Meeting the Challenges of the Future with Sustainable Home and Community Gardening Using GROW BIOINTENSIVE Techniques

A summary of the global situation and the potential for GROW BIOINTENSIVE to help communities empower themselves towards localization, resilience and sustainability

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Preface- A Perfect Storm

A perfect storm is a rare event- it occurs when a number of factors come together at once, releasing a tremendous amount of energy. Today, we are facing a multitude of challenges converging at once and on a global scale. Never before have we been in this position- surely as a species we have experienced perfect storms in the past- but as far as we know, there have never been so many people accelerating so quickly towards a tipping point.

A perfect storm is the result of environmental conditions, it doesn't arise on its' own. In this storm the conditions set are social, cultural, technological, political, ecological and above all, personal. The conditions can change at any minute- we actually have the power to alter the course of this approaching storm. We can harness its destructive energy and channel it into creative force. The decision is ours, the storm is approaching.

In Nature, after disturbance opportunity arises and life reorganizes. For example, when a fire burns through a prairie or forest causing a state-change within an ecosystem, seeds once dormant and forgotten germinate and emerge. New expressions of life fill ecological niches and fast spreading plants grab ahold of the soil. Birds, insects and animals which fled the fire return- wildflowers explode into color and fragrance. The energy once held tight in the system is released into a new order and a profusion of beauty takes over.

The perfect storm which is about to shake the foundation of our current systems is in fact the opportunity we need to create the world anew and reinvigorate humanity with a sense of shared interest in the outcome. In this moment we share the great responsibility as a human species to create a new culture- one which embraces the conservation of our resources, the preservation of the wild diversity of our planet and the restoration of our reverence for life. We cannot afford to sit back idly and wait for someone to "fix" our situation for us- we must meet these challenges in our communities with creative and appropriate action. We must take control of our futures.

A friend of mine once told me that to change the course of a river takes great effort. Or, one can alter its entire course by simply placing their finger at the source. I believe that the source of our problems is in the loss of a wholistic sense of who we are. The dominant colonial and imperialistic cultures represent that aspect of ourselves which rationalizes and separates the world of matter to better understand how to manipulate it. The peaceful and creative part of ourselves sees the wholeness of spirit and that which is indigenous in Nature. We must reconcile these two potentials and learn to engage both aspects of ourselves and work together to ensure that everyone has enough, including Nature.

Now is not the time to sit back and wait for the world to happen. It is not the time to carry on as we have been. It is the time to do what is right and appropriate. It is a very special moment to be alive…

I have serious hope. My mentor and friend John Jeavon's is fond of saying "*feed your dreams and your fears will starve.*" The work ahead is about following our dreams, listening to our hearts and boldly stepping into the future to meet each day. That day can be right now. In this very moment the decision can be made within ourselves to take a stand for justice, equality and peace. In each moment is the seed-potential to redefine ourselves and how we relate to the world. We can forgive the past and move forward because we are running out of time. We can create a new future right now, where life of all forms is respected as one, indivisible and sacred.

However, this future will not come easy- it will take courage. History shows that in times of systemic stress, those most invested will in their fear seek to divide us and manipulate us into war. We have to build a peaceful, equitable and sustainable future in ourselves and with our neighbors of all ethnicities and backgrounds- and with our living planet as well. We have to cultivate that resolute sense of peace within ourselves so that we can stand strong and united.

Buckminster Fuller once said- *"You do not change the world by fighting the existing reality- you create a new reality that makes the old reality obsolete."* I hope that you find the beautiful simplicity in this one solution offered in this book. I hope that you see what is possible in your own backyard when you reconnect yourself and realize the abundance you can create for yourself, your family, and your community. This booklet is about personal empowerment through doing the work, cultivating the soil and cultivating ones' self. I hope that you harvest well, and eat great and share love and laughter

at the table and in the garden. I hope that you find peace and happiness as you walk through the timeless sacred forests and prairies of our ancestors and children. I hope that we can navigate through this storm together and become stronger and more determined to bring peace into the world. *The future is ours.*

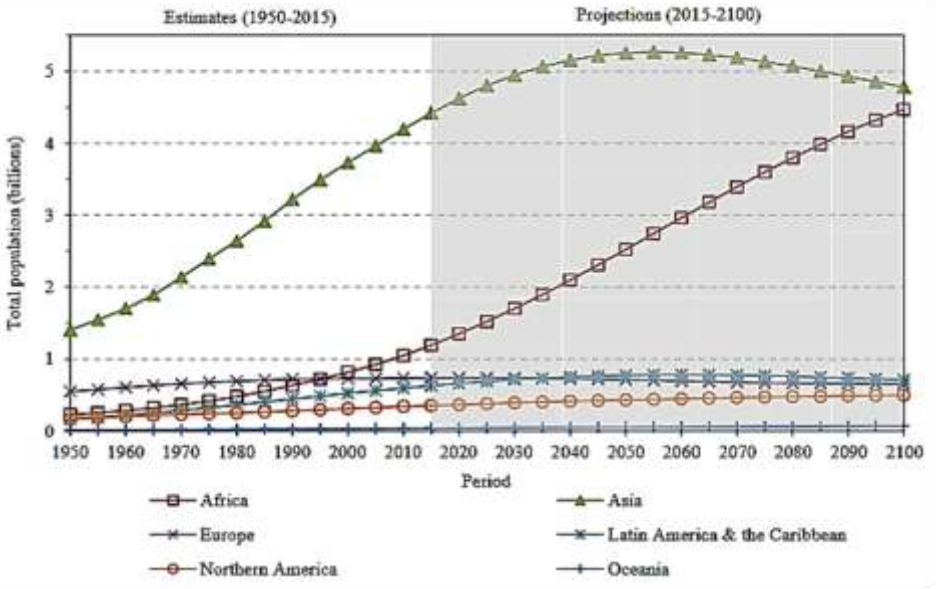
The world needs a drastic reduction in resource use, a microscaling of the human footprint, and a massive restoration and conservation effort in order to stabilize a rapidly evolving situation. The sooner we turn the ship around, the greater the likelihood that peace will be maintained. History has shown that the competition for resources, especially amidst stresses amongst populations leads to desperate attempts of forceful action. The threat of war poses a rapid force-multiplier to this perfect storm- a storm which we need to approach with cooperation as a united, global effort to solve this great challenge. In fact, this challenge could be something that unites us all, and should be celebrated.

Agriculture is the act of subsistence off of our planet and its resources- it is how we nourish ourselves. It is also a leading contributor to greenhouse gases, uses a tremendous amount of resources, and is the leading factor leading to the loss of ecosystems, habitat and species. The GROW BIOINTENSIVE Method demonstrates that micro-scaling our agricultural footprint has the potential to contribute greatly in solving this great challenge. What follows is a brief summary of the challenges which create this *perfect storm*.

Population

As of 2018, there are over 7.6 billion people on Earth. There is a net increase of around 200,000 people added to the Earth daily and UN states that by 2050, we can expect 9-10 billion human beings to be inhabiting our planet Earth.[3] Each year over 130 million children are born on Planet Earth. Accounting for total deaths, this puts our annual global population increase at 83 million per year- and the growth rate is rising.[4]

Table 1: Population by region: estimates, 1950-2015, and medium-variant projection, 2015-2100[4]



Solution: Small-Scale food raising using the GROW BIOINTENSIVE Method feeds more people using less resource meaning there is enough for everyone and frees up agricultural land to be restored to natural ecosystems.

Soil Loss and Desertification

Depending on our environment it can take anywhere from 500-2000 years to build an inch of topsoil. For the 6" of topsoil we rely upon, this can take upwards of 3,000-12,000 years. The UN states that 30,000,000 acres of topsoil are lost each year.[8] Mechanized agriculture is destroying our soil base 18x faster than it is replenishing it[2]- some estimates put this at 40x.[9] It is widely accepted that we have lost 50% of our soil organic matter (SOM) in the last 200 years. In 2015, the UN reported that *at current rates of soil loss* the world has less than 60 years of top soil remaining and almost half of the world's soils are degraded.[9] Even in organics, the vast majority of fertility is imported- some estimates ranging from 60-

84%. This fertility is robbed from other soils and ecosystems and is not being used sustainably. The UN states that over 44% of our farmlands are in arid or dryland regions and are at high-risk of desertification.[9]

Solution: The GROW BIOINTENSIVE Method grows soil 60x faster than occurs naturally, has the potential to reclaim desertified land, microscales the agricultural footprint allowing for ecosystems to be conserved and soils healed without continued abuse.

Food

The UNFAO states that in order to meet the nutritional needs of the 9-10 billion individuals expected by 2050, our farms need to increase their production by 70%.[5] Each year, an additional 19,600 sq. miles of farmable land are needed to feed our growing populations and it is not happening. Right now, 1 in 9 people, or around 800 million individuals do not have enough food.[6] 80% of the world's hungry live in rural areas and most of them are farmers or farm-workers and many of them women.[7] Only 3% of food produced is available to low-income families who represent a majority of the population.[8]

Solution: The GROW BIOINTENSIVE Method increases yields sustainably. The 10-Bed Design presented in this book will demonstrates how over 40 people can be fed in the area it takes to raise an average American diet grown with conventional technologies.

Water

Currently, about 1/3 of the world's population is living under water stress. By 2025, the UN predicts that 1.8 billion people will be living in absolute water stress and almost ½ of the world's population will be living under high water stress.[11] The average Californian uses about 1500 gallons of water per day, about half of which goes towards raising food in the form of meat and dairy.[12] In fact, most of our water use- around 530-1320 gallons per day- is used for growing food.[11] One hamburger requires around 600 gallons of water to grow, one pound of beef around 2500 gallons and one pound of cheese takes roughly 900 gallons of water to produce.[13] Agriculture accounts for 80-90% of all water consumption in the U.S.[13]

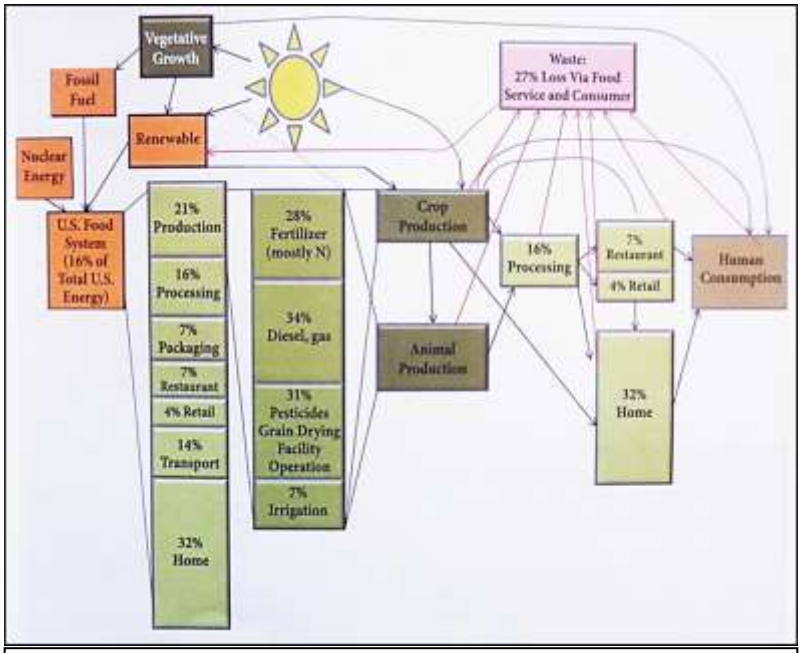
Solution: On average, GB methods uses 33% of the water per pound of grain and 12% of the water per pound of vegetable produced compared to conventional methods. With close-plant spacing, carbon farming, composting, good crop selection and rotations a smaller dietary footprint can be achieved which requires even less water. The 10-Bed (1,000 sqft) complete and sustainable diet design grown in a 6-month growing season with the GB Method uses around 2% of the water resources as the average American diet[14]. This same diet grown with the GB Method in the tropics, requires around 1% of the water resource due to the 12-month growing season.

Energy

From 1860-1991, our population increased 4x but our energy use increased 93x.[19] In 2007 the United States used 100 quadrillion BTU's of energy- the equivalent of 170 million barrels of oil or 17.5% of our total energy resources.[20] There have been several studies initiated to look into how much energy it takes to produce our food and most estimates range from 7-13 calories invested to produce 1 calorie of food.[20,21] Perhaps even more shocking was an analysis of a 180-member CSA farm in Kentucky which required 40 calories to produce 1 calorie of food.[19]

A roto-tiller, as an example, has around 2,000,000 calories of embodied energy and runs on gasoline which contains around 35,000 calories in a gallon. A garden spade is manufactured using around 63x less energy, doesn't require gasoline or spare parts, and can last a long time if properly cared for.[22] A lifetime of growing one's own food requires 65x more embodied energy using drip tape, than it would using a rubber hose.[19] Multiply that out over the current 7.6 billion people on the planet and it's enough drip tape to wrap the Earth at the equator 9,000,000 times in plastic![22]

A 6-mile round trip drive to the grocery store burns around 7,500 calories of energy- about 3x than the dozen eggs, loaf of bread and 1/2 gallon of milk you might have just picked up.[19] For each calorie of strawberry consumed in New York city, it took 435 calories to produce, transport and refridgerate.[19] In 2008, when the economic collapse hit the global economy, the cost of nitrogen fertilizer increased 32%, phosphate 93% and potassium 100%.[23] Our economy is so tied into the fossil fuel industry that when one sector takes a hit, the other falls too. The fertilizer price volatility was a major factor in the 45% increase in global food prices in the 9 months following the 2008 crash.[24] As populations increase and resource availability decreases in the midst of climate change, we can expect more economic volatility which threatens social instability and food security.



From Steve Moore's *Energy Use in Biointensive Food Production.* Ecology Action, 2013.

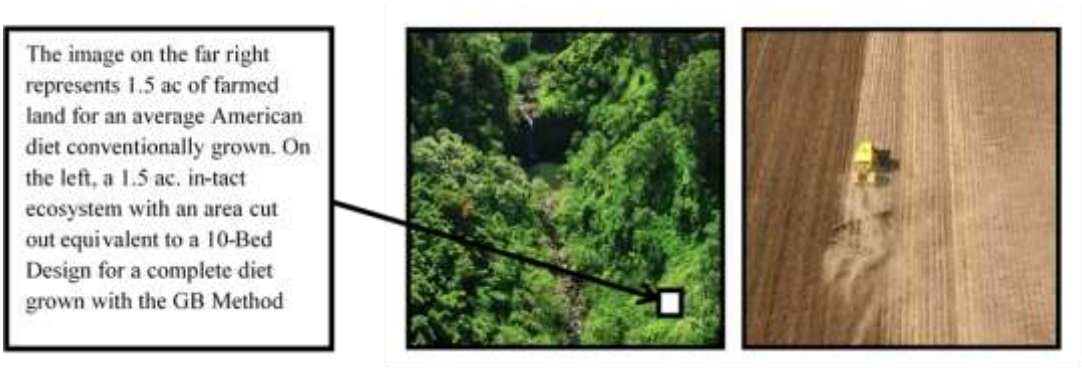
GROW BIOINTENSIVE techniques require about 99% less energy on average, than conventional mechanized agriculture. Food grown in your backyard or community garden requires no energy to transport, no fossil fuels to produce, and requires only the energy of the sun.

Ecology

One acre of rainforest is destroyed each second, with only 40 years remaining until completely lost. These forests are the lungs of the Earth and regulate hydrologic and atmospheric cycles.[25] As of 2010, agriculture covered 38% of the Earth's surface.[26] In 1700, only 7% of the Earth's surface was being used for agriculture.[27] Each year, over 12 million more acres of farmable soil are needed to feed the growing population and each year we lose 30 million acres of soil.[28]

Globally, 95,000 sq. miles of ocean have been destroyed from hypoxia resulting from excessive soil and nitrogen run-off in our watersheds and into the ocean. This number has been doubling with each passing decade.[29] In addition, ocean acidification caused by the increase in atmospheric CO_2 is expected to collapse our fisheries first and then the entire ocean foodweb within the next few decades.[30]

Our glaciers and permafrost are also melting rapidly- many estimates say that by 2050, there will be no more permafrost. Thawing permafrost releases even more methane, carbon dioxide and other atmospheric gases into the atmosphere, further accelerating a changing climate. As our northern and southern poles continue to melt, sea levels will rise, our coastal cities will be at risk of being submerged, and populations forced to migrate.



Sources state an average American diet requires an average of 1-3 acres. With GROW BIOINTENSIVE techniques we can take that median of 1.5 acres of land (65,340 sqft) that it takes to raise an average American diet and grow all of our food in 1,000 sqft- allowing the remaining 99% of the land (64,340 sqft) to be preserved as functioning ecosystem. Ecosystems are self-regulating and help stabilize climates, hydrological cycles and carbon cycles.

Climate Change

Many estimates place the total contribution of greenhouse gases from agriculture to be around 15-24% annually.[34] However, these statistics do not look at the *historic loss of soil organic matter* through over-tillage and exploitation. In 2012, William Brinton from the University of Maine investigated this and concluded the following[35]:

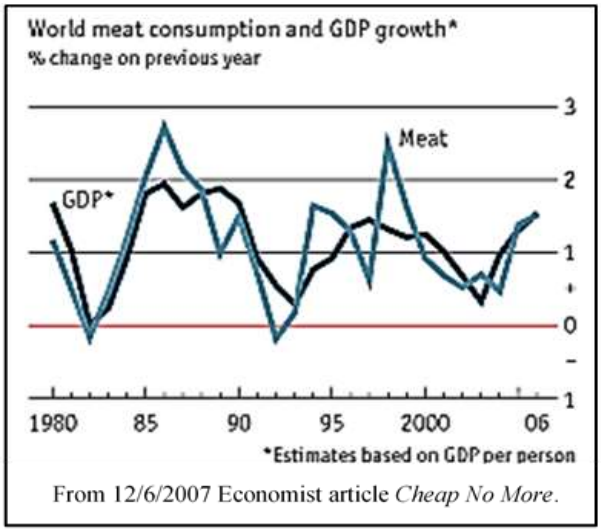
- Today we have 1,680gT (gigatons- 1 billion metric tons) of SOM remaining
- We've lost 50% of our SOM in 100 years to the atmosphere through excess tillage
- 100 years ago, we had 2,500gT of SOM. In 100 years, we've lost 820gT of SOM
- Total fossil fuel industrial contributions are 5.5gT/year. Agriculture has contributed 8.2gT/year over the last 100 years.

This number does not factor in the conversion of forests to agricultural land which scientists estimate is responsible for an addition 10-20% of all manmade carbon dioxide emissions.[36] Animal agriculture can fix carbon in a holistically managed system. Although switching all grazing lands over to this system may fix 16 gigatons of carbon, it releases 10 gigatons of methane which is a gas 20-89x more potent than carbon dioxide as a greenhouse gas.

Microscaling agriculture sustainably is an important first step. The GROW BIOINTENSIVE Method helps decrease the impact of agriculture on a changing climate, helps stabilize local economies and food availability and actually can reverse the trend of climate change through growing carbon crops and composting them to fix atmospheric carbon into the soil. By microscaling our agricultural footprint, reforesting our denuded agricultural landscapes and preserving more of our land for natural ecosystems we can make significant steps towards addressing the issue. And perhaps most importantly- the GROW BIOINTENSIVE Method has the potential to activate and empower individuals in all soils and climates to take a powerful and direct form of action that turns us all into the solution- and it's done through growing a beautiful garden that nourishes life.

Economy, Consumption and Agricultural Footprint

China has one of the fastest growing economies in the world and represents around 20% of the world's population. The UNFAO reports that in the 20-year period from 1989 to 2009 the caloric intake of Chinese citizens increased from 1800 to 3000 calories per day on average. During that time, the meat and dairy portion of Chinese diets increased from 11.7% to 22.9% of total calories consumed.[38]

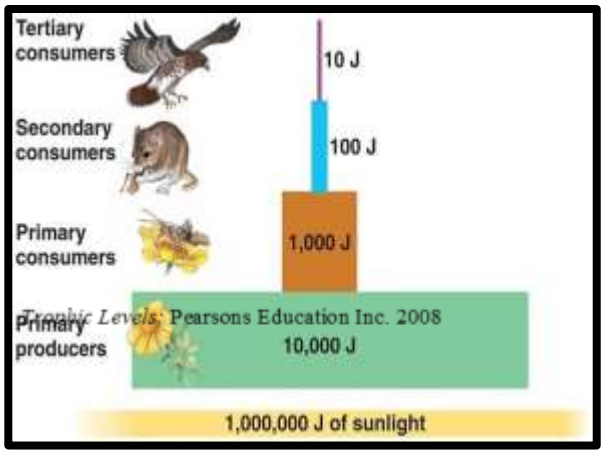


From 12/6/2007 Economist article *Cheap No More*.

The United States represents less than 5% of the world's population yet consumes over 30% of its resources and produces 30% of its waste. Today Americans consume 2x more than they did 50 years ago.[39]

It takes 13-20 lbs of grain to produce a lb of beef- that's 19,500-30,000 calories of grain to produce 871 calories of beef. Human beings need around 2,000 calories per day. So another way to look at the above figure is that it can take 8-12.5 day's worth of plant-based calories to produce 8 hours' worth of calories in the form of a steak for human consumption.

An article in the Independent from January 31, 2016 cited that 40 million tons of food are required to end world hunger and that 20x that amount is fed to animals for meat and dairy each year.



Trophic Levels: Pearsons Education Inc. 2008

For each step up in the trophic levels (ex. cow to human) there is a 90% loss of energy. In other words, the cow is only to utilize 10% of the energy available in the plants it eats, and humans can only then utilize 10% of the energy (calories) from the cow. This loss of energy is why food chains typically only go on for 3-4 links before reaching apex predators. In other words, it is a more efficient utilization of sunlight to become a primary consumer.

A New York Times article from January 27, 2008 titled *Livestock's High-Energy Costs* compared a meal of a 6 oz steak to an equivalent plant-based meal of vegetables and rice (1 cup broccoli, 1 cup eggplant and 8 oz of rice) and demonstrated the following: The 6 oz steak required 16x more fossil fuel energy to produce and generated 24x the carbon emissions of the vegetable dish. Globally, livestock generate 1-2 million tons of Nitrous Oxide (N_2O) yearly- N_2O is 296x more destructive than CO_2. In a paper titled "The Energy of Food" published by Stanford University on November 9, 2015 the following figures were given:

- Per gram of protein, ruminants produce 250x the greenhouse emissions than plants.
- A cow burps 117 lbs of Methane (CH_4) per year- CH_4 is 20-89x more potent than CO_2.
- 1kg of protein produced from kidney beans requires 18x less land, 10x less water, 9x less fuel, 12x less fertilizer, and 10x less fertilizer than 1kg of protein produced from beef.

Diet and Land Area Requirements	Land Area Requirements	Efficiency Index
Conventionally grown American Diet	100,000 sqft	1x
Conventionally grown Diet (1/2 Animal Product Consumed)	70,000 sqft	1.4x
Conventionally grown Vegan Diet	7,000 sqft	14x
Biointensively Grown 10-Bed Unit	1,000 sqft	100x

Lowering consumption of animal products or going vegan all together is an important step towards minimizing resource consumption. With GROW BIOINTENSIVE techniques more food can be produced, more efficiently, and with greater yields than conventional systems. By becoming producers rather than consumers we can transform our world into one of abundance and work together to stabilize economies, ecologies and the climate.

The GROW BIOINTENSIVE Method

The GROW BIOINTENSIVE® (GB) Method uses simple low-tech and accessible agricultural techniques based on a *best-practices* approach to food production derived from millennia of agricultural development from various cultures around the world. The goal behind biointensive is to create an agricultural system which holistically addresses the challenges created by our current agricultural system and in a way that nurtures healthy soil, produces high yields and reduces the agricultural footprint from our ecosystems. These 8 basic principles are the foundation of a scalable, highly productive future for agriculture:

1. *Deep Soil Preparation*: Creating a healthy soil ecosystem 2' deep to encourage conservation and cycling of nutrients, water, carbon and life.
2. *Composting*: Giving back to the soil so that nutrients and humus are retained.
3. *Intensive Planting*: Maximizing production and efficiency while creating a living mulch to protect the soil microclimate.
4. *Companion Planting*: Encouraging diverse living relationships- increasing resilience.
5. *Carbon Farming*: Growing plants efficient at fixing atmospheric carbon dioxide and then stabilizing this carbon into the soil through proper composting.
6. *Calorie Farming*: Selecting crops to maximize calories grown per unit of space and time.
7. *Seed Saving of Open-Pollinated Seeds*: Developing and saving varieties that are otherwise rare and unique to local growing conditions while promoting healthy seed.
8. *A Whole Systems Perspective*: Understanding the garden as an organism and using these principles in harmony so that sustainability can be achieved and maintained.

Ecology Action has demonstrated that with the GB Method, farmers can grow food while using:

- 67-88% less water than in conventional agriculture
- 50-100% less purchased fertilizer
- 99% less energy

And in addition:

- Produce 2-6x the yield of conventional agriculture
- Grow soil sustainably up to 60x faster than normally occurs
- Reduce the agricultural footprint 50% or more, leaving more land for functioning ecosystems.

For more information on the GB Method, visit www.grobiointensive.org Also, see *Biointensive Sustainable Mini-Farming* in the Journal of Sustainable Agriculture[2] or read How to Grow More Vegetables by John Jeavons.

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