CHAPTER SIX

WATER MANAGEMENT SYSTEM
All large cities require that the supply of drinking water for the citizens should be assured and plentiful. Since Jaipur is not near any perennial river and in the absence of any perennial source of water, rains—being its only source—were and are only for three months. But the need of water remains for the whole year; this posed a difficult problem for the planners of the City. It made essential for the rulers of Amber to collect and store rain water through different means and so they planned and constructed various types of water bodies which I came across in Jaipur during my archaeological-survey of the region.

During the course of conducting the physical survey of the walled city of Jaipur and its surrounding area, and then after corroborating it with the relevant contemporary sources, I found that in the area there was an elaborate system of water management—rain water collection, its conservation and supply system. The whole system was made in such a way that every effort was made to ensure the optimum utilization of it and no wastage of water was allowed. In the area, there found many types of masonry water bodies which may be categorized as: water bodies for storage, inlet and outlet channels or the distributory channels, water cistern or the filtration chambers water works for pleasure. The water management system of Jaipur was composed of canals, ponds, reservoirs, dams, tanks, kunds, wells, step-wells, channels, aqueducts, etc. Basically this system facilitated the conservation of rainy water and its distribution for catering the various human needs within the City and outside as well. Besides, a precaution has been taken to device the water system in such a way that it may be available for cattle and other animals.

From the contemporary records it appears that Sawai Jai Singh was very much concerned about the water supply for his new Capital, and he had given attention to this problem from the very beginning. Old City-Maps of Jaipur available at the City Palace indicate his concern and also the techniques of canal construction of that period. Before executing the plan, the natural resources and their entire routes had been surveyed and

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1 The annual rainfall for the State of Jaipur is said to have averaged around 23 inches.
2 G.N. Bahura, Catalogue of Historical Documents of Kapad-Dwara, Jaipur ['Kapad-Dwara Catalogue'], Jaipur, Vol.II, Maps and Plans, Jaipur, 1990, Map Nos. 116, 119, 214, 232, 300, 301, etc. An examination of these maps reveals that proper arrangement for water supply was the focal concern of the ruler of Amber while planning the City of Jaipur.
plans were prepared accordingly, which show height of the pillars and depth of water at
different distances.

The rivers – Jhotwara, Banganga, Banas, and Darbhavati - were surveyed and
the natural channel of each was taken into account. It was noted that Jhotwara was in the
north-west of the City; and while the Banganga ran beyond the eastern terrain of hills, it
originated in the south-east of Jaipur⁵. Banas was in the south of the City and all its lower
courses were within the limits of Jaipur. River Darbhawati forms the theme of a number
of contemporary maps and documents related with the City's foundation. The water for
the Jaipur City could be collected from the rivers Darbhavati and Bandi, which join each
other⁴. Wherever the natural course of the river water could be used, it was drawn on
maps and described in the related description and estimates and actual measurements of
lengths of the water courses were made later⁵. The general direction of drainage is
towards south in the southern part of Jaipur; towards east in the eastern
part and towards north-east in the northern part.⁶

The work was started on a canal to bring water from the Jhotwara River to the
new city then under construction. The preliminary proposal about this project (canal
construction) was submitted in July 16, 1726 A.D.⁷, The Jhotwara River in the north-west
was diverted through the ‘Amani-Shah-Nallah’⁸ and a number of canals were channelised
through ‘Brahmapuri’ and ‘Jainiwas’ to supply water to the City⁹. Another City Map¹⁰
shows a canal, constructed of bricks, Kirajal¹¹ (near the ‘Man-Sagar’ Dam) to the
Jainiwas¹². This canal also supplied water to the nearby villages.

⁷ Ibid, Map Nos. 28, 128 and 130.
⁹ Arzdast, Shravan Vadi 13, V.S.1783/1726 AD - ‘Anand Ram to Jai Singh’, the writer informed that a canal
from Bandi River, about 9 *kos* from Jainiwas, would prove a more difficult and lastly undertaking that one
from the Jhotwara River, which was about 2 *kos* from the palace, and intervening sand dunes were also not
very high; cf. V.S. Bhatnagar, *Sawai Jai Singh and his Life Times*, p.331.
¹⁰ The ‘Amani-i-Shah’ or ‘Amani Shah-Ka-Nala’ originates in the foothills north of the
Jaipur City, it supplies the city with sweat drinking water, and joins the river, Dhund
south of Sanganer after flowing 35 kms, in it water sustain whole year, *Vir-Vinod*,
¹² Ibid, Map No.287.

A kind of water body which was built for entertainment.

The length of this canal is mentioned in the map as 2.5 *kos*, Map No.287, *Op.cit.*
Kapad-Dwara Map Nos. 29 and 61 give a vivid description of a canal joining the river Banganga along with its length and slopes, the height of the pillars at many points, depth of water at different levels and other measurements which are given in yards. It also refers to a Talab or the water tank built in front of Banganga. The canal of 'Sawai Jai-Sagar' is also depicted on the map according to which it also originates from the Banganga. The lengths from (mound at) Ramgarh to Dundh is 6800 yards and the height is 45 yards - Till the gate (darwaza) and wall (motia-kot), the length is 1400 yards and the slope 4 yards - 'Pitambar Bohra-ki-Baoli' - from mud-wall to big gate (barha-darwaza) the length is 1650 yards and the slope is 19 yards - From big gate to opening (mori) for Jai-Sagar, the length is 480 and the slope 19 yards – Raised edge (pali) of Jai-Sagar.

To facilitate water supply to the City, he planned a canal from a nearby stream ‘Darbhavati’, and some distance to the north-east of the City, between Jaipur and Amber, it was dammed to create the ‘Jai-Sagar’ and ‘Man-Sagar’ lakes (that later housed the ‘Jal-Mahal’ or the Water Palace). The tract, at present occupied by the lake, Man-Sagar, created by this dam (Bund) was formally a marshy land. It also formed the bed of a rivulet which passing through a narrow gorge in the hills used to flow towards the north-east. This rivulet called ‘Darbhavati’, which was dammed in V.S.1792/1735 A.D. during the period of Sawai Jai Singh, and it was built under the supervision of an

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13 Ibid, Map Nos.119, 125.
14 Though, no such river or stream exists today, and historians of the Jaipur City have speculated on the problem of identification of the stream for many year. A reference to the ruin of an ancient barrage near Jaipur in one of the older reports of the state Public Work Department has helped in identifying the old course of this river- Roy, A.K., Op.cit, p.xiv. Maps related with ‘Darbhavati’ which forms a conspicuous part of the Collection (Kapad-Dwara, M. S. Man Singh II Museum, Jaipur), at Jaipur also help in identifying the course of the river.
15 See Plate No. 24 (B)
16 This is borne out by the Map No.56 (in the Kapad-Dwara Catalogue, it is listed at No.29 and entitled as "Tarah Sawai Jai Sagar wa Mansagar") that a lake in the vicinity of the main palace, which it identifies as 'Jaisagar'. According to Jaipur Palace traditions, Jaisagar was renamed 'Ayamal-Sagar' by Jai Singh Sawai. From this one may infer that this particular map, which also depicts Man-Sagar Dam, was prepared at a time when the above lake was still known as Jai-Sagar, i.e. some time during Jai Singh Sawai's reign when it had not yet been renamed Ayamal-Sagar. The fact that Man-Sagar Dam also figures in this map goes to suggest that it existed during Sawai Jai Singh's reign, "The Man-Sagar Dam of Amber", Op.cit, pp.4-5.
17 See Plate No. 24 (A)
18 See Plate No. 24 (B)
19 See Plate No. 25 (A)
architect Ganga Ram\textsuperscript{20}. The Man-Sagar Dam at the river created a reservoir serving two purposes i.e. supplying water as well as afforded protection to the City. This dam is a massive masonry structure truly illustrative of the type of dams noticed by Babur on his march to Chanderi, i.e. dams built “across between hills”

Inspection of Man-Sagar Dam and its surroundings reveals that it was built on ‘trabeate’ principle with stone, rubble and mortar to play a gorge. Its length, along the down-stream wall and over the opening left for the spillway, measures about 202 meters. The dam thus creates a reservoir on its western side\textsuperscript{21} that extends up to the road connecting Jaipur with Delhi. ‘Jal-Mahal’ built by Sawai Jai Singh in 1734 A.D. stands on an island close to the southern bank of the reservoir\textsuperscript{22}. According to a noting on one of the old city maps, the bed of the reservoir slopes in the west-easternly direction. At the base of the dam, according to this noting it is “3.5 yards’ lower than its level near the steps of Jal-Mahal. A huge tank was also constructed below the Man-Sagar Dam.

According to the ‘Technical Report’ of the State’s Irrigation Department\textsuperscript{23}, the catchment area of the lake in the surrounding hills measured approximately 10 square miles (16.09 kms.) and “the full tank level (of the lake) before any modifications in the structure were carried out, stood at R.L. 117 FF/35.66m.”. Water flowing out of the Man-Sagar irrigates at present about 1648 acres/667.206 hectares of land. There are two canals that originating on the down stream side of the dam flow towards the east. One of them that originate at the spillway is clearly depicted in the Archaeological Survey Sheet no. 45, N/13. There are two sluices for the outflow of water, one on the left end the other 95 meters to the south of the first. These sluices form the only existing outflow discharge.

\textsuperscript{20} Dasnir-Kaumwar (Jaipur), Vol.23, V.S. 1792/1735 AD, Jaipur Records, R.S.A., cf. Bikaner; G.N. Sharma, A Bibliography of Medieval Rajasthan, Agra, 1965, p.42; Iqtidar Alam and Ravindra Nath, who surveyed the Mansagar Dam three decades ago, suggest that the specialized knowledge relating to the problems of dam building that is clearly reflected in the basic design of the Man-Sagar Dam was probably acquired by Ganga Ram from an indigenous tradition, see for details, Iqtidar Alam & R. Nath, “The Mansagar Dam of Amber: A detailed study of its structure and working”, in Annirudh Ray and S.K. Bagchi (eds.), Technology in Ancient and Medieval India, Delhi, 1986.

\textsuperscript{21} See Plate No. 25 (A)

\textsuperscript{22} Ibid.

\textsuperscript{23} This report was prepared by the Irrigation Department, Government of Rajasthan, under the title “Remodelling of Man-Sagar Bund and Canals System”, in 1978 as to make some modifications in the dam structure so that the Jaipur- Delhi road may not get submerged.
from the tank and the surplus capacity of this tank was inadequate in comparison to the inflow received into the tank.

The whole structure of the Man-Sagar Dam can be divided in three distinct parts – (a) The structure up to the plinth level; (b) The super-structure rising from the plinth in successive storeys; (c) The fortification represented by a battlemented rampart rising on the downstream side of the super-structure. About the basic nature of the structure and the building technique, and devices used for ensuring the functional viability of the dam, some important points are as follows:

Firstly, it may be suggested that the Man-Sagar Dam is an interesting specimen of a gravity dam built on the trabeate principle. The exclusive use of the trabeate principle in this dam tends to suggest that it represented a pre- Turkish tradition of dam building. This tradition appears to have survived, in the territories dominated by the Rajpurt chieftains, down to the beginning of the 18th Century. Secondly, an awareness of the basic problems of the dam engineering such as preventing a tension failure on the part of the architect who designed this dam. The fact that Man-Sagar Dam is still operational and that in A.D.1981 it survived the fiercest floods in living memory testify to its accurate planning. Thirdly, the sluices in the dam was designed in the form of small tanks located between the lake and openings of the tunnels carrying water across the dam with an aim to regulate water discharge, to prevent silting of the tunnel and also to protect the mouth of the tunnel from seeping and erosion resulting from continuous contact with and pressure of the lake water. And, finally, the battlement rampart, atop the downstream wall of the dam continues on the flanking hills. The Man-Sagar Dam was originally planned to strengthen a fortification aimed at securing the outer fringes of the military purposes. Firstly, it strengthened the defense of the fortified space by providing a source of continuous water supply; secondly, it served as a bulwark blocking entry into the fortified space.

The river Darbhavati runs from the Saiswara Gate, and there are sand dunes in the water, due to which the water can be drawn by two charas (Persian-Wheel) till the

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24. The Technical Report proposes that the capacity of the spillway be increased and a gateway be introduced to regulate the flow through it. Through the device the Technical Report planned to bring down the F.T.L. from R.L. 117 ft/35.66 m to R.L. 116 ft./35.36 m; which was apparently necessary for avoiding the inundation of Jaipur-Delhi road.
month of *Chaitra*. The Bhav-Sagar is brought from the Pali River measuring 170 yards and the places touching the water are stated in the records. Ten *charas* draw water from the Bani River from where the canal starts. Water was also conserved through draining streams towards Man-Sagar in 1735 A.D.26 The canal of Bishan-Sagar from the River Darbhavati was brick land and 40 *bighas* of land is recorded to have been dug up for this purpose. The account of the Jhotwara Canal, north-west of Jaipur City, shows the area to be sandy. The canal was very deep and steps (*chotthi*) were sunk in the sand27.

As Temples and gardens were a regular feature of different areas, so water-supplying to these gardens by means of canals was also found in Jaipur. Thus, a listing of such gardens and sources of water was undertaken. There was a separate state-department, called ‘*Bagayat*’, which looked after these gardens. Map No. 10728 indicating the area around Brahmapuri up to Amber with prominent gardens, such as, garden of Purohit-Gangaram, Samratji, Sarkar, ‘Naulakha-Bagh’, ‘Chandra-Bagh’, ‘Nand-Bagh’, ‘Vijay-Bagh’ and ‘Man-Bagh’, and ‘Vyas-Kund’ (Tank), ‘*Mia-Ki- Sarai*’, and a Jain temple.

Another City Map29 shows the area, from ‘Talkatora’30 in Jainiwas to ‘Kanakbagh’, was dotted with so many reservoirs. To the east of ‘Talkatora’, there were two water reservoirs, popularly known as ‘Rajamal-Ka-Talab’ and ‘Bhagwant-Sagar’31. Talkatora and Rajamal-Ka-Talab, both were within *Sarhad* or the boundary of the Palace Complex. Talkatora, which exists in the northern part of the Palace Complex, is still in preserved condition, but Rajamal-Ka-Talab was filled up32 later on. Another water body

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25 It runs below Nahargarh: Vidyadhar Diwan was conferred honours for bringing it to Sawai Jaipur, *Datur-Kaumwar* (Jaipur), Vol. 23, V.S.1792/1735 AD; Also see *Kapad-Dwara* wherein the plans of Man-Sagar and Jal-Mahal are referred to – Map No.198; Step by step construction is recorded right from the digging of the foundation and the construction of a sanctum (*garbagriha*) – Map No. 216. The water was channelized towards Man-Sagar from Jhotwara. Guni, Matol canals which ran towards Saraswati, since in the four months water was plenty, therefore it was directed towards Man-Sagar – Map No.283, Sumbul Halim Khan, “Planning the Pink City: Maps and Documents”, *Indica* – 35, The Heras Institute, St. Xavier’s College, Mumbai, 1998, pp.34-35.

26 In the second half of the 18th Century, the Akaida Tank was constructed. It was brick-laid because of the sandy soil. Its measurements are also given in the records. The water of this tank was used mainly for washing clothes (at the *dhobi-ghats*) – *Kapad-Dwara* Map No. 120; Planning of the Pink City, ibid, p.35


28 *Kapad-Dwara Catalogue*, Map No.287

29 See Plate No. 25 (B)

30 *Kapad-Dwara Catalogue* Map No. 121 is entitled as "Tarah Bhagwanta Sagar".

31 It was filled up during the period of Ram Singh-II and at present, an Ayurvedic College is exists there in its place.
‘Santosh-Sagar’ is also referred in the city maps again. The Kapad-Dwara maps, listed as No. 249 and 251, show the work being done in ‘Jagannath-Sagar’, a water body in Brahmapuri named after Jagannath Samrat, and at the Ghat near Paundarik-Haveli with a water-outlet for Jainiwas. These water bodies were interconnected by a network of masonry canals and aqueducts or conduits.

‘Talkatora’ is a masonry water body in the almost square shape with the length 288 Yards and the breadth 286 Yards. It is enclosed by the high masonry walls from all sides, except the northern one, where it is partially opened. Inside this water body an octagonal masonry structure, attached to the boundary of each side, except northern one where it is situated towards inside, is built. The water was raised or lifted from this Talkatora to the Badal-Mahal or the Cloud Palace, which was linked to Jainiwas or the Palace Garden and the City Palace through a continuous chain of the water channels and fountain tanks. In this way water was supplied from the Talkatora Lake to the Palace and other buildings within the Palace Complex. And, water was supplied to other blocks of the City from the Rajamal-Ka-Talab, which was connected to the water tanks, built in the central squares of the City, through underground aqueducts or the conduits.

The water supply system was further augmented by water bodies known as ‘Kunds’ existing in the centre of ‘Bari-Chaupar’\(^{33}\) and ‘Choti-Chaupar’\(^{34}\) which are linked further to wells and ‘Baolis’ or the step-wells in the inner streets through underground aqueducts or conduits. The old city plans\(^{35}\) mention the wells placed alongside the planned street and the other streets which joined it. Map No. 170\(^{36}\) refers to a well of the ‘Tikkiwals’, along with a temple and a ‘Kagadya’ (Paper-makers) Mosque. Two other contemporary maps\(^{37}\) of the City also refer to a _pukka_ or the masonry well and a sweet water well. Thus, the analysis of the above mentioned sources signifies that there was an integrated system of water conservation and its management, and water was not only stored, carried over long distances but also distributed among the various parts of

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\(^{33}\) See Plate No. 15 (C); Jaipur City underwent significant transformations in the period of Sawai Ram Singh II (1835-1880 A.D.) when the earlier water bodies of the ‘Rajamal-Ka-Talab’ and _Kunds_ in _Chaupars_ or the Squares were filled up and new water pipe lines for water supply were installed in the city and so the original water system became redundant.

\(^{34}\) See Plate No. 19 (C)


\(^{36}\) Ibid; This map is dated 1700-1725 AD.

\(^{37}\) Ibid, Map Nos. 106 and 133 dated early 18th Century.
the City. The structural characteristics of these *Kunds* or enclosed tanks—judicious disposition of steps and flights of steps turned the *Kunds* into objects of great architectural merit. These *Kunds* having enclosed a limited area made provision for letting water in and out of the tank in a controlled way.

In the survey of the water bodies of the City, a number of step wells are found, though some of them are now redundant. A *'Baoli'* or Step-well was a much more enlarged and highly advanced version of a well or stepped-well with a flight of steps so as to make access to the water easy. It combined the utilitarian aspect with a pleasure resort. The structure of the *Baoli* or Step-well is tiered with the steps leading downwards from one storey to the other such that the lower tiers would emerge as the water table declined in the dry seasons. This stepped arrangement allowed the users access to the water level even during the dry seasons. The tiered galleries are also widely used as spaces for rest and are often ornamented by elaborate relief sculptures. The *Baoli* may differ in terms of their design and the structure of the steps. Although the *'Kale-Hanumanji-Baoli'* was built on what was originally the outskirt of Jaipur, its location has come to be a densely populated area of the City. The *Baoli* derives its name from the temple of Hanuman across the road from it. A step-well, known as *'Jagga-Baoli'*, was located towards *'Galtaji'* . Unfortunately it is presently in a very dilapidated condition.

The new city was linked to the old hilly fortress city at Amber and to the two forts of *'Nahargarh'* and *'Jaigarh'* . These forts are like any other fort with one exception, i.e. they have an elaborate system of collection and storing water. Amber has a large number of water bodies—lakes, *Kunds* or tanks, *Baolis* or step-wells, etc, some of

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38 Step-wells were an important part of the social life of the people and an integral part of their social fabric. The people in the area would come to the step-well to rest and socialize, protected from the summer heat. Further more, the step-wells location in temple compounds and on trade routes granted them the position of a traveler’s heaven, a place of business and wedding transaction. Royal havens and summer parties were also held in the premises of these Step-wells. In Western India, particularly Rajasthan and Gujarat the step-well was converted into an architectural monument of beauty.

39 The *Baoli* still holds water and ought to rightfully have been a resting area for pilgrims or visitors to the temple; it no longer serves its intended function due to the well having been littered with all manner of garbage.

40 Its dilapidated state has been used it in a dumping well for their garbage up until recently when the *Baoli* has been cleaned and restored to its original function.

41 See Plate No. 23 (C)

42 See Plate No. 26 (B)
them deserve mention here. One of these is the ‘Maota’ Lake located below the hill top Palace Complex of Amber. Another is the old lake ‘Sagar’, situated in the valley to the hill top palaces i.e., to the north-west of the Jaigarh Fort, was also an important source of water. Among Amber’s numerous tanks, reservoirs and step-wells, the ‘Khasa-Baoli’ a three-tiered step-well, with arches and walk-ways, is noteworthy. Another significant water structures or Baoli at Amber is the ‘Punna-Mian-Ka-Kund’, build by Mian Panna, who is reputed to have been a eunuch in the service of Bishan Singh and his son Sawai Jai Singh II, this structure has four octagonal ‘Chhatris’ or the pillared verandahs.

The Nahargarh Fort had a far more elaborate water supply system. It has a number of open tanks at various levels for collecting and storing rain water. Rain water was channelized by masonry walls and other supports all along the hills, and stored in a number of water bodies built within the fortification walls. Towards the western side of the main palace, two large storage Kunds or the tanks are accessed by a long series of steps that snake downwards to the water level forming a crescent shape. Direct access to the water is also provided through another series of steps which proceed straight from the top to the water level. There are a number of channels that are covered with stone slabs and lead from ground level to the storage tanks below. Small tanks that were separated from the main tanks were also created on a side, and the water from these was reserved for the animals that were housed in the fort. To the north-eastern side of the palace, there exists a beautifully structured step-well in nearly triangular shape which shrinks downwards. Together the system used at this Baoli served to efficiently harvest all of the regions scanty rain water.

The water supply system in Jaigarh is one of the most significant features of the fort. This fort is self-sufficient with respect to its water requirements. Water, being the basic necessity, was most meticulously preserved and more conscientiously used. Here, the tanks could store water for thousands of men for years together. The catchments area

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43 See Plate No. 29 (D)
44 See Plate No. 28 (B)
45 See Plate No. 29 (C)
46 The cenotaphs of King Kuntal and his queen, Ladan Devi are near this ‘Baoli’.
47 See Plate No. 28 (C)
48 See Plate No. 28 (D) & 29 (A)
49 See Plate No. 29 (A)
50 See Plate No. 29 (B)
of rain water\textsuperscript{51} for Jaigarh extends to about 4 kilometers from the fort. A network of drains, small canals and their arteries are laid in and out-side the fort. All along the hills paved ways were constructed of brick and lime mortar\textsuperscript{52}. Rain water was channelised along these into small canals or plastered channels, which were connected with the main tanks inside the fort. These small canals bring rain water from the higher reaches of the hills. The bed of these canals is designed in such a way that it is on a gradient and also at the same time has an undulating course. This allows the sand to settle in the low of the canals. This also helps the water to flow swiftly in the canals. Water was allowed to drain or overflow through open or covered ducts made of stone or brick and lime mortar\textsuperscript{53} to huge reservoirs. There are also many small tanks on the path of the canals which allow the small stones and other waste material to settle down in these tanks. Structures similar to silt traps had been constructed to ensure that the dirt settled in such traps and only fresh water reached the tanks. Water of the first one or two rains was channelized into the open tank in the south-east of the fort\textsuperscript{54}, by closing the gate of the canal loading to the main tanks. This not only allowed the contaminated water of the first few rains to fall into the open tank\textsuperscript{55} but also wash the canals of the dirt and filth. The water of this open tank was used for horses and other animals. Only fresh and clear water was allowed to collect in the main tanks\textsuperscript{56}. Even today water is collected in Jaigarh in this same old. The inmates of the fort use this water for drinking and cooling.

There are five main ‘Tankas’ or big tanks inside the fort. Three of these tanks are in the southern courtyard of the fort and the other two in the north-east corner of the fort (the fourth is near the ‘Aram-Mandir’ in the garden). Four of these tanks were covered to prevent evaporation and the growth of bacteria, so to keep water clean. There are a few smaller tanks inside the palace complex, some of them are overhead tanks used for supplying water in the bathrooms. The largest tank in the southern courtyard is 158 ft. long and 138 ft. wide and 40 ft. deep. This tank is covered from the top\textsuperscript{57}. The roof of the tank rests on huge arches supported by 81 pillars constructed inside the tank. The storing

\textsuperscript{51} See Plate No. 26 – (A) & (B)
\textsuperscript{52} Ibid.
\textsuperscript{53} See Plate No. 27 – (B) & (C)
\textsuperscript{54} See Plate No. 28 (A)
\textsuperscript{55} See Plate No. 27 (A)
\textsuperscript{56} See Plate No. 28 (A)
\textsuperscript{57} See Plate No. 28 (A)
capacity of this tank is six million gallons of water. The second covered tank just adjacent to the bigger tank is smaller in size. This tank measures 69ft. by 52ft. by 52ft. there are nine holes in the roof of this tank and there is a room under each hole (it is said that the rooms were used as a treasury-house until the reign of Sawai Jai Singh II. It is argued that the wealth stored here was used for building the new city of Jaipur. The third tank in this courtyard is the smallest. It is an open tank measuring 61ft. by 52ft. by 27ft. The other two main tanks inside the fort are also covered from the top. The one in the ‘Aram-Mandir’ was used to fulfill the water requirements of the palace complex and the garden. The other in the north-east was perhaps meant for use in times of emergency.

Jaigarh’s ‘Laxmi-Niwas’ Palace, which was constructed by Mirza Raja Jai Singh and further added by Sawai Raja Jai Singh II and later by Ram Singh II, has a ‘specific system of central heating’, which kept the floor of the hall uniformly warm. The long tunnels under the floor are connected to a furnace, which opens in the north-west corner of the tunnels, keeping the floor warm during winters. The ceiling of the furnace opens into a boiler tank above the bathrooms of ‘Laxmi-Niwas’. Accordingly, one of the bathrooms had a provision for a steam bath, and other bathrooms had provisions for hot and cold water. The central heating system in the palace was a

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59 See Plate No. 28 (A)
60 ‘Luxmy-Vilas’ (‘Niwas’) has a provision of putting cotton-stuffed curtains. The curtains were used in winter and when drawn made the hall air tight to keep it warm. These curtails are still preserved and are used in certain occasions. The hall allows a free access to breeze during summers when the windows are opened and the curtains are lifted up”, R.S. Khangrot, Jaigarh, Op.cit. p.53.
61 There is another complex attached to the bathroom which provides the facility for steam bathing. This complex is smaller in comparison to the other bathroom; measuring 13ft. by 10ft. It has a marble sunken bath-tub of the same size as in the other bathroom. This complex is also attached to a boiler tank. There is a round copper plate having a diameter of 2feet fixed at the bottom of this tank. Just below the plate is the furnace which kept the water in this tank warm. When the complex is closed from all sides (it has only a window as an opening) and water in the tank boils, it produces steam. Steam being lighter than air spreads in the whole complex which was used for steam bathing. The boiler tank and the other two tanks in the bathroom are connected with an overhead tank. It has 6 outlets connected with the taps in the bathroom and the steam bath, cf. R.S. Khangrot, op.cit, pp.54-55.
62 Shikha Jain (ed.) Princely Terrain, ed. by, Op.cit, p.45; The doorway, in the north of ‘Laxmi-Niwas’, leads to the two toilets and the royal-bath. The peculiarity of the toilets is that one was meant for summers and other for winters. The one for summer has three windows which open out side the palace complex. It also has a hook on the ceiling which was used for hand-pulled ‘Punkhas’ or fans. An opening on the wall was used for pulling the rope of the fan from outside. The other toilet meant for winter is closed, having fixed glass window panes. There is no hook for the fan on the ceiling. Instead, there is a Chimney through which the stream and gases escaped when the central heating system worked. The opening for the rope has not been provided in it. The structural design and the lavish use of marble on floor and the walls of the
specific system by which the royal palace complex was kept warm during the winter season. Looking at the total system, at these fortresses at the tops of the hills, one finds that no water was allowed to go waste, it being collected and stored for use. Thus looking at the total system of rain-water collection, storage and its management at these fortresses at the tops of the hills, one finds that no water was allowed to go waste, it being collected and stored for use.

The lake 'Sagar' to the north-west of the fort, as already stated, was also an important source of water supply in the fort. This lake is divided into two sections by means of a _pucca_ or masonry dam and the rain water flowing from the southern and the western hills was collected in them. Water from this lake was carried by elephants in large leather begs and emptied into the tank below the western out walls of the palace. It was lifted up as it is done in wells. There was a lift system for water supplying from the lake 'Sagar'. Water from the lake 'Sagar' was collected in small tanks by means of masonry channels. Steps were constructed so that water could be lifted up to fill the tanks on a higher lever. The men on the bottom step would fill a container with water and hand it to the person on the immediately higher step, whom turn would pass it on to the person on the next higher step. In this way water was carried right up to the tank at the bottom of the fort walls. Once this tank was filled with water it would be further lifted up with the help of a pulley as is done in the case of a well. The water in the palace and other parts of the fort was supplied manually as well as mechanically. ‘Persian-Wheal’ or

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_bathroom give it an elegant touch. The central portion of the bathroom is 21 feet high, measuring 21ft by 19ft. A small drain all around it was used to carryout water from the bathroom. In the western corner of this bathroom is a marble sunken bath tub. The tub is connected with two tanks on its either side. One tank was used for storing cold water and the other for hot water. The tank for hot water is connected with a boiler tank. It is evident that water from both the tanks was mixed in the tub to a required temperature during winter seasons; ibid, p.54.

63 It consists of a circular furnace of 4 feet 5 inches in diameter and 3 feet and 8 inches in height. The furnace lies just below the boiler tank which boils the water in the tank also. The furnace has two openings, one towards the west and other towards the north. One opening is meant for putting in fuel and the other to allow regular flow of air inside the furnace to help in combustion. The roof of the furnace is the same copper plate which is the bottom of the boiler tank mentioned above. The furnace leads to a series of long and narrow tunnels laid under the floor of the palace complex. When the fuel was burned in the furnace, warm air gushed out into the small opening of the tunnels under the floor of the palace complex. Thus, the air circulating under the floor kept the royal palace warm in winters, ibid, p.55.

64 See Plate No. 28 (B)

65 _Cf. Khangrot, R.S., Jaigarh: The Invincible Fort of Amber, p.63._

66 In the former case, water was carried by hardy labourers in large pots or pitchers from the tanks to the different parts of the fort. It is assumed that more then one pot was carried on a wooden plank or platform by two or more men. In the later case, water was supplied by filling the over head tanks in the bathrooms of
‘Rahatghadiya’ was generally used to raise water to over head tanks from which it was distributed to various chambers\textsuperscript{67}.

Thus, the above analysis signifies that there was an integrated system of water conservation and its management, and water was not only channelized, stored, carried over long distances, but also distributed among the various parts of the Jaipur City. The whole system was made in such a way that every effort was made to ensure the optimum utilization of it and no wastage of water was allowed\textsuperscript{68}.

\begin{flushleft}
\textsuperscript{67} This device was extensively used in the City of Daulatabad (17\textsuperscript{th} C. A.D.) and in the ‘Later Mughal’ period. The remarks on the river Darbhavati reflect that it runs from the Saiswara Gate\textsuperscript{67}, and there are sand dunes in the water, due to which the water can be drawn by two charas till the month of Chaitra. The Bhavsagar is brought from the Pali River measuring 170 yards and the places touching the water are stated in the records. Ten charas draw water from the Bani River from where the canal stats, as discussed earlier.

\textsuperscript{68} The system is still working at the hilly fortresses e.g. Nahargarh and Jaigarh in the north of the City of Jaipur.
\end{flushleft}
Distant views of Man-Sagar (A) from Jaigarh & (B) from Nahragarh
(A) A closer view of the Man-Sagar Dam showing the Water Palace

(B) Talkatora Lake, northern side of the Palace Complex, Jaipur
(A) & (B) Rain-water encatchment areas at the Jaigarh Hills

(C)
Views of the masonry water canal in the southern side of the Jaigarh Fort, showing the water hole which is connected with water tanks inside Jaigarh.
(A) Open Tank within the Jaigarh Fort, connecting the outer water canal

(B) & (C) Aqueducts connecting outer canal with the tanks inside Jaigarh
(A) An open & a closed Tank, Jaigarh & (B) A view of the lake Sagar

(C) Water-encatchment area & (D) A Step-well, at Nahargarh (western side)
(A) Closed tank (northern side) & (B) Step-well (eastern side), Nahargarh

(C) Panna-Mian Baoli or the step-well and (D) Maota Lake, Amber