Ag2030 – A New Realm of Food

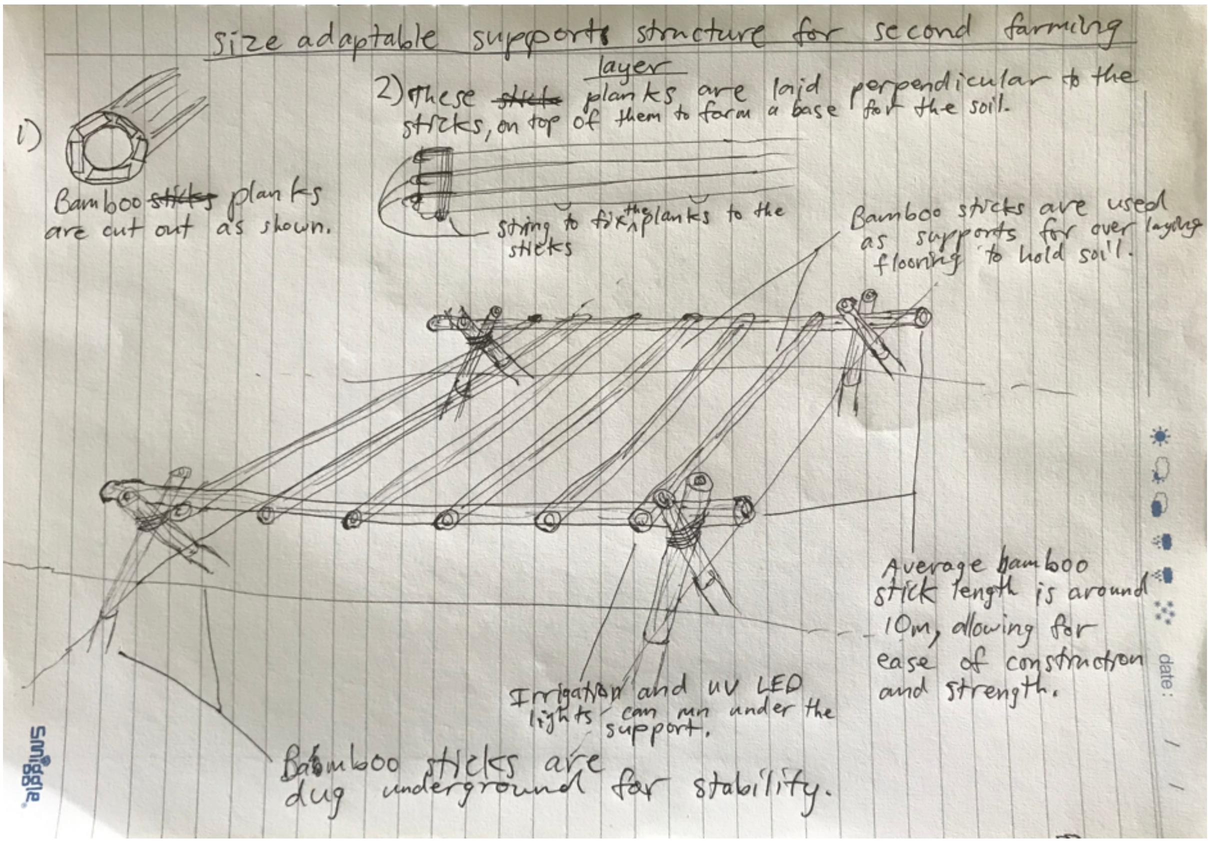
Introduction: The fundamental issues which can be fixed in our current farming methods are generally based on monocultures, mass labour and repetitive processes, and two-dimensional plantation. Simple but important ways to get around this, focussed on using tested and mass producible equipment, will be presented in an ordered manner. These changes include automatization, farming layers, public incentives, and with the help of automatization, permacultures based around combining farms and evenly distributing different crops which benefit the yield of each other, both increasing production and decreasing the negative environmental effects of fertilizers.

Perhaps the most important idea surrounding my proposal is that we should be sustainable and long-term thinkers. Whether or not the proposal leads to meeting the production goal of 2030, it will definitely increase food security, and have long term cultural and environmental benefits which continue increasing for fifty or so years and sustain their benefits for hundreds after that.

Farming Layers (Using 3D Space): With the advent of indoor vertical farming, we have proven significantly capable of creating low-cost artificial sunlight and manufacturing layered shelves filled with soil. If each tree farm (e.g., avocado farm) grew two layers of plants in between, and each other farm adopted another two layers of plants, we could roughly triple our food production. The existence of different plants in between an otherwise monoculture of trees would create biodiversity, attracting wildlife. This would create a much healthier ecosystem.

The problem is, however, that significant resources are used in the production of these layers and the light sources and energy transportation required. To significantly reduce the harm to the environment, renewable plant-based resources can be used. Possibly by far the most sustainable and ecofriendly resource readily and widely available is bamboo. With a floor-like design and frequent support bases, an added layer of soil could double production yield on farms.

Aquaponics in the form of vertical hollow bamboo sticks filled with soil could act as a support structure for the added layer and significantly more surface area in the form of vertical farming. In addition, small wind turbines could be added on top of these 'poles' with waterproofed wires running down to UV LED light sources, evenly spaced to allow for photosynthesis on the bottom, otherwise dark, layer. Even more layers could be added. The following calculation and sketch shows the ratio of bamboo farming area to produce farming area in order to have enough bamboo to double the produce farming area for another layer:



For optimal bamboo clump size, Guadua Bamboo recommends growing around 400 evenly spaced clumps per hectare (10000 square metres). Considering small clumps, perhaps 25 large poles can be produced per clump. As seen in the image below, this is very generous. Estimating that around 10 planks, each 5mm thick and 20mm wide, can be cut from a bamboo stick, around one bamboo stick is needed per square metre of flooring. The supporting structure above (estimated at covering a minimum of 50 metres squared) includes approximately 12 bamboo sticks. This means around 0.25 bamboo poles are needed per square metre for structure. The result is that around 1.25 bamboo poles are needed per square metre to double its production yield. Around 10000 bamboo poles can be produced per hectare (from the above data) every five to six years. This means the ratio of bamboo growing area to produce area is 1.25:1, meaning that only around 44% of farmland would be used for farmland for five to six years.

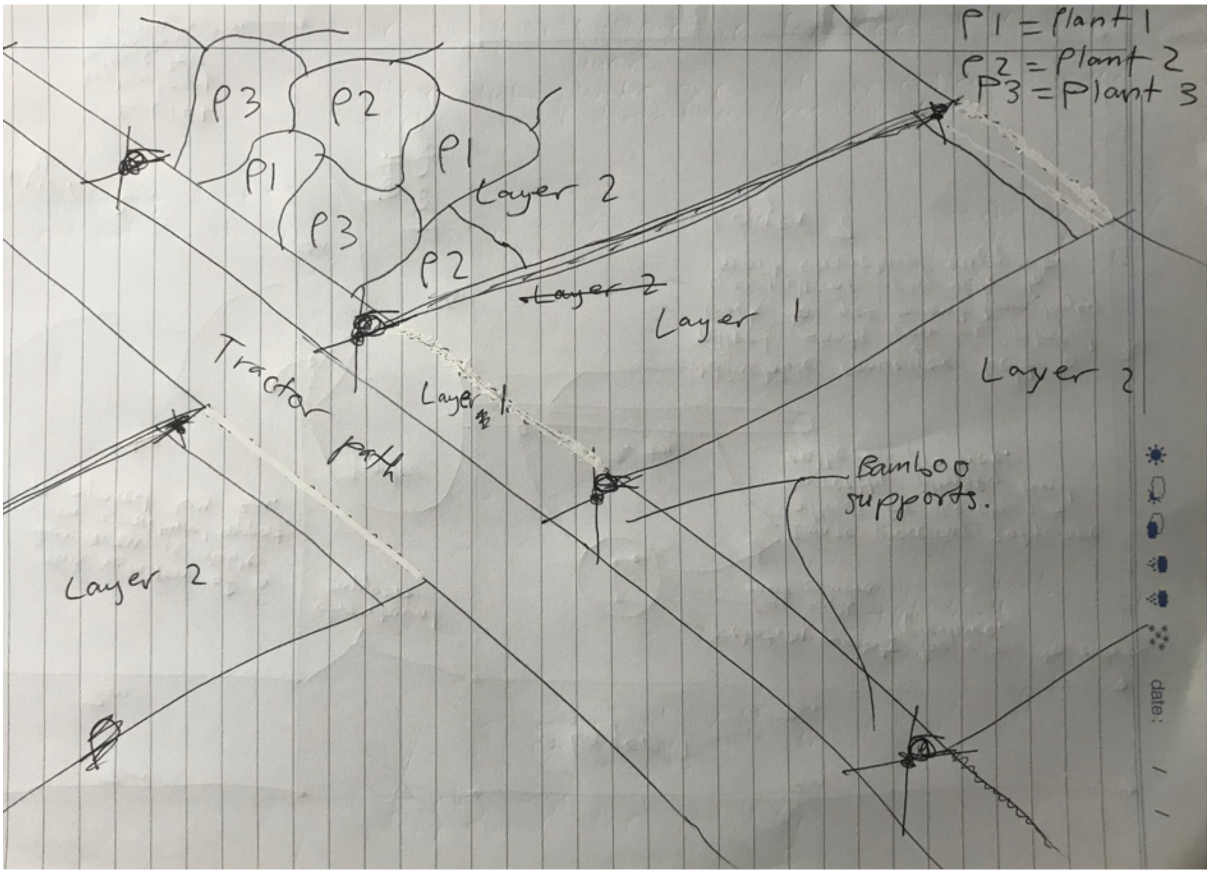
This is obviously not viable, however keep in mind that this process does not need to be done all at once. Even small changes in increasing farmland by adopting this system on small farms and in urban areas would lead to tremendous outcomes in produce yield. Some of the advantages of bamboo for construction and the environment are listed on the first two websites in the reference list. The most important effects are perhaps low cost, fast growth, and carbon dioxide reduction (significantly higher than the trees of ordinary timber). According to, bamboo absorbs over 56 tonnes of carbon dioxide per hectare per year. This is more than 1.5 to 2 times more than that of young forests.

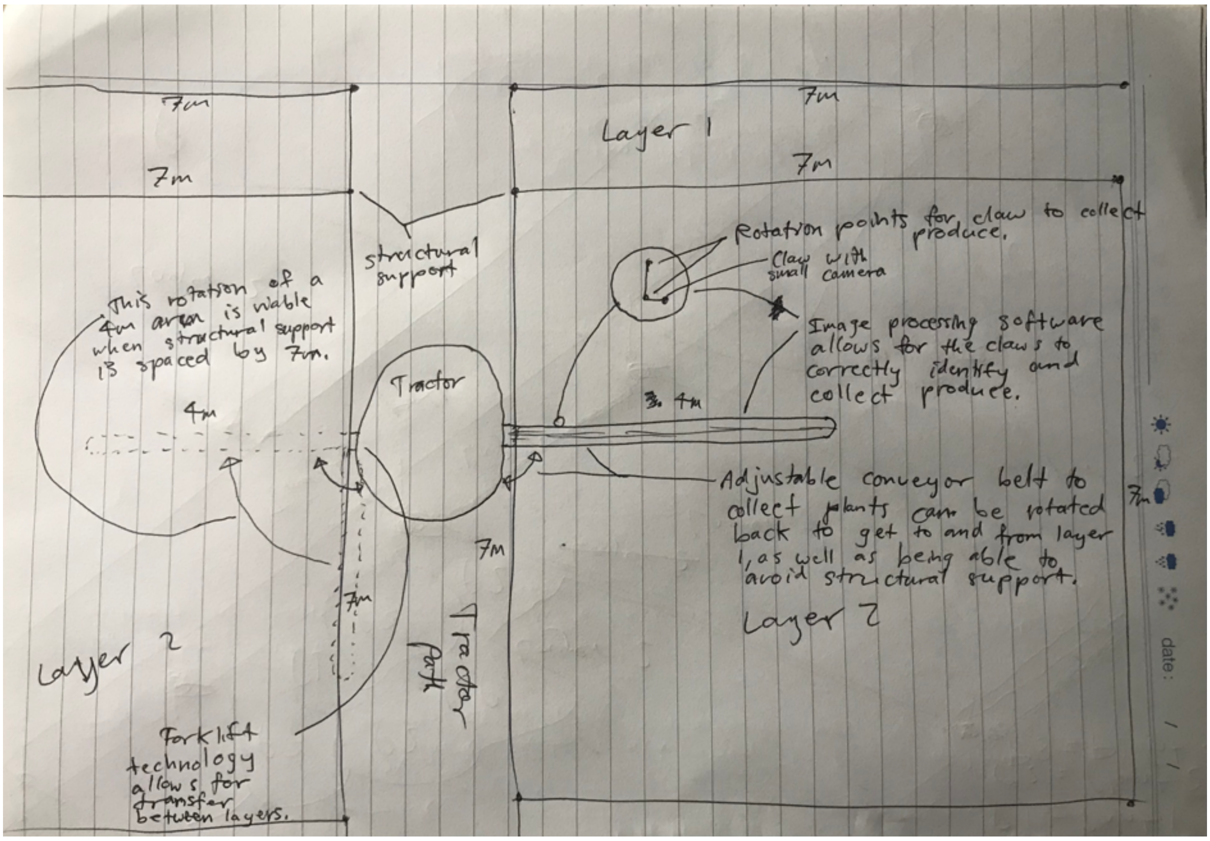
Public Incentives: Most private and community gardens produce a significant amount of food for their size, especially when foods like potatoes, carrots, or other plants with high volume produce are grown. For this reason, establishing a system where people produce a significant quantity of their own food would allow for reduced pressure on farms to feed as many people. To maintain enough work for the farmers, businesses with the central principle of helping amateur gardeners to produce low maintenance food would incentivise people to produce food high in nutrients and low in transport, no matter their location. As mentioned above, there now exists UV LED lights, which would even allow for high quality indoor farming.

Government initiatives for cities could even adopt handing out large grants to plant food on the roofs of skyscrapers and the sides of roads to limit the need for transport and herbicides and pesticides (which are needed in monocultures on farms), each of which impose significant harm on the environment at a large scale. This would also lead to more appealing cities, and with the help of robots, a much higher food production yield. The idea of planting food in cities is not to increase agricultural farmland, but rather to create public gardens for residents to use, as to reduce the pressure on farms to meet production demands.

Nevertheless, farmers would not lose their jobs, as new community land care jobs would be created in the cities. Education programs would also allow many young people to see and do gardening in action, giving them an initial impression that farming is easy on a small scale, and it is a good way to save money, reduce carbon emissions, and make their house look greener. Rather than being a job for minorities, everyone would become involved, and both progress in farming and the attitude towards it would benefit.

Permaculture and Automatization: Plants initially grew in the wild, and so I often wonder, why do they need so much maintenance? The answer predominantly lies in permaculture. Permaculture yield in some community gardens was measured, and the result was that it almost doubled the yield of commercial monocultures of the same plant types. This provokes the question: Why does large scale agriculture not adopt this solution already? Because doing so would make mass production much harder. This is where automatization and public incentive are involved. The sketches below detail a possible use of robots on pre-programmed or manually driven routes to identify and collect produce. As can be seen, the only automated part about this process is identifying and picking up plants. That is what makes permaculture take long on an industrial scale. The incredible ability computers have to do visual processing is only growing, and in the example below, the 'claws' would only need to distinguish between three plants and the edible segments, rather than facial features of different people as has been done since the 1960s. The same tractor system as shown below could also be used to plant seeds according to crop rotation by using navigation systems to identify different plant areas and the 'claws' on the conveyor belts to deposit these seeds.





Completely autonomous driverless cars first appeared in the 1980s, making them very well tested, and although not perfect for the roads, where pedestrians can become hazards, farms do not pose these hazards, especially for low-speed vehicles. The variety of routes in driverless cars would also not be needed for farm based driverless vehicles, as they generally have limited task variation. Drone technology for mapping, spraying, and other systems has already been adopted as well, meaning that farms already have the potential to incorporate automatization into farming, as to allow permaculture in mass production.

One significant permaculture-based idea which could easily be implemented into farming is: Moving animals onto tree farms and adjacent to vegetable farms such that their manure can be used as fertiliser, and they do not damage the crops they are located with. This would also allow the space which previously hosted the animals to be used for planting crops. In coastal areas, this space would easily be adapted for crop growth given the large amount of rainfall. In more arid areas, the problem could be addressed as shown in the next section ('Water'). This idea of combining plant and animal farming would also better join the farming community so that they can discuss general ideas to further increase produce yield.

Another few ideas for implementing permaculture include:

- Crop rotation. This increases soil fertility, decreases waterlogging, and allows for increased root growth and nutrient and water uptake in crops.
- Planting small trees to provide shade for low-sunlight crops.
- Including undulations in farmland to replicate optimal growing land and water runoff that is found in the wild.
- Planting crops on the intersection of different ecosystems for the benefit of both ecosystems.

- In fish farms, seaweed could be planted to add oxygen to the water. Other small marine life and habitats could be implemented as well such as crabs, sea cucumbers, underwater caves, and stones.

Water: Here I will briefly describe how a project by ‘Aqua Aerem’ could help supply water to farms in the outback of Australia. I will also describe how water can be transported to such places. The water content in the air in the outback is between 22% and 50% humidity. This means that considering temperatures between around 4°C and 38°C, the outback of Australia has a maximum possible range of around 1 to 20 grams of water per kilogram of air. Aqua Aerem is extracting this water from the air, and if extracted on a large scale, this could dramatically increase our potential land to grow crops among livestock.

On the other hand, it may be easier to transport water from areas with a lot of it. With Elon Musk’s hyper bubble technology, low energy transportation could occur by taking back the kinetic energy from the hyper bubble upon arrival to a destination by transforming it into electrical energy via conflicting magnetic fields between the cylindrical wall and capsule.

Reference List:

https://civiljungle.com/bamboo/

https://www.sciencedirect.com/science/article/pii/S2214509515300048#:~:text=Bamboo%20development%20reduces%20pollution%3B%20its,and%20villages%20from%20washing%20ceaselessly

https://iea.blob.core.windows.net/assets/imports/events/297/BambootoEnergyProject_30_04_2014_IEADEREKFINAL.pdf

https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2009/10/using-rotation-crops-to-improve-soil-quality#:~:text=This%20can%20promote%20root%20growth%20and%20uptake%20of%20nutrients%20and%20water.&text=These%20soils%20tend%20to%20be,aeration%20and%20water%2Dholding%20capacity

https://en.wikipedia.org/wiki/History_of_self-driving_cars

https://en.wikipedia.org/wiki/Facial_recognition_system#:~:text=Automated%20facial%20recognition%20was%20pioneered,computer%20to%20recognize%20human%20faces

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6320530/

https://www.google.com/search?q=how+long+until+bamboo+is+harvested&oq=how+long+until+bamboo+is+harvested&aqs=chrome..69i57j0i22i30j0i390l2.6344j0j7&sourceid=chrome&ie=UTF-8#:~:text=Useful%20Info%20About,info%20%E2%80%BA%20about%2Dba

https://www.guaduabamboo.com/blog/how-to-plant-bamboo

https://cityfarmer.info/urban-crops-a-new-belgian-company-specialising-in-indoor-growing-systems/

https://www.rechargenews.com/energy-transition/extracting-water-from-desert-air-unique-10gw-green-hydrogen-project-set-to-begin-construction-in-2022/2-1-1122086

https://championtraveler.com/dates/best-time-to-visit-golden-outback-wt-au/#:~:text=Humidity%20and%20Wind,Golden%20Outback%20is%20usually%20moderate

https://www.engineeringtoolbox.com/water-vapor-air-d_854.html

Growing Fresh Food and Herbs – Using Easy Permaculture Methods – Angelo Eliades