Towards a Food Sovereignty Strategy in Singapore

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Synopsis

Given its size and dense urban environment, it is not realistic economically or spatially to meet Singapore's entire food needs through in-country cultivation. A more pragmatic and viable solution would be to build flexibility and adaptability in the planning and development strategies so that land and space can be quickly deployed for food production when the need arises.

1. The Impending Food Crisis

The global population is expected to grow from the current seven billion to over nine billion by the mid-century. In addition, the global population is also expected become increasingly urbanised. At the same time, farming and fishing yields are declining through increased demand, reduced amounts of arable land, unsustainable agricultural and fishing practices, not to mention the impact of climate change.

The recent International Food Policy Research Institute (IFPRI) studies on the impact of climate change on monsoons cycles suggest that South Asia will experience large agricultural declines. Breakthroughs in food production – another "green revolution" – are urgently required, as will be urban agriculture, which will be increasingly important to supplement traditional, rural agriculture.

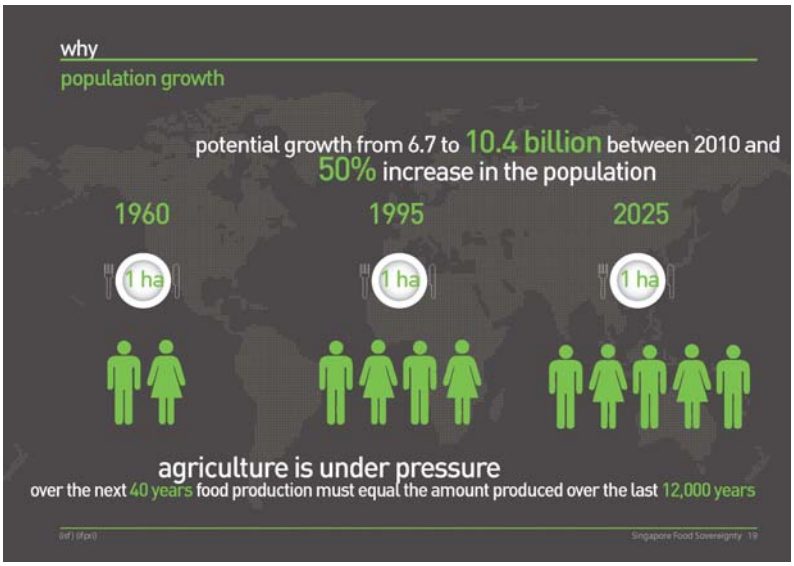

Figure 1: Agriculture under pressure

Singapore is almost completely reliant on food imports (about 90%), and therefore is in a very vulnerable position when the food crisis occurs. The National Research Foundation (NRF) recently issued a call for research innovations in this area, and the Singapore government, through the Agri-Food & Veterinary Authority (AVA) is actively seeking to diversify the source of our food imports. This includes the creation of food zones overseas, such as the China-Singapore Jilin Food Zone. However, the question remains: given Singapore's small size and already dense urban environment, how can we address the spatial requirements to attain a satisfactory degree of food sovereignty[i] and security?

Over two semester-long studios with fourth-year architectural students at the National University of Singapore, I explored the food aspect of urban resilience, to understand the spatial implications of an island-wide planning and design strategy that could help Singapore extend its "total defence" approach to include food sovereignty during a crisis situation. The study area, naturally, covers the entire territory of Singapore, including the off-shore islands. The "five pillars" of Singapore's existing strategy are: military, civil, economic, social and psychological. This strategy is comprehensive and extensive, and the government has invested heavily in the physical elements required, such as emergency shelters in metro stations and schools, and in all public housing apartments. The studio contends that food sovereignty should be an integral consideration.

2. Assumptions

A key assumption for the studio explorations is that, given Singapore's small size, large population and economic profile, it is not realistic, nor would it be economically or spatially viable to attempt to meet Singapore's entire food needs through in-country cultivation.

Instead, the more pragmatic and viable solution would be to build flexibility and adaptability into the urban planning and development strategies so that land and space could be requisitioned by the government, and be quickly re-deployed (say, within three to six months) for food production as and when the need arises, that is, during critical or emergency situations. At all other times, when the sources of imported food are secure, these land and spaces would retain their "normal", everyday functions.

Another key assumption for the studio explorations is the notional food crisis that will be precipitated in 2030. The choice of this date was informed by the research scenarios proposed by IFPRI and other food, population and climate change studies. Adopting 2030 as the notional "crisis year" to work towards, also helped to outline the other assumptions (such as the one-year duration of the crisis, the amount of stockpiled food available, the capacity to requisition buildings, etc) within which the policy proposals could be framed.

3. The Food We Eat

The first, more quantitative, part of the studio examines Singapore's food sources: (i) the amount and type of food we consume; current food production areas in Singapore; where are we are importing food from and at what ecological cost (ii) our actual food requirements in calories; the calorific content of different type of foods available in the region; and the spatial implications for growing our own food.

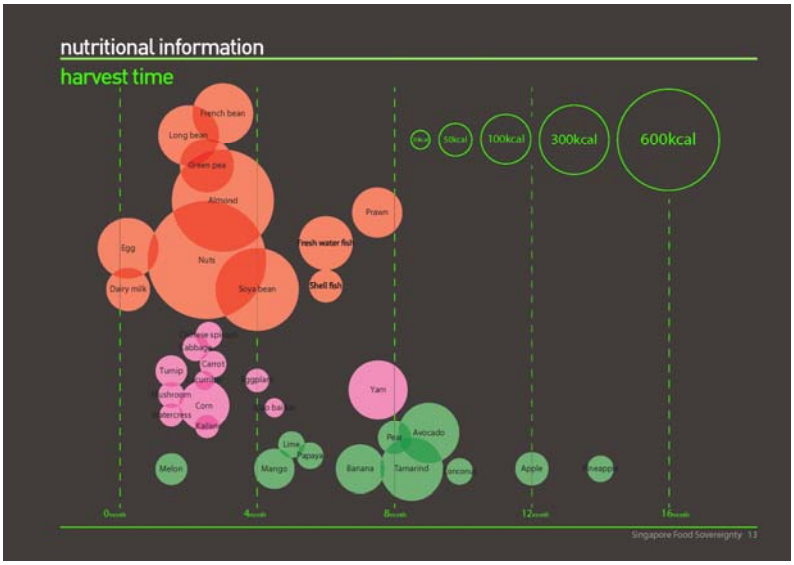

Figure 2: Nutritional Value and Harvest Times

Information from the Urban Development Authority (URA), the Agri-Food and Veterinary Authority (AVA) and the Ministry of Health (MOH) that provided insight into the food production and consumption patterns of Singaporeans were compiled and analysed. Likewise, site visits to the AVA's Sembawang Research Station and the Marine Aquaculture Centre on St John's Island broadened the technical understanding of the issues.

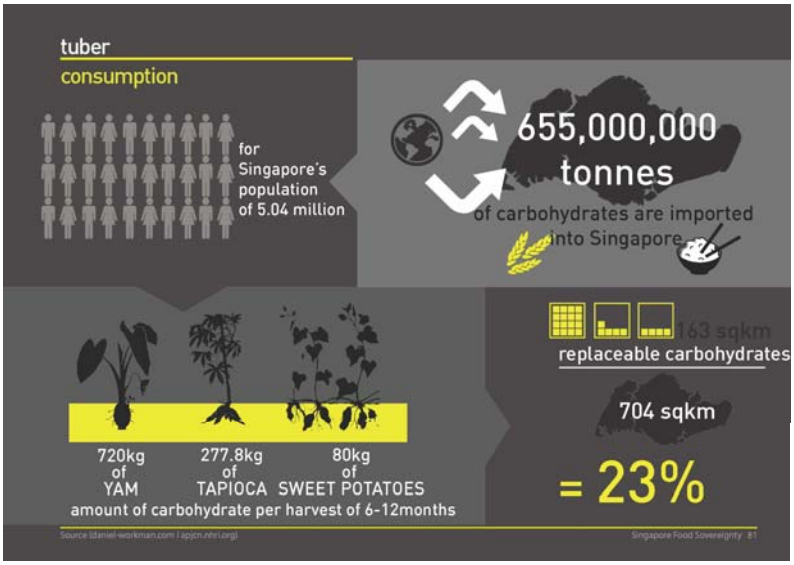

Figure 3A: Land required for production of carbohydrates

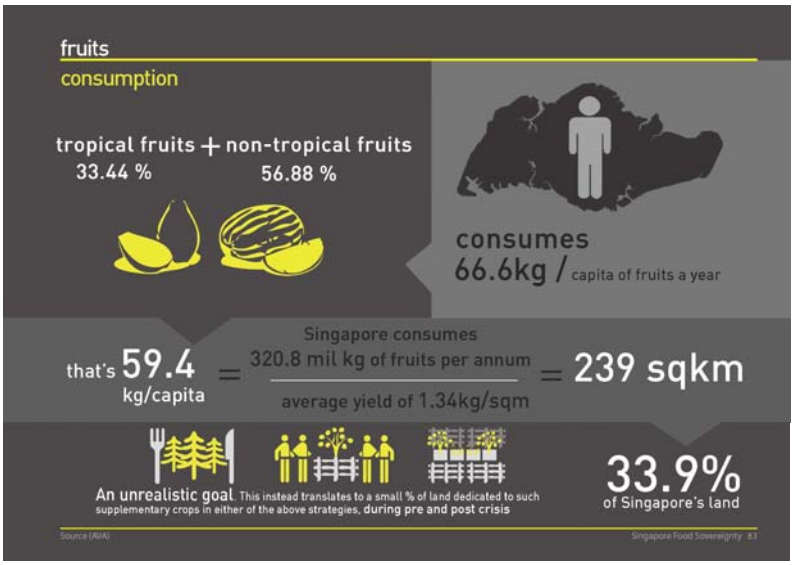

Figure 3B: Land required for production of carbohydrates

Formulating a Strategy

Quite early in the first studio, the discussions began to coalesce into three major strands, namely, **vertical (stacked) farming** (primarily green vegetables and egg production), **aquaculture** (primarily off-shore fisheries) and **productive landscapes** (for carbohydrate substitutes). International case studies, such as Cuba's Urban Agriculture Movement, WWII "Victory Gardens", Norway's Svalbard Seed Vault, even traditional fish-rice farming practices in the region, etc, informed the studio of the multi-faceted aspects of the challenge.

In Singapore, only 1% of the total land area of 700km^2 is formally allocated for agricultural use. However, this includes land used for non-food production activities such as orchid farms or ornamental fish farms. The actual amount of land dedicated to food production is much less than 1%. It is a measure of the efficiency and productiveness of Singapore's agricultural sector that we produce about 7% of the green vegetables we consume (including 100% of bean sprouts) and 23% of chicken eggs.

Singapore is also short of sea space. The amount of "usable" sea area for open sea farming is constrained not only be the water depth, currents and quality, but also by active port uses or as anchorages. In spite of this, the existing fish farms produce about 8% of the fish that is consumed annually.

While there is substantial scope for increased productivity through rotating planting structures or open sea fish farms, if the need for secure food sources is considered important enough, perhaps the land (and water) areas could be allocated for agricultural uses.

For each of the three strands, we developed strategies to increase the capacity for increased food production during the pre-crisis, crisis and post-crisis periods. In reference to the realistic possibility of an impending food crisis, the strategies were designed encompass an initial increase in food production with a further increase during a crisis period.

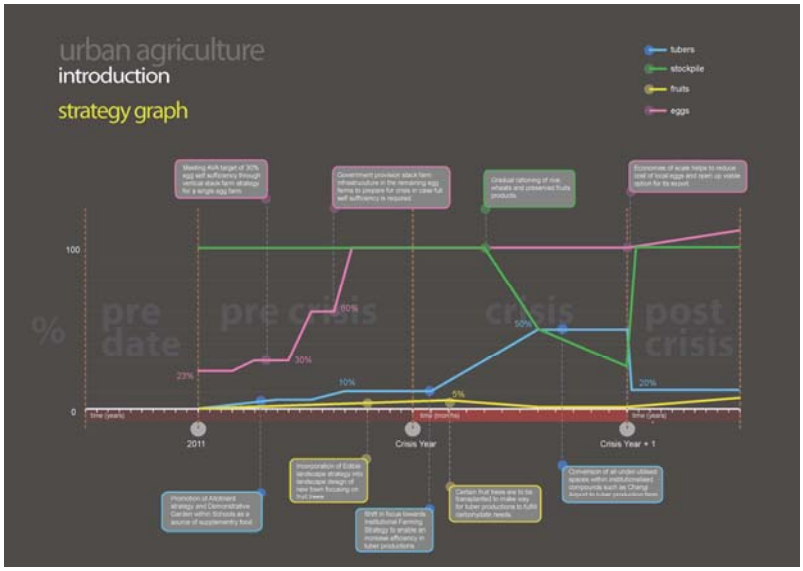

Figure 4: Timeline of the proposed Food Sovereignty Strategy

Over the two semester-long studios, the students first identified/developed strategies for each, at the national level, and then zoomed into a new town to examine potential spatial ramifications for efficient deployment during emergency situations. Bedok New Town was chosen for its mix of mature public and private housing, as well as the industrial area, not to mention the canal, reservoir and coastline. Underlying the proposals is an understanding of the key technical/scientific requirements of each "strand", sensitivity to the political and social

contexts, and the adoption of the ethos of sustainable urbanism. Some of our key recommendations/proposals are:

Vertical farming:

- Pre-Crisis: Expansion of farms using rotation structures to increase productivity to meet 15% of green vegetable needs. Stockpiling of materials, soil and seed.
- Crisis: Conversion of HDB multi-storey car parks during an emergency to fully meet 100% of green vegetable requirements.
- Post-Crisis: Car parks revert back to regular usage. Car park roofs can be retained as community gardens.

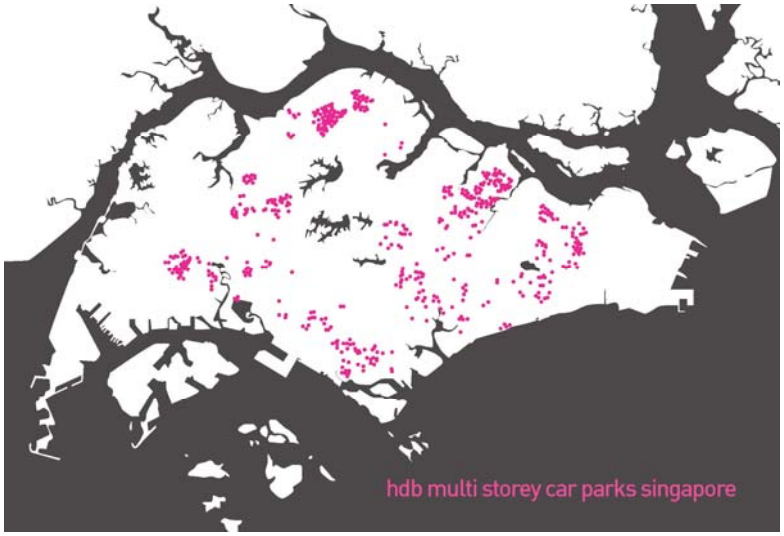

Figure 5: Location of HDB Carparks

A key architectural component of the studio comprised (i) the design adaptation of HDB car parks to be converted into vertical farms during emergency situations, including solar energy, planting modules, water harvesting, composting etc, and (ii) vertical farms that can be used as car parks during non-emergency situations. The design for these components included the cost of fabrication and stockpiling of materials.

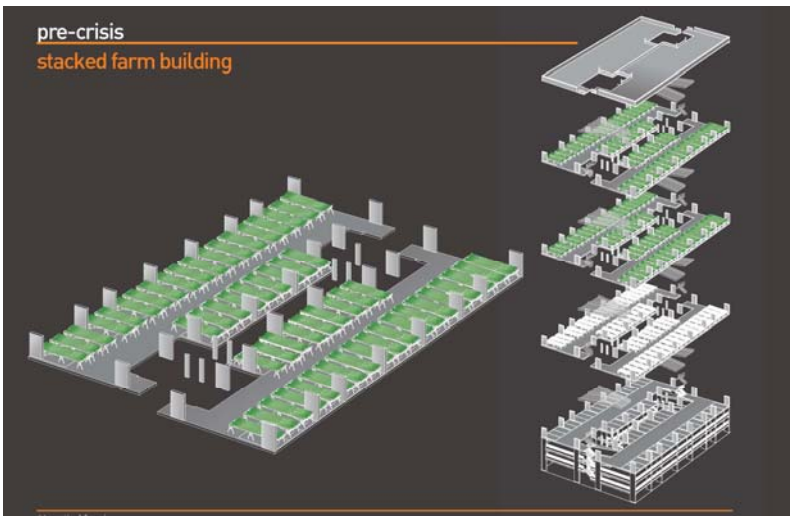

Figure 6A: Conversion of HDB Car-Parks to Vertical Farms

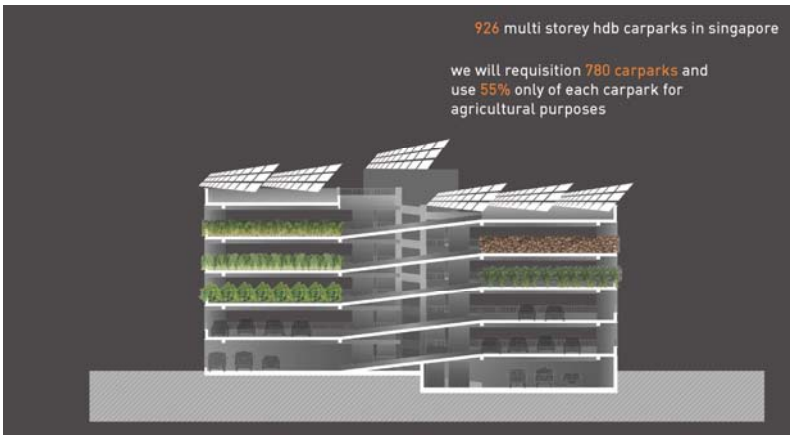

Figure 6B: Conversion of HDB Car-Parks to Vertical Farm

Egg Production:

- Pre-Crisis: Construction of stacked egg farms. 30% self sufficiency
- Crisis: Ramping up egg production requires lead time of 9 months for chick to mature, but potentially can be major source of protein.
- Post-Crisis: Revert to pre-crisis levels. Extra eggs produced for export.

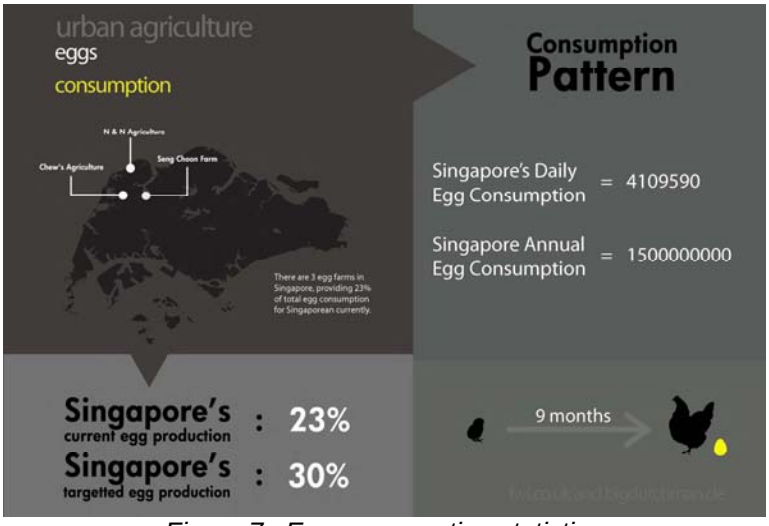

Figure 7: Egg consumption statistics

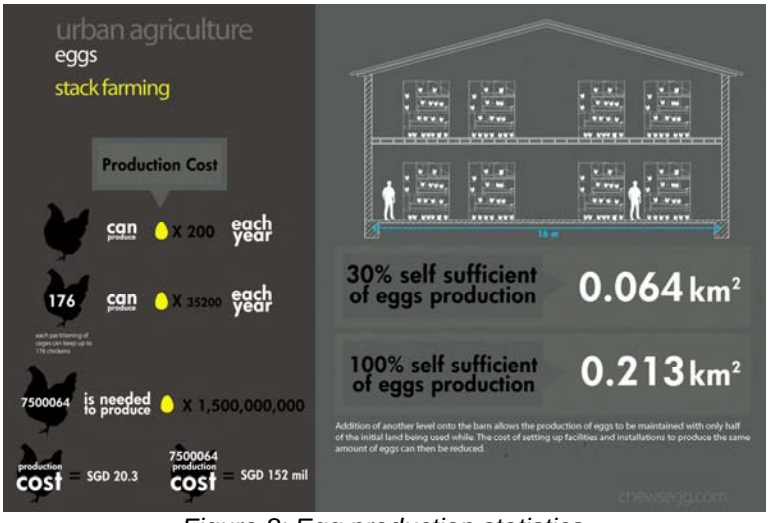

Figure 8: Egg production statistics

Aquaculture:

- Pre-Crisis: Expansion of intensive open-water fish farms, possibly in collaboration with Indonesia. Conversion of some inland fish farms to hatcheries to supply open-water farms. Aim to meet 100% protein requirement. Requires long lead time.
- Crisis: Export component redirected for domestic consumption instead
- Post-Crisis: Revert to pre-crisis status. Extra fish produced for export.

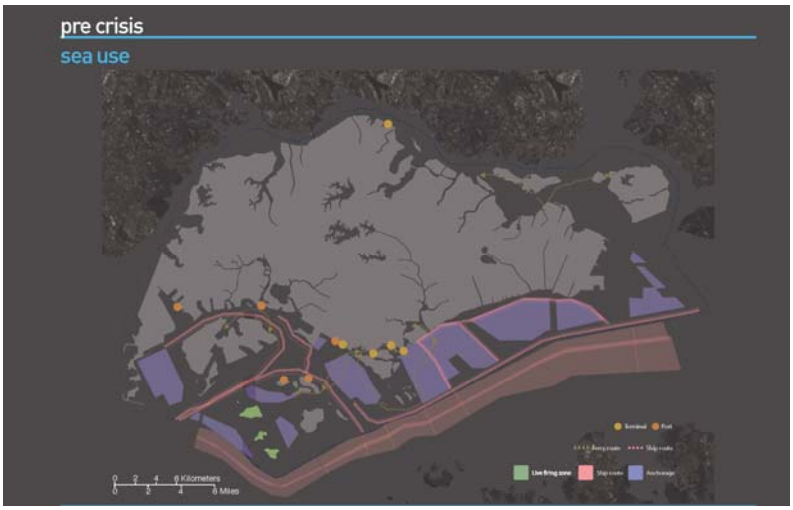

Figure 9: Existing Usage of Sea Space

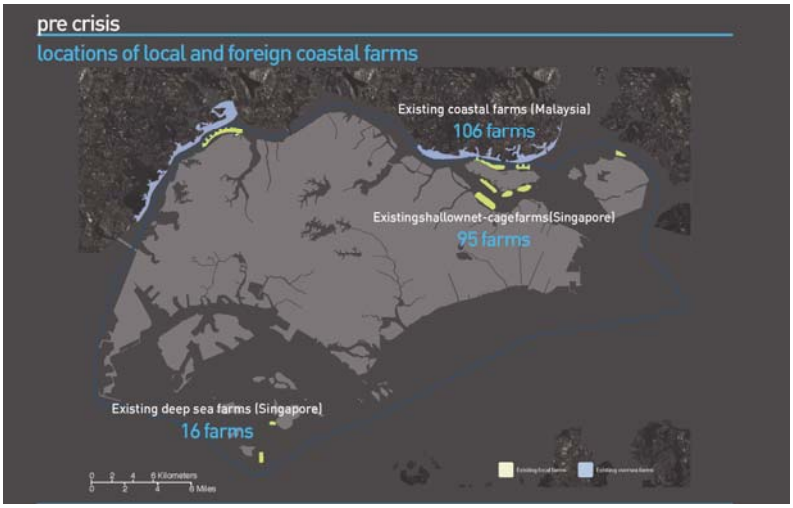

Figure 10: Location of existing fish farms

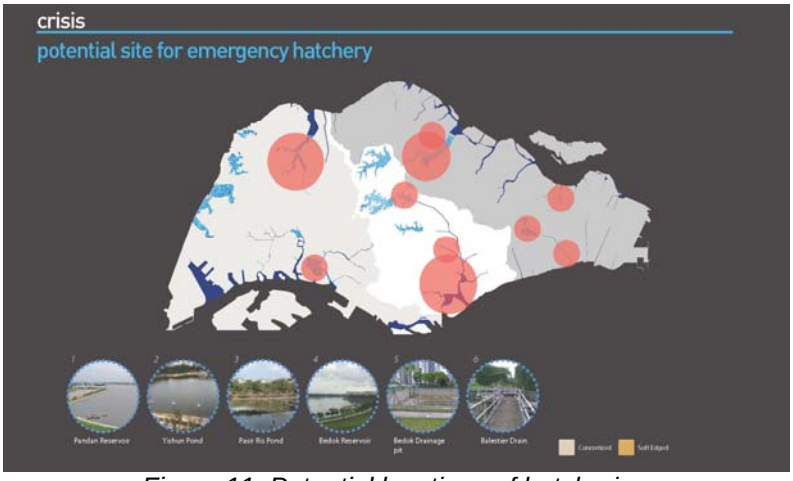

Figure 11: Potential locations of hatcheries

Productive Landscapes:

- Pre-Crisis: Stockpiling of food, materials, soils and seed. Pilot projects to increase food literacy, community/institutional farms, allotments, incorporate more edible landscapes
- Crisis: Achieving 50% sufficiency in carbohydrates; rationing of stockpiled food
- Post-Crisis: Gradual reversion to pre-crisis status, but some areas can be retained as allotments or community/institutional farms.

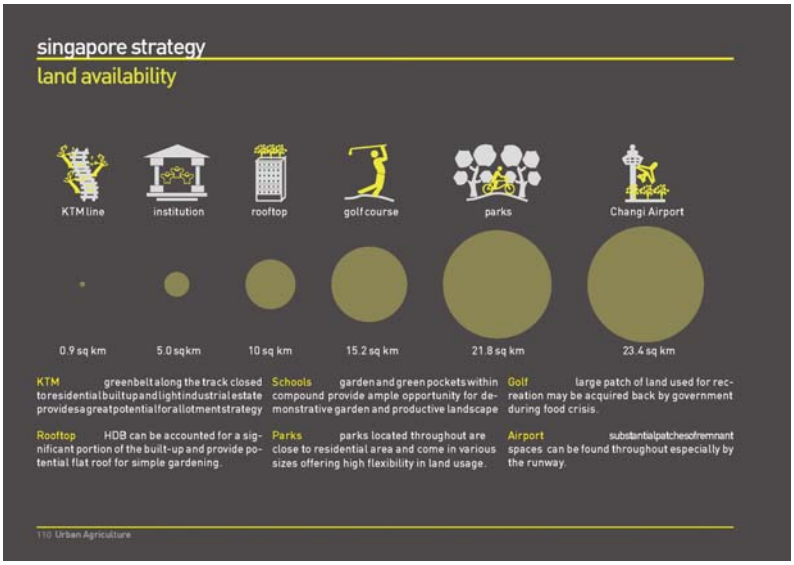

Figure 12: Potential land for productive landscapes

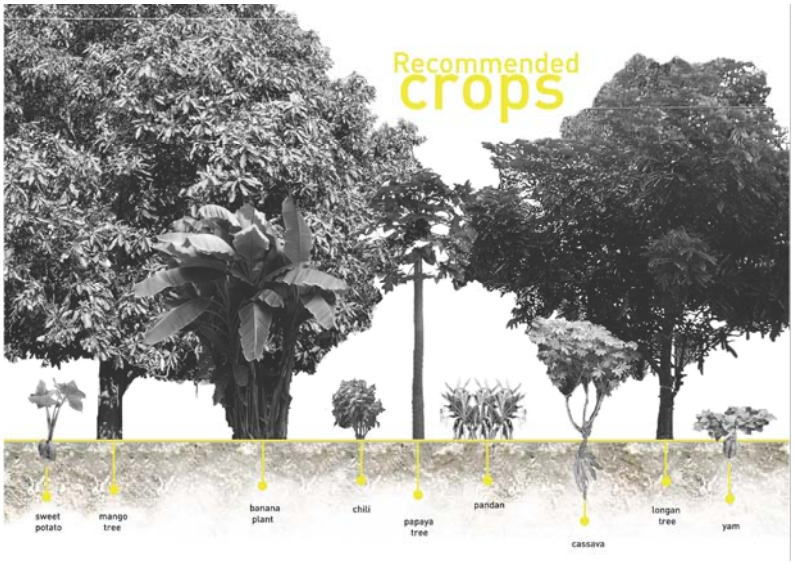

Figure 13: Suggested Crops

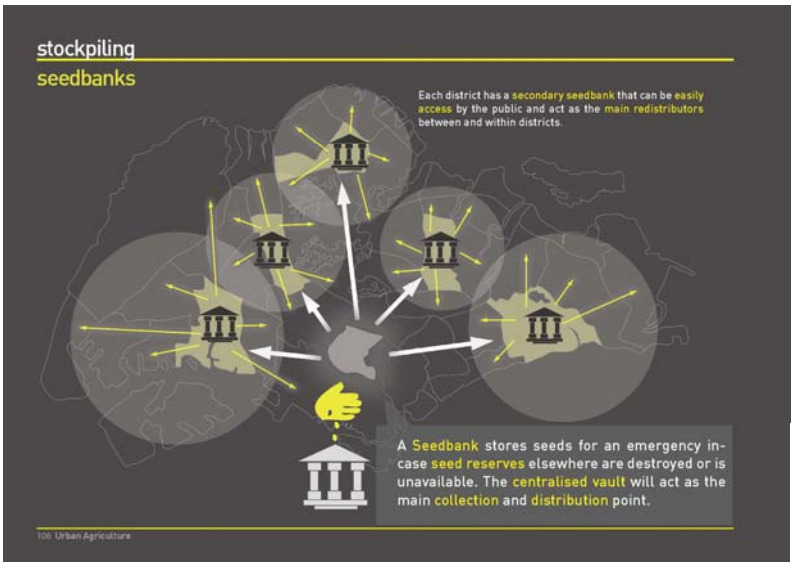

Figure 14: Stockpiling: Seedbank policy

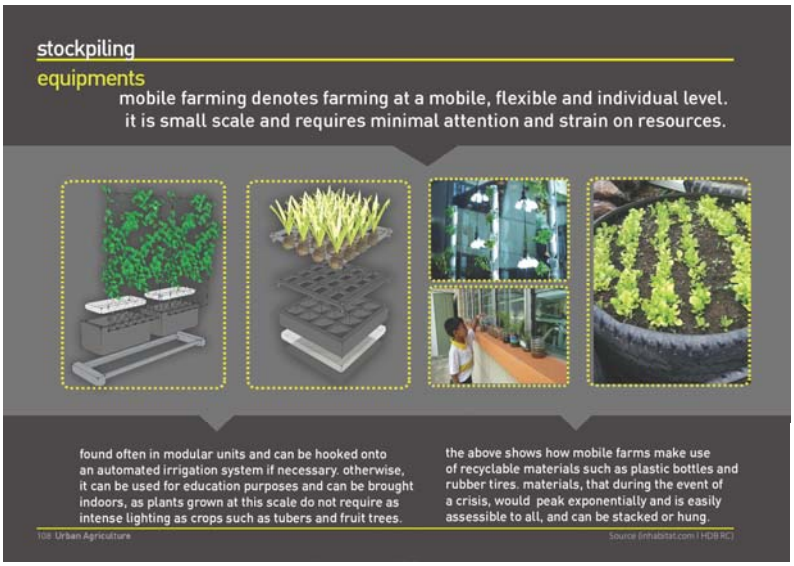

Figure 15: Stockpiling: Farming Equipment

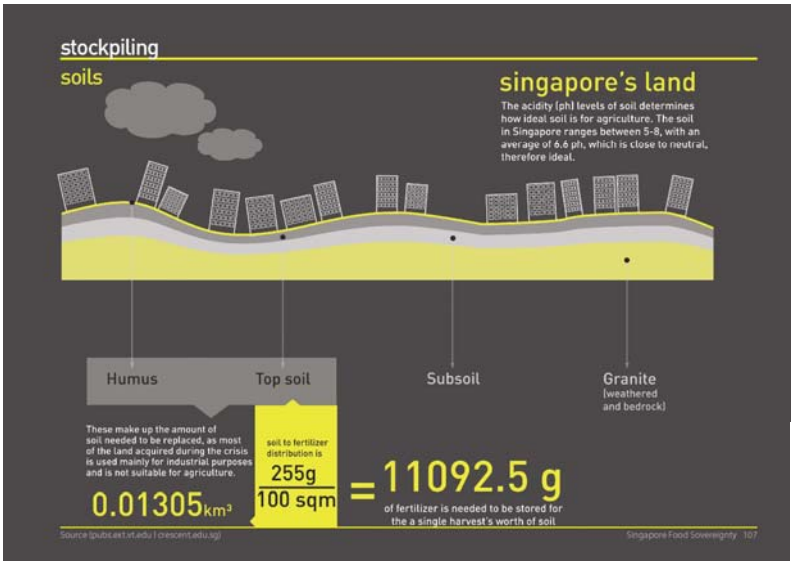

Figure 16: Stockpiling of Topsoil

4. Bedok New Town

Following the development of the three "strands" at the national level, Bedok New Town was selected to test out the potential deployment/implementation at the level of the new town. Bedok New Town has a population of about 300,000 people, and the study area covered about 15 sq.km.

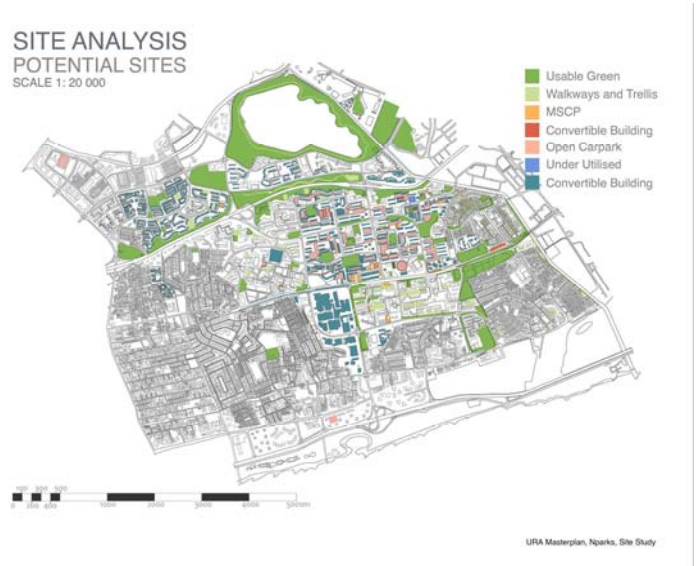

Figure 17: Potential Sites for Urban Agriculture in Bedok

Figure 18: Potential Redeployment of Open Spaces in Bedok

Figure 19: Potential Conversion of an Educational Institute

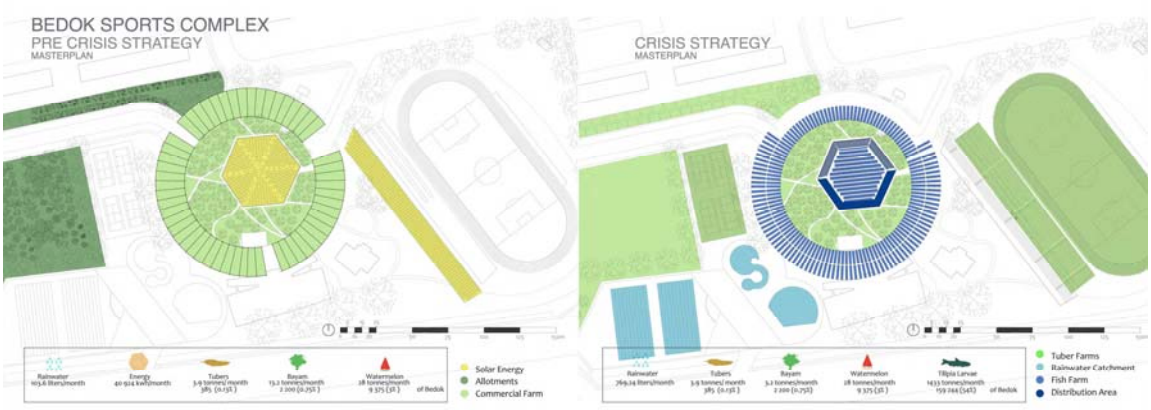

Figure 20: Proposed Conversion of Community Sports Complex

Figure 21: Potential for Converting Bedok into a "Food Stream"

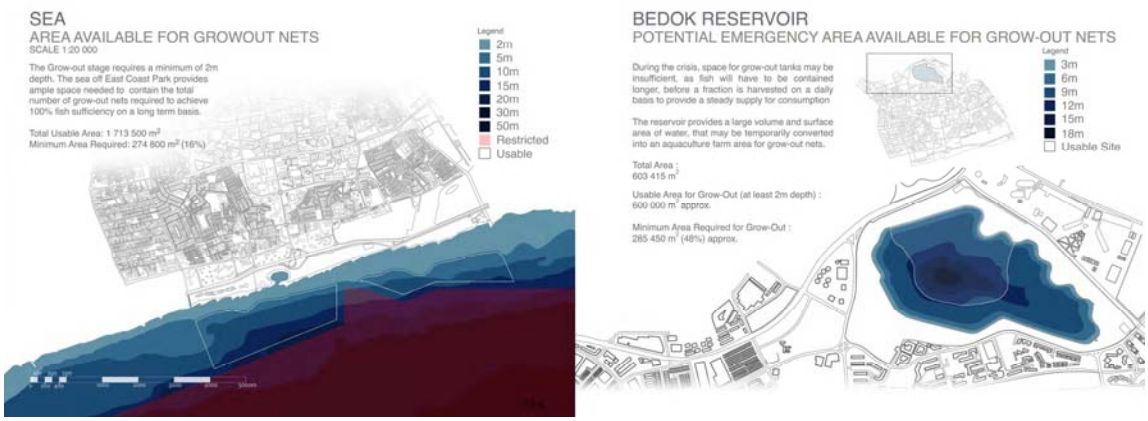

Figure 22: Potential for Aquaculture in Bedok

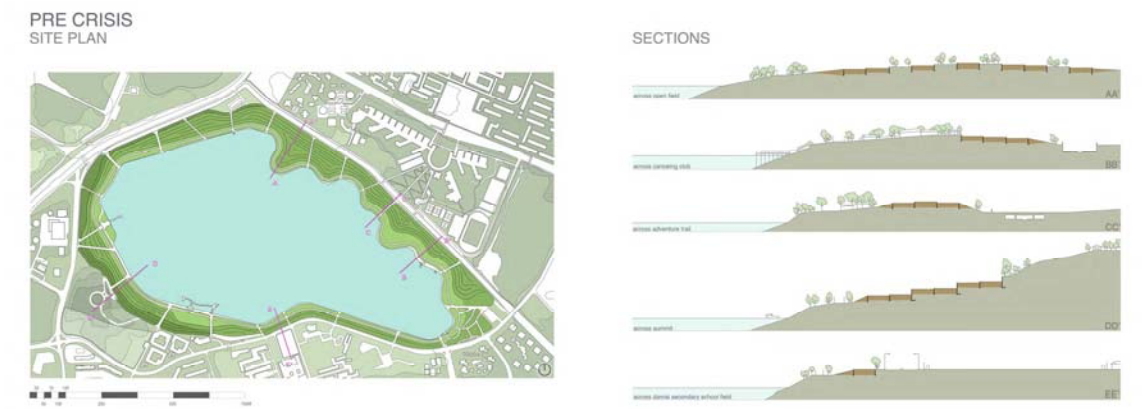

Figure 23: Stockpiling of Topsoil around Bedok Reservoir

5. Conclusion

The two Food Sovereignty studios was an experiment in bringing together research and teaching on an issue related to urban resilience. Designed as a prototype "research by design" studio, the studios first examined Singapore's vulnerability (to risks such as energy, water, food, climate change, etc.). The second part of each studio focussed on the developing possible policy and design solutions.

The study demonstrated that that even if it is not economically viable for Singapore to dedicate land during non-crisis periods for agriculture, with flexible and innovative land-use planning and urban design, it is very plausible for Singapore to achieve some level of self-sufficiency during a crisis situation. Indeed, the study argues that is essential that the country dedicates resources towards developing the missing "sixth pillar" of Singapore's "Total Defence". In the case of the vertical farms, it is anticipated that further studio-based design research will deepen the not only the aspects of building design, but also enable us to produce vertical farming modules that could be commercially viable.

[i] Food sovereignty refers to the right of all persons, communities and countries to have safe, nutritious and culturally appropriate food within their unique resource, social, economic and cultural circumstances (Foodfirst, 2002).