Chapter 4. Capacity building and public services in China

Capacity building, including provision of essential public services, is one of the main channels or incentive areas to support innovation and sustainable development. This chapter concerns five relevant policy areas: infrastructure and rural development; land use planning and regulation; water; labour market and social security; and education and skills.

4.1. Infrastructure and rural development policies

Infrastructure investment has played a key role in the People's Republic of China's (hereafter "China") economic growth, and continues to do so. Infrastructure links different elements of the economic system and enables the movement of factors of production, goods and information across agents and markets. The availability and quality of infrastructure affect the decisions of firms and individuals to invest. As such, infrastructure is important in determining the location of an economic activity and the kinds of activities or sectors that can develop. For example, well-maintained transportation networks in rural areas connect agricultural products to markets, while information and communication technologies (ICTs) connect farmers and rural populations to information and knowledge networks. ICTs have a distinct role in enhancing innovation by speeding up the diffusion of information, facilitating networking, reducing geographic limitations and improving efficiency in communication.

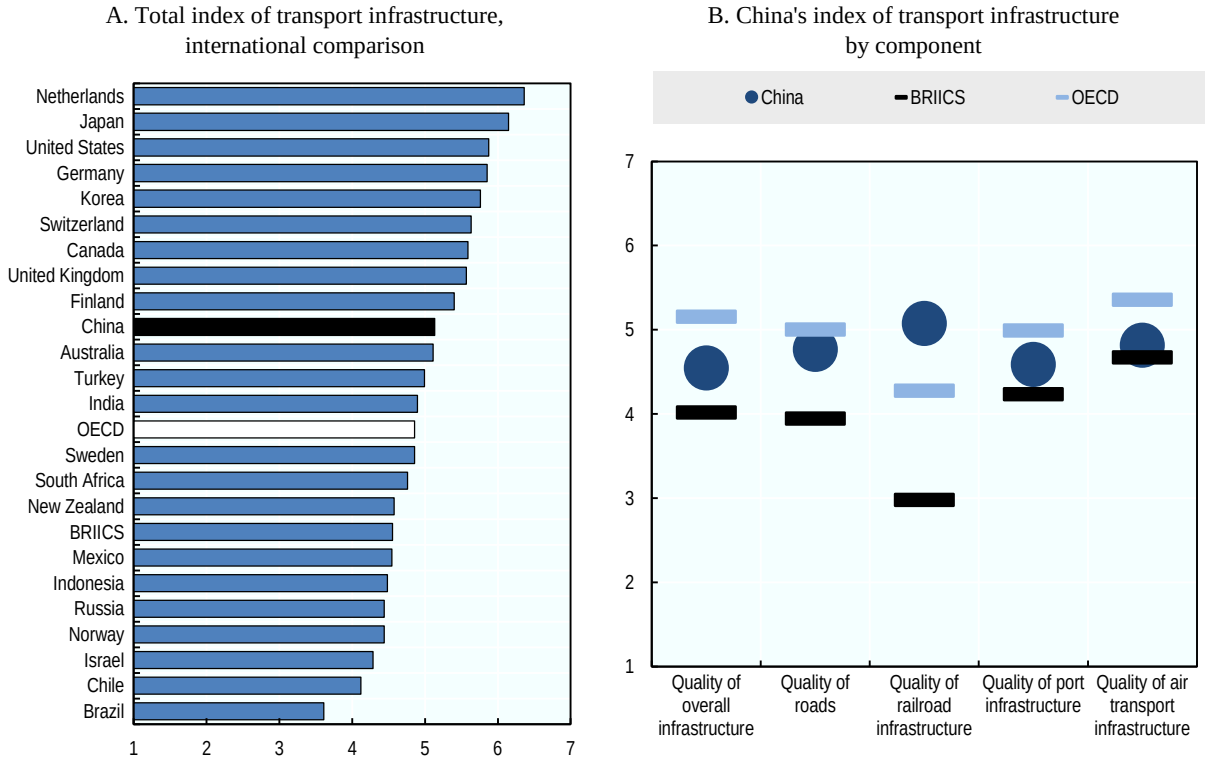
Within the central government of China, infrastructure policy and planning is provided by key agencies under the State Council, including the National Development and Reform Commission (NDRC), the Ministry of Finance (MOF), the People's Bank of China (PBC) and the sector-level ministries that implement projects. In 2000, the Central Government made infrastructure and social development in rural areas a priority, including through the improvement of roads, electricity utilities, drinking water utilities and biogas supply. In 2006, agricultural tax was abolished to reduce the burden on farmers, consequently reducing local government's possibilities to generate funds for rural infrastructure projects and maintenance (OECD, 2009). Meanwhile, fiscal transfer payments to local governments have increased. Overall, the total investment in agricultural infrastructure increased at an annual rate of 20% on average during the 11th and the 12th Five-Year Plan periods (2006-15).

China defines four broad areas of infrastructure investment to achieve the goal of constructing a "new rural area". The first is agricultural production infrastructure, including farmland improvement and irrigation. The second is rural life infrastructure investment, which includes ensuring water safety, rural roads and rural electricity. Access to basic infrastructure in rural areas has improved significantly over the last decades. The entire rural population had obtained access to electricity by 2012. The proportion of the rural population with access to improved water sources increased from 56% to 93% between 1990 and 2015 (World Bank, 2015). Similarly, access to improved sanitation facilities among the rural population increased from 41% to 64% between 1990 and 2015. Investment in ecological environment is the third area of rural infrastructure investment, which includes forest protection, construction of natural protection areas and other investments in protecting the natural environment. Finally, the fourth investment area is in rural social development infrastructure, which includes investment in rural education, health and cultural infrastructure.

China drastically improved its transport infrastructure, with almost all administrative villages gaining access to the public road system by the end of 2006 (OECD, 2009). The World Economic Forum's Global Competitiveness Index shows that China has developed an overall higher quality transport infrastructure than the OECD average (Figure 4.1). In particular, the quality of the railroad system in China is scored highly, while the quality of other transport infrastructure (roads, ports and airports) is more favourable than in other BRIICS countries but below the OECD average.

Figure 4.1. Global Competitiveness Index: Quality of transport infrastructure, 2016-17

Scale 1 to 7 (best)



Notes: Indices for BRIICS and OECD are the simple average of member-country indices. The OECD aggregates do not include Lithuania.
Source: World Economic Forum (2016), The Global Competitiveness Report 2016-2017: Full data Edition, www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

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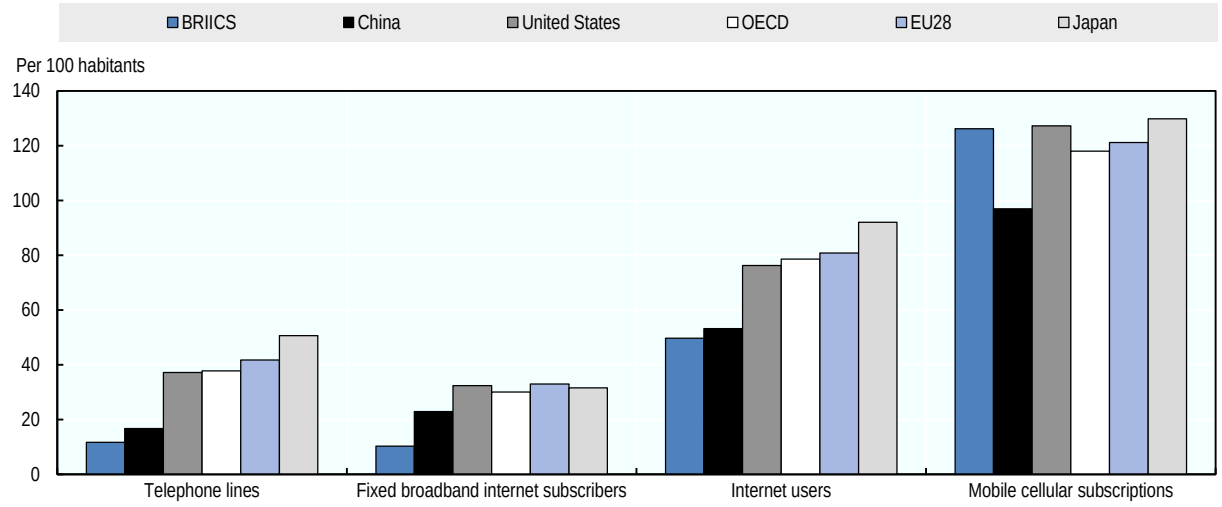
Whereas development and maintenance of remote networks of road and rail carry larger costs than in urban areas, telecommunications and Internet technologies offer connection at decreasing marginal costs. ICT use is essential in developing a knowledge-based economy, as it provides opportunities for better education and training for general skills that promote innovative thinking and facilitate knowledge transfer for farmers. China's 13th Five-Year Plan also aims to integrate agriculture and ICT to improve agricultural productivity. The government is encouraging ICT companies to establish a service platform to connect producers and consumers to accelerate the development of agriculture-related e-commerce. An international comparison shows that China has higher ICT penetration than BRIICS countries except for mobile cellular subscriptions, but lower penetration than the OECD average (Figure 4.2).

Figure 4.2. ICT penetration, 2016



Note: The OECD aggregates do not include Lithuania.
Source: World Bank (2017), World Development Indicators (database), http://data.worldbank.org/indicator.

StatLink http://dx.doi.org/10.1787/888933829227

China has developed a range of specific policies to promote greater adoption of ICT and development of the ICT industry. The State Informatization Development Strategy (2006-2020) includes long-term objectives to establish, promote and expand wider use of ICT across sectors and at the household level. Access to ICT infrastructure varies in China: while three fifths of urban Chinese use the Internet, a 2012 household survey revealed that less than a quarter of the rural population has access to it (Minges et al., 2014), though government investment in ICT readiness in rural regions has accelerated in recent years (Wan et al., 2008). To reduce the urban-rural digital divide, the government has set high-speed Internet connectivity as a strategic public infrastructure programme through its 2013 Broadband China Strategy. The strategy aims to equip 98% of villages with Internet access and provide high-speed connections by 2020 for all rural households.

According to the rural household survey of 2012, almost all villages had electricity and received a mobile signal, but only 20% of the households had a personal computer or accessed the Internet. Few rural public Internet facilities, notably village libraries, offer training on Internet use, and farmers lack knowledge on how to access resources, training and networks on farming online (Minges et al., 2014). The penetration rate of the Internet increased to 33% as of December 2016, which is still below the rate among the urban population (69%) (CNNIC, 2016). The National Agricultural Modernization Plan (2016-20) aims to increase the share of Internet use among the rural population to 52% by 2020.

The National Plan for Education Informatization (2011-20) also aims to equip all rural schools with Internet access. Most teachers even in the rural setting receive information technology training formally through MOE or informally. Students are exposed to information technology but there are limited computers available in rural schools (Minges et al., 2014). In rural communities, one-to-one computing for children would expand the reach to families, providing access and informal training to farming families.

Despite growing investment in rural areas, overall rural infrastructure still lags that of urban areas. Farms benefit significantly from basic infrastructure investment in roads, electricity, water and telecommunication networks as well as knowledge transfer and learning through ICT. Efforts to enhance the penetration of ICT in rural areas should continue, including the use of ICT in agricultural production and marketing.

4.2. Land policies

Protection of land use rights

In China, the rural reform in 1978 initiated the household responsibility system, which allocated land contract rights to households and gave farmers freedom in agricultural operations. This institutional reform stimulated households to improve productivity and profitability. Under the current household responsibility system, land-use rights include property, contract and operation rights. Land property rights belong to village collectives and the sale of land ownership is prohibited (Kung, 2000; Yao, 2000). The village collectively owns land and retains rights to contract, adjust, supervise and take back contracted land to ensure an effective use of collective land.

Securing land use rights is fundamental to the encouragement of investment and the sustainable use of farmland. China has implemented a number of institutional reforms to secure land use rights, which protect farmers' right to use, transfer, pledge land and return contract land (Box 4.1). In 1984, the central government ordered local governments to grant more than 15 years of contract rights. However, most of the villages continued to reallocate land frequently (Brandt et al., 2002). Local leaders reallocated land mainly to maintain egalitarianism rather than to achieve efficient land allocation (Deng et al., 2006). In 1998, the revision of the 1986 Land Management Law granted all farmers 30-year written contract rights and limited administrative land reallocation by village leaders to exceptional occasions. The Rural Land Contract Law in 2002 further strengthened farmer's contract rights by guaranteeing 30 years of security and the freedom of transaction of land operation rights as well as providing dispute settlement rules on land rental contracts.

China is also strengthening the security of contract rights by registering the owners of those rights and issuing certificates to promote investment and sustainable use of land as well as to facilitate transaction of operational rights of land. Pilot work to determine, register and certify contracted rural land-use rights have proceeded across the entire area of 12 provinces and 2 160 counties. As of June 2015, 350 million mu (23.3 million hectares) of land have been measured and the rights to 260 million mu (17.3 million hectares) of land have been verified. The 2016 No. 1 Document targeted the completion of registration and certification of all contracted land by 2020.

Box 4.1. China's Land Administration Law

The Land Administration Law, which entered into force on 1 January 1999, is China's main land use regulation. The Land Law states that land collectively owned by farmers belongs to a village. The collectively owned land is registered by county governments, who issue certificate of the ownership. The use rights of other agricultural land such as grassland and woodland are defined in other laws such as the Forest Law, Grassland Law, and Fisheries Law. Article 14 stipulates that land owned by farmers' collective economic organisations (villages) is to be contracted to members of the organisations for purposes of farming, forestry, animal husbandry and fishery activities for 30 years.

Other government documents including the No. 1 Documents regarding agricultural and rural affairs propose concrete measures to implement the Land Law. For example, the No. 1 Document of 2013 emphasised the importance of promoting transfers of land operational rights, particularly to specialised large farms, family farms, and farmers' co-operatives. The No. 1 Document of 2014 clarified that farmers are allowed to collateralise the land contract rights as a tool to finance investments in farming. The 2015 No. 1 Document put emphasis on the strict implementation of the clarification, registration, and certification of land rental contracts to facilitate the smooth transaction of land operation rights.

The Land Administration Law also protects productive cultivated land and controls non-agricultural use of cultivated land. When cultivated land is converted to other purposes, the same area of cultivated land has to be reclaimed to compensate for the loss. "Basic agricultural land" is defined as particularly protected areas of land; this includes arable land within the production base of grains, cotton and oil seeds, arable land with good water conservancy and water and soil conservation facilities, land within the vegetable production base, and agricultural experimental and education land. This basic agricultural land has to make up more than 80% of total cultivated land at the provincial level.

In addition to maintaining the area of basic agricultural land, the Land Administration Law also protects the productivity and environmental quality of land. It mandates governments to preserve irrigation and drainage facilities, improve soil quality and fertility, prevent desertification, salinisation, soil erosion and land pollution. The conversion of unutilised land is allowed under the overall land use plan, subject to scientific assessment. The Law also prohibits the conversion of forest, grassland, and lakes to cultivated land, but allows cultivated land to return to forest, grassland and lakes. These elements of the Law provide the legal bases for the "returning land to forest" (Grain for Green project) and "returning land to grassland" projects. Regulations on land conversion to construction land include protection of the holder of land contract rights. For instance, the Law sets out the compensation principle, including subsidies for relocation, as well as compensation for properties and crops.

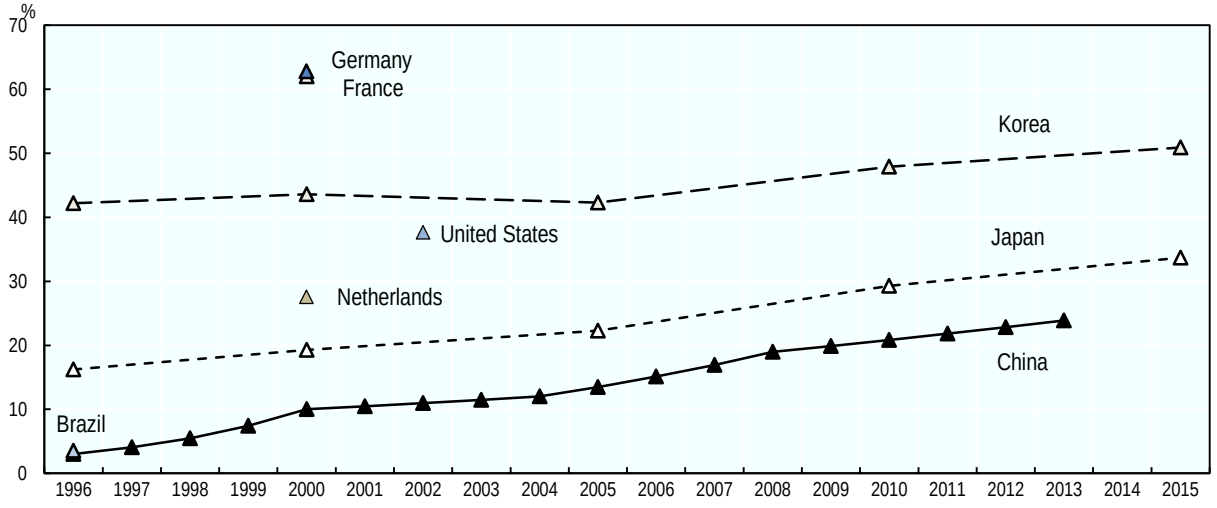
Promoting land consolidation

In pursuing improved farm-level productivity, the introduction of the household responsibility system generated small scale family farms and led to land fragmentation and dispersion. This farm structure has been a major constraint to further improving productivity and competitiveness, particularly in land-intensive agriculture. China took a number of steps to promote more efficient allocation of land resources, while strengthening the security of land contract rights. A reform to separate operational rights from contract rights stimulated land rental. The 2002 Rural Land Contract Law specifically defined the scope of transferability of land and mandated the transfer of land operational rights based on a written contract.

These institutional reforms in land regulation helped to accelerate the transfer of land operational rights (land rental) from the late 2000s, and by the end of 2015, the operational rights of 443 million mu (29.5 million hectares) had been transferred. The share of land whose operational land was transferred increased quickly, from 12.4% to 33.3% between 2009 and 2015 (Han Changfu, 2015). However, the share of rented land in China is still lower than in many OECD countries, where typically more than half of farmland is rented, e.g. Korea, France and Germany (Figure 4.3). While the transfer of land operational rights among relatives and friends within the same village was dominant in China, land transfer to new types of farm operators has been increasing in recent years (Huang, Gao and Rozelle, 2012). For example, of rented-out land in 2013, about 20% was transferred to the Farmer Professional Co-operatives, more than 9% to firms or companies, and the rest to individual households (MOA, 2014).[1]

Figure 4.3. Proportion of rented farmland, 1996 to 2015

Share of total cultivated land rented



Notes: The figure shows that the share of rented cultivated farmland in China increased from 3% in 1996 to around 24% in 2013. Estimates from the World Census of Agriculture highlight that China's share of rented farmland by 2013 remained below point estimates for many developed economies taken around 2000. These included France (taken in 2000), Germany (2000), the United States (2002) and the Netherlands (2000).

Source: FAO (2013), 2000 World Census of Agriculture: Analysis and International Comparison of the Results (1996-2005), FAO Statistic Development Series; Gao, L., J. Huang and S. Rozelle (2012), "Rental markets for cultivated land agricultural investments in China", Agricultural Economics 43(4), pp. 391-403.; State Council of the People's Republic of China.

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Given the dominance of small-scale farms, transaction costs associated with farm size expansion through the transfer of land operational rights is likely to be high, particularly for a large operation. To facilitate the transaction of land operational rights, the local government recently set up land transfer service centres (LTSC) or platforms. Most of these LTSCs were established at township level and, in some cases, larger networking platforms pooling rental information across townships have been set up at county level. Major mandates of these LTSCs are: 1) conducting land rental market surveys and collecting information on who is willing to transfer the operational rights of their land; 2) facilitating land operational rights transfer by providing clients with information on location, area, major characteristics of land plot, and suggested rental prices for each plot of land; 3) preparing and recording formal land transfer contracts; and 4) being responsible for land transfer contract dispute mediation. By 2014, more than 13 000 towns in around 800 counties had established the LTSCs (China Development Press, 2015).

Besides formalising the transfer of land operational rights, China is encouraging various ways of consolidating farm management to explore more effective forms of land operation. One innovative organisational development in response to the agricultural structure dominated by small-scale family farms is the growing consolidation of farm operation to farmers' co-operatives and corporate farms through the transfer of land operational rights or farm machine service contracts. Diverse formats of farm consolidation into these new farm management units have developed in China. For example, land equity and land trusts have emerged, whereby individual farmers can lease farmland or machinery to co-operatives in return for shares in their large-scale farm operations.

These formats of farm consolidation are likely to be a more efficient way to facilitate structural change towards a desirable agricultural production structure than conventional land rental transactions between family farms. This organisational experience of China provides an important lesson for countries dominated by small-scale producers in how organisational innovation can facilitate structural change and allow farmers to integrate with food supply chains.

Conservation of farmland

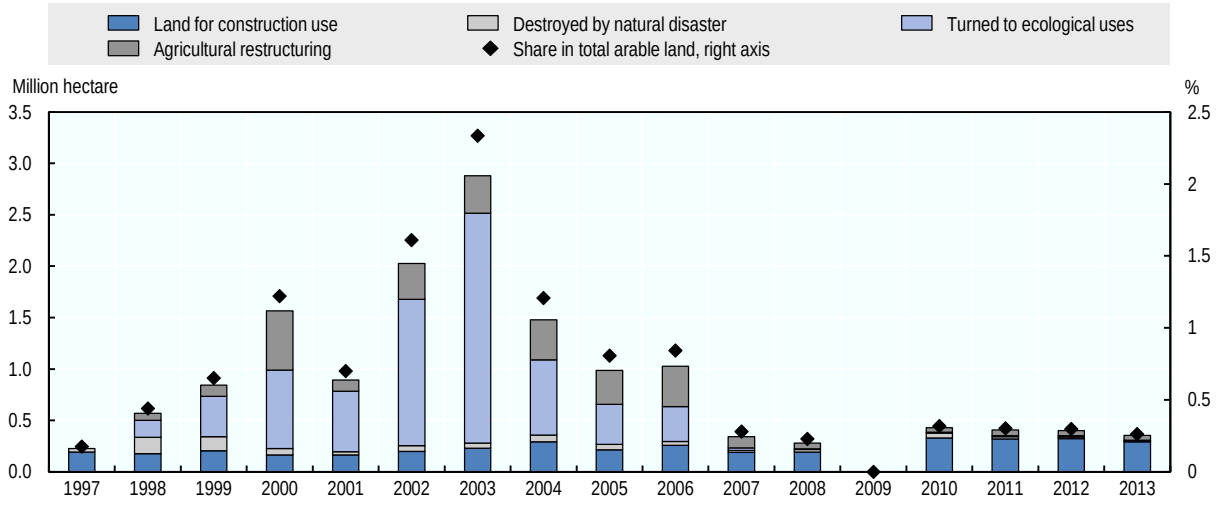
Land is a scarce resource in China and the country's rapid economic growth has increased competition between agricultural and other land use. Arable land area declined an average of 500 000 hectares per year between 1997 and 2013; in the early 2000s, the area of converted arable land exceeded 1% of the total area, but the majority of this was converted to ecological use such as forests and grasslands (Figure 4.4). However, Kong (2014) finds that around 3 million hectares of high-quality arable land and 1 million hectares of paddy land were converted to urban use in just over a decade, and more than 3 million hectares of farmland suffered from environmental degradation. It is often the case that arable land plots favourable for agricultural production are also suitable for construction use because of their good road access, and the flat and square shape of the plot.

China places the preservation of high-quality arable land high on its policy agenda. It has also set a "red line" for the protection of certain areas of farmland (permanent basic farmland) as a result of national food security concerns. The Outline of the National Overall Planning on Land Use (2006-2020) aims to preserve 1.805 billion mu (120 million hectares) of arable land, including 1.546 billion mu (104 million hectares) of basic agricultural land. It also limits the conversion of arable land to construction land to 45 million mu (3 million hectares) in total by 2020. The Outline also includes the target of preserving ecological land. Alongside the protection of arable land, "basic ecological land" is strictly protected to ensure that cultivated land, orchards, forests, pastureland, water areas, and certain unutilised land that have ecological functions have to exceed 75% of the total national land area. The Outline strengthens the ecological function of land, including maintenance of the retirement of certain cultivated land, the ecological rehabilitation and reclamation of wasteland from mining activities, and the prevention and treatment of degraded land.

Given the scarcity of land in China and the higher return on industrial or residential use of land, the conversion of agricultural land to non-agricultural use is inevitable. The conversion of land use may contribute to the diversification of economic activity in rural areas. The land use policy should prioritise the conservation of high-quality farmland and concentrates agricultural investment to such area. They should also guide the conversion of farmland to other purposes based on a clear land use plan at the local level.

The geographical distribution of agricultural production has been rationalised over the past three decades, reflecting the production conditions of different regions. For example, rice production has been concentrating in northern China, mainly in Northeast China. The 2017 No. 1 Document proposed to establish functional zones for production of rice, wheat and corn, and production protection zones for soybean, cotton, rapeseed, sugar cane, and rubber, which concentrate infrastructure investment and subsidy programmes. In April 2017, the State Council issued a guideline establishing these functional and protection zones.

Figure 4.4. Area of arable land converted to other use in China, 1997 to 2013



Source: MLR (2015).

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Farmland improvement

In addition to the institutional reform of land markets, China recently started to emphasise the promotion of construction of high-standard farmland. The 2016 No. 1 Document urged the government to speed up the investment in farmland improvement so that China develops 800 million mu (53 million hectares) of concentrated and contiguous, drought proofed, consistently high-yield, eco-friendly farmland by 2020. The government prioritised investment in the main grain producing regions. The construction of high-standard farmland will be one of the assessment criteria for the performance of local governments.

The high-standard farmland thus achieved will be maintained as permanent basic farmland. The public investment in farmland is expected to improve productivity and environmental performance of crop farms by improving the efficiency of farm machine use, mitigating the weather risk for production and reducing water use.

4.3. Water policy

China faces multiple water challenges, including an uneven distribution of resources, large water consumption from agriculture and increased water demand from other sectors, and growing water quality issues (Jiang, 2009, see Annex 4.A). These concerns are expected to last: water shortages are projected to increase, particularly in the North China Plain, adding to the tensions of projected large increases in water demand (2030 Water Resources Group, 2009; Fang et al., 2010; Hijoka, et al., 2014).

Sustainable productivity growth in agriculture requires a sufficient and stable quantity of usable freshwater for crops and livestock, and minimised impacts of agriculture activities on water resources. Irrigation is particularly critical to agriculture productivity in China (Khan, Hunjra and Mu, 2009); for example, crop productivity directly relies on irrigation in the North China Plain (Wang et al., 2001). Fulfilling these conditions depends on the effectiveness and direction of i) quantitative water resource management policies; ii) water

quality oversight; iii) water risk mitigation policies; and iv) the financing and management of infrastructures supporting these functions.

This section reviews current and planned water policies in these areas, drawing on examples from key agricultural regions. The analysis draws on recent policies (listed in Annex 4.B) and available publications.

China's water governance

As in many other large countries, multiple institutions manage water resources in China, at different levels, separating responsibility both horizontally and vertically through the combination of regional management and watershed management (Box 4.2). But the existing fragmentation is affecting the effective management of water due to a lack of co-ordination and co-operation across agencies (Jiang, 2009). For instance, in the case of drinking water, the lack of a co-ordination mechanism associated with unclearly defined responsibilities creates gaps and overlaps in management (Liu, 2006).

Furthermore, river basin agencies are often superseded by regional political authorities, impeding the objective of integrated water resource management (Jiang, 2009). The unclear delineation of authorities among administrative levels creates transaction costs and inefficiencies. The fragmentation of authorities also leads to ineffective application of management objectives, with water use exceeding quotas in some regions (ibid.). Moreover, different objectives across regional and national authorities have contributed to the mismanagement of water pollution (Moore, 2013).[2] In some cases, diverging regional priorities has generated inter-jurisdictional conflicts (ibid.).

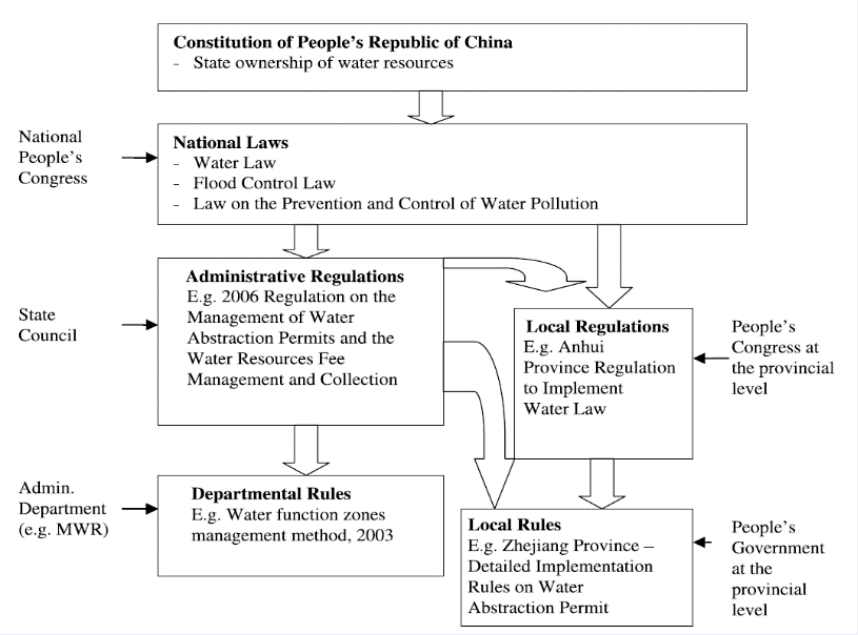
For these reasons, the governance of water in China appears to be below the standards defined by the OECD Principles on Water Governance (OECD, 2015c, Annex 4.C). This is particularly the case when considering the lack of co-ordination, unclear allocation of responsibility, and lack of stakeholder participation (Gleick, 2009). Still, efforts at the regional level have been conducted to cope with some of these issues and to increase co-ordination, information and stakeholder participation, for instance, in the Hai river basin (Wijnen et al, 2012).

Box 4.2. Legal framework and governance of water in China

China's water management relies primarily on three key pieces of legislation: the 1988 Water Law (revised in 2002, 2009 and 2016), which frames water rights and allocation systems; the 1997 Flood Control Law, which focuses on floods; and the Law on the Prevention and Control of Water Pollution of 1984 (amended in 1996 and 2008), which focuses on water quality. These laws were used in the development of regulations and rules for departments and provinces (Figure 4.5).

Water governance is covered by multiple administrative departments under the oversight of the State Council. The major administrative body responsible for water management is the Ministry of Water Resources (MWR). Two layers of lower-level management co-exist under the MWR. First, the Provincial Water Resources Departments, which oversee multiple levels of Water Resource Bureaus or, increasingly, integrated "Water Affairs Bureaus" (or "water authorities"). These local bureaus' responsibility can cover water resources management, but also water supply, urban water savings, flood control and management, and wastewater treatment. In practice, these Bureaus often respond more to provincial authorities than to the MWR. Second, the seven National River Basin Commissions are charged with implementing the MWR activities along river basins.

Figure 4.5. China's legal framework on water



Multiple functions are devolved to other ministries: the Ministry of Environmental Protection (MEP) enforces environmental laws; the Ministry of Agriculture (MoA) focus on agriculture conservation through resources including engineering facilities, agricultural technologies, machinery and biotechnology to develop water-saving agriculture; the Ministry of Land and Resources (MLR) oversees groundwater resource management; and the NDRC administers pricing of water. In the case of drinking water, the MWR, MEP and MoA share responsibilities with the Ministry of Housing and Urban-Rural Development (urban water supply), the Land Department (groundwater quality), and the National Health and Family Planning Commission (water quality monitoring).

Source: Liu, B., and R. Speed (2009), "Water Resources Management in the People's Republic of China", *International Journal of Water Resources Development*, Vol.25, No. 2, pp.193-208; Liu, B. (2006), "China's Agricultural Water Policy Reforms", in *Water and Agriculture: Sustainability, Markets and Policies*, OECD Publishing, Paris; Lohmar, B. et al. (2003), "China's Agricultural Water Policy Reforms: Increasing Investment, Resolving Conflicts, and Revising Incentives", *Agriculture Information Bulletin* No. (AIB-782), Economic Research Service, United States Department of Agriculture.

Sustaining sufficient water resources

Several policy alternatives have been pursued to cope with the growing water quantity challenges associated largely with growing use and uneven distribution of resources. Significant investments have first been made on supply-side engineering approaches, with the goal of relieving the constraints (Jiang, 2009; Barnett et al., 2015). More than 87 000 reservoirs have been built to store a capacity of over 7 000 km^3 of runoffs and precipitation in the last 65 years (Xiao-jun et al., 2012). A number of large dams have increased hydropower capacity but were often accompanied by significant social and environmental problems (Box 4.3). Large water transfers have progressively moved water from agriculture to municipal and industrial sector use, at the risk of social tensions and conflicts (Gleick, 2009). The latest development has been the South to North Water Diversion (SNWD) project, shifting up to 9.5 billion m^3/year from the upper reaches of the Yangtze River to the Yellow River, to help lessen droughts and water shortages in parts of

North China. Despite its immense scale, reports suggest that this project will not be sufficient to cope with the expected increased demand (Barnett et al., 2015).

Box 4.3. Major infrastructure investment in the Three Gorges Dam and the South to North Water Diversion

The Three Gorges Dam is the largest but also most controversial dam in China. Built in 12 years and finished in 2005, it sits on the Yangtze River in Hubei Province and has a capacity of 39.3 million m^3. The dam regulates flow downstream (reducing Shanghai's flooding), provides 22.4 GW of hydropower and facilitates trade on the river. However, its building was accompanied by significant problems: it required the resettling of over 1 million people and was associated with water quality and broader environmental damage. Concerns remain regarding sedimentation of the dam, its stability in an active seismic zone and periodic salinisation of the Yangtze River.

The South to North Water Diversion (SNWD) is the largest inter-basin transfer scheme of the world. It is expected to have the capacity to extract up to 9.5 billion m3 per year from the Yangtze River basin in the south to the drier north China, feeding megacities and provinces. The Central and Eastern routes, each transferring water over 1 000 km, started to operate in 2014; the project includes a possible Western route, shorter but requiring the drilling of hundreds of kilometres of tunnels in hard rocks. Construction of the SNWD has cost about USD 80 billion, resulted in the displacement of 300 000 people due to rising water, and created new water quality and environmental challenges. Originally seen as an important instrument to relieve the water shortages in north China, the transfer is now seen as providing "temporary" relief to overall water stress, particularly when considering the North China Plain Aquifer depletion.

Source: Barnett et al. (2015), "Transfer project cannot meet China's water needs", *Nature*, Vol. 527, pp. 295-297; Jiao, L. (2010), "Water Shortages Loom as Northern China's Aquifers Are Sucked Dry", *Science*, Vol. 328, pp. 1462-1463; Tan et al. (2015), "Towards a water and energy secure China: Tough choices ahead in power expansion with limited water resources", China Water Risk.

The government progressively increased its emphasis on water demand management. Water rights systems were introduced in the 1988 Water Law, and then strengthened in 2002 (Liu and Speed, 2009; OECD, 2015d). Water is publicly owned by the state and allocated via both basin and regional multi-annual plans. Priority is given to urban users over agriculture and industry (Lohmar et al., 2003). Water users have to use a permit (right) to abstract water for a specified fee set at the regional level. The framework also allows for the trading of water rights, but it was primarily used by the government to support transfer initiatives. Water pricing measures have been initiated and applied particularly in cities. The 2002 Water Law aimed for charges at cost recovery levels (Lohmar et al., 2003). Water efficiency measures were also introduced in the 2002 Water Law. Public campaigns were launched to raise public awareness of the need to conserve freshwater (Zheng et al., 2010). Regarding groundwater, the 2002 Water Law allocated all groundwater property rights to the state and forbade unsustainable groundwater use (Wang et al., 2009). This was accompanied by policy measures to regulate drilling of wells, well spacing and adding a fee for groundwater collection (Shen, 2015). In 2005, groundwater zoning was also introduced for allocation and planning purposes (Shen, 2015).

While China made progress in increasing water use conservation, leading to minimal increase in demand compared to GDP growth, unsolved challenges remain, including gaps in policy and insufficient implementation, particularly in rural areas. The Yellow River achieved partial success in its comprehensive allocation of water, but the water rights system remained unclearly defined, incomplete, unmonitored, and partially enforced (Jiang, 2009; Liu and Speed, 2009). For instance, abstractions in the largest irrigation

districts were not monitored. Pricing was incompletely applied, and limited if at all applied for agriculture (Liu, 2006; Khan, Hunjra and Mu, 2009). A large number of provinces implemented water efficiency measures and quantitative restrictions, but not fully in rural areas (Liu and Speed, 2009; Blanke et al., 2007). Groundwater laws were not effectively implemented; instead, local farmers and rural institutions actively responded to shortages (Wang et al., 2007).

The latest policies, initiated by Document No 1 of 2011 and most recently reiterated by Document No 1 of 2017, emphasise a higher control on water use, its more effective allocation and increased water efficiency. The water conservation objective centres on the "red line for controlling total water use", which caps total water use to 670 billion m^3 in 2020 and 700 billion m^3 in 2030. The plan is meant to be applied at the provincial level, with sub-totals for cities and counties. The system relies first on the introduction of water quotas for water users from river basin level to irrigation districts and village levels. It is supported by withdrawal permission and water fee collections for all water users. Second, socio-economic planning and project construction is required to adapt to local water resource conditions, with limits for regions close to their water caps. Third, groundwater resource management has been strengthened. Provinces have to determine the status of groundwater resources. Exploitation should be gradually reduced in regions with groundwater overdraft, and quasi-forbidden for deep confined aquifers.

The government also introduced measures to improve water resource allocation. They include an integrated water allocation set at the river basin level, superseding other allocation plans. A continued effort is directed towards the water supply side, involving both improved transfer and the promotion of reuse of treated wastewater and desalination. Based on the water quota system, the government also aims to introduce water rights institutions to encourage water markets and transactions across sectors, regions, and/or specific users.[3]

These initiatives are complemented by efforts on water efficiency improvements under the "red line for water use efficiency", with a set of goals for 2020. In particular, water use per GDP should decline by 23% between 2015 and 2020, while irrigation efficiency should reach 55% by 2020 for a total irrigated area exceeding 1 billion mu (66 million ha). These targets are supported by investments in upgrading irrigational infrastructure in large districts, and a stricter control of new constructions in regions suffering from water shortages. Water saving facility should be included in new investment projects. In 2015, the central government invested in pilot projects for controlling over-exploitation of surface water and groundwater. Where efficient water-saving irrigation was adopted based on local conditions, the planting area of crops with high water consumption was reduced and groundwater wells were filled so as to improve agricultural and aquatic environments. Lastly, a stronger water pricing policy is being introduced, gradually increasing water prices for urban and industrial water uses.

Agriculture water price is also subject to a comprehensive reform. In particular, in January 2016, the State Council announced that China will establish a new agricultural water price mechanism within ten years. The policy is aimed at adjusting agricultural water prices to cover the cost of operation and maintenance. According to the proposed system, water prices would increase when water use exceeds a certain level and would also reflect seasonal differences in water use (OECD, 2017a).

Preserving water quality: water sanitation and pollution control policies

The government's main policy responses to the degradation of water quality have included setting regional objectives, approving standards, and strengthening the monitoring and enforcement of regulations. Under the 2002 Water Law, water quality protection is applied by zones, classified by MWR basin commissions and local departments (Liu and Speed, 2009). Each zone is defined by the specific intended functions of the water body. Discharge caps are set in each zone, and permits can be acquired depending on this cap and other regulations. The 2008 Water Pollution Prevention and Control Law strengthened monitoring and enforcement, setting up regional supervision centres and water quality bureaus under the Water Basin Commissions (Moore, 2013).

There has been measurable but insufficient progress in water quality since the 2002 Water Law. Water pollution remained very serious in multiple areas (OECD, 2007), and sewage treatment rates have increased dramatically, but insufficiently to avoid having large amounts of untreated wastewater dumped in the environment (Jiang, 2009). Toxic discharge from industry were reduced by 60-70% from 1998 to 2006 (Liu and Speed, 2009), but continued to be too high in many locations. Municipal waste discharges were decoupled from economic growth but remained high (OECD, 2007).

More recent policies emphasised even stronger monitoring and control on water quality sources. They first introduced the "red line to strictly control the total discharge of sewage into rivers and lakes", with goals on increasing the share of total water of good quality (class III or higher) in major river basins (higher than 70% by 2020, and 75% by 2030) and the proportion of high quality drinking water in cities (above 93% in 2020 and 95% in 2030), but also reducing the share of water areas with low quality (under class V) to below 15% by 2020. These goals are supported by the reinforcement of early warning and monitoring systems on water quality at the regional level, and special treatment plans to control discharge from ten key polluting industries (including paper, printing and dyeing and agriculture). For agriculture, the government's 2020 Zero-Growth Action Plan for Chemical Fertilizers and Pesticides introduced targets and means to reduce pollution. The government also introduced pollution discharge fees, above set minimal levels, for industries on selected key pollutants including ammonia, nitrogen, heavy metals, nitrogen oxide and sulphur dioxides.

Special attention has also been devoted to the improvement of groundwater quality. First, the government launched a comprehensive survey of groundwater pollution (completed in 2015) and a national monitoring and management system devoted specifically to groundwater. It has also established a risk prevention mechanism for groundwater used for drinking purposes. This includes strict monitoring and control of groundwater pollution from key industries and urban uses. In agriculture, efforts have been made to encourage farmers to reduce fertiliser and pesticide use, and to promote organic agriculture. Groundwater remediation actions have also been planned.

Protection of water resources is the responsibility of the MWR and MEP. In collaboration with the NDRC, the MOA and the Ministry of Industry and Information Technology (MIIT), the MWR and MEP developed a Water Pollution Prevention and Control Action Plan in 2015. In this plan, various references and measures have been made to water pollution deriving from agricultural activities.

First, to reduce pollution from intensive livestock and poultry farming, strict zoning regulations are in place to keep certain areas free from these activities; existing large scale operations and specialised farm households are to be closed or reallocated. This measure is

to be first implemented by the end of 2017 in the Beijing-Hebei-Tianjin area, the Yangtze River Delta, and the Pearl River Delta. Permitted large-scale operations must build complementary manure and waste-water storage, processing, and reutilisation facilities, whereas areas with intensive backyard livestock and poultry activities need to implement a system of individual manure and waste-water collection and of collective treatment and reutilisation. From 2016, newly built, expanded, and remodelled large-scale livestock and poultry farms must implement separate treatments of rain and waste water, and provide processing and utilisation of manure and waste water. These requirements are to be coordinated by the MOA with participation from the MEP.

Second, concrete measures are initiated to control agricultural non-point pollution from the use of fertilisers and pesticides. Aside from government programmes for supporting the use of low-toxicity pesticides and the application of formula fertilisation by soil testing, environmental requirements are also imposed on the construction of high-standard farmland and on land consolidation and exploitation. In particular, in sensitive areas and large- and medium-scale irrigation areas, existing ditches and ponds are to be utilised for growing water biomes and for installing permeable dams and other installations, for purposes of purifying farmland drainage and surface runoff. These measures are to be implemented by the MOA, with participations from NDRC, MLR, MEP, MWR, and others.

Third, adjustments are to be made to the nationwide structure and spatial distribution of the crop sectors. In water-shortage regions, pilot projects are to be implemented on retirement of land for reduction of water use. In areas where ground water is susceptible to pollution, priority should be given to the cultivation of crops requiring less fertiliser and pesticide. In areas where surface water and underground water has already been over-drafted and where agricultural water withdrawal is high, such as Gansu, Xinjiang, Hebei, Shandong, and Henan, appropriate adjustments are to be made on reducing the cultivated areas of crops that are intensive in water use. By the end of 2018, it is planned that comprehensive adjustments are to be made on 33 million mu (2.2 million hectare) of irrigated farmland to achieve water saving amounting to more than 3.7 billion cubic meters. These projects are to be led by the MOA and MWR, with participations from the NDRC and MLR.

Other measures relevant for the agriculture sectors in the Water Pollution Prevention and Control Action Plan are: the development of water-saving technology and constructing of water-conservancy infrastructure to meet the target of having 700 million mu of farm land covered by water-saving irrigation technology; the implementation of comprehensive reforms of the agricultural water pricing schemes; and the inclusion of agriculture pollutants in the national survey and monitoring system of pollutants, especially via the inclusion of nitrogen and phosphorus in the binding targets of total pollutant discharges.

China issued *Administrative Measures for the Collection and Use of Compensation Fees for Water and Soil Conservation* in 2014, clearly stipulating the requirements for the collection, payment into the treasury, use and administration of compensation fees for soil and water conservation, and considering compensation for water and soil conservation. In May 2014, China implemented the trial charging standard for water and soil conservation.

Managing climate-related water risks

Several policies have been introduced to address water risks. A target was set for 2020 to improve flood control and drought resistance capacity, which includes improvement of river reaches and reservoirs. In parallel, the government strengthened the monitoring and early-warning information systems. It also reinforced the emergency management system for water risks that clarifies responsibilities across departments to ensure co-ordinated

action. Emergency rescue teams were established and charged with efforts to set up emergency plans and to improve flood control and drought relief services in counties and townships.

Other actions have been undertaken gradually to respond to drought, combining water reservoir and demand management (Xiao-jun et al., 2012). Most recently, the government has encouraged the construction of a limited number of approved drought-resistant water projects, specifically designed to store and release water in case of emergencies. The government has also explored the use of artificial rainfall, notably by using climate engineering solutions to trigger precipitation.

In the case of flood management, policies have shifted from engineering supply-side approaches to more institutional management resolutions (Liu and Speed, 2009). Very large efforts have been made by governmental authorities to ensure better information, preparation and mitigation infrastructure, but damage remains high in large flooding events (ibid.).

Sustaining finances for management and infrastructures for water conservation

The government has pushed to increase investment in water conservation. Under the 2011 No. 1 Policy Document, "efforts should be made [by the government and other stakeholders] to increase investment in water conservation so that the annual average investment of the whole society on water conservation in the next 10 years is two times as much as the level in 2010". In particular, the government supports a central water conservation construction fund (CNY 4 billion - USD 600 million - in recent years) to support projects, maintain or repair water infrastructure and fund emergency flood activities.

At the local level, the fund can be allocated to a wider range of programmes, covering improvement of river breaches and reservoirs, erosion and flood control, and emergency flood control. An additional special subsidy fund is dedicated to the operation and maintenance of water conservation projects in central and western China (amounting to CNY 1 billion - USD 150 million - in 2011). In addition, the State Development Bank, Agricultural Bank, Rural Credit Cooperatives, Postal Saving Bank and other financial institutions are encouraged to further increase the provision of bank loans to rural water conservancy projects.

Water policy and the future agriculture productivity growth

The above overview shows that the government of China has increased its efforts, investments and policies to address the multiple major water challenges it faces. Recent policies, prompted especially by Document No. 1 of 2011 (the first to focus specifically on water security instead of agriculture) has led to ambitious plans to increase water conservation, water use efficiency and quality improvements. In particular, groundwater investments have been bolstered and are increasingly becoming a priority for action.

Given the scope and complexity of China's water challenges, prioritising future policy efforts to agriculture production regions identified as facing the most water risks – using a water risk "hotspot approach" – could help accelerate progress at a lower cost (OECD, 2017b). This may involve upscaling and continuing to support successful pilot programmes, and extending those in high risk regions.

Examples from the past have shown that implementation remains the key challenge for water management improvements. The co-ordination of action across the multiple agencies

and implementation levels will need to be closely monitored to see if progress can effectively be achieved. In particular, the proposal to strengthen agriculture water prices should be carried out progressively.

Whether agriculture can achieve sustainable productivity growth will critically depend on the ability of water policies to fulfil the set goals effectively; however, both the agriculture sector and the policies to which it directly responds also have a key role to play in increasing efficiency, reducing pollution, and adapting to water risks.

4.4. Labour market and social security policy

Labour market policy influences employment composition and can play an important role in facilitating structural adjustment. Flexibility in labour mobility and social security help provide the conditions for innovation and skills training. It also facilitates the transition of labour from agriculture to other sectors and retirement of aged farmers from the sector. Labour regulations affect the cost and conditions of employing labour, and thus production choice by firms and their incentives to invest in new products and processes. Innovative enterprises engaged in changing technologies, processes, or business organisations are likely to be particularly sensitive to adequate conditions for hiring and dismissing people, complemented by a good unemployment insurance system and support for job placement, skills training and continuous learning. Labour market policies play an important role not only for the general economy, but for bringing innovation into the agricultural sector through improved opportunities for rural employment overall.

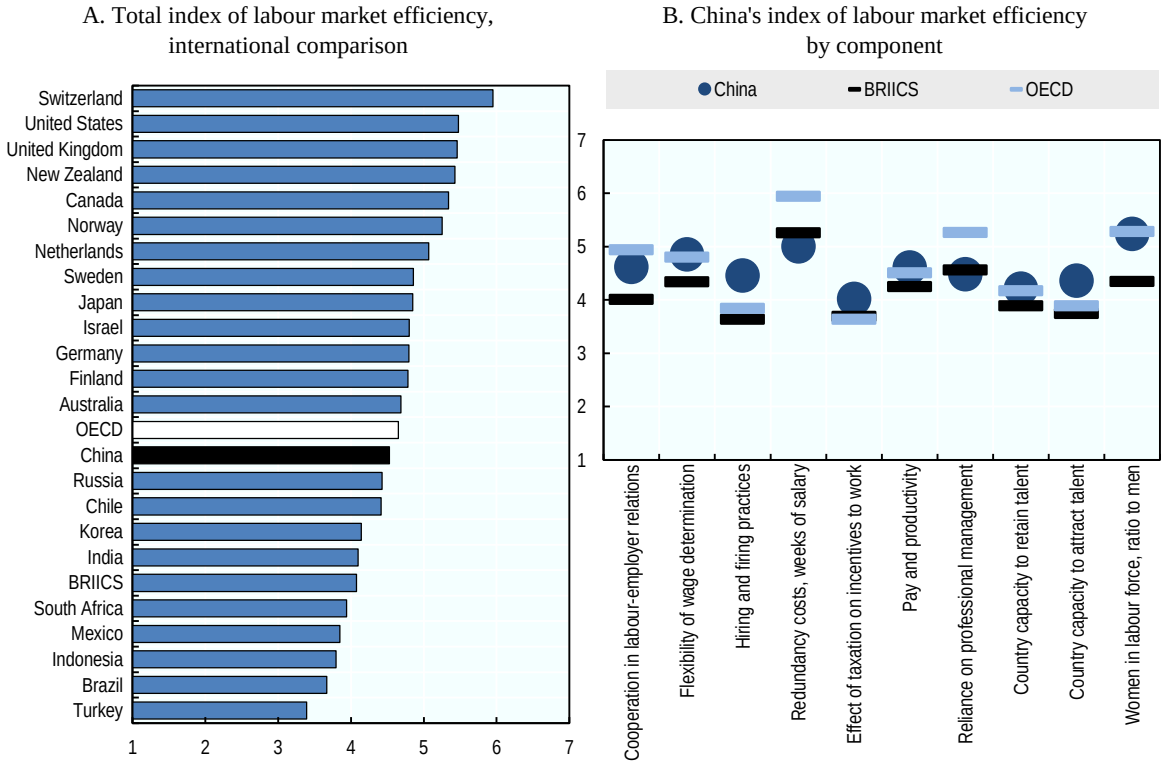
General features of the labour market

The 2008 labour laws provide the legal basis to regulate labour contract and working conditions, and provide a framework for dispute settlement, employment services, unemployment insurance and training programmes. While the labour laws are particularly strict in the procedure to change working conditions or terminate indefinite employment contracts, the regulation on fixed-term contracts are more liberal compared to other countries (Herd, Koen and Reutersward, 2010).

The World Economic Forum's Global Competitive Index ranks China slightly below the OECD average in overall labour market efficiency (Figure 4.6). The database ranks China particularly high in flexibility of wage determination, the hiring and firing process, pay and productivity, and female participation.

Figure 4.6. Global Competitiveness Index: Labour market efficiency, 2016-17

Scale 1 to 7 (best)



Note: Indices for BRIICS and OECD are the simple average of member-country indices. The OECD aggregates do not include Lithuania.
Source: World Economic Forum (2016), *The Global Competitiveness Report 2016-2017: Full data Edition*, www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1.

StatLink http://dx.doi.org/10.1787/888933829284

Facilitating rural to urban migration

China's economic growth can be largely attributed to the massive movement of migrant workers from rural to urban areas (Taylor and Martin, 2001). In 2014, more than 168.2 million migrant workers lived and worked in China's cities (NBSC, 2015). Outmigration improves productivity in both agriculture and non-agricultural sectors through more efficient allocation of labour (De Haan, 2000). China's Household Registration (*hukou*) System differentiates rural and urban registration, and this is linked to different social services. Rural residents are entitled to the allocation of farmland from villages, but do not qualify to receive most urban public services, including education and health care, when they reside in China's cities (Chan and Zhang, 1999). The *hukou* system has been a barrier to integrating rural and urban labour markets.

China has taken steps to improve the *hukou* system and social security system for rural residents (Table 4.1). A New Rural Cooperative Medical Scheme (NCMS) in 2002 extended coverage to the majority of the rural population, leading to a significant improvement in the quality of health care (Blumenthal and Hsiao, 2005). However, children and the elderly with rural *hukou* who had migrated to suburban or urban areas were hardly covered by the urban health care system, which was targeted to residents with urban

hukou. In 2016, China implemented a reform combining the NCMS with the Urban Resident Basic Medical Insurance without the constraints of rural registration. This was an important achievement in equalising the social security system for urban and rural residents and in facilitating the integration of rural and urban labour markets.

Table 4.1. Evolution of China's hukou system

1956-1957	Started restricting the migration of the farmers with rural *hukou* to cities.
1958	Differentiated the urban and rural *hukou* registration system, abandoning the freedom of migration under 1954 Constitution.
1984	Allowed the farmers to settle in township
1985	Set quota for converting the rural to urban *hukou* as 0.02% every year. Started the resident ID card system. Rural residents are allowed to migrate to urban cities for non-farm employment.
2002	Started the reform of *hukou* system. For example, Promoting the migrants to relocate in the cities; In rural area, government started the trials of the New Cooperative Medical System (NCMS) and up to 2008 NCMS covers all of the rural areas; Started to reform on the education of migrants' children in urban or suburban area.
2006	Started free compulsory education for nine years in rural area.
2009	Started the trials of the new rural social pension insurance system, covering all rural residents by 2012.
2014	Single national registration system (*jumin hukou*) was established for both urban and rural residents.
2015	Unified basic standard of old age pension for urban and rural residents.
2016	Integration of New Rural Cooperative Medical Scheme with Urban Resident Basic Medical Insurance.

In the absence of a public pension system, the elderly in rural areas typically work until they are unable to do so. Pang, de Brauw and Rozelle (2004) reported that only a very small percentage of healthy individuals over the age 60 stop working. Almost all people in the 50-60 age group, and over two-thirds of those between 60 and 70 years old are working. The analysis from a nationwide random survey of 2 000 households in 100 villages located in five provinces showed that until 2011, roughly two-thirds of the cohort over 60 years old still worked on or off the farm. The share for those between 60 and 70 years old was even higher – as much as three quarters.

Developing a pension system for farmers could facilitate the retirement of elderly farmers and assist young farmers to enter the sector. The pension system can be linked to agricultural policies. For example, in Switzerland eligibility for the direct payment system terminates as farmer reaches the pension age. Japan used to have a farmers' pension system that paid an extra premium when aged farmers transferred farm assets to a full-time successor, to promote early retirement of elderly farmers.

China has recently started to develop a pension system for rural residents. In 2009, the government issued "Guidance regarding the development of the new rural social pension insurance pilot", and gradually extended its coverage to all rural areas by 2012. The new rural social pension system combines individual contributions and government subsidies. The basic standard was set at CNY 55 (USD 8) per month for people over 60 years old, but allowed local government to change the payment rate. This system aligns with land entitlement, social assistance and other social security policies in its aim to guarantee a basic quality of life for elderly rural residents. In 2015, China announced unified standards of the basic pension, whereby both urban and rural residents over 60 years old can get at least CNY 70 (USD 11.15) per month. Central government covers the full cost of the subsidy for central and western regions, while supporting half of the budget in eastern regions. Although the benefit from this pension is relatively small, it is likely to assist the retirement of elderly farmers.

4.5. Education and skills policy

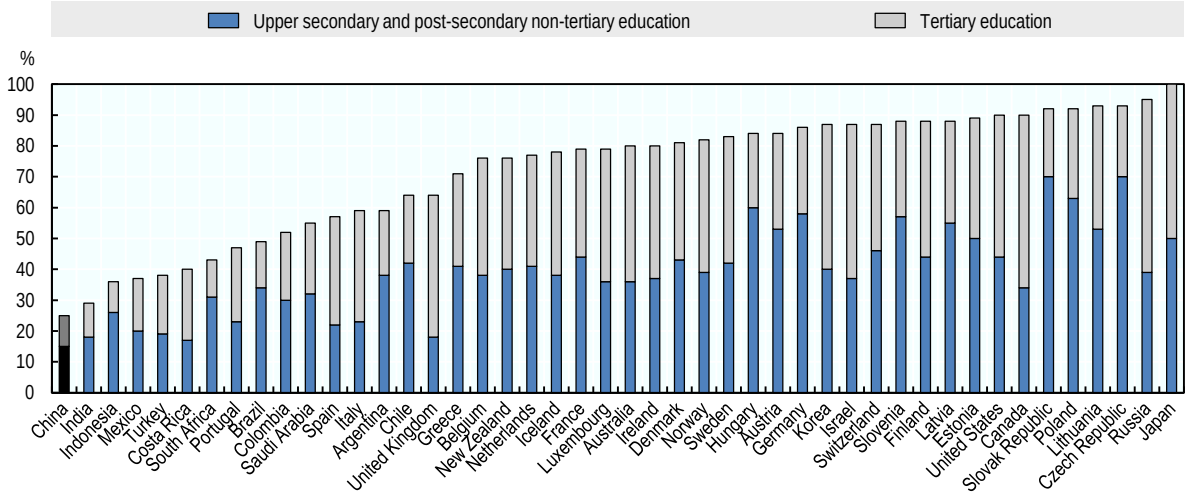
Education policy has strong and diverse links to innovation. A high level of general and scientific education across the population facilitates acceptance of innovations by society in general. Effective innovation systems require well-educated researchers, teachers, extension officers and business owners. Producers with a good general, technical and business education will generally be more willing and better skilled in fostering and adopting innovations. Ensuring the equity of access to quality education is a key factor to improve the skill level of human capital in rural areas, including in agriculture.

Overall education status

China has made considerable progress in improving the educational attainment of the population. Currently, most of the working age population has completed lower- and upper-secondary education. However, the proportion of the adult population who completed tertiary level education in China remains 10%, which is significantly lower than OECD counties (Figure 4.7). International surveys of business leaders evaluating the overall quality of higher education and training for market competitiveness also ranked China below the OECD average both in terms of quantity and quality of higher education and training (World Economic Forum, 2015). Increasing the level of attainment of higher education and training in a broader skill set would be particularly impactful in building the capacity needed to adapt and innovate in the agricultural sector.

Figure 4.7. Education attainment, 2016

Percentage of the population aged 25-64 years old



Note: Data for Brazil, Chile, Indonesia, Ireland, Russian Federation and South Africa refer to year 2015, for Argentina and Saudi Arabia to 2014, for India to 2011 and for China to 2010.
Source: OECD (2017c), Education at a Glance 2017: OECD Indicators, http://dx.doi.org/10.1787/edu-data-en.

StatLink http://dx.doi.org/10.1787/888933829303

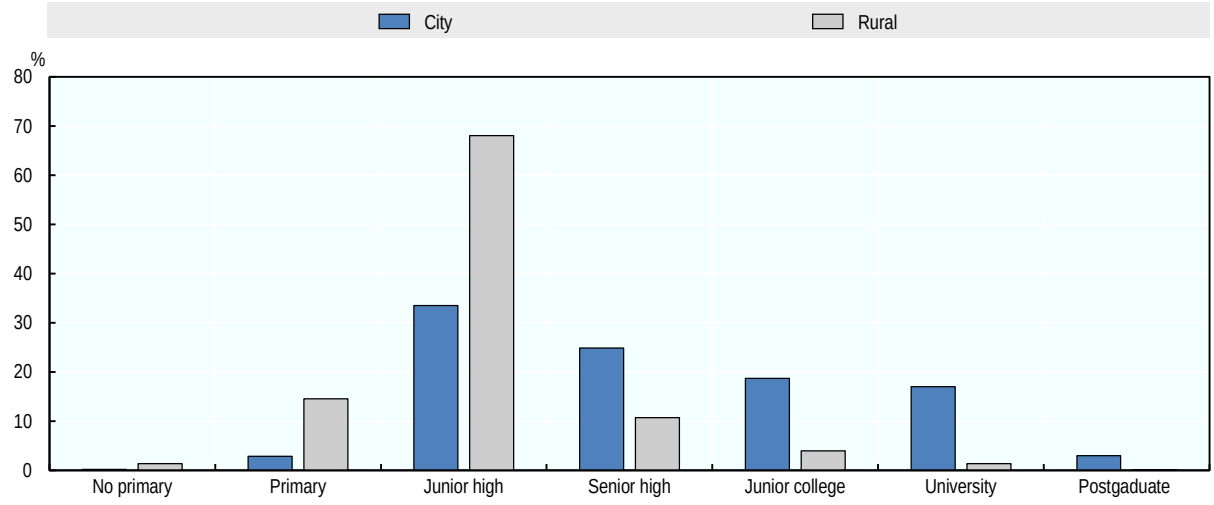
Improving the rural and urban disparity in education

The urban-rural divide in the household registration (*hukou*) system also plays a large role in educational opportunities. Rural students have lower access to higher education

(Figure 4.8). This is partly because lower quality in education in rural area reduces chances to succeed in entrance exams for higher education. The educational regulations still require university admission examinations to be taken in the locality of the student's registration and to follow the local syllabus (Herd, Koen and Reutersward, 2010).

Figure 4.8. Disparity of education attainment between urban and rural youth in China

Proportion of 25 to 29-year-olds with a given maximum level of education in 2010



Source: OECD (2015a), "All on Board: Making Inclusive Growth Happen". Tabulations of the 2010 Chinese Census.

StatLink http://dx.doi.org/10.1787/888933829322

With more than 168.2 million migrant workers living and working in China's cities as of 2014, the children of migrant workers are particularly vulnerable in terms of access to quality education. Migrants' children are often not allowed to enrol in urban schools for primary and secondary education or they have to pay an admission fee (so called "*zan zhu fei*") which is often unaffordable (Liu et al., 2011). Even though private schools can accept the children of migrant workers, the tuition is found to be high; moreover, these schools are often equipped with poor facilities and staff are under-qualified (Chen and Feng, 2013). Some teachers lack a teaching certificate, while some of the schools are not certified by the government and run the risk of being shut down. Access to high-school education is even more limited for children of migrants. In China, high-school education is not free, and the cost of tuition is known to be one of the most expensive in the world (Liu et al., 2011). Moreover, to attend high-school it is necessary to take an entrance examination, and this must be taken in the locality of registration rather than the locality of residence.

Without access to public education in urban areas, migrants often leave their children at home to attend the local rural public school. The children in this situation are called left-behind children (LBCs). According to the All China Women's Federation's report based on the 2010 Population Census (ACWF, 2013), there are more than 61.02 million LBCs aged 17 years or under in China. These left-behind children accounted for 21.9% of all children and 37.7% of rural children.

The negative impact of migration on the quantity and quality of the human capital of migrants' children could constrain China's sustainable economic growth in the future. Liang and Chen (2007) indicate that temporary parental migration into the cities or the

suburban areas in Guangdong province can significantly increase the dropout rate of children. Based on survey data in western provinces, Zhao et al. (2014) also implies that even though migration has short-term financial benefits to a family it has a significantly negative impact on the human capital accumulation of the children in the long run.

China has established a course of reforms which includes targets for enrolment, expansion of compulsory education, improving the quality of the education system, and reducing regional disparities in education (OECD, 2015b)[4] Since 2000, the Central Government has implemented policies to improve the access to education in rural areas such as reducing fees for compulsory education, distributing free textbooks and providing stipends for poor families (Chen, 2010). The government encourages young teachers to teach in rural and poor regions through financing their salaries for an initial three years. The government also provides free vocational education for rural students and all students pursuing agriculture-related subjects (OECD, 2015b). However, urban areas still receive greater allocations of per-pupil spending than rural areas (MOE, 2012).

Recent policy documents emphasise the importance of human resource development. In particular, the No. 1 Document of 2016 recognised that five-year basic training is necessary for the managers of new professional farms, and urged that the development of new professional farmers become part of the national education and training development plan. Secondary-level agricultural vocational education is expected to receive national funding, and the government encourages farmers to participate in vocational education on a part-time basis.

Overall, China has made significant progress in educational attainment. However, the enrolment rate in higher education is lower and the capacity and skills for innovation is considered lower than in most OECD countries. Moreover, reducing the rural-urban disparity in access to a quality education service is crucial to ensuring sustainable productivity growth in agriculture. For example, the government could ensure access to pre-education for all students and provide free education for all subjects. Monitoring and evaluation of skills across the country would improve the evidence base for education reforms, particularly in improving equity in access and quality of education in poor, rural and agricultural regions. While the proposed *hukou* reform allows rural *hukou* holders access to urban social services and better school education, further improvement in education in rural regions will reduce the urban-rural divide in educational opportunity.

4.6. Summary

China has developed a competitive transport and electricity infrastructure network which is comparable with most OECD countries. Economic activities benefit from a well-developed national transportation infrastructure network. On the other hand, the penetration of Information and Communication Technology (ICT) among the rural population still lags that among the urban population. The effort to increase the penetration of ICT in rural areas should continue, including the promotion of ICT in agricultural production and marketing, as stated in 13th Five-Year Plan.

The institutional reform in the late 1970s to allocate land contract rights to individual family farms contributed significantly to the productivity growth in agriculture in the early 1980s. Since then, China has taken a number of steps to secure land contract rights and to activate the transaction of land operational rights between farms. However, the operational size of farms is small and the share of rented land remains lower than many OECD countries. The consolidation of small and fragmented farm operations to large-scale units is one of the

most important pathways of productivity growth in Chinese agriculture. The consolidation of land use to large farms can also have a sustainability benefit, as small farmers who engage in off-farm activity have an incentive to apply fertiliser and chemicals more intensively to reduce labour input in agriculture. The local government should play a proactive role in providing information on potential lenders of land and reduce the costs related to land transactions. Securing land contract and operational rights is also important to providing incentives for holders of such rights to commit to long-term investment in land. Promoting the entry of new and diverse types of entities to agriculture (including agri-business ventures and migrants from urban to rural areas) by allowing them to obtain land operational rights would bring fresh capital to the agricultural sector.

China's policy approach to promote consolidation of farm operations through various organisational formats (e.g. transaction of operational rights, farmers' co-operatives, land trust and farm operational services) is effective in adapting to local conditions. A traditional approach to promote land consolidation through transactions of land ownership and tenancy faces high transaction costs under the country's small and fragmented farm structure. China's approach provides a policy lesson for other counties who wish to promote consolidation of small and fragmented farm operations.

The recent policy to establish geographical zoning for grains and other crops targets government support to designated areas. The zoning policy would facilitate a structural change of agriculture and more sustainable agricultural production though rationalising the geographical distribution of agricultural production to reflect natural and environmental conditions. It is also expected to promote the consolidation of farm operation to large-size units and improve the efficiency of government infrastructure investment.

Saving labour inputs through farm mechanisation is an important driver of agricultural productivity growth in China, considering the rising costs of labour in rural areas. Mechanisation allows farmers to operate larger farms or to engage more time in off-farm activities. The development of farm machinery services in China made a significant contribution to a rapid increase in the use of modern farm machinery, including on small farms. Indeed, outsourcing major farming operations (e.g., ploughing, planting and harvesting) of small farms to farm service providers allows small farms to benefit from economies of scale in farm operation and reduce the cost of capital inputs. However, fragmented land structure and lack of farm access roads limit the efficient use of farm machinery. China's recent policy emphasis on increasing investment in high-standard farmland would address this constraint to productivity improvement through mechanisation.

China's household registration (*hukou*) system limits access for households registered in rural areas to social security and education systems in urban areas, despite the introduction of a single national resident registration system in 2014. While China is improving medical insurance, pension and public education for rural residents, unequal access to social security systems remains between urban and rural residents. For example, the children of rural households living in cities have difficulty accessing the public school education system in urban areas. Meanwhile, only the members of rural collective economic organisations (villages) can have an allocation of land contract rights.

Ensuring more equal access to social services would facilitate the migration of rural residents to urban areas and allow aged farmers to transfer farm resources to efficient and productive farmers. This would reduce an existing large income disparity between urban and rural populations and improve productivity in agriculture. The allocation of farmland contract rights should also be decoupled from rural household registration to allow the entry

of diverse types of farm operators, including individuals and corporations migrating from urban to rural areas.

While most of the working age population obtained lower- and upper-secondary education, China currently has the lowest proportion of the adult population with tertiary level education compared to other OECD and BRIICS countries. The education attainment of rural residents is largely limited to lower-secondary level. Increasing the attainment of education and training in a broad skill set would be particularly impactful in rural regions as it would improve the competence and capacity to adapt and innovate in the agriculture sector. Public support to vocational education in agriculture should be increased.

Notes

[1] Box 2.2 describes the role of Farmer Professional Co-operatives in expanding the operational size of farms.

[2] This phenomenon has also been observed more broadly for policies pertaining to environmental protection (Zhang and Cao, 2015).

[3] There are several pilot projects implementing water rights transaction, such as Dongyang-yiwu water rights transaction (between two cities), water rights transaction in the Inner Mongolia and Ningxia Provinces (between agricultural and industrial water users), and water rights transaction among individual farmers in the Shiyang River Basin.

[4] For example, China's National Plan for Medium and Long-term Education Reform and Development 2010-2020, the State Councils' Medium and Long-term National Plan for Science and Technology 2006-2020 and the National Medium-and Long-term Talent Development Plan (2010-2020).

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Annex 4.A. Current and future water demand

Annex Table 4.A.1. Spatial distribution of water resources in China

Basin	Mean annual surface runoff		Groundwater		Total annual water resources[1]		Population		Arable land		Annual per capita water resources
	km³	%	km³	%	km³	%	million	%	million hectares	%	m³
North	334.3	12.3	168.9	20.3	405.4	14.4	520.5	44.4	57.4	59.5	778.9
Song-Liao	165.3	6.1	62.5	7.5	192.8	6.9	113.2	9.6	19.5	20.2	1 703.2
Hai-Luan	28.8	1.1	26.5	3.2	42.1	1.5	117.6	10.0	10.8	11.2	358.0
Huai	74.1	2.7	39.3	4.7	96.1	3.4	190.5	16.2	14.7	15.2	504.5
Huang	66.1	2.4	40.6	4.9	74.4	2.6	99.2	8.4	12.4	12.9	750.0
South	2 260.8	83.4	591.7	69.3	2 276.6	80.9	327.4	53.5	33.5	34.8	3 628.6
Yangtze	951.3	35.1	246.4	29.7	961.3	34.2	402.5	34.3	22.9	23.8	2 388.3
Peral	468.5	17.3	111.6	13.5	470.8	16.7	141.5	12.1	6.5	6.7	3 327.2
Southeastern	255.7	9.4	61.3	7.4	259.2	9.2	65.1	5.6	2.4	2.5	3 981.6
Southwestern	585.3	21.6	154.4	18.6	585.3	20.8	18.3	1.6	1.7	1.8	31 983.6
Inland	116.4	4.3	89.2	10.4	130.4	4.6	24.7	2.1	5.4	5.6	5 279.4
Total	2 711.5	100.0	828.8	100.0	2 812.4	100.0	1 172.6	100.0	96.4	100.0	2 398.4

Note: The sum of water resources from surface water and groundwater may exceed the total water resources by the amount of overlap between them, since surface water interacts with groundwater, with the river base flow formed by groundwater and part of groundwater *recharge coming from percolation of surface water.*
Sources: World Bank (2009).

StatLink http://dx.doi.org/10.1787/888933829949

Annex Table 4.A.2. Projected water demand in China, 2000 and 2030

	Total demand (km3)			Per capita demand (m3)		Share by sectors					
						2000			2030		
	2000	2030	Increase	2000	2030	Municipal	Industry	Agriculture	Municipal	Industry	Agriculture
River basins											
Songhuajiang	35.2	51.7	16.5	559	689	9	22	69	9	20	71
Liao	16.6	22.7	3.1	356	355	13	18	69	20	25	55
Hai	40.2	42.9	2.7	312	262	13	17	70	21	21	58
Huang	43.7	48.1	4.4	397	364	7	14	79	13	19	68
Huai	65.1	71.6	6.5	332	320	10	16	74	18	20	62
Yangtze	193.9	223.9	30.0	454	451	10	29	61	15	33	52
Southeast Rivers	33.9	33.8	-0.1	471	367	12	26	62	20	34	46
Pearl	79.2	81.0	1.8	492	5	13	20	67	20	29	51
Southwest Rivers	10.6	13.6	3.0	530	544	8	3	89	14	6	80
Northwest Rivers	59.8	64.2	4.4	2 062	1 646	2	3	95	4	3	93
Regions											
6 Northern regions	263.6	301.2	37.6	453	432	8	14	78	13	17	70
4 Southern regions	317.6	352.3	34.7	467	433	12	25	63	17	31	52
Nationwide	581.2	653.5	72.3	461	432	10	20	70	16	24	60

Source: World Bank (2009).

StatLink http://dx.doi.org/10.1787/888933829968

Annex 4.B. Recent water policies referred to in section 3

Policies relevant to managing water quantity

The General Office of the State Council issued "Notice on promoting the reform of water price to promote water conservation and protection of water resources" On 19 April 2004 (No. 36 document in 2004).

The "Outline of China's Water Saving Technology Policy" was made by the National Development and Reform Commission in conjunction with the Ministry of Science and Technology, the Ministry of Water Resources, the Ministry of Construction and the Ministry of Agriculture made on 21 April 2005.

"Management Regulations for Water Withdrawal Permission and Water Resources Fee Collection" was issued by the State Council on 21 February 2006.

The National Development and Reform Commission, the Ministry of Water Resources and the Ministry of Construction issued No. 236 document on "Water-Saving Society Construction of the Eleventh Five-Years Plan" on 14 February 2007.

The "Decision of the CPC Central Committee and State Council on Accelerating the Development of Water Conservancy Reform" was promulgated as the No. 1 Document of 2011.

The State Council promulgated the "Opinions on the implementation of the strictest water resources management system" in January 2012.

The General Office of the State Council issued the "National Agricultural Water Conservation Program (2012-2020)" in November 2012.

The Ministry of Water Resources issued the "Opinions on Accelerating the Construction of Water Ecological Civilization" in January 2013.

The State Council issued the "Water Pollution Prevention and Control Action Plan" on 16 April 2015.

Policies relevant to managing water quality

The Ministry of Environmental Protection issued "National Groundwater Pollution Prevention and Control Planning (2011-2020)" on 28 October 2011.

The State Council formally approved the "Planning of water pollution prevention and control in key river basins (2011-2015)" proposed by the Ministry of Environmental Protection, the National Development and Reform Commission, the Ministry of Finance and the Ministry of Water Resources on 16 May 2012.

The State Council promulgated the "Opinions on the implementation of the strictest water resources management system" in January 2012.

The Ministry of Environmental Protection issued the "Twelfth Five Year Development Plan for National Standard of Environmental Protection" on 17 February 2013.

The Ministry of Water Resources issued "Opinions on Accelerating the Construction of Water Ecological Civilization" in January 2013.

The Ministry of Water Resources issued "Opinions on Accelerating the Construction of Water Ecological Civilization" in January 2013.

The National Development and Reform Commission, the Ministry of Finance and the Ministry of Environmental Protection jointly issued the "Notice on the Adjustment of Sewage Charges and Other Relevant Issues" on 1 September 2014.

The State Council issued the "Water Pollution Prevention and Control Action Plan" on 16 April 2015.

Policies relevant to managing water risk

"The Law of the People's Republic of China on Emergency Responses" was issued on 30 August 2007.

The State Council issued the "Regulations of the People's Republic of China on Drought Resistance" on 26 February 2009.

The State Council made the second amendment of the "Regulations of the People's Republic of China on Flood Control" on 8 January 2011.

The General Office of the State Council issued "Opinions on Strengthening the Work of Meteorological Disaster Monitoring, Early Warning and Information Dissemination" on 11 July 2011.

Policies relevant to investment on water conservancy projects

The "Management Measures for the Collection and Use of Fund for Water Conservancy Construction" was issued by the Ministry of Finance, the National Development and Reform Commission and the Ministry of Water Resources on 10 January 2011.

The Ministry of Finance and the Ministry of Water Resources issued "Notice on Provision of Funds for Farmland Water Conservancy Construction from the Land Transfer Income" on 4 July 2011.

The Ministry of Finance issued "Opinions on the Implementation of the Spirit of the Conference on Water Conservancy Work of Central Government", 2011, No. 265.

In 2011, the Ministry of Finance and the Ministry of Water Resources issued the "Interim Measures for the Administration of the Use of the Maintenance Funds from Financial Subsidy of the Central Government for Public Welfare Water Conservancy Engineering in Central and Western Areas and Poverty-Stricken Areas".

In 2012, the Ministry of Finance and the State Administration of Taxation issued "Notice on Tax Policy for Supporting the Construction and Operation of the Rural Drinking Water Safety Projects".

The Ministry of Finance and the Ministry of Water Resources issued "Administrative Regulations on Overall Funds of Central Finance for Farmland Water Conservancy Construction Provided from the Land Transfer Income" on 8 April 2013.

Annex 4.C. OECD principles of water governance

OECD (2015c) defines 12 core principles for a better governance of water under three main goals: effectiveness, efficiency and trust and engagement. These principles are aimed to apply to any country's water system, OECD and non-OECD countries.

- **Principle 1**. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.
- **Principle 2.** Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.
- **Principle 3.** Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.
- **Principle 4.** Adapt the level of *capacity* of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.
- **Principle 5**. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related *data and information*, and use it to guide, assess and improve water policy.
- **Principle 6.** Ensure that governance arrangements help mobilise water finance and allocate *financial resources* in an efficient, transparent and timely manner.
- **Principle 7.** Ensure that sound water management *regulatory frameworks* are effectively implemented and enforced in pursuit of the public interest.
- **Principle 8.** Promote the adoption and implementation of *innovative water governance practices* across responsible authorities, levels of government and relevant stakeholders.
- **Principle 9.** Mainstream *integrity and transparency* practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making.
- **Principle 10.** *Promote stakeholder engagement* for informed and outcome-oriented contributions to water policy design and implementation.
- **Principle 11**. Encourage water governance frameworks that help manage *trade-offs* across water users, rural and urban areas, and generations.
- **Principle 12.** Promote regular *monitoring and evaluation* of water policy and governance where appropriate, share the results with the public and make adjustments when needed.