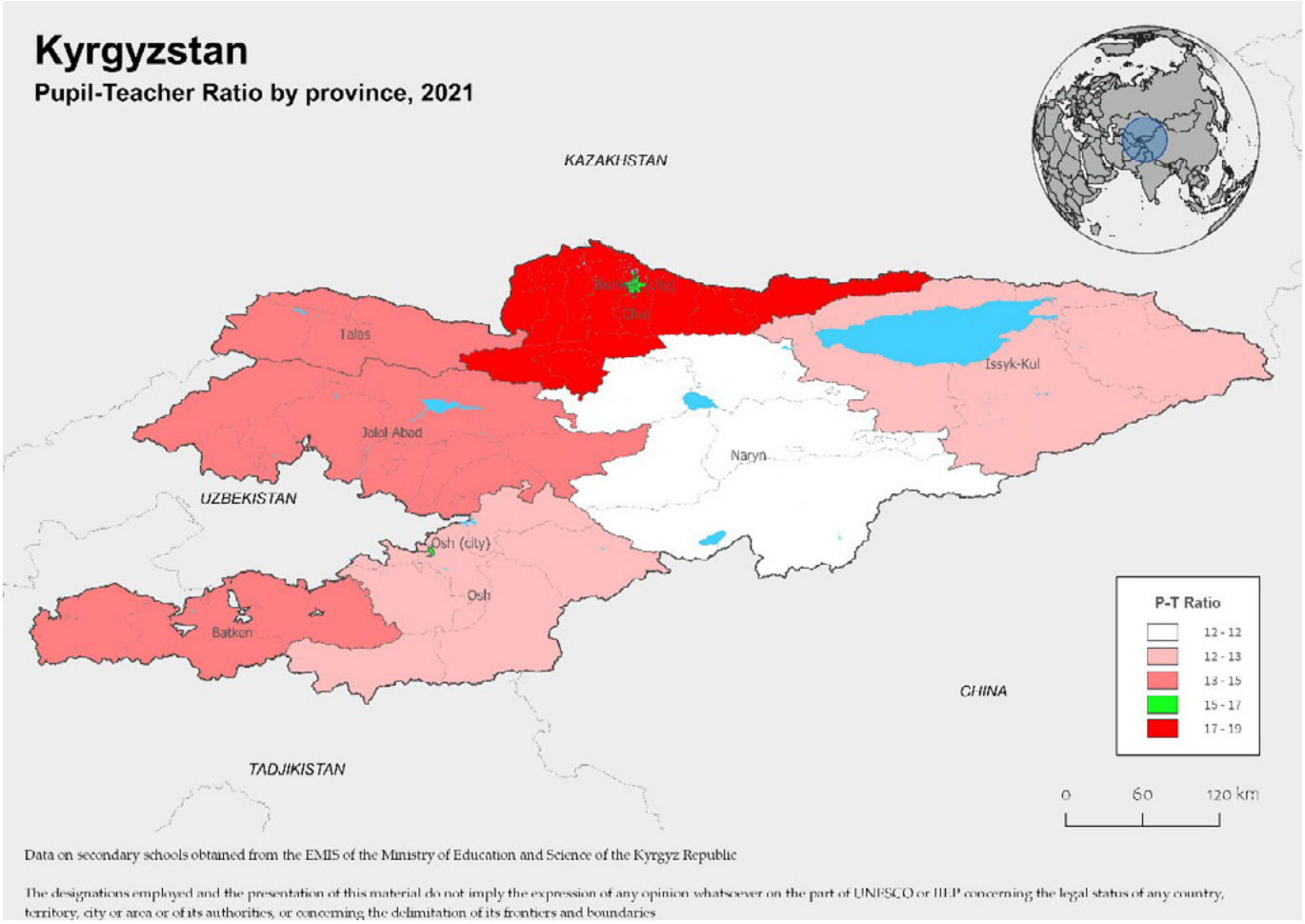


Figure 5: **Pupil–teacher ratio by province (2021)**

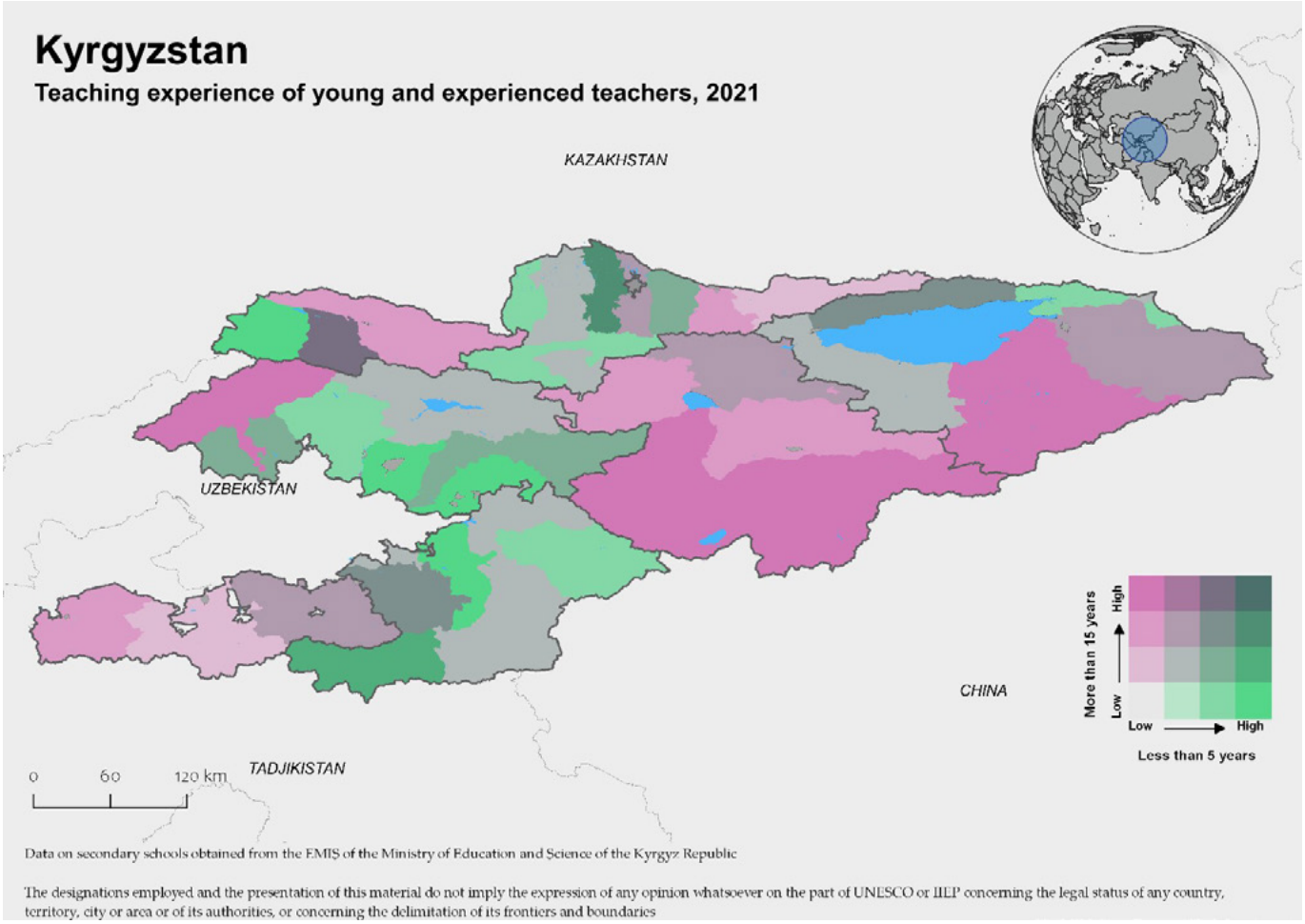


experienced teachers, and it may be necessary to conduct research to understand the specific reasons for that to inform potential policies, teacher training and other forms of assistance.

The following map (Figure 6) shows that in the Naryn, Batken and parts of the Issyk-Kul and Jalal-Abad regions, the teaching staff are older and that in most of the Jalal-Abad, Osh and Chui regions, young teachers predominate. Overall, some areas are replete with numerous young and experienced teachers, while others are practically bereft of young and/or experienced teachers. This is an interesting fact that requires further study.

In order to study this issue more deeply and devise management decisions, there is a need for more reliable and nuanced data on teachers. For example, data is needed on teacher age, academic load, subjects and languages of instruction, terms and types of advanced training courses completed and if possible, achievements. This would make it possible to accurately plan teacher training activiites and tailor plans for professional development. If we could make a similar map for cities and *aimags*, we would be able to ascertain where and what measures should be undertaken in order to improve the quality of education in schools.

Figure 6: **Teaching experience of young and experienced teachers (2021)**



5

POLICY RESPONSES FOR MORE EQUITABLE ACCESS

The analysis presented in this case study shows only a few parameters of the supply and demand of the education system of the Kyrgyz Republic. The demand for education was shown by comparing the population density of preschool age children with the location of schools and the corresponding shifts of study. The supply of the education system was presented through indicators relating to the distribution of schools in the various regions by specific forms of governance (state, municipal, private and mixed) through pupil–teacher ratios in schools, districts and regions and their distribution through the teaching experience of the teachers within the districts. This was an example within the framework of the IIEP-UNESCO training course on how the EMIS and geospatial data can be used to make informed management decisions at the state and local levels and plan proactive policies for the development of the education system.

The use of analyses based on geospatial data will allow the ministry to effectively implement the tasks set out in the DEP-2040,[5] plan measures and make operational decisions on local tasks and focus its efforts and resources on priority measures. For example, it will be possible to determine territories with dense populations and high birth rates, in turn facilitating decision-making on the construction of new schools with modern amenities. The data could also be used to reconstruct and renovate schools in states of emergency or plan the construction of extensions or the redistribution of pupils from overcrowded schools by improving the learning conditions in nearby schools. It is very important for the ministry to design measures to provide schools with teachers, textbooks and computers as well as improve school infrastructure and accessibility so that all children can overcome distance and transportation barriers. Geospatial data may allow us to make a statistical correlation between the provision of schools with resources and the educational achievements of students. It is important for management bodies to be able to visualise and justify their decisions as well as compare indicators between *aimags*, districts and regions.

One of the objectives of the DEP-2040 is to ensure equal access to education. The use of geospatial data makes it possible to study factors related to the inclusive socialisation of children in education. To do this, it will be necessary to have more detailed data on income and social poverty levels, both of which are currently unavailable. For now, it is more realistic to study issues related to the provision of conditions for high-quality educational processes, including measures and policies addressing teachers, textbooks, computers, Internet connection, availability of sewerage, heating, clean drinking water, etc. This will help in planning and decision-making regarding the implementation of the other two tasks of the DEP-2040, that is, ensuring quality education and the effective management of funding.

Another issue that the ministry is concerned with is the availability of schools for children in the border territories. There is considerable distance between the villages and schools in the border areas, with no transport connection between them, and children are forced to walk long distances on occasionally dangerous routes. Geospatial data on the location of schools and safe roads would allow us to design measures to organise transportation for children or solve issues of re-consolidation or the opening of new schools.

Currently, MoES, with the support of UNICEF, is preparing a digital bulletin on education based on EMIS data. The plan is to introduce this into the practice as an annual publication contributing to data accumulation. Access to the digital bulletin will be provided to all government bodies, international and national partners, civil society, educational organisations and the general population. This will allow these entities to establish strategic planning for the development of the education system, make operational decisions at all levels of management, conduct analytical and comparative studies to make informed decisions and help the population make informed choices regarding educational institutions. To do this, it will be necessary that geospatial data be included in the EMIS and that MoES employees use these data in their practical work.

5 See footnote 2.

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