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DINE BITOH: NAVAJO WATER USE[1]

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In arid country, water is life. Control over water sources means survival. No one knows this better than Navajo Indians, although when the Diné migrated into the southwest, the arid environment they encountered was novel to them. They adjusted to this new environment, and in adjusting, incorporated into their culture certain conventional understandings about water. As one author puts it:

> " Any lessening in the amount of either the rainfall or the snowfall would mean starvation for these desert dwellers, or the abandonment of their chosen homelands. For this reason every precaution is taken not to offend the rain spirits, the water people or the winds that bring the clouds across this thirsty land. To guard against such offenses many taboos have been established that concern rain,hail snow, fog and both still and running water." (Newcomb 1940:60)

The success of the Navajo adaptation to the arid environment was one of the factors which led to a steady and at times spectacular increase in the human and animal population of the area. In the early contact period, when people and herds increased, Navajos moved into new areas. The new lands were often more arid than earlier occupied land, necessitating continuing adjustment to increasingly arid conditions. The flexibility of the Navajo is evidenced by their successful adjustment to steadily worsening environmental conditions.

Under conditions of political subordination after the treaty of 1868, the solution of additional territorial

occupation became increasingly difficult to apply, and the expanding population put a growing strain on already scarce water resources. New lands were given to the Navajo by the U.S. government at first as the population grew, but the increase in reservation size never kept pace with the population. Territory was given in response to population pressure and actually did little more than recognize the rights of Navajos to land they already held (Young 1957:59). As the Anglo population of the area grew, even these concessions became more difficult to obtain. Some other solutions to water scarcity had to be found.

Early reports indicate that Navajos had turned to improving on Nature long before Fort Sumner. A witness testifying before Governor Don Joachin Codallos y Rabal of New Mexico stated that when he had participated in an expedition into Navajo country between 1712 and 1715, he had observed that " in some of the valleys they found holes with rain water, that was dammed by the Indians by sand dikes " (Hill 1940:402). Goldfrank refers to the archeological evidence "... of extensive systems of diversion ditches, check dams and boulder breaks at numerous ancient sites in the Navajo and adjacent country " (1945:268).

These constructions may have been for the purpose of providing stock water, or increasing the amount of land irrigated by flood waters - the use to which the water was

put is disputed by some authors (cf: Goldfrank 1945 and Hill 1940). It seems clear, however, that as Gregory said, " the use of flood waters for irrigation has been a feature of agricultural practice ... for perhaps a thousand years " (Gregory 1917:103ff). Bryan also stresses the importance of flood water farming during " both ancient and modern times " (Bryan 1929:444).

Although according to Hill, canal irrigation only came into Navajo country in 1860 (1938:183), evidence of Fray Silvestre Velez de Escalante is specific in regard to ditch irrigation among the Navajos in 1775. He wrote:

> " Here (about three and a half leagues west northwest of Rio Puerco) we saw many farmlands with little ditches for irrigation. I asked the Zunis who cultivated them and they replied that the Navajo Apaches did. (120-121) ... We stopped at this watering place an hour and a half while the animals refreshed themselves to go on. During this time a family of Navajos arrived."(Adams 1963:120-121).

In the light of the archeological and documentary evidence it is difficult to escape the conclusion that Navajos have been assisting Nature by small water channel constructions for centuries.

After the release from Fort Sumner, more extensive attempts at water control were made by Navajos and others interested in them. According to Hill, shortly after the return from captivity,the Navajos in the Chinle valley were using spreader dikes to improve the efficiency of flood farming (1938:25). In 1880 the personnel of the Navajo

Agency at Fort Defiance began trying to develop more adequate water resources for the Navajo. Captain F.T. Bennett, 9th Cavalry, the acting Indian Agent, wrote that three "wind engines" and fifty-two "stock pumps" had been placed throughout the reservation. Captain Bennett felt that improved water supplies might attract some of the Navajos back to the reservation, and would insure that those already on the reservation would stay there and would not have to move around quite so much in their search for water for their herds (Young 1958:60).

In 1883, D.M. Riordan, agent at Fort Defiance, wrote about his problems with dams in Blue Canyon. Every time one had been put in it had washed out (ibid). This problem has been perennial on the Navajo reservation, where many of the water control systems have been installed or designed by people unfamiliar with the climatic and ecological characteristics of the region. For example, in 1895, a technician finally showed up to spend $60,000 which had been allocated for water development in 1893. His constructions were washed out within two years, due to his unfamiliarity with the climatic conditions (Young 1958:61).

Inadequate as the Anglo dams often were, the example encouraged more ambitious constructions by Navajos. Agent Edwin H. Plummer reported in 1893 that an Indian named Captain Tom built a dam of log cribs filled with rocks and

backed by earth in Cottonwood Wash. The dam turned water from the creek into a prairie and irrigated about two hundred acres (Young 1958:61).

In 1895, an observer reported:

> " I found several dams made, which were a great credit to them (the Navajo). One was in the bed of an old wash which was seventy feet long and six feet high. Water was backed up by this dam fully half a mile.... By actual measurement I found the embankments around the field under this dam to be about 4000 feet. Another dam I found to measure 310 feet, with a long ditch connected therewith " (Hoopes 1946:45).

Dams and dikes have continued to be a solution to the water supply problem. In 1917, Herbert Gregory reported:

> " The Navajos sometimes endeavor to direct the floods and to prevent excessive erosion within the fields by constructing earthen diversion dams a few inches to a foot or more in height - dams which require renewal each season. Along the smaller washes and in places where the slope of the ground is moderate the common practice of the Navajo is to build a series of check dams 50 to 200 feet apart and two to five feet high, which not only retard the run--off but also serve to form temporary ponds for stock watering " (104).

Damming is not the only solution that has been used to improve the water supply, of course. In 1923, Indian Agent Albert Kneale was so depressed by the sight of animals mired down, dying and dead in shrinking water holes that he determined to do something about it. He experimented, developed a system that satisfied him, and began work which he said "was pushed vigorously until practically all water holes in the jurisdiction had received attention " (1950: 353).

Kneale was not alone in his concentration on wells and water holes. The Navajo Tribe, the Federal government and private individuals all resorted to the construction and improvement of wells. From 1910 to 1930 about 110 wells were constructed. Between 1930 and 1950, 70 more wells were developed, mostly to aid Navajo livestock. The well-drilling program was accelerated considerably in 1950 and between that year and 1957 some 262 wells were drilled (Young 1957:65). In 1958,another 56 wells were added. The total number of wells which had been drilled in Navajo country to the year 1958 was given as 587, of which only 510 were still active. In addition to the drilled wells, official recognition was given to some 401 dug wells and 622 springs (Young 1958:79).

These official water sources were at first maintained and repaired by the Bureau of Indian Affairs, as part of their program in cooperation with the Navajo Tribe. From the beginning of the accelerated program in 1950, however, the Tribe began to take more responsibility for drilling, repair and maintenance. In 1955, the Tribe took over the maintenance of 38 wells, and in 1957 it had responsibility for 159 (Young 1957:66). During 1958 the Tribe assumed 50 % of the cost of repairs and servicing drilled wells and surface water developments, and the budget of 1959 included money for the purpose of operation and maintenance of all ground water sources (Young 1958:79).

In spite of all the concern over water supply problems of the Navajo, and the abundant literature on the topic, there are few general descriptions of the whole complex of Navajo water use. Accounts have concentrated on one or another aspect of the problem, such as irrigation, the availability of water, etc., or have been descriptions of water use within a single kin group. This report gives some detail of the broader pattern of water use in one area of the Navajo reservation with emphasis on stability and change in these patterns.

The data for this report were collected while the author was resident anthropologist at the Navajo-Cornell Field Health Research Project, Many Farms, Arizona. This project supported a clinic for the purpose of doing research on Navajo medical problems. The medical clinic served people from an area 30 miles long by 33 miles wide (Young 1957:39). The area included the low-lying Chinle valley, the slightly higher Carson Mesa and Rough Rock plateau area, and parts of the high Black Mountain mesa. The population in the area at the time of the study was 2,371 according to a census taken in April, 1958 (Young 1958:43).

WATER SOURCES IN THE MANY FARMS CLINIC AREA

Drilled wells

Well drillers were active in the project area during the entire period of research, and there were already

several wells in the vicinity. There were three trading posts within the area served by the clinic: Rough Rock, Red Ridge and Valley Store. All had wells. In addition the Many Farms community chapter house had a well and there was another stock well nearby. The local school, the residences of government personnel, and the clinic all had water, the clinic being supplied from two separate wells. There were two stock wells on Carson Mesa, pumped by windmills, and an old, unfunctional windmill to the southwest, near the edge of Black Mountain. The well drillers were working on a well to the north, near Red Ridge, and another on top of Carson Mesa. Across the Chinle Wash on the east side of the clinic area there was another stock well, served by a windmill. Just outside the project area, the trading post of Round Rock was served by a windmill. On Black Mountain there was a stock windmill near the edge of the project area, and others just outside the limits. Other wells were outside the project area in the direction of Kayenta, but were used by project residents in this region. Project residents also used wells in Chinle, Pinyon or even farther outside the project area.

Stock wells usually had concrete troughs attached which were filled when stock was watered. Some of the windmills and wells had open storage tanks, but in other cases the tanks were closed.

Reservoirs

An irrigation project had its headquarters at Many Farms in 1958-59. (The name of the community itself indicates the presence of agriculture in the area.) The dam impounding water for the irrigation project was on the east side of the Chinle Wash. The reservoir covered from one to one and a half square miles depending on the amount of impounded water. In some years the reservoir was entirely dry, in others the dam impounded a sizable lake. When the Chinle Wash flooded, water for the irrigation project was taken out at a point south of the Many Farms Clinic location and guided into the reservoir. In 1954, the main canal and distributing system were extended, adding about 274 acres to the project (Young 1955:19). In 1957 the project irrigated about 500 acres in total (Deuschle & Fulmer 1959:6). This was the only reservoir within the limits of the project area, although there was another to the northeast, at Round Rock.

Catch basins

There were several spreader dikes and catch basins in the Many Farms Clinic area which served to impound water for stock for varying periods of time. One of these was on Black Mountain and held runoff water for about two-thirds of the dry season. When the rains came early, continued later, or when there were a few showers during the usually

dry period, this catch basin had water all year. According to informants, this dike was constructed by local people with some financial help from the Tribe.

There was a similar spreader dike with a catch basin on Carson Mesa. This basin did not have water as often as the one on Black Mountain mainly because the area, being lower, is considerably drier. The basin received less run-off and had to go longer periods between rains.

There was still another large spreader dike on the east side of the project area, and this one had an interesting effect on the local environment. A steadily increasing shallow lake had developed to one side of the dike (not directly behind it) and spread beyond it. The increase in the size of this lake could be estimated by observing the route of the road, which originally ran directly through the position occupied by the lake. Successively wider and wider turns of the route were apparent as change was forced by the gradual increase in the area covered by water. In 1958-59, four or five old tracks disappeared into the water which covered several acres, probably no more than a few feet in depth. According to Professor William T. Ingram, a Sanitary Engineer who visited the Many Farms project, the lake was probably the result of the spreader dike's interrupting the normal drainage pattern. This lake was growing even during the dry season when other water sources were shrinking.

Seeps

The geological formations in the project area lend themselves to the presence of springs and seeps. Rock escarpments drop abruptly to sand or clay flats. Mesas lift in a series of set-backs on both sides of the Chinle Wash, to Black Mountain on the southwest and the Lukachukai Mountains on the northeast. The area is cut with dry arroyos and washes, tributaries of the Chinle Wash. At the base of bluffs, at the head of washes or arroyos, or part way up a cliff, water sometimes seeps from a fault in the rock. The amount of water coming from these seeps in any one spot is usually scant (except in times of considerable precipitation) scarcely exceeding a trickle, but sometimes it escapes in a series of tiny streams over a line of several yards. Most often this water is lost by evaporation into the dry air, or disappears into the sand before it does more than support a scant amount of vegetation. Navajos in the Many Farms Clinic area increased the usefulness of seeps by hollowing out basins in the sand where water could collect, or by constructing a tiny dam of sand only a few inches high to hold the water in a hollow of rock. The amount of water in these basins and hollows was seldom more than four or five gallons, but it was usually fairly constant and was a valuable supplement to other sources of supply.

Springs

There are a few springs in the project area. One of these is east of the Chinle Wash, about five miles from the Red Ridge trading post. In 1958-59, it supported a pond about twenty yards in diameter with a boxed in section at one end for the convenience of householders, who could get water from this more easily than from the pond itself. This spring is located on a point slightly higher than the surrounding land, and according to Professor William T. Ingram is the result of the surfacing of an aquifer from a distant mesa. It is definitely not a collection point for local ground water.

The water from a spring usually disappears into the ground a short distance from the source, except during times of heavy rainfall. As a result it was very difficult to find springs in the Many Farms area without assistance. Many of them were unknown to Bureau of Indian Affairs personnel and even to Navajos who were not familiar with the area. There are undoubtedly more springs and seeps in the Many Farms Clinic area than were shown to the author.

Wells

Most of the wells in the area other than the drilled wells already mentioned, were little more than water traps in washes and arroyos, or deep springs. An example of the latter is located near the foot of Black Mountain, to the

southwest of the Many Farms Clinic building. This is a spring which has been covered and boxed in. The families who used the spring in 1958-59 had built up the rock around it and put the cover on (FN:61). In addition the whole thing was fenced in with wire. The fence had a gate and the well cover had a padlock. The well was about twelve to fifteen feet deep.

Wells in arroyo beds varied. They were never very elaborate since periodic heavy flooding made it impractical to spend much labor or material on such a well site. One was a metal barrel with perforated sides and no bottom. Another was a rock lined hole about two feet deep, too narrow to permit the entrance of a pail. Water had to be dipped out with tin cans or coffee tins. A third well had a wooden box type top, and was dug in the bank of the wash rather than in the bed itself. Such a well is practical only when the sides of a wash are low.

Streams

There are a few permanent streams with surface flow in the project area. One of these is located east of Chinle Wash, and is a tributary of it. The stream is intermittent in the sense that it does not flow on the surface throughout its course, but the flow is permanent, and in the location cited is on the surface for several hundred yards. The flow is reliable enough so that Bureau of Indian Affairs

personnel used the location for sheep dipping in 1958-59. The location served the flocks of a considerable area.

There is another permanent stream at the extreme northeastern edge of the project area with an occasional surface flow.

The Chinle Wash and Black Mountain Wash, the principal drainage channels of the area, have very little surface flow within the project area limits, although they both have a steady sub-surface flow.

There is one permanent stream flow which may be the result of human intervention. Below the dam which impounds the irrigation water there is a permanent flow which apparently results from seepage, or at least is caused in some way by the reservoir.

None of these flows is very great and none remain above the surface of the ground for any considerable distance, except after a heavy rain. Some of the larger washes and arroyos of the area may have stretches of permanent surface flow which are known only to local residents.

Irrigation ditches

The ditches attached to the one irrigation project within the Many Farms Clinic area served as a water source for a few families at the northeastern end. These ditches run along the sides of the Chinle Wash north of the Clinic

building, toward Round Rock.

There was a former irrigation project which had its ditches between Red Ridge and the highway, west and north of the Clinic building. At the time of the study these ditches were barely discernible, being filled with earth and unusable.

WATER USE IN THE MANY FARMS AREA

Throughout the contact period, observers have written about Navajo water use in more or less detail. Several elements seem to be characteristic of the Navajo pattern of water use as described by these writers.

Examination of the water use pattern of the residents of the Many Farms Clinic area reveals both similarities with and differences from the published descriptions. Some of the differences may be due to change through time, some may be the result of people adjusting to a slightly different environment. When the differences are in the direction of closer conformity with Anglo practices, or when modern artifacts are used which were previously unavailable to Navajos, change, rather than areal difference is most probably the cause.

1) One of the elements mentioned by various writers is irrigation. Fields were irrigated by flood waters, either through taking advantage of natural characteristics of the terrain or by improving on nature through the construction

of dikes, embankments, or water traps (Goldfrank 1945: 268; Hill 1940:passim; Gregory 1917:103 ff; Bryan 1929:444).

Most fields in the Many Farms Clinic area still depended on flood water irrigation in 1958-59. There had been changes, however, some more recent than others. As mentioned above, the area had experienced two irrigation projects, one of which was still functional in 1958-59, and supported some 500 acres of irrigated land. Neither of these projects affected a majority of the residents in the area because both were located near the Chinle Wash at the northern end of the area served by the Clinic. The earlier irrigation project was not successful according to local Navajos, who indicated their quite strong dissatisfaction in interviews. The location of the fields was the reason given most often as the cause of the failure. The fields were situated between the Chinle Wash and a barren ridge of red sand, rock and clay, locally known as Red Ridge. After every rain, material from this ridge washed down on to the flat plain toward the Chinle wash. As one Navajo pointed out,

"That red ridge has been there for hundreds of years and nothing grows on it. It washes right down into the valley and that is what they want us to plant on "(FN:357).

Navajos in the area claimed that when the ground was wet, tractors bogged down in the mud, and when it was dry,

as one Navajo said, it took a jackhammer to break through it. From personal experience in trying to grow a few plants on this outwash, the author can vouch for the fact that the local "soil" is singularly uncongenial toward plant life. The only use the old irrigation project served in 1959 was to channel runoff waters directly into the clinic compound.

The current irrigation project seemed to be more successful. At least those farmers who took advantage of it appeared to do well in terms of food production. There was, however, still dissatisfaction. Some of this might have been the result of past disillusionment, but some was merited since according to Professor William T. Ingram, the intake ditches and settling basins were not well designed. They were so narrow and deep that instead of permitting the incoming water to drop its silt load, they facilitated its retention, with the result that much of the potential water had to be sent back into the main channel again to avoid silting in the reservoir. This meant that much of the potential water for storage was lost (and carried on downstream a load of silt which added to the problems at Lake Mead).

Some other complaints about the project are difficult to evaluate. Individuals stated that the government interfered too much. They said they had been ordered not to plant in certain areas where they had been accustomed to grow

flood irrigated crops and to plant in other areas in which they were not accustomed to do so. Navajos also did not always approve of the way the water was distributed. One farmer summed up by saying,

"They want us to farm white man's way. We were farming before they came along but they won't listen to us"(FN:357).

People did not know the rationale behind the orders and seemed to feel the controls were simply more examples of the arbitrary nature of the Indian Bureau. Misunderstandings meant that many families did not get crops they usually relied upon, with consequent economic difficulties.

Some of the dissatisfaction might have been due to problems of land use. A family ordered to plant in one area instead of another might have been unable or unwilling to take up the suggested land because of use rights of other families over that land. Land tenure is a complicated topic and the Bureau of Indian Affairs has a long history of failure to understand Navajo approaches to the subject.

Local Navajos continued to plant along the edges of the reservoir in 1958-59, in spite of the government requests. Since 1958-59 was a rather dry year, no crops were lost by such planting because the water in the reservoir was receding rather than advancing. If the year had been a wetter one, however, impounded water could have flooded many of the fields, with consequent tension between Navajos and Bureau of Indian affairs irrigation personnel.

The reservoir itself seemed to impound water in an area where several families had had farm land in former years. There were some springs above the reservoir which served to maintain the water level somewhat. These springs might have served as a water source for irrigation in the past, and the loss of farm land could account for some of the feeling about the irrigation project, particularly if the families were unable to replace the lost land with other irrigated fields.

2) A second element mentioned in the literature is the Navajo attitude toward water sources. Water sources were theoretically considered communal property and open to any Navajo (Hill 1938:23). There were very strong conventions based on use rights, however. People who consistently used a particular source had a prior claim to the water and other individuals were not supposed to use it unless their own source dried up or they were far from home (Kluckhohn & Leighton 1946:59; Van Valkenburgh 1936: 21). Individuals who dug a well or improved a water source had a prior claim to the water, and people who shared in the use of a particular water source were expected to assist in the upkeep. Only government or community developed water sources were treated as communal (Leighton & Leighton 1949: 22 ff; Van Valkenburgh 1936:21).

Navajos in the Many Farms area in 1958-59 continued to hold these traditional values and attitudes toward water sources in general. Non-government sources were regarded virtually as the private property of the families who used or developed them. Members of such a family resented anyone from another family using the same source without permission unless the usage of the other family was equally well established. Individuals exhibited reluctance to use strange water sources without permission except to obtain a drink of water.

When a source was large enough to be used for stock, several families usually made use of it. All participated in keeping it in good condition unless it was a government installation. The Navajo Tribe has now taken over responsibility for maintenance of such facilities, as mentioned above. Many Navajos did not seem to be aware of the difference in control at the time of the study, however, and still considered the wells as the property of the Federal Government managed through the Indian Bureau.

Sources which were improved by tribal or Bureau of Indian Affairs funds were regarded as communal property. The same was true of sources attached to government institutions or trading posts. Any individual who went to a trading post felt free to water his stock and fill his household water barrels there.

3) A third item mentioned in the literature on water use was water hauling. Water for household use was usually hauled by wagon from some distant source (Haile 1938:51; Leighton & Leighton 1949:8; Leighton & Leighton 1944:13, 73). Wagons were driven into pits to make it easier to load full water barrels (Bailey 1940:276).

Computing the average distance water for domestic use was hauled was virtually impossible in the Many Farms district because most camps used more than one source. (A "camp" as used in the Many Farms Clinic records referred to a geographically distinct residence grouping of related households.) Even camps that used only one source during one season of the year usually needed another source when they made the customary summer or winter move. Only four camps out of sixteen reported use of a single source for domestic water, and all four camps were within walking distance of a steady, copious flow and did not move seasonally. Some camps, particularly those located near trading posts, did not have to haul much water since they were near enough to bring water to the hogan in buckets as it was needed, but most camps had to haul at least some domestic water.

The hauling technique had changed recently. Instead of wagons, many Navajos in 1959 used pickup trucks. Even in 1956, 20 % of the families in the Clinic area had a car or

a pickup truck (Deuschle & Fulmer 1959:8), and the proportion of families so equipped increased every year. Even if a particular family did not have a truck, if one of the other families in the same camp had one, it was usually used to haul water for everyone in the camp. Families in camps which were entirely without a truck were sometimes fortunate enough to have a relative (consanguine or affinal) who had one in another camp. Any time this relative visited, his truck was pressed into service to haul water. The use of a truck made some changes in water use patterns, and in the social relationships connected with water use. People could go farther for water, and could thus indulge their taste more. They spent less time getting water if they did not change the source they used, and consequently might be willing to go for water more often and thus might use more. The advantage of a truck in water hauling could lead, however, to an increase in group dissension. Demands placed on a single truck in a large camp were quite heavy. If the driver refused a relative, this created social problems that were not easily solved in the context of a Navajo camp. On the other hand, a Navajo could earn money by providing transportation to Navajos who were not relatives. Thus, conflicting desires were built into the situation.

Computing the frequency of water hauling and the amount of household water used by Navajos in the Many

Farms area was complicated by factors of season, household size, and activity. Except during a ceremony, no camp in a selected sample reported hauling 50 gallon water barrels more than once a day. As a minimum, no family reported hauling 50 gallon barrels less than once a week. Usage during one ceremony (which was not typical usage for the camp, of course) was estimated at about 300 gallons a day, almost all of it for cooking stew and making coffee.

Within the extremes of 50 gallons a day and 50 gallons a week, there was considerable variation from family to family and also within one family, depending on the season of the year, the number of family members at home, and the amount of washing that the family wanted to do.

One family, for example, consisting of a man, his wife and nine children used 50 gallons a day in the summer when all the children were home from school, and only about 13 gallons a day when all the children but the three youngest were away.

Another family which consisted of a man and wife, one adult unmarried son, one married son, his wife and their three children used about 22.5 gallons of water a day for cooking and drinking purposes alone. They hauled two 50 gallon barrels every four or five days. Water for washing was obtained from a nearby irrigation ditch as needed and no estimate of the amount could be given by the family.

Another family reported the use of 20 gallons of water a day. In the morning and evening from two to four adults were in the camp but during the day the wife was home alone. This family had its own source nearby and did not normally haul water.

When all water was obtained from one source, the decision to wash clothes might drastically change the amount of water used during a week and consequently the frequency of water hauling. Decisions to dye wool also usually meant an extra trip to the water source. People who used nearby sources for these purposes and relied on their water barrels only for drinking and cooking water varied less in the frequency with which they hauled water.

The smallest amount of water used per person was reported from a camp which had two adults and four children. in residence. This camp reported only 14.5 gallons of water used per day. This amounted to a little over 2.4 gallons per person per day. Another camp, mentioned above, used only a little more per person. They reported about 13 gallons a day used for five persons, or 2.6 gallons per person.

Babies in a camp usually meant more water was used, primarily for washing soiled clothing and diapers. Families who used traditional methods of diapering (shredded bark) did not have to wash so often. Men and women who used

sweat baths for cleanliness rather than using soap and water also kept water consumption down. Thus changes in other cultural factors might well be reflected in changing patterns of water use.

4) A fourth aspect of patterns of water use dealt with in the literature is water handling. Water was dipped from the source using a rope and bucket. It was stored in wooden barrels, kegs, washtubs or other large containers and covered with gunny sacks (Bailey 1940:276; Roberts 1951:29).

Education and public health information seems to have had an effect on Many Farms area residents in regard to the way they handle water. The most common technique for transfering water from one container to another was no longer dipping with rope and bucket but siphoning. Black one half inch hose was most commonly used. A Navajo customarily thrust one end of the hose into the water tank, sucked on the other end until the water began to flow and then (usually after taking a long drink of water) put the free end of the hose in the water barrel. This technique eliminated the use of pits for the wagons to be driven into (if they were ever common in the Many Farms area) since the barrels were never removed from the wagon bed until they were returned to camp. In the camp, some water was occasionally siphoned from the full barrel on the truck to a partly empty one, or to one or two buckets, to lighten the load.

Storage containers were almost invariably 50 gallon metal barrels with either metal or wooden tight fitting covers. These covers often had only a single two inch opening through which the hose was inserted for siphoning. Water was often transferred from the storage barrel to a pail or bucket by the same siphoning technique. Even small Navajo children in the Many Farms area were expert at this. Even if the main source for water did not permit the use of a siphon, one was often used in camp. When a siphon was not used at camp, or when water in the storage barrel was too low to make it feasible, the storage barrel was tipped and water poured from it into a bucket. The author never observed water dipped from a storage barrel in the camp.

Water dipped from a source using a rope and bucket was observed at one camp, water dipped using a hand held tin or bucket was observed at several camps. The camp at which the rope and bucket was used poured the water from the bucket through a funner into a covered 50 gallon metal barrel. The barrel was never uncovered. Wooden storage barrels, washtubs, or similar containers for water storage were not observed. The only water storage container other than a metal barrel observed was a large metal tank with a spigot on one end which had been erected at one camp, probably for use during a ceremony.

Jute sacking was never observed used for covereings for water storage.

Inside the hogan, water was usually stored in a metal bucket or a pot which might or might not be covered. In one camp, water was stored inside the hogan in an uncovered metal barrel, smaller than the type used for outdoor storage, which, although uncovered, was kept under a shelf, protected from having something accidently drop into it.

To get water from the bucket or pail inside the hogan, sometimes a special dipper was used, sometimes the dipper also served as a drinking cup, and sometimes whatever utensil was handy was used for dipping. When adults drank water, they usually rinsed out the cup or dipper before use (but not afterwards) by taking a small amount of water, swishing it around inside the cup or dipper, wiping the rim with their fingers, and then throwing the water out and taking fresh water to drink.

Waste water was sometimes thrown into a container but more often was simply tossed out on the ground. There was some priority of distance given to different types of waste water. Water left over after drinking was thrown just outside the door; water that had been used for washing people or dishes was thrown farther away, and water left after washing clothes was usually thrown some distance from the hogan.

Similar priority was given to water use. Water for drinking or cooking was the clearest water available. Water for washing might be from a source regarded as unfit for drinking purposes. People and dishes were always washed in fresh water, but that water was sometimes saved to wash clothes in.

Detergent was a product which had recently come into popularity in the area. It was used for dishes and clothes in some camps. Even camps which used detergent for clothes and dishes still used soap for people. Dishes were rarely rinsed, clothes usually were.

5) During the winter, according to some writers, snow was melted by Navajos to supply household water (Leighton & Leighton 1949:8; Leighton & Leighton 1944:13; Roberts 1951:29).

Snow melt was rarely used in the Many Farms area, mainly because there was usually not enough snow to provide a reliable supply particularly in the Chinle valley which is at a lower elevation. Families which lived on Black Mountain, or even in the Rough Rock area, had snow to melt more often. When it was plentiful some were observed to use it for household water, although one family in this area said they used snow melt only when the roads were impassable and they could not get other water (FN:192). During the year 1958-59, the Chinle valley had snow on

the ground only for about one week during the entire winter, and families in the area consequently could not depend on that source. The next winter there was more snow, but it still did not last long enough to provide families with water during the entire winter.

When snow was unavailable and the weather was cold, families sometimes had difficult with their domestic water supplies. The winter temperature often falls below freezing at night in the Many Farms area and when it fell for an water in the barrels stored outside were frozen . . . some water remained in the hose, it also froze solid. If some water remained in the hose, it also froze solid, so any water that might have remained unfrozen in the barrel could not be siphoned out. Consequently, during the winter, some families had to store more water inside the hogan. Even though the temperature sometimes dropped below freezing inside, once the fire was started the hogan warmed up rapidly, and there was little delay in obtaining water.

6) Among the Navajo stagnant water was not acceptable for drinking purposes (Newcomb 1940:61).

Navajo concepts about water have been changing in recent years. An informant expressed the nature of some types of change to one of the Navajo staff at the Many Farms Clinic. Referring to the old days, he said:

> " There wasn't any disease in those days. ... We even used to drink surface water and it never hurt us. We would drink from ponds or puddles all over the place . . . to drink water any time we found it and we never got sick from it. ... Now all the surface water is gone, nothing but sand dunes. ... The white people now tell us that surface water is no good and they start digging wells (Morgan FN:526). They dig wells here and there and then they say that the ground water in some places isn't good either" (Morgan FN:527).

The idea that some [illegible] ickness is not, however, [illegible]. Newcomb mentioned that stagnant water was apt to cause trouble and that Navajos said " if anyone should drink this bad water, his throat would swell until he would have difficulty in breathing and in swallowing. Also, his eyes would protrude like those of a frog "(1940: 61).

In 1958-59, Navajos in the Many Farms area had very definite ideas about good and bad water, although the classification was according to taste rather than purity. Water which was too saline was avoided, and individuals traveled a considerable distance to obtain good tasting water. One family hauled water 30 miles or more (the maximum distance reported), passing up a nearby windmill pumped well because that water was too salty (Morgan FN: 598). Other families also passed nearby sources to get more distant but better tasting water. This sometimes resulted in their passing a satisfactory (from the public health point of view) source to get household water from

a contaminated source which to them had better tasting water. Taste is to some extent an individual matter, and families sometimes disagreed about the value of a particular source in terms of taste.

Aside from matters of taste, Many Farms Navajos seemed to have changed some concepts in the direction of more acceptance of Anglo beliefs about water. Care in handling water has been mentioned above. Most of the water sources in the area had been covered or "improved" (a Bureau of Indian Affairs term) in some way. Many Farms Navajos were very conscious of the desirability of "improved" water sources even if they did not always know just what was meant by the term, nor understand the germ theory of disease. When the sample of water taken from an arroyo well tested pure, the family expressed surprise. They had never expected such a good report, they said, because the well was just a hole dug in the canyon floor and was not improved or anything (FN:495). The water was pure because it was filtered through sand for some distance and there was no nearby human habitation in a position to provide a source of contamination. The family did not understand that reasoning at all.

Members of a family which used a nearby stock well (not an approved source) did not like to use it although they had to. The wife complained about the water, not be-

cause it was saline, but because the tank in which the water was stored was open and "things fall in there, sometimes even, the kids may throw things in there"(FN:53).

Several families had two separate barrels for domestic water. One barrel held drinking and cooking water and the other held washing water. The distinction was made by families who normally obtained their water from more than one source. In one case, washing water came from a nearby catch basin for stock water, and drinking water came from various wells at trading posts, the nearest more than twenty miles away. In another case, washing water came from an irrigation ditch, drinking water from a nearby well. In a third case, washing water came from a nearby stock water well, and drinking water from a trading post well more than ten miles away.

Navajos in the Many Farms area gave a somewhat mixed reception to attempts to control water production. The Long Range Plan for water development adopted by the Navajo Tribe and the Bureau of Indian Affairs had had some effect in the Many Farms area. As mentioned above, well drilling crews were working constantly in the area during the author's field research. Navajos in the area were not aware of the involvement of the tribe in this, however, and considered well drilling entirely a U.S. government program. One complaint they voiced about the program was that since it

began, the small springs, seeps and water holes had been drying up. The Navajos seemed to feel that in tapping the underground water sources, water had been taken away from reliable sources familiar to them. How much of this was an accurate appraisal of the situation and how much was related to the "golden age" phenomena is difficult to estimate. It is certainly correct that heavy pumping of underground water is apt to lower the water table and if the pumping in the area exceeded the replacement, it might very well have caused sources to go dry. On the other hand, dry years, overgrazing, channel cutting, and other erosion phenomena could also have contributed to the drying up of water sources, if indeed they had dried up or were drying up.

It was also true that the engineers of the well digging program were generally unfamiliar with the local water sources and drilled with little apparent concern over possible consequences. Both Navajos and Anglos shared in their ignorance of the local sources of water. For example, the Bureau of Indian Affairs agent in charge of the Many Farms irrigation project asked information about "some springs" above the reservoir, stating that he knew of their existence, but did not know where they were, how many there were, or how big they were. The local sanitarian (a Navajo) had never known of a seep supplying household water to at least two separate camps until he was shown its location on a field trip with the author.

If these sources dry up due to the increased number of wells tapping underground water, Navajos will have to change their water habits more drastically than they have to date, since it will remove nearby sources of supply for many Navajo families.

On the other hand, the growing lake in the northeastern part of the Clinic area was a new phenomena and might well have been the result of tribal and government attempts to improve the range and provide more water.

In the light of this report it would seem that more extensive research into the water supplies available in certain reservation areas is certainly called for.

New water uses

This report has dealt with changes in patterns of water use primarily in the area of modifications of already existing techniques. In the Many Farms area in 1958-59, however, there were some new water uses introduced. The

The Many Farms reservoir was used by Anglos of the area for boating, fishing, picnicing, and even water skiing. It was not often used for swimming because the water was somewhat muddy, and also because of the presence of a small parasite which caused intense itching if not removed from the skin quickly. During the year of 1958-59, occasional flocks of migrating water birds settled for a day or so at a time on the lake, to the delight of hunters.

In their arid environment, Many Farms Navajos had not often been exposed to lakes, or even running rivers. Very few people used the lake as a source of domestic water & in general the Navajos of the area lacked many of the habits of the recreational use of water to which Anglos are accustomed. Some of the Navajos who had been to school had been exposed to Anglo recreational habits, and Navajos in the vicinity of reservoirs where Anglos also live had been exposed to others.

The Navajos of the Many Farms area, as a community project, and using tribal funds, on their own initiative developed and then improved a picnic ground beside the Many Farms reservoir. This picnic ground was used by Navajos and Anglos. Although Navajos were not participants, they were interested observers of fishing, swimming, and even water skiing that local Anglos indulged in in the reservoir.

Many Farms Navajos were for the most part convinced of the desirability of showers. Although showers were not available at home for most of the local Navajos, they tended to take advantage of whatever opportunity they did have, and medical personnel at a reservation hospital commented to the author that one of the problems with Navajo patients was that they had to be ordered NOT to bathe, or they headed for showers every opportunity they had.

In the Many Farms area, plans were made to put showers and laundry facilities into the community building. These plans were made entirely by the Navajo community without urging, pressure or even consultation with the local Anglos.

SUMMARY AND CONCLUSIONS

Household water use

Families obtained water from various sources, as a rule. When possible it was siphoned from one container to another. It was usually hauled in 50 gallon barrels to the camp. Variations on this method included: water brought in pails from nearby sources as needed; snow melted as needed.

Water was sometimes divided into drinking and washing water, particularly if it came from separate sources.

In the camp, water was poured or siphoned from the storage barrel into pails or pots for immediate use. Used water was thrown out or accumulated in a container for reuse washing clothes. Dishes were not usually rinsed but clothes were.

Water in the hogan was dipped from the pail or pot with a special dipper or with a common cup - reused without washing. Adults generally rinsed the cup out before but not after use. Children did not bother.

Water was usually hauled every two to four days, depending on season, family size, and activity pattern.

Irrigation

Flood farming was still practiced on many parts of the clinic area. There was some irrigation in the northeastern part of the area. Irrigation water was used as is customary in a controlled irrigation project, that is. the amount of water which was to be released was decided upon, it was released at certain times, and each of the farmers using it was entitled to a certain amount.

Stock watering

Navajos have herded their flocks to water for centuries. The technique had not changed much at Many Farms. Navajos had more large sources to which to take the herds; and they sometimes had modern equipment to use, but otherwise there was little change in techniques imported from the old world.

New uses

With the appearance of large bodies of water in the environment,along with Anglo residents, Navajos in the Many Farms area were exposed to new uses of water, for fishing,boating, swimming and water skiing. Hunting of water fowl also became possible. By 1959 there had been little change in Navajo behavior in the direction of recreational water use and the new possibilities had not been widely realized. It is probable that in the future, however, Navajos may begin to make more recreational use of water.

Conclusions

Water, which is so important to continued existence of Navajos in their homeland, has been a matter of concern to writers for some time This present report gives some detail of the current pattern of water use in one area of the Navajo reservation. This examination reveals that some of the water use patterns in the Many Farms area differ from patterns reported in the literature, while other Many Forms patterns are similar to published descriptions. Many of the differences are in the direction of a closer approach to Anglo patterns of water use, and thus probably represent changes through time rather than areal differences. Not all of the patterns presented by Anglos have been accepted completely or uncritically, however, by the Navajos. In some cases this appears to be due to poor communication and the consequent Navajo lack of understanding of the Anglo rationale behind proposed changes. Navajos, however, often have a more complete knowledge of the ecology of the local environment than the Anglos (theoretically there to help Navajos), so some of the difficulties and misunderstandings are due to the failure of Anglos to appreciate the way in which water is used and regarded by Navajos. Some misunderstandings are due to the failure of Navajos to partake of the goals or basic assumptions of the Anglos and vice versa.

Additional research is needed into water use among the Navajos in two distinct subject areas:

1) Current water sources, other than ones officially known, to determine location, capacity and potentialities.

2) Changing Navajo water use patterns and concepts.

This report has examined some of the change and stability in water use patterns in one small area of the reservation. It would be valuable to examine other areas of the reservation in similar detail to determine how characteristic these changes are of the reservation, or of the Navajo population as a whole.

FOOTNOTES

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