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## GROWING SUSTAINABLY IN CANADA THROUGH CONTROLLED ENVIRONMENT AGRICULTURE

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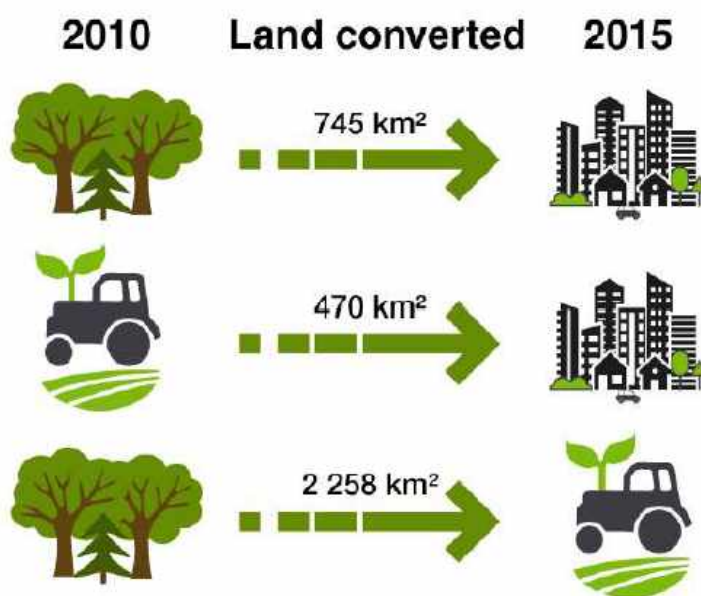
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**ABSTRACT.** There are many places where food production is limited by a vulnerable supply chain, lack of arable land and climate change. To provide more reliable solutions to food security, the research of advantages and shortcomings of existing CEA solutions was completed and ZipPod™, the turnkey container system was designed to make it simpler for community leaders, individuals and non profits to set up CEA food production quickly and to grow fresh produce in an environment that prioritizes plant health and human health.

**KEY WORDS:** Controlled Environment Agriculture (CEA), modular farms, modular farming, container farms, ZipPod™, ZipGrow™.

**Introduction.** While Canada's built-up area represented only 0.1% of the country's total area, urban expansion results in the loss of prime agricultural land because numerous communities across the country were originally established on fertile agricultural land.<sup>[3]</sup> The expansion and intensification of built-up area also results in the loss of green space and natural land covers. These changes are normally permanent—once agricultural or natural land is used for urban purposes, it is unlikely to return to a natural state.

According to the Statistics Canada and Canadian Environmental Sustainability Indicators,<sup>[2]</sup> only from 2010 to 2015 there were such a national land-use change between cropland, forest and settlement south of 60° North (the southern territorial border of Yukon, Northwest Territories and Nunavut) as follows:



- 3 473 km<sup>2</sup> of land-use change was observed, representing well under 1% of the overall area

- Of the land-use change observed, a large proportion (65% or 2 258 km<sup>2</sup>) was the conversion of forest to cropland

- About 1 215 km<sup>2</sup> of cropland and forest were converted to settlement <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/land-use-change.html>

Responding to concerns about local food security in a cold weather climate in Canada and reduction of fertile soil and croplands the idea of sustainable controlled environment agriculture arose.

Indoor Vertical farming – one of the most successful methods in controlled environment agriculture – features warehouses or modular farms with vertical towers for growing, with irrigation and lighting systems, and space to pick up and transport crops. One of trends in Indoor Vertical farming

are container/modular farms. These constructions are flexible and self-contained systems that allow to grow herbs and vegetables without the need for soil or sunlight.

**Theoretical and experimental research:**

A commercial hydroponics designer and manufacturer, ZipGrow Inc experimented and analyzed the pros and cons, as well as crops yield for such modular systems as:

- 1) Modular system that used shipping containers as outer shell. The shipping containers were used for these container farms because they are compact, available to transfer everywhere in the world, they are solid and can be customized as a plug and grow machine.
- 2) The container farms with specially designed Structural Insulated Panels (SIP). Such Container Farm System is a suite of fully functioning hydroponic farms and farm implements.

The result of tests revealed disadvantages of the shipping containers farms such as:

- Limited working and growing space: all shipping containers are 8 feet width which causes the problem of narrow rooms.
- Insulation problems: containers corrugated metal ‘sheathing’ serves as an integral part of the structure. This effectively means there is no cavity inside the walls in which to place insulation, unlike a typical wooden wall with studs. Therefore, the insulation must be placed on either the inside or outside of the corrugated metal sheathing. Since most insulating materials are generally somewhat unsightly and not very durable, there is an only option with insight insulation. In case of putting insulation on the interior side of the container, there is a need of an interior wall surface over the top of it to provide a better esthetic appearance and give an easier place to mount cabinets, light switches, etc. As a result, there is even less available space inside the container. If insulation is done on the exterior side of the container, there is a problem of exterior cladding on top to better protect it from nature and provide a more visually appealing look. In addition, interior walls with corrugated metal walls inside are not esthetical. Even when using high-cube shipping containers, there really isn’t enough clearance to run ducting in the ceiling while maintaining enough roof for insulation, light fixtures, etc. The problem is only worsened when regular-height containers are used.
- Health safety problem: the durable, industrial paint used in containers could contain some other chemicals. The exposure to chemicals at certain concentration and over certain time periods may cause health problem for people and affect the plants.

**Results of research and development.** Research and engineering team of ZipGrow Inc has developed the container farms solution with specially designed Structural Insulated Panels and designed the most successful option of the complete turnkey hydroponic farms, ZipPod™ Systems. One of the limiting factors for the farmers is the exorbitant costs and time involved for construction or renovation of the building and then, begin to purchase growing equipment. ZipPod™ allows a new farmer to begin to grow within hours of purchasing a farm. Utilizing ZipGrow’s patened technology of growing vertically in towers, the company has developed a «growing pod» complete with everything needed for an indoor hydroponic farm, including HVAC, all plumbing, work area, seedling areas, all electrical and lighting etc. To start the indoor vertical farm with ZipPod™ there is only one requirement: to place it on a level spot, then « plug in », and start running the farming business. The farms are portable, highly insulated, and custom built from the ground up to allow farmers to grow produce year-round, in any climate.



The ZipPod™ is loaded with an extensive list of specialized indoor growing equipment and technology. It's purpose-built to grow fresh healthy food fast in an environment that prioritizes plant health AND human health.



The ZipPod™ is a prefabricated building manufactured from composite steel, designed to perform in the harshest conditions and within a small footprint.



It is supersized: It's 750 cubic feet larger than traditional container farms and when it comes to controlled indoor-ag every extra inch counts. More space means more plant sites, streamlined workspace and increased air circulation - the key to success for healthy plants and quality crop yields.



**Product details of ZipPod™ System :**

The ZipPod™ is a 40' x 10' x 10' pre-fabricated composite steel container. It weighs approximately 5,500kgs and has an insulation value of R22-R35. The container's interior features



advanced climate control and can simulate different growing environments. Each system is equipped with stainless steel workspace, powder coated and mold-resistant aluminum structures.

Patented ZipGrow™ Towers are a truly vertical hydroponic system and the core of ZipGrow's technologies. Their convenient lightweight design is simple to move, plant, and harvest. Designed for high density crop production of leafy greens, herbs, and fruiting plants. Advanced HVAC unit purpose-built for Controlled Environment Agriculture and specialized plumbing allows growers to target specific rows for flushing and irrigation.



ZipPod™ is supported by the Atom controller for scheduling all different parameters of the farm including temperature, CO2 levels, and humidity.

This controller is cloud-based for convenience but also fully functional offline.

ZipPod™ has low energy usage, low heat, and color optimized for growth, LED lights which provide the most efficient, effective, and customer-friendly way to grow indoor crops.

LIGHTING:	CLIMATE:
<ul style="list-style-type: none"> <li>❖ Illuminar 'Spectra Blade' LEDs 60,</li> <li>    ❖ 8ft double-sided lights</li> <li>    ❖ 150W/lamp with customizable spectrums*</li> </ul> <p>*customizable spectrums are a special order item Automated day / night schedule</p>	<ul style="list-style-type: none"> <li>❖ Commercial HVAC with dedicated dehumidification and duct delivery</li> <li>    ❖ Closed-loop air recycling system eliminates the need for ambient air</li> <li>    ❖ Automated venting, heating, chilling, dehumidification, and CO2 supplementation</li> </ul>
PLANT SITES:	OPTIONAL FEATURES:
<ul style="list-style-type: none"> <li>❖ Over 3,800 plant sites</li> </ul> <p>NURSERY:</p> <ul style="list-style-type: none"> <li>❖ Seedling of 3,600 plan</li> </ul>	<ul style="list-style-type: none"> <li>❖ Reverse osmosis water filtration</li> <li>    ❖ 5-stage, in-duct UV &amp; carbon air purification</li> </ul> <p>Farm is CSA and TSSA approved for use in Canada, temperature rated to +/-40C and requires a 200-amp electrical service.</p>

The result of the completed research and experiments with the prototypes of used shipping containers and modular farms was a creation of ZipPod™ system. With specially designed Structural Insulated Panels, ZipPod harnesses the power of ZipGrow's patented hydroponic Tower™ technology, used by farmers and home growers worldwide for over a decade. Adopting the knowledge of plant health scientists, lighting specialists, and indoor farming experts the

innovative design allows for high density crop production and seamless workflow. It boasts the most space-efficient equipment in controlled environment agriculture including advanced HVAC system and custom controlled plumbing allowing growers to target specific rows for flushing and irrigation.

#### References

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### **ОСОБЛИВОСТІ РОЗРОБКИ ОСВІТНЬОЇ ПРОГРАМИ "ГЕОДЕЗІЯ ТА ЗЕМЛЕУСТРІЙ" (СПЕЦІАЛІЗАЦІЯ ЗЕМЛЕУСТРІЙ ТА КАДАСТР) У ЧЕРНІВЕЦЬКОМУ НАЦІОНАЛЬНОМУ УНІВЕРСИТЕТІ ІМЕНІ ЮРІЯ ФЕДЬКОВИЧА**

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За даними ЄДЕБО станом на 01.01.2021 р. зареєстровано 45 суб'єктів освітньої діяльності, які здійснювали підготовку здобувачів вищої освіти за першим (бакалаврським) рівнем вищої освіти. На всіх курсах бакалаврату навчалася 4543 здобувача (переважно на денній формі навчання – 83%).

Відсутність стандарту вищої освіти призводила до різних неоднозначностей в процесі підготовки бакалаврів, зокрема: тривалості навчального навантаження, структури та обсягу вивчення дисциплін, термінів та черговості проведення практик та ін. [1].

11 травня 2021 р. МОН України затвердив стандарт вищої освіти за спеціальністю 193 «Геодезія та землеустрій» галузі знань 19 «Архітектура та будівництво» для першого (бакалаврського) рівня вищої освіти.

Положення законів України «Про освіту» та «Про вищу освіту» з метою успішного надання освітніх послуг регламентують, що вдосконалення освітньо-наукової діяльності повинно відбуватися постійно. Оцінювання освітньої діяльності на предмет забезпечення та вдосконалення якості вищої освіти за освітньою програмою, можливості досягнення заявлених результатів навчання здійснюється добровільно з ініціативи закладу вищої освіти під час акредитації.

Інформаційною основою та ключовими критеріями розробки освітньо-професійної програми безперечно був стандарт вищої освіти за відповідною спеціальністю. Стандарт встановлює сукупність спільних вимог для всіх освітніх програм у межах певного рівня