From Transplant to Harvest: The Hands-Off Farming Revolution - Mobile Gully System

Introduction

The Mobile Gully System (MGS), developed by Hortiplan, Belgium in 1994, is a form of hydroponics cultivation that is labour and space saving. Also known as a moving gully or sliding bench system, it provides an option for efficient and sustainable greenhouse production of leafy greens and herbs.

By utilizing a hydroponic approach, this system eliminates the need for soil, reducing the risk of contamination and improving water use efficiency.

Figure 1 Leafy greens thriving in MGS

Seedling Propagation and Transfer Seedlings can be grown in an Ebb-and-Flow propagation system (Figure 2). Once ready, seedlings are placed into the MGS system.

The MGS System MGS is typically built off a Nutrient Film Technique (NFT) hydroponics system. Narrow long growing gullies/channels are used to hold growing plants and allow nutrient delivery. What is different from conventional NFT hydroponics is that the gullies are mechanically moved as the plants grow, typically from one end of the greenhouse to another.

Nutrient Delivery Nutrient solution is fed into each gully through individual pipes, ensuring even distribution of nutrient solution to every plant (Figure 3). The gullies are typically installed at a gentle gradient to ensure a smooth and continuous flow of nutrient solution by gravity.

Automated Plant Transportation and Spacing These gullies are mounted on a frame that mechanically moves the gullies apart as the plants grow, allowing for optimal spacing and growth conditions. Movement of the gullies could be electronically set at predetermined intervals, speeds, and directions. By the time the gullies reach the harvesting end of the bench, the plants are fully grown and ready for harvest (Figures 3 & 4).

Figure 2 Ebb-and-Flow system (Image from PureHydroponics)

Figure 3 Nutrient solution delivered into individual gully (Image from Hort Americas)

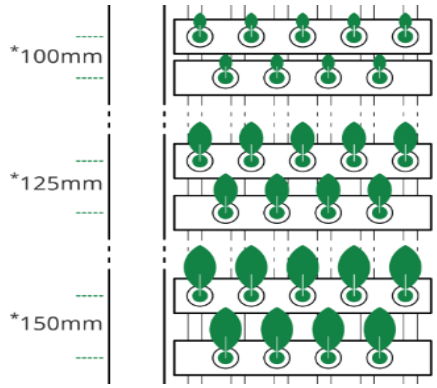

Figure 4 Gullies are spaced further apart as plants grow (Image from Hortiplan)

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Adoption of MGS in Singapore

The MGS was introduced to Singapore's local farming sector 5-6 years ago, and since then, there has been growing interest in its application for leafy vegetable cultivation. Given that labour is a key constraint for farming in Singapore, the MGS's labour saving features have made it particularly attractive. Consequently, some farmers engaged in soil cultivation have also transitioned to hydroponics using the MGS. As of 2024, 11 farms have adopted the MGS system, all under greenhouse; 8 farms are on the ground, while 3 farms are situated on rooftops of buildings.

Figure 5 Harvest-ready crops in MGS

Benefits

Automated Processes and High Labour Efficiency

MGS introduces a "hands-off" approach. Once plants are loaded into the MGS gullies, they will be moved, as they grow, to the place for harvest. Workers do not need to move around to cut and collect the vegetables, as the plants are brought to them. This reduces the need for menial hard labour and make farming work less arduous. As harvesting is centralized in one location, it is also easier to manage in terms of clearing wastes or washing the gullies after harvest. Washing of gullies can also be automated, improving labour efficiency.

Optimum Space Efficiency and Higher Productivity

There is no need to have spacing between gullies for working staff, increasing the area for growing plants by 20-30% compared to conventional NFT system, and thus improving the productivity. Having different plant density at various stages of growth will also result in space savings:

Seedling Stage

Seedlings are at a high density as plants are small e.g. 200 plants per m^2

Vegetative Stage

Maintain a moderate density to allow for plant growth and development while minimizing competition e.g. 100 plants per m^2

Harvest Stage

Enable plants to reach harvest size, to avoid overcrowding e.g. 60 plants per m^2

Challenges

Multiple growth stages within the same system

As all stages of plants exist in the same system, it will be challenging for nutrient and pest management, e.g. cannot provide customization in nutrients for small vs big plants; cannot spray pesticides for pest control on small plants as harvestable plants will be affected.

Energy Consumption

Continuous movement of plants in the MGS can result in significant energy requirements, potentially impacting operational costs and sustainability.

Crop Diversity

The system's design may limit the practicality of maintaining multiple separate nutrient tanks for different vegetable varieties, potentially restricting crop diversity.

Maintenance

Mechanical components need to be well maintained to ensure smooth functioning of the MGS e.g. no vegetable debris trapped between the gully and the conveyance system. It will be challenging to carry out sanitizing of the whole MGS especially to those areas not easily accessible.

While the MGS demonstrates significant potential to revolutionise greenhouse production, it is important to consider both its benefits and challenges. By offering improved efficiency the MGS represents a major advancement in hydroponic cultivation technology for leafy greens and herbs, but careful management is required to mitigate its challenges.

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Potential Yield

Below shows the potential yield of a 1-ha farm growing common leafy vegetables such as lettuces and leafy Asian brassicas in the MGS, using empirical calculations of crop cycles, planting density and weight per plant, and assuming ideal growing conditions (Table 1). The MGS has the potential to produce **335.6 ton/ha/year** of a variety of leafy vegetables.

Table 1 Yield per hectare of MGS farming with 70% planting area*

Planting area (m^2)	Type of Vegetables	Optimal EC	Seedling Stage (days)	Growing period (days)	Maximum no. of crop cycle/ year	Planting density at harvest (plants/m^2)	**Weight per plant (kg)	Yield per year (kg)
2,000	Lettuces (assorted)	1.8	15	24	15	30	0.10	90,000
1,000	Gailan	2.5	12	28	13	40	0.08	41,600
1,000	Chinese cabbage	2.2	12	24	15	40	0.10	60,000
1,000	Xiaobaicai	2.0	12	18	20	60	0.04	48,000
1,000	Caixin	2.0	12	18	20	60	0.04	48,000
1,000	Naibai	2.0	12	18	20	60	0.04	48,000
Total								**335,600**

*Planting area denotes approximately 7,000m2 or 70% utilized for farming out of 1 hectare of land.
**Derived from SFA's R&D growing trials

Addressing Cost Concerns With improved labour and space efficiency, and higher productivity, local produce could be priced more competitively in the market.

Future Prospects and Integration MGS represents just the initial step in our exploration of high-productivity, cost-effective farming technology. By integrating MGS with well-established scientific findings on other innovative advancements, this approach has the potential to revolutionise local agriculture, enhancing both productivity and food security.

Find out more!

Local farms can tap on the Agri-Cluster Transformation (ACT) Fund with the enhanced Energy Efficiency Programme (EEP) to build capabilities and capacities that drive higher productivity in a sustainable and resource-efficient manner. Farms can tap on co-funding under the EEP to undergo an energy efficiency audit which would establish their baseline energy consumption and identify potential areas for improvements. Farms can also leverage the enhanced Capability Upgrading component to adopt resource and energy-efficient equipment and technologies from SFA's prequalified list. All licensed farms can apply for co-funding under the EEP.

Let us know your thoughts

About the Author
Leong Weng Hoy is from the Agri-Technology and Food Innovation Department of the Urban Food Solutions Division with over 40 years of experience as a farm extension specialist. Throughout his career, he has provided numerous farm solutions, encompassing technical innovations, knowledge sharing, and expert advice.

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