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# Biofuels: Conducting Scientific Research into Crop Biology and Agronomic Techniques for Improving Yields, Disease and Drought Resistance, and Sustainable Agricultural Systems in the Arab Republic of Egypt

Egypt, or officially the Arab Republic of Egypt, is located mostly in northeastern Africa, but a small part, the Sinai Peninsula, is located in southwestern Asia. Most all of Egypt's terrain is desert, separated into two parts by the Nile River (Egypt); however, the entire population of Egypt, 70 million, lives on only eight percent of this land mass, which causes several problems in the agricultural aspect of things (Where We Work-Egypt). In this country, economically speaking, there are two distinct groups of people. The smaller of the two consists of the wealthy and well-educated. The larger of the Egyptian population consists of the poverty stricken people who can not afford what they see the wealthier class promoting (Egypt). This population exists mainly in Upper Egypt, where subsistence farming becomes more popular. Most of the families who must resort to subsistence farming are of average size, and most always have a male figure overseeing everything. A basic diet consists of foods such as bread, legumes, or seasonal fruits and vegetables (Egypt Health and Wealth). Among these families, the illiteracy rates are quite high, (Rural Poverty of Egypt) and the wages are very low. In Egypt, all agriculture employees receive the lowest of any other type of worker. The subsistence farmers can barely make enough to support a family. The farm sizes are typically very small and are rented from a wealthy land owner, so they are able to farm only enough crop to feed their family and have an extremely small amount left over to turn over into income (Cumming). Many crops are grown throughout Egypt. The most common are cotton, clover, wheat, corn, and rice. The cotton crop helped introduce the people of Egypt to perennial irrigation, which lead to the option of double and triple cropping areas; however, over the years, cotton has become a less demanded crop, dropping its profitability, but it still remains the most popular among subsistence farms. The clover crop is used mostly for the feeding of livestock that the subsistence farmers may possess. Wheat, corn, and rice remain the staple crops of the farmers. On most farms, in order to provide for the family, several crops of are grown at once by the same family. This is also possible because the yields between the different crops vary immensely (Egypt Health and Wealth). When considering major barriers to improve the productivity of these farms, as well as the income, there are several that play a large role. The government has a small part, because in the past, they have put a maximum limit on the amount of cotton that can be produced. In Upper Egypt, the water becomes a large issue. The availability of clean and safe water is very scarce. Aside from that, the amount of land in Egypt that is even available for any irrigation systems is very small. Almost ninety-seven percent of the population that is confined to the desert areas of the Nile Valley and Delta encounter great difficulties when trying to find land that is suitable for acreage and any type of agriculture at all. Because these subsistence farmers must rely on agriculture for their income, there is little that they can do to increase the current income. First off, the land that they possess is small in size, making it difficult to produce the needed larger amount of crop. Secondly, the crops that they are able to produce, such as cotton, are very low income crops. Also, these farmers are not able to take the risk of producing the higher income, non traditional crops. Finding a second employment, for most of these farmers, is not an option because the development in the small enterprises is miniscule. The local markets are also poorly funded and very underdeveloped (Rural Poverty in Egypt).

It is obvious that poverty is a large problem in this country. Subsistence farmers struggle greatly because of Egypt's poor farming terrain and lack of agricultural knowledge (Rural Poverty in Egypt); however, with the right tools, proper amount of time, adequate amount of funding, and the will power of the country's people, as well as people from around the world, the life of a subsistence farmer, or any

other poverty stricken individual, can take a turn for the better. It can't be solved overnight, and it can't be solved completely, but the hardships can be reduced to that of a much more bearable level.

Biofuels are becoming a promise to these subsistence farmers by ensuring better food security, which will, in turn, help give them the needed ability and desire to improve crop yields. Eventually, the improved crop yields will indirectly lead to improved lives of the poorer class. There are several ways and many factors that can come into play when considering biofuels and how the current agricultural problems should be approached. Scientific research concerning crop yields and alternative agricultural systems could be put into action. By adapting the current farming to the water scarcity of the desert terrain, many agricultural issues could be solved. Also, improving Egypt's marketing techniques or addressing the problems that past trade policies have caused could, over time, increase agricultural productivity. Educating the farmers about improving yield and other agricultural techniques, as well as applying public policies and becoming a more diplomatic country would eventually lead to increased biofuel popularity and better food security. Focusing on the scientific research factor, it is believed that researching crop biology, yield-improving agronomic techniques, disease and drought resistance, and other lasting agricultural systems is a key point in increasing the productivity for biofuels and improving food security.

Currently in Egypt, there is one major problem that affects the farmers' ability to produce a sufficient crop yield. This problem is the lack of water conservation, water management, water usage, and just overall, lack of water. Naturally, being located in a desert area, drought is a severe problem. In most areas of this country, they receive only up to eighty millimeters of rainfall each year. The southern part of the country will receive even less than eighty millimeters annually (Egypt Weather and Climate). The world's driest location is located in Aswan, Egypt. Rainfall is a very important aspect when raising any variety of crop . Having a low annual rainfall makes it extremely difficult for farmers to grow a healthy and abundant crop. The kinds of crops that they currently grow are not drought resistant (Egypt). As far as irrigation systems, there is not much to speak of. The little water that is received is being used poorly.

Presently in Egypt, there are several research programs in effect that are working towards improving the yield of crop lands by fixing a major problem in the area, drought. Being in a desert terrain, water management is a large concern. One of the active projects is called Integrated Irrigation Improvement and Management Project, and its main objective is to improve irrigation, and then to improve the efficiency of the irrigated water. This project started in May of 2005 and is scheduled to be completed in March of 2014 (Egypt-Active Projects). As of right now, irrigation systems are very poor, making it difficult to raise a successful crop, which explains the low crop yields and low incomes. A second active research project, West Delta Water Conservation and Irrigation Rehabilitation Project, is working towards increasing the income and quality of live of those living in the West Delta area. It hopes to accomplish this goal by "mitigating further environmental degradation caused by excessive drawdown of the groundwater resources; and (ii) establishing a framework for financial sustainability of irrigation infrastructure in the use of water resources," (Egypt-Active Projects). Starting in June of 2007, this project is hoped to be completed by June of 2011 (Egypt-Active Projects). A third project, The Second National Drainage Project, seems to allude to the most promising outcomes. Its objective is to increase agricultural productivity , and in turn, raise the incomes of the rural people by providing surface drainage in the old, cultivated areas, renew existing surface drainage systems, remodel the open surface drainage systems, and support the management of these drainage systems through technical assistance, training provisions, and other ways as well. This project, started in June of 2000, is set to be completed in June of 2008 (Egypt-Active Projects). As seen above, there are several promising projects in progress aimed towards helping increase this country's agricultural productivity and income of the farmers; however, they are all still in progress, and much work still needs to be done because the productivity level is still no where it should be, and the incomes of most families are still extremely low.

The three active projects described above are only three of many active projects at this time. Most of these projects are several year-long endeavors because of their complexity and multi-goal purposes. The obvious trend that can be noticed is the ambition to improve irrigation and other water management techniques, seeing as drought is one of the most major problems in Egyptian farming. As of right now, all three of these projects are in progress, so no significant change has been documented; however, the potential change should be thought to be tremendous (Egypt-Active Projects). All three of these projects are meant to improve irrigation techniques, as well as set up organizations or other plans, to enforce these irrigation techniques and provide the needed training. One of the main objectives of The Integrated Irrigation Improvement and Management Project is to set up another organization, the Environmental Management Plan, or EMP, that will demonstrate how improvements in water quality can be carried out (Egypt-Active Projects). The West Delta Water Conservation and Irrigation Rehabilitation Project also has a similar goal. Through funding from various organizations, it will provide a project management unit office to regulate any training or carrying out of the operation (Egypt-Active Projects). When looking at the four goals of The Second National Drainage Project, the fourth one is one that makes promises. It states that it intends to "support management, and institutional building through technical assistance, and training provision. . . and in support of the Environmental Management Plan. Farmers outreach, and participatory activities will be supported, and, monitoring and evaluation, as well as operation and maintenance of the drainage system, will be supported through technical assistance and training," (Egypt-Active Projects). Because all three of these projects are still active they have neither helped or hindered the situations of the struggling subsistence farmers. Until a project is completed and put into action, the yields and incomes of those farmers will remain unaffected.

By improving the amount of research that is currently underway, many more problems could be addressed. Drought is not the only problem; many of the crops that subsistence farmers can grow have a very low market income. The crops that produce a higher market value also come with a higher risk, which is something that subsistence farmers can simply not toy with. The risk is higher for the higher market value crops because of the lack of enterprises in their economy. The farmers are unable to finance these high market value crops due to the lack of a microfinance system tailored to their needs. This leads to the deficiency of smaller enterprises and micro enterprises, which diminishes the number of alternative employment opportunities. With a larger number of secondary employment opportunities, farmers, or other members of the family, could seek a second job, earning a second income. This would, obviously, make the low income situation less of a burden, therefore providing more solid grounds to invest in higher market value crops. Then, once invested in the higher market value crops, the farmer would be able to turn a higher profit, allowing even more income to provide better food security to the family (Rural Poverty in Egypt).

Biofuels would be an excellent addition, in several ways, to the current and proposed research concerning drought resistance and irrigation techniques. First of all, the biofuels must be produced, and most everything that is produced comes from a plant or crop of some sort. Naturally, the growing of the crop used for biofuel could immediately help the situations of the subsistence farmers. It would provide the farmers an opportunity to raise a crop that would be guaranteed to have a higher demand and a higher market value. This would turn over into more income, which would positively affect all other aspects of the farmers' lives. Knowing that there is a higher demand for such crops, it could also draw others into the agricultural field, benefiting not just one individual, but the entire economy. Secondly, all of the tools, training, supplies, and time needed to implement these projects do not come cheap. All of the active projects require machinery of some kind, which all run on fuel. Fuel is a non renewable resource, and is becoming scarcer by the minute. Providing an alternative fuel for these machines to run on would certainly diminish the costs of the projects (Egypt-Active Projects).

Based on research consisting of several active, implemented projects, and research done over the geography and history of the country, I believe that biofuels would benefit every aspect of the agricultural

productivity. As far as implementing biofuels, I believe that they should be introduced slowly. Rushing into it will only cause monetary issues, as well as confusion due to inexperience. Biofuels, if implemented in the right way, can lower the dependence on other oils, which will cut the costs of many processes. By cutting the costs of the processes of the projects that are being implemented, it will make them much more affordable for everyone. Better affordability will equal more popularity, which will drive up the demand and market price. This will give the subsistence farmers more income to use for providing food to their family on a more consistent basis.

When considering various corporations, national governments and other high powered organizations, the best way to give them roles is to just divide everything up based on their abilities to make change happen. The United Nations has to power to bring many countries together to put plans into action. The World Bank has the power to find the funds and get the private organizations together. One suggestion I would make is to start with the United Nations. I believe that because they have the power to reason with many brilliant individuals from many countries, they have to power to present the idea, and put it into action, or at least find organizations with the will power and desire to start a project. From there, I would suggest that the World Bank get involved. They have many programs underway and are very experienced when it comes to projects like these.

In conclusion, biofuels would benefit the agricultural industry of Egypt greatly. Numerous positives would result from biofuel usage. In the end, it would help to significantly diminish the number of struggling subsistence farmers, as well as provide a successful example to neighboring countries struggling from the same problems.

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