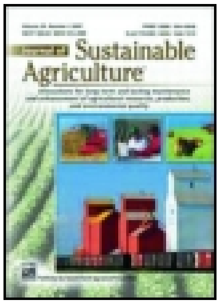

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Biointensive Sustainable Mini-Farming: V. Future Potential, Some Representative World Applications, Future Challenges and Research Opportunities

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Biointensive Sustainable Mini-Farming: V. Future Potential, Some Representative World Applications, Future Challenges and Research Opportunities

John C. Jeavons

ABSTRACT. The purpose of this paper is to: Look at the future potential of "Grow Biointensive" sustainable mini-farming in terms of the production of calories and carbon per unit of water; discuss world applications by briefly looking at the overall preliminary results of two experiences in India and Russia; and review the future challenges and research opportunities for the "Grow Biointensive" method of agriculture and the need for corroboration through comparison with independent research projects and programs with data collected on a rigorous statistical basis and subjected to statistical analysis.

KEYWORDS. Biointensive, small-scale, high-yielding, resource-conserving, organic

FUTURE POTENTIAL

Caloric Production per Unit of Water

The apparent potential of "Grow Biointensive" practices for producing increased yields per unit of area offers a hope of growing complete diets in

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one-half, or less, the area currently required. In addition, key root crops, such as potatoes, sweet potatoes, salsify, garlic, burdock and parsnips, by this approach are both very water-efficient in the amount of calories produced per unit of water used *and* possess *caloric area efficiency* when compared with grain, seed and bean crops. For example, all the calories for one person for all year might be grown with the Grow Biointensive method with potatoes in as little as 55 square meters (600 square feet) while the same caloric productivity may take approximately eight to twenty times the area, or 440 to 1,100 square meters (4,800 to 12,000 square feet), with likely soybean yields.

Grow Biointensive practices have significant potential to produce more calories per unit of water. This potential can be observed from the generally increased yields per unit of area at both Ecology Action test sites and the significantly decreased water consumption per unit of area experienced at the Palo Alto, California, test site. A higher clay content in the Palo Alto test area soil enabled Biointensive practices to be more water-efficient in terms of the amount of calories and carbon produced per unit of water there. *Assuming only a doubling of yield and a halving of water used per unit of area, as little as one-quarter the water per pound of food and/or per calorie produced can result.*

Therefore, the levels of caloric and carbon production per unit of water shown in Table 1 have been developed to demonstrate only conservative estimates of the overall potential for the efficient use of water by Grow Biointensive practices. This table assumes only one-half the water consumption per pound of food and/or calorie produced. Some key yields at the Willits location, however, have been significantly higher than the ones shown in this five-part series, indicating the potential for higher yields over time as the soil continues to improve and as the environmental constraints of the site are minimized.

Biomass Energy

Grow Biointensive manual farming practices also appears to have the capacity both to produce food with one-half or fewer the kilocalories of energy–in all forms–through its manual farming practices *and* to produce high levels of "energy" in the form of the carbonaceous food needed for the soil microbes in order to maintain sustainable soil fertility. This can be seen in Table 2 when the carbon produced by Biointensive techniques per unit of water is compared with the carbon produced by the conventional approach.

TABLE 1. Use of Water in Agriculture (estimated)

APPROXIMATE. Based on U.S. Average Yield figures and Weeks to Maturity data in *How To Grow More Vegetables*, 1991 ed. (Columns G and M). Assumes water use of 20 gal/100 sq ft/day for vegetables and 12 gal/100 sq ft/day for grains.

					CALORIES		
TO PRODUCE 1 LB (0.45 KG) **OF**	**WATER NEEDED****				**CALORIES/ LB** (0.45 KG) **OF CROP**	**CONVENTIONAL CROP CALORIES/ LB** (0.45 KG) **OF WATER**	**CONSERVATIVE COMPARISON– BIOINTENSIVE CROP CALORIES/ LB** (0.45 KG) **OF WATER*****
	gal	**lit**	**lb**	**kg**			
Japanese Millet (grain) (?)* (45 days)	79	299	619	280	1,483	2.40	4.8
Corn, Fodder (grain) (112 days)	118	449	927	420	1,579	1.70	3.4
Proso Millet (grain) (?)* (90 days)	158	599	1,238	561	1,483	1.20	2.4
Carrots (70 days)	23	87	185	83	156	0.84	1.68
Potatoes (120 days)	45	170	355	161	279	0.78	1.56
Soya (120 days)	399	1,512	3,120	1,414	1,828	0.59	1.18
HRS Wheat (grain) (120 days)	388	1,525	3,035	1,376	1,497	0.49	0.98
Hamburger	3,205-6,410	12,132-24,264	25,000~50,000	11,340-22,680	1,216	0.048 -0.024	0.096-0.048

* Estimate: full data not available. Crop worthy of investigation. Assumes millets require half the water compared to wheat and other grains, ~6 gallons/100 sq ft/day (22.5 liters/9.3 sq m).

** Assumes growing-season average water use of 20 gallons/100 sq ft/day (75 liters/9.3 sq m) for grains and 12 gallons/100 sq ft/day (45 liters/9.3 sq m) for vegetables.

*** The Biointensive example assumes two times the yield per unit of area (conservative estimate of Biointensive production efficiency) and the same input of water per unit of area compared with commercial agriculture. This means double the production of carbon and calories per pound of water used.

SOME REPRESENTATIVE WORLD APPLICATIONS

Biointensive sustainable mini-farming has been disseminated around the world primarily through Ecology Action's many self-help publications. This process has been amplified through volunteer, intern and apprentice positions, introductory-level Three-Day Workshops, *basic-level* Five-Day Workshops, *intermediate-level* Seven-Day Workshops and *advanced-level* Six-Week and Ten-Week Workshops.

India

In 1976, Ecology Action offered free "how-to" information by mail to 160 key farming programs around the world. The Director of the Shri AMM Murugappa Chettiar Research Centre in Tharamani, Madras, India,

TABLE 2. Use of Water in Agriculture (estimated)

APPROXIMATE. Based on U.S. Average Yield figures and Weeks to Maturity data in *How To Grow More Vegetables*, 1991 ed. (Columns G and M). Assumes water use of 20 gal/100 sq ft/day for vegetables and 12 gal/100 sq ft/day for grains.

					CARBON		
TO PRODUCE 1 LB (0.45 KG) **OF**	**WATER NEEDED****				**CARBON/ LB** (0.45 KG) **OF STRAW**	**CONVENTIONAL CROP CARBON/ LB** (0.45 KG) **OF WATER**	**CONSERVATIVE COMPARISON– BIOINTENSIVE CROP CARBON/ LB** (0.45 KG) **OF WATER*****
	gal	**lit**	**lb**	**kg**			
Japanese Millet (grain) (?)* (45 days)	45	169	351	159	0.52	0.00146 (5.5×)	0.00292 (11×)
Proso Millet (grain) (?)* (90 days)	90	340	702	318	0.52	0.00073 (2.7×)	0.00146 (5.4×)
Corn, Fodder (grain) (112 days)	90	342	709	321	0.52	0.00071 (2.6×)	0.00142 (5.2×)
HRS Wheat (grain) (120 days)	240	908	1,872	849	0.50	0.00026 (1×)	0.00052 (2×)

* Estimate: full data not available. Crop worthy of investigation. Assumes millets require half the water compared to wheat and other grains, ~6 gallons/100 sq ft/day (22.5 liters/9.3 sq m).

** Assumes growing-season average water use of 20 gallons/100 sq ft/day (75 liters/9.3 sq m) for grains and 12 gallons/100 sq ft/day (45 liters/9.3 sq m) for vegetables.

*** The Biointensive example assumes two times the yield per unit of area (conservative estimate of Biointensive production efficiency) and the same input of water per unit of area compared with commercial agriculture. This means double the production of carbon and calories per pound of water used.

Note: For the production of a unit of calories or carbon, Biointensive mini-farming uses as little as 1/3 the water per pound of grain and as little as 1/8 the water per pound of vegetable produced. Wtih Biointensive techniques:

8-30 gallons (30-114 liters) per 100 sq ft per day at hottest time of year
4-15 gallons (15-57 liters) per 100 sq ft per day annual average and 2 to 4+ times the yield.

Dr. C.V. Seshadri, requested this free information which included the first 1974 edition of *How to Grow More Vegetables* . . . . He then initiated a Biointensive Project with 22 low-income families who had:

- never really grown food before,
- growing areas in very sandy soil, and
- only fresh manure for fertilizer.

The crops grown were cluster beans, ashgourd, pumpkin, bhendi, tomato, onion, radish, chillis, eggplant, cucumber, luffa and amaranth greens. After two and one-half years, by the end of their third growing season, the yields of the vegetables these families were growing had reached 75% to 100% of the *good farmer yields* in India. The principal conclusions of the project were:

1. this method can be taught to people with no previous experience of vegetable growing,

2. they can produce good yields with locally available resources in poor soils, and
3. they can become self-reliant and self-confident after very little training. This was a result not just of the effectiveness of the Biointensive method, but also of the teaching program of the Indian center (for detailed data see: Shri AMM Murugappa Chettiar Research Centre, 1978).

After other experiments a new project was begun in 1990: ". . . we initiated a project for the Department of Science and Technology, New Delhi, Government of India. The aim of the project was to provide rural women sustainable income by using the . . . [Biointensive] techniques. One hundred women were trained and they started growing vegetables using the . . . gardening techniques in their backyards. As there was no demand locally, a society by the name of 'Shaktha Society for Women' was formed to find a good market for these organically grown vegetables in the city. As the vegetables fetched them better prices, the women got very much interested. We found that with 120 square meters (1,116 square feet), an income of 200-250 rupees can be easily obtained. Most of the women own between 120 and 200 square meters" (Ecology Action, 1993).

Russia

In 1994 Larissa Avrorina of ECODOM in Akademgorodok, Siberia, attended a Three-Day Workshop in Willits and stayed for an additional month of training. In 1995 she began conducting experiments to see how Biointensive methods could be adapted to her harsh climate. The crops were shallots, beets, carrots, onions, radishes, green peas, dill, squash, cucumbers, sweet corn, string beans, potatoes and lettuce. In the first year, vegetable yields were 83% to 230% greater than the control tests. Except for lettuce and potatoes, which require some modification in technique and/or variety for all three agricultural approaches in order to grow most effectively in this situation, the Biointensively grown double-dug growing beds yielded much more highly than the single-dug, unfertilized and the single-dug, fertilized growing areas:

- *Single-dug, unfertilized area* (excluding lettuce and potatoes): *61% to 241%* of the U.S. average, or an overall average of *153%*,
- *Single-dug, fertilized area* (excluding lettuce and potatoes): *82% to 347%* of the U.S. average, or an overall average of *186%*,

- *Double-dug Biointensive area* (excluding lettuce and potatoes): *141% to 802%* of the US. average, or an overall average of *286%* (for detailed data see: Avrorina, 1996).

FUTURE CHALLENGES AND RESEARCH OPPORTUNITIES

Where Do We Go from Here? What Information Is Needed to Understand the System Better So It Can Be Improved?

Grow Biointensive Sustainable Mini-Farming offers hope for the future. In addition to being easily accessible to virtually everyone in all climates and soils where food is grown, its intermediate-level yields may enable people relatively unskilled in farming practices to become as effective as the upper 15% of the farmers in their region–once the quality of the soil and their skill have been moderately developed. Encouraging is the fact that people periodically write that they have obtained yields that exceed Ecology Action's expectations for productivity with a given crop. To make a global difference, these higher yields are not necessary–just a doubling can place the world onto a path of greater self-reliance, the building and maintenance of sustainable soil fertility, and the creation of viable mini-ecosystems thriving with genetic diversity around the globe.

What are some of the major issues for examination and research?

Energy–How much energy is expended in Grow Biointensive production as compared to other management systems?

Productivity–How exactly are high yields achieved in Grow Biointensive? Where (geographically) does using Grow Biointensive result in significant yield increases over other management systems?

Plant nutrition–How does the use of organic amendments affect nutrient availability and plant nutrition? What predictive capacity do we have to estimate "fertilizer" needs?

Effects on soil properties–What effects does Biointensive have on soil physical, chemical, and biological properties and processes?

Composting–What composting scenarios lead to greater carbon and nutrient retention?

Social acceptability–What cultural traits lead to acceptance/rejection of Grow Biointensive? What factors within the system limit its adoption?

Environmental impacts–What are the nutrient leaching rates from compost piles and Biointensive beds? What is the erosion potential?

Comparative potential and replicability–It is important that the Grow Biointensive method be tested in side-by-side research plots with controls at five to ten different soil and climate locations in the United States and around the world, so that the level of its potential can be more firmly established.

Each of these issues is region-specific. Therefore, one of the first things that need to be done is to establish long-term, well-funded, replicated trials in major ecoregions throughout the world. Trials should be located on established experiment stations and managed by individuals with knowledge in agronomy, soil science, and statistics (as well as other appropriate disciplines). How realistic this is, is uncertain. The flow of money has been going away from agricultural research (especially internationally) for over a decade. It is bound to increase, though, given current trends in population growth, and the demand for an agricultural system able to meet the food demands of the future.

It is the hope of the author that this paper will create the increased dialog necessary for a transition and transformation to a more effective and strongly sustainable agriculture. There are some areas in the world where resource-effective approaches, such as Biointensive farming, will be needed more urgently than in other regions. Some countries, such as the U.S., Canada, Australia and New Zealand, may have less need for a rapid transition from current agricultural practices to new ones in the near future. Many countries will benefit by the increased employment opportunities that these practices can be designed to accomplish. Most important, this approach can give people everywhere the techniques for a more positive self-reliance while building the more diverse, thriving mini-ecosystems necessary to a better life and healthier planet. Rather than being increasingly forced to flood into conurbations, this way can provide dignity for people while enabling them to remain and flourish where they live.

It may seem a distant goal, an impractical utopia.
But it is not the least unobtainable,
since it can be worked for here and now.
An individual can adopt the way of the future . . .
and if an individual can do it,
cannot whole groups of individuals? Whole nations?

–Mahatma Gandhi

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