"GROW BIOINTENSIVE® CLOSED-LOOP" SUSTAINABILITY PROTOCOL

Give back to Nature more than you take and she will provide for you abundantly!
– Alan Chadwick

Full Closed-Loop Sustainability is the umbrella
under which food and crop growing practices need to be used.

Whole Systems Perspective
It's imperative to view the world as an interrelated whole, in which each action and component affects the balance of the whole. When this concept is accepted, we can discover the *root causes* which allow us to address *symptoms* more holistically.

The Protocol's Goal
Sustainability in the GROW BIOINTENSIVE (GB) system comes from the soil. Achieving this requires maintaining closed-looping sustainability over the years, and relies on practicing, understanding and internalizing the GB procedures that *make* sustainability possible.

This protocol is written for people who have advanced through the beginning stages of GB and are using it to create successful gardens and/or are teaching the method to other people through projects and programs. The goal is to remind practitioners of the procedures required to *create and keep* GB sustainable. It might be thought of as a personal teacher helping guide the practitioner's steps.

The Challenge
The most pressing and ongoing challenge to the GB system is its potential for dilution, even among the well-trained and skilled. GB has been spreading globally so quickly in many places that it can be difficult to have enough oversight to maintain *quality assurance*. The following are the most common areas of *deviation* from a sustainable GB system:

- Relying on more than 1/6 by volume of cured animal manure in building compost. Optimally, none should be used. (See "GROW BIOINTENSIVE Sustainable Mini-Farming: Sustainable Application of Composted Vegetable Matter and Organic Fertilizers," Ecology Action, Revised 2008, in Appendix.)
- Not following the 60/30/10 system of crop-type selection by percentages per unit of area and time. See p. 39, *HTGMV*/2017, p.39. (50/40/10 in the tropics)
- Growing more than 1% to 10% of the total cultivated area in income crops for market.
- Burning off or feeding animals potential compost materials
- Not using open-pollinated seeds

Part of the challenge is that beginning practitioners often do not have adequate land and/or other needed materials to completely follow the GB method. In that situation it can be easy for the practitioner to stay stuck in an unsustainable system. What is necessary is creating a plan *at the very beginning* for *progressing* towards full closed-loop sustainability *within 5 years or less*.

To estimate your level of sustainability, see:
http://www.growbiointensive.org/PDF/Steps_GB_Sust_Checklist_V2.pdf

Principles Which Should Not Change

Animal Manure

If animal manure needs to be used, it should not be more than 1/6th by volume of the *built* compost pile. Much manure contains little nitrogen when it originally contained a large amount of sawdust or straw, which demands nitrogen itself to be broken down. It can also contain excess salt and imbalanced ratios of nitrogen, phosphorus and potassium, which at times result in less than optimal plant growth, which makes the plants more susceptible to disease and insect attack. Beginning biointensivists may need to use more manure to give their garden a quick start, but it is not a good ingredient for *ongoing* sustainability. Compost, particularly compost made with the suggested percentage of ingredients from your own GB garden, will better serve the soil and you.

60/30/10 and Marketing Crops

60% of the growing area in temperate regions should be in carbon and calorie crops (50% in tropical regions) that produce large amounts of carbon for compost, and that, at the same time, produce significant amounts of calories in the form of food. 30% should be grown in special root crops, such as potatoes, sweet potatoes and leeks (see p.40 of HTGMV/2017) that produce large amounts of calories in a limited space, and 10% in vegetable crops for additional vitamins, minerals and income crops. To maintain sustainability, only 50% of the *vegetable crops area* may be used for income crops. Because of the difference in climate and growing seasons, the percentages in tropical regions will be closer to 50/30/20.

It is vital to progress towards these percentages to maintain the health of the soil and of the farmer. It can appear to be difficult in the beginning — when people may be learning to grow and eat different kinds of food from what they're used to — to attain this division of crop land. It can also be a difficult idea to limit the amount of food grown to sell, since most farmers understandably need their income. But as in any learning situation, determination to work through the difficulties, and keeping a vision of the goal, are what lead to success. And, ultimately, *with good crop selections,* a good income can be earned in a small area.

Potential Compost Materials

Burning off crop residue has been a cultural practice in many regions of the world, and it may be difficult for some GB practitioners to change this tradition easily to create a new sustainable path. To overcome that hesitation, it might be useful to view those compost materials as a field of ‘gold', which composted will lead to even more richness for the soil and the farmer. That practice will be validated in future years with crops that are greener, healthier and higher-yielding than before. (And neighbors will then ask to learn the GB system.)

It may be even more difficult to stop raising animals and instead use the entire harvest residue for compost materials. This can involve giving up a long-term relationship with the animals, as well as—again—breaking with tradition. However, , after learning more in depth about GB, an Ecology Action colleague from Kenya told John Jeavons he had finally made the connection concerning why his family's soil had become much less productive in just a *generation*. It's up to each practitioner to make the decisions that will lead to the kind of production s/he wants to achieve for his family, children and grandchildren.

Open-Pollinated Seeds

Open-pollinated seeds have stood the test of time. Many have been used for a century or more and have been passed from generation to generation because of their health, vigor, insect and disease resistance, and for the beautiful color and taste of their edible portions. A farmer can save these seeds from one

harvest and plant them the next year, knowing they will grow true to type. You can grow and save all the seeds for next year's growing area *this year* in just an average of 3% additional growing area.

Soil Sustainability's Two Vectors

Humus

Known by soil scientists as soil organic matter, SOM is agriculture's "canary in the coal mine." Organic matter levels determine whether soil is fertile enough to produce significant yields of food with less water and hold the nutrients where a plant's roots can use them. At 2% SOM, the soil's microbes are just waking up. A healthy, productive soil requires a minimum of 3% organic matter in the tropics, and 4-6% in temperate regions. When we began this work in 1972, the World SOM level average was 2%—now it is about 1.2%.

Nutrient Availability

GB, with its goal of having a 24" depth of good soil structure of farmable soil, has the potential of *four times the nutrient cycling,* in comparison with the 6" cultivated soil depth in standard farming practices. This is one of the reasons it is possible to grow four times the plants per unit of area and time.

The Questions GB Teachers Should Enable Their Students to Ask

As a good, enthusiastic GB Teacher, make sure the participants in your classes have learned enough to ask the following questions at the end of taking a GROW BIOINTENSIVE class—and that they receive answers in full context. (The answers may be found on page 6 in the Appendix.)

- How can I make sure my garden, mini-farm or farm is fully *closed-loop* sustainable?
- Does my design accomplish this full sustainability in all ways?
- Is my diet design effective and equitable, so if everyone in the world grew such a diet, there would be enough fertile soil, water, and other resources, so everyone could live well?
- What is the purpose of leaving half of the farmable soil in the wild?
- How many square feet does it take to grow an average U.S. or other country omnivore diet? How much for a healthy vegan diet?

Appendix

GROW BIOINTENSIVE® Sustainable Mini-Farming: Sustainable Application of Composted Vegetable Matter and Organic Fertilizers

GROW BIOINTENSIVE ® Sustainable Mini-Farming

The goal of a GROW BIOINTENSIVE sustainable mini-farm[1] is *to produce essentially all of the soil's fertility sustainably and to eventually need no outside inputs.* This is possible once the soil nutrients are balanced through *competent soil analysis* followed by the application of the appropriate quantities of organic fertilizers—within the limits of the current Situation of Peak Farmable Nutrient in organic fertilizer forms. Sustainability can be achieved by accomplishing two goals: a) growing "compost

1 Generally, the *minimum* farm size for growing all of one person's soil fertility, human nutrition with a well-designed vegan diet and income on a sustainable basis will be approximately 4,000 square feet of planted surface, assuming intermediate GROW BIOINTENSIVE yields. Overtime, as your skills and soil improve, this may be significantly reduced.

crops" to generate *sufficient* cured compost; and b) returning all of the soil nutrients contained in the crops to the soil through *sufficient* compost and the *proper, safe and legal* recycling of human waste. If these two goals are accomplished, both *humus* and *nutrient levels* of the soil can be replenished in a way that is sustainable. That is, the fertility of the soil can be maintained virtually indefinitely, since these practices do not rely on nonrenewable resources—such as the use of chemical fertilizers which are produced from petroleum, and the use of organic fertilizers and other organic matter which come from other soils and other limited sources.

To ensure that a farm produces enough compost to maintain the organic matter level of its soil, as well as enough food and income for the farmer and his or her family, *approximately **60 percent** of the growing area of the farm on the average is used to grow **carbon-and-calorie crops** on a rotation basis.* Carbon-and-calorie crops (such as grain crops) yield high amounts of carbonaceous residues that produce more cured compost and humus when they are composted than do materials high in nitrogen and water (such as clover, vetch and other crops grown for green manure). These carbon-and-calorie crops also provide food for people.

Thirty percent** of the growing area of the farm should be used for **special root crops that produce large amounts of calories per unit of area, such as potatoes, parsnips and garlic—see *HTGMV*/2017, p.40. (The total area required to produce sufficient calories, therefore, is 90% [60% + 30%].)

The remaining ***10 percent*** of the area is for vegetables to provide the additional dietary vitamins and minerals not raised in the other 90 percent of the area, as well as for income crops. GROW BIOINTENSIVE Mini-Farming is excellent for nutrition intervention: often as little as 2.5 to 5 percent of the mini-farm area is needed to meet the daily vitamin and mineral requirements of the farmer and his or her family. In other words, one person's additional daily vitamin and mineral requirements may be met by GROW BIOINTENSIVE-ly growing as little as 100-square-feet of vitamin- and mineral-rich crops during a four-month growing season. The remaining 7.5 percent of the area can be planted in crops for income or other crops a person needs or wants.

Sustainable Application of Composted Vegetable Matter

Ecology Action has found that the maximum amount of cured compost (including 50% of soil by volume) that 100-square-feet needs and can produce on the average is approximately 4 cubic feet, assuming *high* yields, or 2 cubic feet, assuming *intermediate* yields. This is perhaps the *optimal* amount of cured compost to add to 100-square-feet of soil per four- to six month growing season—see *HTGMV*/2017, p.40. Only under very unusual circumstances (such as when one is improving a soil that has no topsoil or subsoil, only C- and R-horizon material) is more than four cubic feet of cured compost needed this first year. This amount can produce *very good* sustainable yields.

It is most important that beginning GROW BIOINTENSIVE Mini-Farmers begin growing their own compost materials, apply the cured compost they have made, and strive to eventually produce enough cured compost to be able to apply up to 3, 5-gallon buckets: 2 cubic feet (50% soil by volume) per 100 square feet per four-month growing season—and very skilled Mini-Farmers might be able to produce up to four cubic feet in optimal soil and climate conditions. The soil's fertility then may be sustainable on an approximate "closed-loop/closed-system" basis that does not deplete other soils in the process.

Appropriate Use of Organic Fertilizers

Unless the soil is analyzed by a competent laboratory, or the farmer is able to tell by the presence and growth characteristics of certain plants which minerals are missing in the soil, fertilizers (even though

organic) should not be applied, and only cured compost generated from residues produced by the farm should be used. Indiscriminately added organic fertilizers can do more harm than good. Optimally, the minerals that the soil lacks will be identified through plant or chemical analysis and added in the form of organic fertilizers until the mineral levels are sufficient and balanced. Thereafter, if all the nutrients are properly recycled, no additions of organic fertilizers should be needed. An excellent soil testing and evaluation service is www.growyoursoil.org. Also see, *Test Your Soil with Plants*, second edition, 2013 by John Beeby, Ecology Action, Willits, CA.

Compost Application Procedure

The two to four cubic feet (or less, if less is not needed or not available) of cured compost should be applied and mixed into the upper two to four inches of soil only **after** the bed has been double-dug, not before the double-dig. Compost that is added before the double-dig tends to be buried too deep in the soil to be immediately as accessible to, and most effectively used by, the soil microorganisms and the seedlings when they most need it.

One Exception to the Guidelines

If it is necessary to significantly amend a soil that has no topsoil and/or subsoil, or a soil with extremely low organic matter, a complete texturizing double-dig, with compost mixed in 24 inches deep during the double-dig, may help. (See the Soil Preparation Chapter in *How to Grow More Vegetables*/2017, p. 29.) Under such circumstances, no more than eight cubic feet of cured compost (that is 50% soil by volume) should be added, and it should be added *on a one-time basis only*. The purpose of this exception is to produce a significantly greater amount of compost materials resulting in a more rapid increase in soil fertility, thereby contributing to long-term sustainability for the soil and farm. It is important to replace this excess use of compost per unit of area and time, at least over a period of a few years, from excess/high-yielding compost materials from other of your farm's growing areas.

Why Applying Cow Manure is Unsustainable

Often, a half-inch layer of animal manure *composted without soil* (equivalent to approximately four cubic feet per 100-square-feet) is recommended to be applied to a growing area, However, this is likely to be an over-application of nitrogen which could lead to nitrate toxicity in the crops, nitrate in the groundwater, crop lodging, acidification of the soil, and possibly a loss of soil humus.

Even more important, adding this amount of *soil-less composted* manure is unsustainable. Annual fodder production for the cow, using GROW BIOINTENSIVE Mini-Farming with zero-grazing techniques, requires *(at **intermediate** GROW BIOINTENSIVE yields)* approximately 7,500 square feet of soil (75, 100-sq-ft beds). The cow produces approximately 220 cubic feet of manure (dry) annually or approximately 110 cubic feet once the manure is decomposed. 110 cubic feet is enough *cured* manure (without soil) to apply to about 2,750 square feet (or 27.5, 100-sq-ft beds) of soil once per year at the rate described above. Therefore, 4,750 square feet (or 47.5, 100-sq-ft beds) will not receive compost, and the minerals, as well as humus, will not be replenished. This practice will eventually cause the 47.5 beds to lose organic matter, minerals, fertility and productivity—or about *two-thirds* of the area required to feed the cow.

Intermediate GROW BIOINTENSIVE Yields[2]

Area required to feed one cow = 7,500 sq ft
Area that will be fertilized with one cow's manure = 2,750 sq ft
Area that will begin to lose its fertility = 4,750 sq ft

2 The data for chickens and horses are being researched.

Answers to Questions GB Students Should Be Encouraged to Make

- How can I make sure my garden, mini-farm or farm is fully *closed-loop* sustainable?
  Answer: I know I need to recycle everything that I can back into my soil to keep the soil fertility completely sustainable. And that I cannot market more than 10% of my cultivated crop area, not including paths, so nutrients are not exported from my soil in the marketed crops—especially seeds, as seeds concentrate the minerals taken away for sale.

- Does my design accomplish this full sustainability in all ways?

- Is my diet design effective and equitable, so if everyone in the world grew such a diet, there would be sufficient fertile soil, water, and other resources, so everyone could live well?
  Answer: If everyone eats an *omnivorous* diet like the average person in the U.S. consumes, there would only be enough farmable soil globally for *about one-quarter* of the world's population to eat.

- For everyone to eat well and live better, carefully-designed *vegetarian,* with few animal products, or well-designed *vegan* diets, would need to be used. And these diets can be grown on as little as 4,000-sq-ft with beginning GB yields, and once your skill and soil are improved reasonably, on as little 2,000-sq-ft with intermediate GB yields—and even less when higher GB yields occur. *Vegan* diets will generally take less area to grow. An additional advantage for using less farmable soil in the growing of your complete balanced diet with your diet crops—and your compost materials with the same diet crops—is that, in an increasingly water-scarce world, you will need much less water, compost and purchased nutrients.

- What is the purpose of leaving half of the farmable soil in the wild?
  Answer: To protect the genetic plant and animal diversity needed to ensure the sustainable environment we all need for a good life.

- How many square feet does it take to grow an average U.S. omnivore diet?
  Answer: 101,000-sq-ft.

NOTE:

Ultimately, for farming systems to be fully "closed-loop", human waste will need to be *properly, safely and legally* (part of a social decision) recycled. A key approach to understanding the choices is given in the comprehensive publication, *Future Fertility—Transforming Human Waste into Human Wealth*, by John Beeby, Ecology Action, second edition, 1998.