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2.500 Desalination and Water Purification

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Q1: I was wondering if we have any information about the capacities of the wells in either town. With the information we have now, the best we can do is assume that it is okay to draw the town's needs evenly divided between each of the wells. I assume we can't just stick a pump in one of the wells and draw out as much water as we would like without depleting the water source. Any information on this would be great.

A: We have little to no information on the state of the aquifer. In the absence of better data, it would be best to focus more on the water quality (salinity) issues than potential water quantity issues; assume that there is sufficient water to supply each household with 200 liters/day between all the sources and that all wells tap into the same aquifer and refill at the same rate.

Q2: is there a particular health hazard which the water is currently causing? If so what is the hazard and which impurity is causing it?

A: We have no clinical data on health issues related to salinity, though hypertension and complications with diabetes are generally associated with high salinity content of drinking water. Also see Ray's answer. For the purposes of this assignment, it is best to focus on the salinity and to assume that it has negative health impacts.

Q3: Is the main problem a water shortage or cost of water or contamination of the well water?

A: Cost and contamination are both significant issues; see Q1 above regarding water quantity.

Q4: Can you give us a segmentation of the water usage for different purposes.. For example.. If we consider one bucket of water that the villagers buy for ~2.5cents/bucket.. Is there anyway you could tell us the distribution of the usage of that water.. Like 20% for drinking.. 10% for laundry.. etc..

A: Each household is different in size and consumption patterns, but in general, people said they use the water that they purchase primarily for drinking, cooking and other indoor household chores. Water for laundry, bathing, and sometimes cooking and cleaning when there are no resources to buy pumped water, is usually from the wells. So while exact percentages are hard to calculate, you can imagine that each home may have two storage containers, one indoors filled with purchased water, and a second outdoors filled with water from the free wells. For more guess work, consider that it would be unusual for an individual in the U.S. to drink more than half a gallon of water a day and a reasonable guess at the average household size in these villages is six people. Finally, people did say they purchased their 4-8 buckets of water from the pump every day, so at least that indoor storage container of purchased water is getting used completely each day.

Q5: What is the cost and availability of electricity in these villages?

A: Very few people appear to purchase electricity. One person seems to sell electricity of his own system and we did not obtain the price. In another village in Haiti, people paid 200 Gde (~\$5 usd) a month for 4-5 hours of electricity a day (nighttime use).

Q6: In Phaeton and Paulette, there are some community wells and hand-dig wells, and people get water from the wells. But I wonder if the wells have enough resource to supply the water constantly. If we build a desalination device on the well, I wonder at how much flow rate the well can supply the brackish water to the desalination device. If we are planning to build the desalination devices near the wells (not near the sea), that flow rate will determine the size and capacity of the devices.

A: See Q1 above for answer on quantity.

Q7: Along with the question about the max possible flow-rate of the wells and the volume of water in the wells, how often or quickly do the wells run dry? I am wondering if we make a device for pumping and desalinating the water, how quickly it will cause the wells to run dry and how quickly the well water will be replenished through rainfall or other means? Finally, are we trying to provide drinking water for all 350 families? That yields a water demand of approximately 8,750 gallons/day or 33.12 m³/day which is substantial.

A: See Q1 above for answer on quantity.

Q8: We are likewise wondering about the amount of water used for various purposes. Specifically, how much is used for drinking? How much needs to be purified for other purposes? This is really an essential metric.

A. See Q4 above. Whether people would use more if they could afford more is a harder question to answer (consider that the average American uses 240 gallons a day). For the purposes of this assignment, however, we suggest using the quantity suggested in the answer to Q1 as your baseline for daily consumption as your target amount; all of the water does not need to be purified, as people currently use the contaminated well water for laundry, bathing and other outdoor cleaning needs.

Q9: Additionally, can you give us any further information on (1) why the cistern project failed, and (2) the source and pipeline of the pumped water?

A: We have no additional information beyond what we presented. We found the cistern in disrepair (like the water pumps) but without explanation beyond leakage issues; no one was available to explain if this was due to maintenance issues, flawed construction or some other factor. This is, however, a common mechanism for failure of cisterns—

cracks in the concrete lead to seepage of the water out of the tank. Regarding the pumped water, we have no information on the state of that aquifer.

Q10: Do you know how large the cistern that failed is? About how many cubic meters of water can it hold?

A: The cistern appeared to be roughly 7x7x2 meters, but we do not know how much of the cistern was underground. Assume the capacity is ~100 cubic meters.