

Simplified Hydroponics as an Appropriate Technology to Implement Food Security in Urban Agriculture.¹

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1) Urban Agriculture.

Planting in cities is becoming increasingly popular as a result of demographic growth and because it is a source, not only for food but also of jobs, providing city dwellers with an income. This situation, however, gives rise to much concern. Despite the fact that Urban Agriculture is a suitable solution for dwellers of urban areas and the urban periphery, these people live in places where facilities, community infrastructure and other services that ensure a proper quality of life are usually absent.

Cultivation techniques applied in these cases, include the growing of fruits and vegetables based on the traditional model of soil agriculture (organic), where it is possible to make the most of household waste as well as the manure of domestically raised animals. This apparent advantage of organic crops, stemming from the use of household waste and the resulting decrease in its volume, is nevertheless one of the main health hazards for the people who consume this produce, and constitutes the greatest double-edged sword of the model. Since urban soil and the inputs applied for fertilization purposes are the main source of diseases, this gives rise to a major flaw in the food safety of the end product.

Organic soil agriculture, when used in a rural environment, presents significant advantages and a relatively low pollution risk when planting takes place in conformity with certain standards. However, if it is transferred to an urban environment, the situation changes considerably due to the conditions under which the crops are produced.

Conventional crop sown on soil require the proper environment, so one must take into account the quality of the soil and water on which they rely, as plants absorb any existing pollution. The main soil and water disorders observed in most cities are the following:

- a) **Soils** : the soils of urban areas and of the urban periphery are contaminated to a large degree, especially in those areas where the population is disadvantaged socio-economically. Once the soil has been contaminated, it shall remain polluted for many years.
 - Wastewaters from cesspools, which overflow or have overflowed in the past, leave their microbial load in the land and can even contaminate the crops grown there.
 - Soils containing heavy metals (lead, chromium, cadmium, etc.). This is most common in the presence of polluting industries that use these metals, and, in the case of lead, it can also be the residue of car batteries lain to waste on the spot for several years. But there are other contaminants, which are easily overlooked, such as, emissions from motor vehicles

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burning gasoline with lead, and flaking paint from the walls of houses which peels off and falls to the ground where it stays for many years. That is why some environmental scientists advise against planting adjacent to homes, highways and roads, since the plants adsorb these toxic elements and transfer them to the crops that the family consumes, with serious health consequences, especially in the case of children. (Raloff, Janet 2003).

- Landfill soils, where garbage or materials of unknown history have been dumped, on which people later settle, with their dwellings and grown crops.
- b) **Water:** this is another constraint in the urban milieu, since the areas where these low-income dwellers are located do not have easy access to drinking water and sewerage (Figure No. 1). The ground and surface water sources there may be considered low quality because of the high contamination levels of the following:
- Bacteria, protozoa and virus, because the water sources are near cesspools, sanitary landfills, and increasingly so in the absence of a sewerage network, all of which is coupled with high population density.
 - Excess of nitrates: as a result of over fertilization of farmland which reaches the urban environment through the water tables and impinges on the ground water. Additionally, there are fertilizers used in residential gardens, etc.
 - Pesticides : as a result of their use in farming.
 - Toxic chemicals: as a result of industrial residue (fats, soaps, detergents, solvents, tanning chemicals, heavy metals, etc.) and farming wastes (pesticides).



Figure N° 1. View of a settlement in the urban periphery of Latin America, adjacent to contaminated water sources.

Ideally, programs implemented by international and government agencies and non-government organizations should take into account *Good Agricultural Practices (GAP)*, when contemplating planting in soil in cities. Several tests should be carried out on the soil and water sources, and appropriate pollution management practices applied. Manure and solid organic wastes are harmless and they are effective fertilizer, but **only when properly treated**. (Guide to reduce Microbial Hazard

in Food to a Minimum, in the case of Fresh Fruit and Vegetables, Food and Drug Administration USA. 1998). Such programs should also include other measures, such as educating the population on how to achieve a safe end product. Nevertheless, as a result of the dizzy development pace of cities, soil and especially water are subject to environmental factors which are extremely dynamic, which facilitate pollution, dispersion and over time compromise the continuity of efforts geared to controlling factors that guarantee food security.

2) Food Security.

According to the Rome Declaration on World Food Security and World Food Summit Plan of Action". (Rome, FAO1996): food security, *exists when all people, at all times, have physical and affordable access to sufficient, safe and nutritious food to meet their dietary needs enabling them to lead a healthy and active life.*

Even when a country has sufficient food at national level, foodstuffs must be equitably distributed, they must be of good nutritional quality and people must be able to afford them. Foodstuffs must also be safe. According to the Pan American Health Organization (PAHO), safe foodstuffs are those which are fit for human consumption, nutritional and pleasant and that do not harm consumers.

At the World Food Summit held in Rome (1996), Governments promised to strive to cut by half the number of people who did not have access to food security conditions by 2015. Before 1996, there were 817 million people in developing countries. At the beginning, national policies were successful, the malnourished population initially dropped to 778 million in 1997 and then rose to 798 million in 1999-2001 (FAO – The State of Food Insecurity in the World, SOFI 2003).

This stated goal will be very difficult to achieve unless food security in cities is given the priority it deserves. The perception in the early 21st Century is that urbanization will continue and increase. According to the UN Food and Agriculture Organization (FAO), on average 50% of the world's population live in cities, ranging from 22% in China to 72% in Latin America.

2.1) Food Security and its relationship with water quality, disease and malnutrition.

Apart from the quality of water for irrigation purposes, in the context of water quality, disease and malnutrition, it is important to consider water used to wash fruit and vegetables for personal consumption. The poor quality of water used by urban populations without basic utilities in place, contributes to the likelihood of a high degree of contamination being present in the produce grown and washed under such conditions, i.e. **it is not safe for human consumption.** (Guide to reduce Microbial Hazard in Food to a Minimum, in the case of Fresh Fruit and Vegetables. Food and Drug Administration USA. 1998).

In a social and environmental context, urban pollution, coupled with the scarce availability of safe foodstuffs, is directly linked to the existence of the so-called water-borne gastro-intestinal diseases (hepatitis, diarrhoeas, parasites with mites and pinworms, leptospirosis), which are a recurrent problem in populations where basic needs are unfulfilled, especially among children. *Diarrhoea, for instance, is one of the five leading causes of death worldwide in children under 5 years of age.* (Stineke Oenema, FAO/RLC 2001)

Gastro-intestinal diseases reduce the nutrient adsorption efficiency in humans, causing malnutrition, which in turn minimizes a person's immune defenses, facilitating re-infection or diminishing personal development.

3) Simplified Hydroponics (SH).

Simplified Hydroponics which was developed in Latin America, is a suitable technological package that can be easily adapted to the conditions of urban areas and the urban periphery, in the following ways:

- Firstly, the production system is isolated from the soil. Planting takes place at a convenient height, where soil pollution has no impact. It allows for vegetables to be produced “without land” and in small physical spaces. Plants are grown in water containers or in low-cost natural substrates (sand, rice husk, pumice, etc.). With this system, it is possible to grow a vast range of vegetables, for example, lettuce, tomatoes, carrots, celery, watercress (Figure No. 2), eggplants, beans, parsley, wild radish, leeks, strawberries, melons, aromatic and medicinal plants, etc.
- Use of limited space. One of its main advantages of Simplified Hydroponics is the possibility of using urban spaces which until now had not been considered adequate for growing food (*patios*, small gardens, party walls, balconies, rooftops) (Figure No. 4).
- Use of hanging pipes - as an option, fruit and vegetables can be grown in these, thus optimizing space, passing from using m^2 to m^3 (Figure No. 3).
- High efficiency in the use of irrigation water, where water is recycled and does not pollute the environment (Figure No. 3).
- Pest, disease and weed control. Simplified Hydroponics facilitates the adoption of Integrated Pest Management (IPM) programs. There is also a significant reduction in the use of chemicals once used to control pests and weeds. Moreover, neither the produce nor the environment are contaminated by chemicals (Figure No. 4).
- Higher yields and shorter times between harvest. Hence, total output is greater than the case of conventional soil systems.
- Easy to learn – the technique is easy to understand, it does not require prior knowledge and concrete results are achieved quickly.
- Simplified Hydroponics is not highly technological and requires only household labour, generally supplied by women (Figures No. 4 and 5).
- Use of recycled materials – it is possible to use recycled materials to build growing systems. Subsequently, growers can use materials they already have on hand, e.g. wood, disposable packaging materials (Figure No. 4 and 5).
- Simplified Hydroponics is a source of income from direct sales, and in family or community owned micro-enterprises.
- In simple terms, it is possible to grow high quality, safe foodstuffs using Simplified Hydroponics techniques. Fruit and vegetables have a high biological and dietary value. Crops for household consumption are harvested when they are ready to be used. Hence, produce is fresh and has its nutritional and medicinal properties intact (vitamins, minerals, phyto-nutrients, etc). As a result of these benefits, the technique is being promoted by FAO/RLC, as part of its Urban Agriculture strategy, for the production of vegetables in limited spaces in urban and peri-urban areas (Popular Hydroponics Gardens by J. Izquierdo – FAO/RLC, 1994) and (PH&G No. 71).

In order to achieve maximum quality, the availability of good potable water is essential. This drinking water may come from the municipal tap water system, it may be clean rainwater, or it may be filtered and chlorinated. To a large extent, this is made easier because of the low water volume requirements needed for Simplified Hydroponics.



Figure N° 2. Safe watercress and lettuce grown in plastic boxes, grown at a convenient height above the ground.



Figure N° 3. Strawberries grown in upright plastic and PVC pipes, with a home-made irrigation system, recycling the water and nutrients.



Figure N° 4. Small family greenhouse (10 m²) in the backyard of a house, using different SH techniques made of simple materials, making the most of the party wall and with yellow traps to catch insects (IPM).



Figure N° 5. View of a family hydroponics vegetable garden in the back yard of the house, with upright pipes. This garden is under the leadership of a woman.

Currently, the use of Simplified Hydroponics technology is not widespread. Among the factors that account for this are the following:

- * Scarce dissemination of information concerning the benefits of the technology.
- * Constraints regarding the availability of trained technicians with a working knowledge of SH and who produce the nutrient solution locally and at a low cost.
- * Prevalence of the organic agriculture paradigm, where fertilizers are seen as toxic.

It would be valuable for SH programs of this nature to be implemented by governments, municipalities, non-government organizations and International Agencies. Such programs could train more technicians to teach Simplified Hydroponics and provide easier access for nutrients solutions. To ensure food safety to the end consumer, there needs to be a plan from seed to plate. Such a plan needs to look at familiar cost-effective rainwater catchment systems and/or water purification using chlorine and simple filters. It is also necessary to continue researching more options that can be adapted to this urban environment.

Fortunately, successful experiences with SH are available, applied to urban populations with low income populations. These programs started as a result of private and government initiatives, including international programs. These organizations have found that Simplified Hydroponics is a good alternative for producing safer urban crops and they have committed themselves to long-term results.

Conclusion :

Low-cost Simplified Hydroponics should be encouraged as one of the basic tools for Urban Agriculture worldwide, where it can be adapted to conditions in urban and peri-urban areas to enhance food security.

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