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Combining Sustainable Food Production with Historic Preservation in Egypt (Report)

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ABSTRACT

Unlike the good fortune of a suitable supply of potable groundwater apparent in many countries, high groundwater is a current problem in other countries that negatively affects buildings and other structures of the ancient and modern world. Groundwater has been responsible for damage and complete deterioration of ancient and modern structures that have erased historic legacies throughout the globe. In Egypt, USAID has financed groundwater lowering projects surrounding temples and other historic structures to stop or reduce the level of corrosion and loss. This noble work has saved many ancient monuments for future generations but the groundwater has not been used for other applications. This paper outlines a proposal to utilize high groundwater levels and reverse the current scenario and will halt the destructive capacity on historic structures while at the same time, provide a sustainable and secure food producing hydroponics unit that will furnish continuous employment to local areas that suffer from high unemployment and little opportunities. The model can be used in small areas that can isolate a structure but still benefit from the use of the groundwater. There are many other benefits associated with this model including impact on tourism. The model is scalable and can be used on a global basis.

Keywords: Groundwater**,** historic structures, Egypt.

INTRODUCTION

High groundwater creates a problem in many areas of the world. It is occasionally found on the surface where stagnant water houses algae and undesirable aquatic plants that is subject to odors and concentrated types of microorganisms. It is also detrimental to structures, especially stone or concrete assemblies. In particular, ancient stone structures like those found in Egypt are particularly susceptible to the effects of groundwater. The United States Agency for International Development (USAID) has financially supported several large groundwater lowering projects in Egypt in order to preserve the reliefs and structural soundness of these historic edifices. In the case of Egypt, the large quantities of groundwater captured are discharged into the Nile River or nearby canals. This seems to be the only solution when applied to large areas encompassing ancient temples and Islamic monuments.

GROUNDWATER

1. Groundwater effects on structures

Although the groundwater is clean as the soil composite filters most particulates, without treatment or filtration, many situations will yield non-potable water. The problem is exasperated when near agricultural and industrial zones where the runoff can contaminate the groundwater. Many areas around agricultural activities contain high groundwater due to the flooding of the fields required by some crops. This scenario is not limited to the suburban areas but also urban areas especially around highly populated areas. Many historic structures are located in urban areas in Egypt and many are located in high agricultural areas. Through capillary action, the groundwater rises through the stone and presents a condition known as rising damp where sections of exposed stone becomes wet and saturated from water below the surface. Upon reaching the outer surface of the stone, in many cases, salt crystallization occurs and will weaken, distort and eventually remove outer layers of the stone matrix. This problem is particularly destructive to historic text and images carved into the stone. When this condition happens, the tangible historic records are lost forever.

Fig. 1: Experiment on the effects of groundwater on sandstone sample (left) and potable water (right)

There are many areas in Egypt where the historic structures are smaller. This provides the opportunity to install an isolated groundwater lowering method that will protect the structure against the effects of continued groundwater saturation and damage. The model centers on isolation of the structure from the surrounding area with the use of impermeable material such as PVC type sheets and natural clay substance usually in the form of bentonite that is abundant in Egypt. This is done to reduce the effect of other surrounding structures from the impacts of lowering the groundwater such as settling and washout. The depth of the capillary break isolation trench is determined so the groundwater will still be permitted to flow at a depth that will not affect the structure (Fig. 2). Inside the isolated area, other low cost structures can be installed to keep the groundwater at a predetermined depth. This leaves smaller amounts of groundwater available to be used for other possibilities.

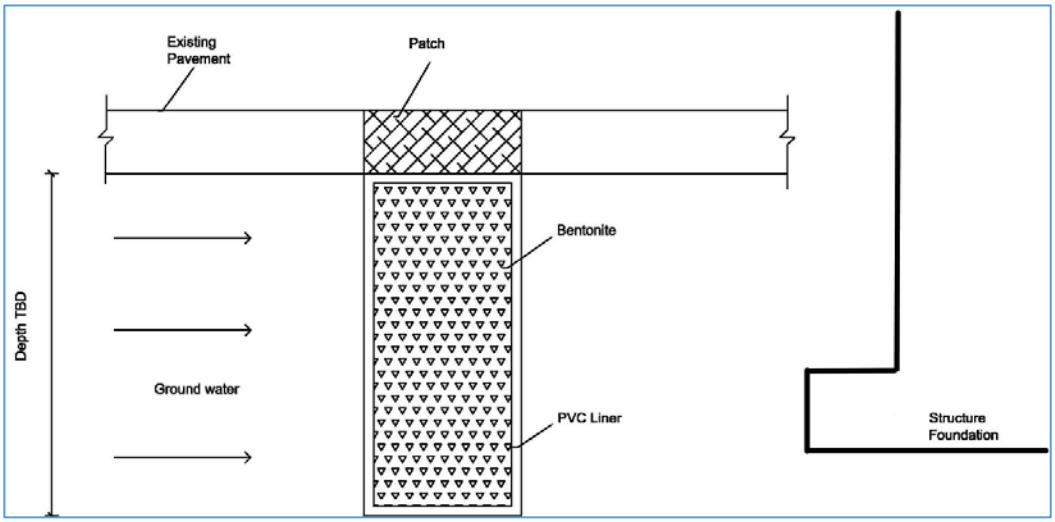

Fig. 2. Capillary break and isolation barrier diagram

SUSTAINABILITY

2- Sustainable Options

The preservation of a historic structure also leaves opportunities to address other issues associated with Egypt. Unemployment is a major factor especially with youth and women. A hydroponics system can be set up to use the groundwater instead of discharging in local sewers or rivers/canals. This system would work well with the preservation factor and at the same time address one of the major problems facing Egypt. A private or village cooperative enterprise growing high-grade produce is a sustainable employment formula for domestic use or for obtaining premium prices when exporting to outside customers. To use the groundwater, either a filter/reverse osmosis system can be used or a tolerant produce could be grown based on the composition of the water. It has been determined that Egypt will have shortages of water in the future. According to Inter Press Service (2022)[(1)], Egypt is facing an annual water deficit of around seven billion cubic meters and the country could run out of water by 2025. As stated by Abdel Aty (2021)[(2)] the Nile River is the main source of life for the Egyptians since it constitutes more than 97% of Egypt's renewable water resources. Egypt faces great challenges with regard to water resources due to its fixed share of the Nile water, and scarcity of rainfall, groundwater and desalination capacities. Climate change causes an additional challenge for water availability and accessibility in Egypt. The Nile Basin upstream developments especially (the Grand Ethiopian Renaissance Dam) will lead to more water shortage that would threaten the Country's water security. Utilization of the current high groundwater makes sense.

Energy costs are another main problem. According to Ibrahim (2022)[(3)] while worldwide growth is fast, demand for electricity is exponentially increasing in Egypt and is expected to continue in the future. Due to the fast growth of Egypt population, Egypt struggles today to fulfill its own energy needs. Currently, the government subsidizes Egypt electricity costs. The Egyptian Minister of Electricity and Renewable Energy, Mohamed Shaker, has stated that subsidization of energy prices in Egypt is one of the highest rates in the world and that all subsidies will be removed by 2025[(4)].

A hydroponic system can work using photovoltaic panels that derives energy directly from the sun. With sunshine a fairly constant aspect of Egypt, it makes sense to use for long term lower cost. At night, the system can shut down and resume the next day. There would be no need of expensive batteries that would need to be replaced after several years. Maintenance would have to be a major duty of the business to keep the panels clean and the pumps in good working order. Incorporated with the energy issue, transportation costs can be reduced when offering the produce to the local population or shipping to nearby export facilities. No refrigeration would be necessary except in a few cases.

A hydroponics system has several more benefits. There is no need to use pesticides as the system is enclosed, making the produce safer for consumers. Food security is also an issue. Food security is defined as meaning that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life[(5)]. The system can adjust to the needs of the people they serve.

Conclusion

A hydroponics system is urgently needed in Egypt as a preservation tool and to utilize the groundwater to solve social issues. Preserving Egypt's historic structures positively influences the tourism industry in several ways by opening numerous smaller sites that provides opportunities for the local population to establish small businesses to serve tourists as well as provide sustainable jobs. The high groundwater together with a hydroponics system can be scaled to fit most existing situations where the effects of the groundwater on historic structures are present. With recent events surrounding global warming and the Ethiopian Dam Project, this scenario is needed more than ever.

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الجمع بين الإنتاج الغذائي المستدام والحفظ التاريخي في مصر (تقرير)

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المستخلص

على عكس الحظ الجيد للإمداد المناسب من المياه الجوفية الصالحة للشرب الظاهر في العديد من البلدان ، فإن ارتفاع المياه الجوفية يمثل مشكلة حالية في البلدان الأخرى التي تؤثر سلبًا على المباني والهياكل الأخرى في العالم القديم والحديث. كانت المياه الجوفية مسؤولة عن الأضرار والتدهور الكامل للهياكل القديمة والحديثة التي قضت على الموروثات التاريخية في جميع أنحاء العالم. في مصر ، مولت الوكالة الأمريكية للتنمية الدولية مشاريع خفض المياه الجوفية المحيطة بالمعابد والمنشآت التاريخية الأخرى لوقف أو تقليل مستوى التآكل والضياع. لقد أنقذ هذا العمل النبيل العديد من الآثار القديمة للأجيال القادمة ولكن المياه الجوفية لم تستخدم في تطبيقات أخرى. تحدد هذه الورقة مقترحًا لاستخدام مستويات المياه الجوفية المرتفعة وعكس السيناريو الحالي وستوقف القدرة التدميرية على الهياكل التاريخية بينما توفر في نفس الوقت وحدة الزراعة المائية المستدامة والآمنة التي ستوفر فرص عمل مستمرة للمناطق المحلية التي تعاني من ارتفاع معدلات البطالة وقلة الفرص. يمكن استخدام النموذج في مناطق صغيرة يمكن أن تعزل هيكلًا لكنها لا تزال تستفيد من استخدام المياه الجوفية. هناك العديد من الفوائد الأخرى المرتبطة بهذا النموذج بما في ذلك التأثير على السياحة. النموذج قابل للتطوير ويمكن استخدامه على أساس عالمي.