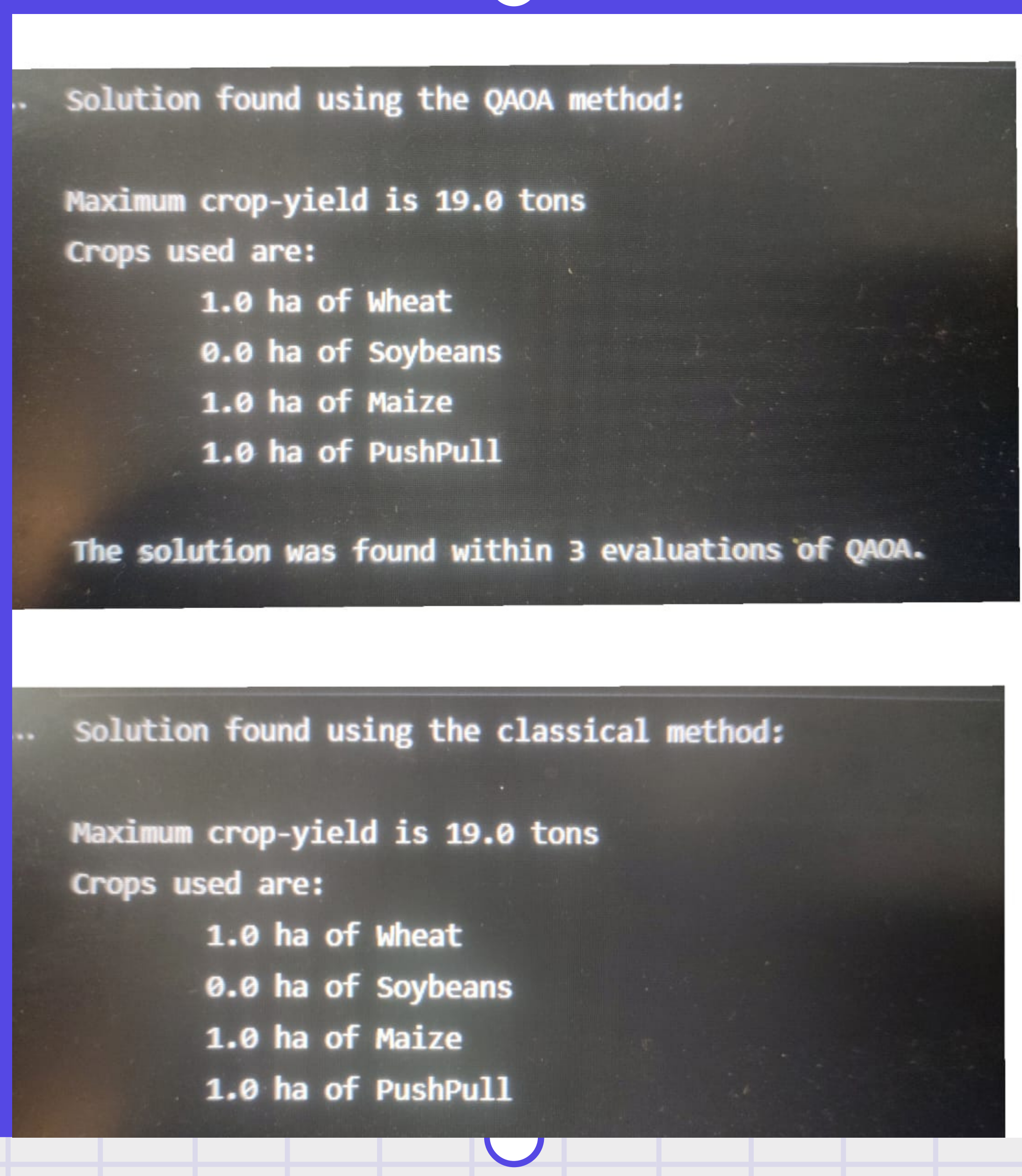
CROP YIELD PRODUCTION USING QUANTUM COMPUTING

INTRODUCTION

It is a common need to optimize the crops and management of a farm to reduce risk while increasing profits. One of the big challenges in the whole world is how to produce enough food for everyone. The problem here focuses not on profits but on the tonnage of crops harvested. Imagine you have a farm with three hectares of land suitable for farming. You need to choose which crops to plant from a selection of four. Furthermore, you also need to determine how many hectares of each you should plant. The four crops you can plant are wheat, soybeans, maize, and a push-pull crop. The fourth cannot be sold once harvested but it can help increase the yield of the other crops. There are three types of farming methods we can use: monocropping, intercropping, and push-pull farming. Monocropping is where only one crop is farmed. This is can make the farm susceptible to disease and pests as the entire yield would be affected. In some instances, growing two different plants nearby each other will increase the yield of both, though sometimes it can decrease the yield. Intercropping is the process where different plants are chosen to increase the yield. Push-Pull crops are pairs of plants that repel pests and attract pests respectively. Integrating them into a larger farm increases the yield of harvested food but with the cost of not necessarily being able to use the harvest of Push-Pull crops as part of the total yield. This is because the Push-Pull crop may not be usable or even edible.



RESULT

METHOD

Only in certain cases can quadratic programming problems be solved easily using classical problems. In their general sense, they are NP-Hard; a class of problems that is difficult to solve using classical computational methods. In fact, the best classical method to solve these problems involves heuristics, a technique that finds an approximate solution. Quantum Computers have been shown to provide significant speed-up and better scaling for some heuristic problems. The crop-yield problem is a combinatorial problem, in that the solution is a specific combination of input parameters. Though the problem shown here is small enough to solve classically, larger problems become intractable on a classical computer owing to the number of combinations of which to optimize.

Solving the above problem using quantum computing involves three components:

1. Defining the problem
2. Defining the algorithm
3. Executing the algorithm on a backend

Many problems in Qiskit follow this structure as the algorithm you use can typically be swapped for another without significantly redefining your problem. Execution on different backends is the easiest, as long as the device has sufficient resources.

CONCLUSION

When we created our quadratic program for the crop-yield problem, we saw that the Ising Model required 6 qubits. We had constrained our problem such that we could only plant up to 1 hectare per crop. However, we could change the model so that we can plot 3 hectares per crop, up to our maximum available farm area of 3 hectares. This was a small attempt to make use of quantum computing in the field of agriculture. There was a limitation while using IBM quantum computers as there were qubit size limitations. We weren't able to take larger datasets for crop yield production. This was our short demonstration of how quantum computing can be used in the field of agriculture. However, this is an emerging field, and this is just a prototype model. This technology can be used further to get maximum production