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WATER SUPPLY OF THE LATE MEDIEVAL AND EARLY MODERN TOWN IN THE POLISH LANDS

The ways of providing water supply and managing it in towns can be at the same time an attempt to show social and economic relations which emerge alongside this process. This kind of a research proposition should serve the most thorough identification of a town, its function and economic possibilities, and, consequently, the level of urbanization development in the Polish lands in comparison with other parts of Europe.

If we consider medieval and early-modern opinions about the quality of water depending on its kind, we must acknowledge that in the written sources concerning towns in the Polish lands, the information regarding the acquisition of rainwater, spring water, water from rivers and from wells is not equally well recognizable. The smallest amount of data concerns rainwater and spring water, which enjoy the highest opinion in treatises. Rainwater was much more often perceived as water carried away from the town, because its excess could cause disturbance or even a disaster in the form of a flood. Only occasionally was rainwater identified as used in the space shared by neighbours: gathered by means of gutters and drainpipes, additionally in relation to dug wells (as in Kraków), enclosed in fire canals (as in Kalisz), or collected in other reservoirs of the same function in the public space (as in Chełmno).

Spring water, understood as water springing out from the ground, appears in records only as suburban and countryside intakes to pipe water supplies, which fact confirms the prevailing opinion about its high quality.

There is incomparably more source data concerning rivers, dug wells, and pipe water supplies.

One can undoubtedly notice the aim of making the fullest possible use of rivers. The fact that medieval towns were situated on rivers was connected to the variety of functions which rivers could perform. Their role depended primarily on accessibility. Thus, for lowland towns situated on large rivers, the river was not only an artery of communication, transport and trade, a source of energy, and a place where one could easily draw water and catch fish, but it also enabled the development of crafts needing water as a material for production. This phenomenon can be shown by the example of large cloth-producing towns in Western Europe, which had highly developed inner water networks created by rivers, their branches or artificial

canals and moats diverging from them¹. Medieval Wrocław enjoyed similar, decidedly favourable conditions, which is why this town became one of the convenient places in Europe for the so-called Walloon weavers to settle.

On the other hand, in upland towns (many cities in the Polish lands were situated like this), even in those which were considered to be on a river, one could observe a clear underdevelopment of craft needing water and working *intra muros*, which resulted in creating low quality products, sold in the local market at best. Together with a lack of other well-developed functions, this could decide about the low economic importance of the towns, which as a consequence could constitute one of the important elements of the weakness of urbanization in the Polish lands. Towns situated on the high bank of the river were in the least favourable situation, as they suffered a constant shortage or lack of water for every need, which was a major difficulty. In that case, the acute problem was not only drawing water from the river – directly or by means of water-work appliances (German: *Wasserkunst*), very costly in these circumstances – but also the existence of a deep-lying water-bearing layer (connected with the river) in the town itself, which rendered digging wells difficult or impossible.

Taking into particular consideration the watercourse network of Kraków, the economic significance of minor streams one can show: the main driving force of every kind of *molendinae*, and also the source of water supply for fish ponds. Everywhere, managing these streams for the needs of mills and fish ponds was one of the more important signs of their owner's power, which was due to the profitability of the facilities. "Giving out water" to suburban ponds of Kraków, the king had control over the waters which were still his (apart from them, there were also "town waters" in the same territory), including water from the town moat, which did not belong to the town (unlike in other cities). In the case of the old capital of Poland, this must have resulted from equating the moat waters with those from the river Rudawa, which (as a royal leat) flowed in the 1280s in the direction of the town, firstly to

¹ A. Guillerme, *Le temps de l'eau. La cité, l'eau et les techniques. Nord de la France fin IIIe – début XIXe siècle*, Paris 1983, p. 87.

the Dominicans, and shortly after its waters were let into the moats created around the town.

A closer look at the royal management of waters in the suburbs of Kraków resulted in the author's new findings concerning not only the management of these suburbs in the 15th century and in the first 30 years of the 16th century, but also the system of functioning of a network of fish ponds belonging to different owners. The condition of an efficient functioning of every reservoir⁶ of this complex (together with the royal ponds) was the correlation in time between periodical draining of certain ponds and filling up other neighbouring ponds (with the same water used as fresh), according to the prevailing technical principles². This was the way in which the local neighbours' system of the functioning of numerous Kraków suburban fish ponds was shaped. It must have been this way also in other towns where ponds were interconnected in a similar fashion but belonged to different owners. In Kraków, this system embraced lay and clerical nobles, and also Kraków patricians. The vision of profits from the developing pond economy caused some people to undertake digging fish ponds, others to try to obtain royal grants of water rights for ponds they had already owned. For everyone this was a privilege and a proof of royal grace, and often the expression of the king's gratitude to the endowed person (e.g. to one of the bishops, Erazm Ciołek, for his Roman missions).

In the *intra muros* space of medieval towns in the Polish lands, wells dug to the water-bearing layer played the most important role (Fig. 1-2). The water-bearing layer decided about the presence of wells in a given place and about their depth, and thus also about the level of difficulty of digging them (this was connected with the kind of ground), and finally about the value of the reservoirs. It was sometimes underlined in the literature that there existed a directly proportional dependence between wealth and having a private well³. However, this can concern only the cases when the cost of building a well with good quality water was high. Nevertheless, there were towns, for example Wrocław, where such water was found in shallow wells that were easy to dig.

The results of the research unequivocally indicate that wells dug on plots in towns in the Polish lands were mostly confirmed as connected with beer-production facilities, including wells belonging to the maltings situated there, and not to dwelling houses (e.g. in 15th-century Poznań

and 16th-century Środa in Great Poland)⁴. The functions of dug wells which are best identified in written sources were perceived as the most important ones, which also shows the fundamental significance of the bourgeois beer production among other tasks needing water and done in the inner-town space. Dug wells served as basic sources of water for this production in late-medieval towns famous for their high-quality beer, as e.g. in the Little-Poland Proszowice⁵ or in the Silesian Świdnica⁶, before they were equipped with pipe water supplies. Besides rivers it were dug wells that supplied 15th-century Poznań with water for all purposes⁷ (convincing evidence of pipe water supplies existing in this town date only from the end of the 15th century), and it was precisely in that period that Poznań developed from a medium-sized town into a large centre⁸.

Due to the scarceness of sources, it is difficult to establish to what degree the importance of dug wells diminished together with establishing pipe water supplies in individual towns in the Polish lands, but it is worth noting that the irreparable destruction of the network in many of the towns (including Kraków) during the Swedish "Deluge" (invasion of Poland in the mid-17th century), necessarily restored their former primary role to the wells. Thus, one can put forward a proposal to conduct research on the importance of these intakes in the life of towns in the 17th-19th centuries, or even maybe in the 20th century; such a study could be based on a far more ample source material.

In the period under present research, dug wells were one of the most important elements not only organizing the space and society of the town, but also integrating it, mainly in the scope of neighbourhood communities. Defining the level of the neighbours' shares in the possession of the well was connected both with the possibility of drawing water from it, and with taking care of it. This has been illustrated by instances gathered during this research relating to Kraków from the beginning of the 16th century and to Środa in Great Poland from the middle of the 16th century⁹ as well as by the examples from 15th century Świdnica¹⁰. Recognizing the presence of wells in the public space of towns, the author made closer studies of the Old-Kraków wells from the end of the 14th century and the beginning of the 15th century; she reconstructed, socio-topographically,

² For the Polish lands cf. O. Strumieński, *O sprawie, sypaniu, wymierzaniu i rybieniu stawów, także o przekopach, o ważeniu i prowadzeniu wody*, Kraków (1573) 1605, pp. 35-41.

³ A. Berdecka, *Lokacje i zagospodarowanie miast królewskich w Małopolsce za Kazimierza Wielkiego (1333-1370)*, Wrocław-Warszawa-Kraków 1982, p. 127; F. Piponnier, *Les Dijonnais et l'eau à la fin du Moyen Âge*, „Mélanges de l'École Française de Rome. Moyen Âge. Temps Modernes” (MEFRM) 104-1992-2, p. 483; D. Alexandre-Bidon, *Archéo-icographie du puits au Moyen Âge (XIIe – XVIe siècle)*, MEFRM 104-1992-2, p. 523.

⁴ U. Sowina, *Woda i ludzie w mieście późnośredniowiecznym i wczesnonowoczesnym. Ziemia polskie z Europą w tle*, Warszawa 2009, pp. 163-165.

⁵ F. Kiryk, *Miasto średniowieczne*, [in:] *Proszowice. Zarys dziejów do 1939 roku*, ed. F. Kiryk, Kraków 2000, p. 71-76.

⁶ M. Goliński, *Współwłasność studni w XIV-wiecznej Świdnicy. Przyczynek do poznania problemu*, [in:] *Dom w mieście średniowiecznym i nowożytnym*, ed. B. Gediga, Wrocław 2004, p. 76.

⁷ U. Sowina, *Woda i ludzie...*, pp. 165, 169 and 175.

⁸ J. Wiesiołowski, *Socjotopografia późnośredniowiecznego Poznania*, Warszawa-Poznań 1982.

⁹ U. Sowina, *Woda i ludzie...*, pp. 181-183.

¹⁰ M. Goliński, *Współwłasność studni...*, passim.



Fig. 1. Well of stone construction for obtaining water in the courtyard of the Municipal Arsenal of Wrocław (Photo by U. Sowina).

their arrangement in the space *intra muros*, and drew conclusions concerning their depth based on some elements of their construction or equipment. It was calculated that there were at least 25 public dug wells functioning in the town in that period. This number places Kraków between Strasbourg and Nuremberg, considering the relation between the number of public wells and the estimated number of inhabitants, and the level of difficulty in reaching the water-bearing layer.

It was also observed that the public wells in Kraków were placed by the best situated houses in town, including those in the frontages of the main Market Square. The houses belonged to the most eminent burghers, and their names or surnames were used to describe the wells. Therefore, a hypothesis can be formulated that these intakes – solid constructions reaching deeper layers of good drinking water – as the basic sources of water supply could have been earlier an inherent part of the programme of the organization of space along the frontages of the Market Square, together with the measuring of plots and their development after the introduction of the Magdeburg law in 1257. Since the authors of the programme were the oldest settlers of the town chartered with

German law, and constituted its first patriciate gathered around the Market Square, it is not unlikely that the wells primarily belonged only to them as to the most wealthy citizens, as it was in Italian towns in the early Middle Ages¹¹. These patricians of the Market Square could also create the so-called “neighbours’ well communities”, still existing in some Western European towns in the 15th century (e.g. in Munich¹²).

Despite the fact that in Kraków there existed solid public wells by the houses of at least some of the members of the town authorities, it was them who made the decision to build pipe water supplies. Their construction can be traced in the city accounts from 1399. Among the initiators from that circle, there were mine managers (German: *Bergmeister*, Latin: *supparii*) (acquainted with the construction methods of similar mining facilities), including Godfrid Fattinante from Genoa, a wealthy merchant, who at the

¹¹ P. Squatriti, *Water and society in early medieval Italy. AD 400-1000*, Cambridge 1998, p. 26.

¹² W.C. Wijntjes, *Water Supply of the medieval town*, [in:] *Rotterdam Papers IV. A contribution to the mediaeval archaeology*, Rotterdam 1982, p. 200.



Fig. 2. Well of iron construction for obtaining water in the courtyard of Jan Długosz's house in Cracow (Photo by U. Sowina).

same time was in charge of the town money, and lived in the brick dwelling house on the corner of Wiślina Street and Market Square, where in 1392 one of the wells was situated¹³. Godfrid must have already experienced the benefits of pipe water supplies in use at least from the beginning of the 13th century in his home town Genoa, and from the end

of that century at the latest in Bruges, from where he might have come.

The reason earliest traceable in sources for introducing in Kraków this most accomplished form of supply in water of good quality was a growing need for it in the town¹⁴. One

¹³ U. Sowina, *Woda i ludzie...*, p. 210.

¹⁴ From the 2nd half of the 14th century Kraków experienced a considerable economic and demographic growth – cf. J. Wyrzumski, *Dzieje Krakowa*, Kraków 1992, pp. 314-317.

can identify two signs of this phenomenon for the last 25 years of the 14th century, i.e. for the period directly preceding the construction of the network. The first one was digging new solid public wells (even still in the first decade of the 15th century, namely at the beginning of the network's functioning), and the second one was a twofold increase in the number of town water-carriers between 1375 and 1399, from 10 to 20, as was calculated on the basis of data taken from by-laws passed by the town authorities and from city accounts¹⁵.

As regards other, also smaller, towns, the same reason most often appeared in pipe water supply construction permits, granted to the towns in the 16th century, which were to serve mainly brewers. Therefore, wells were no longer sufficient. In the case of deeper reservoirs, it was because of their insufficient number in relation to the growing population; in the case of shallow wells – judging from archaeological research – due to the impossibility of digging new wells on a limited plot together with a fast pollution of groundwater with organic and household sewage. The insufficient amount of water in wells could also be connected with the decrease of the level of groundwater caused by the digging or deepening of moats (this was, however, mainly the case in large towns). An organized carrying of water was perceived to be too costly for the town budget. Thus, for the further development of towns experiencing such difficulties it was essential to introduce pipe water supplies; and this is the way we should understand the expression used in introductory parts of the royal permits that the giver did it to “ameliorate the condition of the town”. The construction of the network was to enable further economic development of the town by significantly contributing to the elimination of the problem of water shortage, i.e. one of the most decisive factors inhibiting this development. Such a conviction can be seen both among the proponents and the opponents of the undertaking. The proponents, looking forward to their own benefits from the town development, assisted in the creation of pipe water supplies (as e.g. the *advocatus* of Bochnia¹⁶), or even financed them (as in the Sieradz starosty¹⁷). The opponents, picturing an increased competitiveness of town in relation to their own activity, created problems (as the *advocatus* of Little-Poland Pilzno¹⁸ or the starost of Mazovian Płock¹⁹). In specific circumstances, e.g. when the town's means were too limited in comparison with the cost of

construction and later upkeep of the enterprise, both attitudes could also influence the fact whether the pipe water supplies came into being, meaning whether the “best” water flowed in pipes through the town, or whether it only remained an unrealized programme. Another problem in towns which managed to create pipe water supplies was the maintenance of the network's proper functioning, so that it could also be the source of the town's income. It was not always successful, inter alia when the method used was unsuitable for the climatic conditions (e.g. freezing of ducts which were dug in too shallowly as in Nowy Sącz²⁰).

In the case of the Kraków pipe water supply network, the written records made it possible to identify also another probable and direct reason for its creation. It was namely the aspiration of the town's elite to ameliorate their living conditions, which the people could observe or experience elsewhere. This can be testified by the fact that the elite initiated the construction of the network, and that they were later its main beneficiaries, as it follows from the oldest 15th-century permits for establishing pipe connections to private houses, and also bills from the sale of pipes to individual customers in the 15th century and in the first half of the 16th century. The most important aim of this installation was satisfying the needs of the houses situated in the best places in town, first by means of pipe water supply reservoirs within the network in the town centre, which would supplement or take over the role of the above-mentioned wells, and later directly through pipe connections. Only the growing profitability of the Kraków *braxaturae*, traceable in the accounts from 1487, which between 1524 and 1530-1531 became one of the highest incomes in town, established the next goal of the Kraków pipe water supply development, namely increasing the number of pipe connections to people having the right to brew beer for sale. It must be strongly underlined, however, that as long as the patricians used water not only in the brewery but also in the house and kitchen, the payers of the *braxaturae* could only take up the amount of water needed to brew beer. The Kraków network of private pipe connections for production purposes, developed so late, and partly because of a conflict between the common people and the town authorities, could be compared to the 14th-century already well-developed networks in Lübeck, Gdańsk and Wrocław.

It was often declared that the construction and functioning of the pipe water supplies was *pro bono publico*. Watching the history of the Kraków network, one can observe that this *public good* was actually the good of the town's patriciate. In this context, one has to think about the fact whether the lack of decorative fountains in Kraków in its golden age was the sign of the domination of the king residing at the Wawel Castle, or rather the lack of interest of the town's elite in this form of manifestation of the

¹⁵ U. Sowina, *Woda i ludzie...*, p. 359.

¹⁶ Archiwum Główne Akt Dawnych (Central Archives of Historical Records in Warsaw), *Metrica Regni*, Lib. Inscriptio-num 48, pp. 1038-1049.

¹⁷ U. Sowina, *Sieradz. Układ przestrzenny i społeczeństwo miasta w XV-XVI wieku*, Warszawa-Sieradz 1991, p. 30-31.

¹⁸ Archiwum Państwowe w Krakowie (State Archive in Cracow) (APKr.), dok. depoz. 96.

¹⁹ S. M. Szacherska, *Złoty wiek miasta 1495-1580*, [in:] *Dzieje Płocka*, ed. A. Gieysztor, Płock 1973, p. 111.

²⁰ APKr., AD 149, p. 74.

municipal authority. The deplorable condition of Kraków infrastructure in 1533²¹ would rather indicate the second reason, which factors together would testify to the fact that the members of this group did not identify themselves with the town. Ensuring for themselves the most comfortable living conditions in impressive houses-residences, the elite treated the town only as a convenient place for commerce between East and West, for activity in the neighbouring steelworks and mines, or for making profits on transactions in Kraków real estate or on their own profitable facilities, e.g. mills and fish ponds, and aimed at being ennobled and at leaving bourgeoisie.

However, an indisputable merit of the Kraków elite was promoting the Central-European pattern of water supply system construction methods, including water-works designed similarly to drainers used in mines. This was the earliest known example of such a promotion in the Polish Crown of those days. However, neither the analyzed sources nor the hitherto prevailing literature presented convincing evidence for using this pattern soon also in other towns. It is not shown in the few 15th-century records of establishing pipe water supplies in towns. It becomes visible only from the beginning of the 16th century, together with the establishment of the Wawel pipe water supply. This time, however, the initiators were the Jagiellonian kings together with their advisers: King Aleksander, or maybe even Jan Olbracht (who granted the first privilege to establish a pipe water supply in Płock in 1498, wanting this way to acquire the town's approval²²), and surely King Sigismund I.

In contrast to the Wawel pipe water supply, the unsuccessful attempts to establish pipe water supplies in Kamieniec Podolski (1507)²³ and Płock (1509-1511)²⁴ could result mainly from the difficulties being too big in relation to the technical abilities of that time and/or insufficient capabilities of the master fountain-builders.

The professional knowledge of the Czech constructor of the Wawel installation, Jan from Dobruska, proved sufficient to such a degree that not only did he fulfil the difficult enterprise, but he also later successfully took care of it for over 40 years as the royal master fountain-builder. Besides, he must have contributed to the good opinion

about Czechs as his brothers in profession that the Polish King Sigismund I held, because during his entire reign the King consequently made use of their services to establish pipe water supplies in various towns. Jan from Dobruska enjoyed higher social and economic position among the Kraków bourgeoisie (which class he entered) than other town master fountain-builders, who did not match his standing (judged mainly on the basis of economic activity of their wives). However, in other, smaller towns, constructors of pipe water supplies could occupy important positions in the town social hierarchies; the example of the master fountain-builders from Krosno in Little Poland²⁵ can serve to illustrate this point. However, the high status of the brothers master fountain-builders in Sandomierz resulted primarily from the fact that they were royal master fountain-builders²⁶.

The contractors of the network were the people thanks to whom the direct transfer of techniques of the pipe water supply construction took place (Fig. 3). It is, however, always worth looking also from this angle for the initiators of the investment, as was done for Kraków of the end of the 14th century. The construction of the Wawel pipe water supply at the beginning of the 16th century was surely witnessed by Erazm Ciołek, who shortly after, already as the Bishop of Płock, acted as manager of the project of the pipe water supply with the water-work in Płock²⁷ (his role can be compared with that of the papal legate and Archbishop Georges d'Amboise, thanks to whom the pipe water supply "Carville" was created in Rouen in 1500²⁸). In the 1530s in Płock at another attempt to establish a network there, this role was assumed by Jan Alansee, the Kraków apothecary of the Polish Queen Bona Sforza and mayor of Płock, who introduced Mikołaj Łuszczek from the mining town of Bochnia as the contractor²⁹, who shortly before had been mentioned in Kraków as the town master fountain-builder³⁰. The fact that for the difficult case of the Płock construction master Łuszczek chose the "Paternosterwerk", i.e. a "chain pump", and not suction and force pumps, can testify to the lower efficiency of the latter still in the 1530s.

It is worth noting that the presence of water-works in Great Poland towns documented in sources was not ascertained. It is impossible, however, to establish the reasons:

²¹ U. Sowina, *Kanały wód odpływowych w późnośredniowiecznym i wczesnonowożytnym Krakowie*, [in:] *Ulica, plac i cmentarz w publicznej przestrzeni średniowiecznego i wczesnonowożytnego miasta Europy Środkowej*, ed. S. Krabath, J. Piekalski, K. Wachowski, *Wratislavia Antiqua* 13, Wrocław 2011, p. 271.

²² F. Papée, *Jan Olbracht*, Kraków 2006, p. 97; S. M. Szacherska, *Złoty wiek miasta 1495-1580*, [in:] *Dzieje Płocka*, ed. A. Gieysztor, Płock 1973, p. 111-113.

²³ F. Kiryk, *Z zagadnień zaopatrzenia dawnego miasta w wodę*, [in:] *Kamieniec Podolski. Studia z dziejów miasta i regionu*, ed. F. Kiryk, vol. II, Kraków 2005, pp.101-102.

²⁴ *Zbiór Dokumentów i Listów Miasta Płocka*, vol. II: 1495-1586, ed. S.M. Szacherska, Warszawa 1987 (later referred to as: *Zbiór Płock II*), pp. 42-49.

²⁵ F. Leśniak, *Soejotopografia Krosna (1512-1630). Studia i materiały*, Kraków 2005, pp. 47 and 103.

²⁶ U. Sowina, *Les maîtres fontainiers dans les villes de Pologne du bas Moyen Age et au début de l'époque moderne – experts étrangers ou spécialistes polonais?* [in:] *Questiones medii aevi novae*, vol. 3, 1998: *Foreign experts*, pp. 211-213 and 216.

²⁷ *Zbiór Płock II*, p. 42-43.

²⁸ U. Sowina, *De l'eau pour la ville: Le Livre des Fontaines de J. Le Lieur (Rouen 1524-1525)*, [in:] *Etudes Normandes*, Université de Rouen, n°2-2001, p. 31.

²⁹ *Zbiór Płock II*, pp. 166-169.

³⁰ APKr., *Liber Testamentorum* 772, p. 257; *Cracovia artificum* II/3: 1501-1550, ed. J. Ptaśnik, M. Friedberg, Kraków 1948, p. 536.



Fig. 3. Wooden and ceramic water pipes from the collections of the Institute of Archaeology of Wrocław University (Photo by U. Sowina).

was it caused by the lack of such a vision among the initiators and the absence of suitable contractors, or simply by the lack of such a need, because natural conditions did not require the construction of water-works. The latter seems, however, less probable if we consider the example of Kościan, where in the 16th century water was carried gravitationally from sources situated at a distance from the town³¹, and only in the end of the 18th century a water-work was installed on the neighbouring river as a complete novelty³².

Besides the above-mentioned reasons, Renaissance currents and opinions played a very important role in the proliferation of pipe water supplies in towns in the Polish lands. The awareness of the dependence of human health on clean water used to appear and disappear from the times of Aristotle, but now became highlighted. It was clear in

the Pilzno praise of pipe water supplies from 1488³³, and in some of King Sigismund I's documents, which might have been written at the dictation of the King's physician, Piotr Wedelicjusz, an advocate of Hippocrates's views, including the one concerning the dependence between bad water and diseases. The matters were far worse when it came to the social understanding (also accompanying the organization of the work space) that working pipe water supplies should not be polluted either by their intake (by throwing organic and production sewage to the river) or along their course. However, this always resulted from the ambivalent attitude towards the problem of water pollution: canals for wastewater were built, but sewage from these canals was carried to rivers, because people believed in the purifying force of rivers.

³¹ U. Sowina, *Woda i ludzie...*, p. 277.

³² K. Górską-Gołaska, *Topografia średniowiecznego Kościana*, [in:] *Spółczesność Polski średniowiecznej*, ed. S. K. Kuczyński, vol. VI, Warszawa 1994, p. 228.

³³ *Talia enim corpora nostra fieri necesse est, qualibus nutriuntur. Aër enim primum et aqua, si clemencia sint et salubria, corpora clementata incolumnia reddunt* – Z. Kowalska-Urbankowa, „*Spominki Pilzneńskie*” z przełomu XV. i XVI. wieku, „*Studia Historyczne*”, vol. XXIX, 1986, fasc. 3 (114), p. 455.

Streszczenie

Zaopatrzenie w wodę w mieście późnośredniowiecznym i wczesnonowożytnym na ziemiach polskich

W prezentowanej pracy omówiono główne sposoby zaopatrzenia w wodę i gospodarowania nią w miastach na ziemiach polskich w późnym średniowieczu i we wczesnej nowożytności. Zauważając, że najmniej danych w źródłach pisanych odnosi się do wód deszczowych i źródłanych, pokazano korzystanie z rzek, z wód studziennych oraz z tych doprowadzanych wodociągami. Wskazując na dążenie do jak najpełniejszego wykorzystania rzek, zwrócono jednocześnie uwagę na różną rolę, jaką spełniały duże rzeki w zależności od położenia miast względem nich. Ze szczególnym uwzględnieniem sieci wodnej Krakowa pokazano ekonomiczne znaczenie mniejszych cieków wodnych: jako

źródeł energii dla różnych rodzajów młynów wodnych, oraz jako zaopatrujących w wodę stawy i sadzawki rybne, istniejące wokół Krakowa. Podkreślono społeczną i ekonomiczną rolę studzien kopanych, jako najważniejszych źródeł zaopatrzenia w wodę przestrzeni *intra muros* średniowiecznych miast na ziemiach polskich, zwłaszcza w procesie produkcji piwa. Ta ważna gałąź wytwórczości okazała się też głównym powodem powstawania sieci wodociągowych w wielu miastach, chociaż w Krakowie początkowo wodociągi służyły raczej tylko dla wygody patrycjatu – jako najdoskonalszy sposób zaopatrzenia w wodę.