A SUSTAINABLE FARM DEMONSTRATION FOR THE STATE OF TEXAS

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ABSTRACT

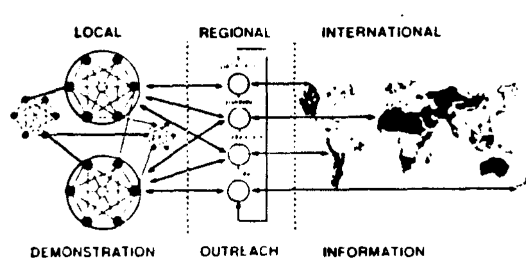
Because of the extraordinary breadth covered in farm operations, a demonstration "blueprint" farm must bridge a tremendous number of issues both now and in the future, perhaps like no other type of demonstration can or should. The Center's participation in the Laredo Demonstration Farm Project covers the general field of sustainable development, with specific applications in the farm's buildings, field support systems, and other infrastructure elements, and attempts to bridge the social and technical aspects of sustainable agriculture. By admitting state of the art theories being raised in many disciplines, from biology and physics to philosophy and politics we are, in short, attempting to guide the Laredo Demonstration Farm towards what we believe to be the key elements of the future of sustainable farming in Texas and elsewhere.

1. INTRODUCTION

Farming is a solar energy system that contains within its working parts performance issues such as efficiencies of scale, long vs. short term economics, embodied vs. operating energy costs, and other issues akin to the solar technical community. Unlike most solar activity, however, farming embraces more solar-related businesses than all other solar businesses combined, perhaps excepting the lumber industry, which is in a similar league of production capacity. Since so much attention is placed on this particular solar business--not, mind you, as a solar business per se but rather as a mainstay of the national economy--virtually every facet of farming's operational, social, economic, and environmental aspects have undergone careful scrutiny, perhaps more than with any other renewable energy business.

This paper concentrates on how the region's physical resources are used to design, build, and operate a regionally sustainable farming system. The Laredo Demonstration Farm, located in Laredo, Texas, is a joint project of the Texas Department of Agriculture, Texas-Israel Exchange, Laredo Junior College, and the Center for Maximum Potential Building Systems. The Farm is comprised of three key components: **a physical demonstration, an outreach/ training component,** and **a global information field**.

Due to the nature of physical resources, we find that unlike information, the distance between a resources' point of origin and the farm site is critical. Our approach scans resource needs beginning with the farm itself, progresses to the adjacent urban area, and finally moves to more rural conditions depending on the resource type, e.g. climatically-based, organic-based, mineral-based, soil-based. We approach all sectors of the farming process in this manner including buildings, water, soils, and fertilizers. Crop choices are made based on their ability to retain genetic diversity within the region coupled with their ability to thrive on little else but the region's available solar radiation, precipitation, good soil and other physical and human resources.



SUMMARY OF SCALAR RELATIONSHIPS OF THE LAREDO DEMONSTRATION FARM

2. PRIMARY INFLUENCES

2.1 Global Conditions

Desertification/deforestation, carbon dioxide and sulfur dioxide build-up, ozone layer depletion, and water shortages and contamination are issues that demand attention in any farming process, particularly in the southwestern U.S. In some way, each of the aforementioned global conditions have resulted from contemporary farming practices and the way we view food on and off the field.

2.2 Texas Conditions

Each week in Texas, 175 small farms fail. In the Rio Grande Valley and other areas along the Texas-Mexico border, the population suffers from chronic unemployment despite its highly skilled farm labor force. The introduction, therefore, of smaller, less mechanized high production farming could rectify this imbalance.

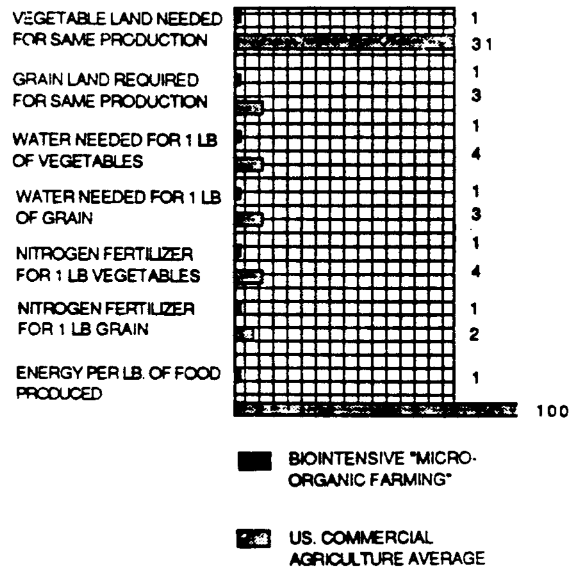
According to the 1989 State of the States Report, Issued by Renew America, Texas ranks 30th out of 50 states ranking lowest in areas of drinking water, solid waste recycling, and environmental degradation.[1] One of the underlying premises of the Laredo Demonstration Farm is that certain urban and rural problems--especially those relating to resources--can be addressed through property bridging the two in a symbiotic rather than competitive relationship. Urban areas, for example, are overwhelmed by solid waste to the point where dumping tip fees are as high as $130/ton in some densely populated areas.[2] Yet national statistics indicate that more than 25% of the municipal solid waste stream is composed of organic wastes that can be converted to useful, organically-based compost[3]--some claim that percentage to be much higher.[4] Additionally, many plastics--a growing segment of the nation's waste stream--are recyclable and may be useful in farming in such basic areas as manufacturing fence posts.

In a like manner the energy cost attributed to growing, processing and distributing food is 20+ times the energy value of the food supplied.[5] This energy cost can be reduced in many ways, from incorporating adjacent farm land into urban and regional planning strategies, to reducing transportation,[6] to supplying the necessary fertilizer from urban waste, virtually eliminating the need for chemical fertilizers.[7] For example, both the waste energy and carbon dioxide generated by power plants can be collected and used to increase crop production. Another problem facing urban areas--wastewater disposal--could supply the farm with its nutrient needs. In this way, instead of wastewater treatment being an economic drain on cities it could benefit both the urban and rural areas by eliminating cost to the cities while providing for one of the farm's most important needs.

2.3 The Farm

Farming is a responsive system, not a determining force that reflects overall human conditions at a given point in history. Presently in the U.S., farming is experiencing a transformation that, contrary to most opinions, is shifting focus from large farms to small, from chemical to organic, from machine intensive to labor intensive, and from rural to urban.[8] Agricultural peak efficiency occurs at a relatively small scale of approximately $45,000 to $133,000 of gross sales. (This figure is inclusive of debt structure, operations and maintenance costs).[9] Within the last year in California, organic produce sales have increased 41%, and are projected to double or triple in the next two years.[10] Currently in Texas, the demand for organic produce is five times that of available supplies.[11] A recent Gallup Poll published in USA Today found that 84% of people surveyed prefered to buy organic produce, with 49% of those willing to pay more for the organic produce.[12]

Most organic farms trying to keep pace with the surge in demand are run by small dedicated farmers who intentionally have opted for labor intensive healthy farming practices and often are intimately connected with a specialty marketplace that caters to year-round fresh produce.[13] Organic farmers in general adhere to growing practices different than those of most commercial, chemically-based growers, and which are unfamiliar to most extension agents and state agricultural departments. Numerous studies comparing chemical vs. organic techniques such as intensive micro-farming, bio-intensive farming, and three-dimensional space utilization indicate the organic methods achieving yields as high as 31 times those of conventional U.S. farms while using a fraction of the energy, water and other resource inputs.[14] Whenever possible, these organic farmers create added value to their products before leaving the farm by implementing techniques such as drying, juicing and cooking.[15]



OVERALL EFFICIENCIES OF BIO-INTENSIVE FARM "SOLAR SYSTEMS" COMPARED TO CONVENTIONAL

3. PLANNING PROCESS

Sustainable agricultural planning is accomplished by relating the farm to an information field, comprised of its regionally based human and physical resources, and by relating these resources to a particular need as thoroughly as possible. An overall action plan is used based on observing the region and documenting experiences of people who already (knowingly or unknowingly) have used sustainable methods as inherent parts of their particular techniques. The information field can be extended beyond a local and regional basis to include a global geographically similar condition within which experiences over history have produced knowledgeable people.

Institutions, research labs, and practitioners form (or can form) international, regional and local knowledge networks related to the particular issues of and and semi-arid agriculture. Using this knowledge network, we find, for instance, shade techniques used in virtually every advanced arid to semi-arid setting, the nearest being approximately 100 miles south in Mexico where an entire orchard is covered with a continuous shade system. In Arizona, we find the use of the ancient Persian downdraft chimneys in use with agriculture. In Central Texas, we find amazingly successful no-water organic farming methods relying on tremendous amounts of organic compost and mulch applied to the soil year-round. We also find a few examples of highly innovative low energy, water, and sewage treatment methods, including two towns with experience using vermiculture (earthworm) waste treatment and several towns using aquatic treatment (hyacinth). In Texas we find approximately 80 organic farmers going through the organic certification process, many of whom are knowledgeable of farming systems such as biointensive techniques, permaculture, or agroforestry methods. In one sense, then, a demonstration farm can be viewed as a catalyst for better communicating this knowledge field--a place to bring into a region the state of the art gleaned from this particular knowledge field.

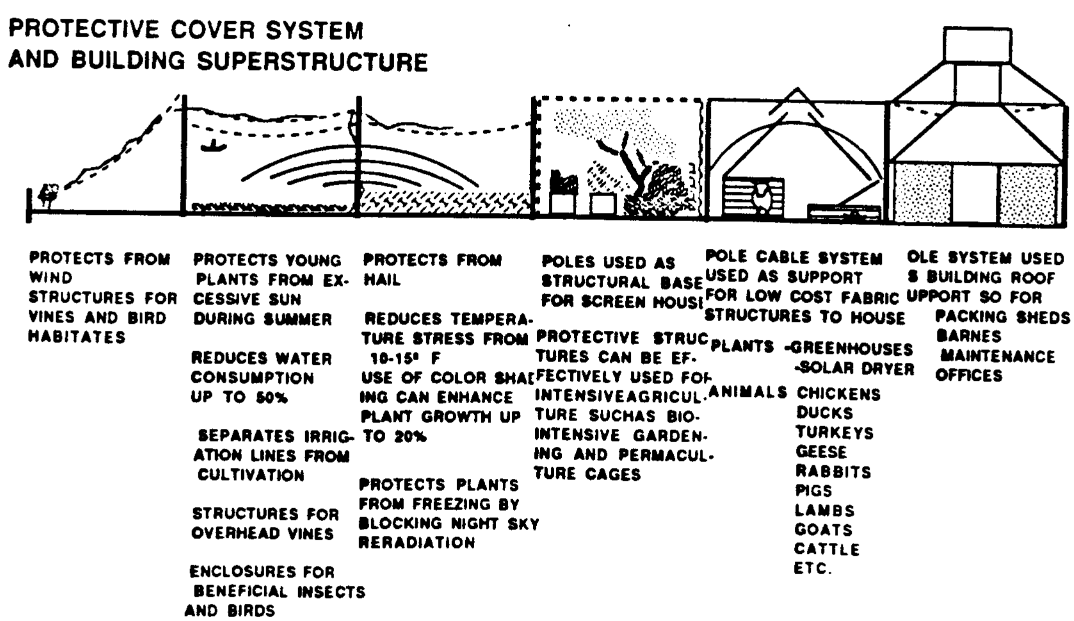
4. THE FARM AND CITY AS A SYSTEM

The importance of bridging arming processes with the city will become more apparent as the costs of transportation, chemical fertilizers, storage and packaging begin to catch up to their **real** energy costs. The fact that farming currently benefits from heavily subsidized coal, oil, gas and nuclear industries, whose costs therefore are not representative of their values over time, places conventional agriculture on a false basis of productive efficiency.[10] Sundworld Small, intensive production, low energy farming adjacent to the city must occur and the proper value of good agricultural land for such purposes acknowledged. For example, the coupling of sewage nutrients from non-industrial uses needs to be monitored and reused not only for its nutrient value but also for its water value. Similary, the importance of solid organic wastes recycled as compost is paramount for the future of farming.

On the farm a high degree of coordination between activities must occur in order to optimize energy, materials, and labor. Multi-use and sharing of implements and structures, development of beneficial relationships of many kinds between plants and animals, the use of aromatic flowers to camouflage smells while providing honey, flowers for food and for nutrients for beneficial insects, vines for shade and for harboring beneficial birds--all going under the auspices of integrated pest management--should also occur. The nature of this activity largely depends on the evolution of knowledge developed by the farmer and a willingness to actively experiment and use one's imagination.

The Farm's extensive shade system, a principal design element, is built over a series of 30'x30'x24' units, within which a variety of farming activities occur. The three dimensionality of the environment enables many plant and animal species to thrive at all elevational levels. In this way, for example, beneficial insects are surrounded by a protective envelope and birds are kept in as in a protective aviary surrounding the plant environment. This envelope--light filter, plant trellises, variable shade cloth, bird netting--becomes part of an integrated pest management system, as well as a micro-climatic environment suitable for plant growth in this semi-arid region. The three dimensional units can be the basis for an input/ output simulation process that can be analytically applied to the farm so that the major flows of materials and energy can be directed within the farm and with the farm's connectivity to the adjacent urban environment. The farm, however, is not completely 'modelable' in the classic sense. Some units receive primary inputs from the City of Laredo or the Laredo Junior College campus where the farm is located. Waste units in particular become bridges to the adjacent campus environment providing a critical cconnection between the city and farm.

Topsoil is one of the most needed resources in any semi-arid environment. Earthworms are Increasingly being demonstrated as a low energy effective method for converting various organic wastes--food processing waste, municipal garbage, and animal manures--into organic fertilizers. Expertise in Texas was developed to handle municipal sewage in the late 70's. It was shown that "clean"[10] sewage sludge can be processed at the rate of 6000 persons per acre of worm beds using 12,000 pounds of red wriggle worms. It has been demonstrated that vermicompost can supply all the trace elements and phosphate necessary for plants as long as one trace element does not exceed toxicity limits of the plants being grown. Earthworms at this density per acre will supply 50 tons of compost per year as long as the worms are kept within a 54 to 84°F. range using solar input and simple greenhouse cover during winter months. To serve the waste needs of the 250 dormitory



SHADE AND WIND AS DOMINANT FORCES IN THE LAREDO DEMONSTRATION FARM

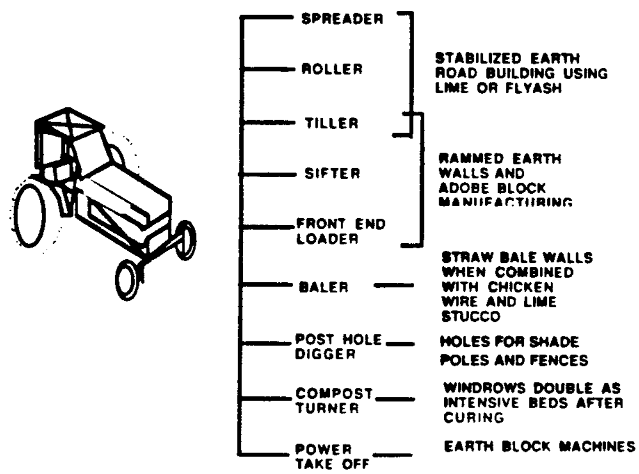
students housed at Laredo Junior College, approximately two 30x30 foot module units are required, producing about two tons of compost per year.

Other units become examples of state of the art organic growing practices. Four units (3600 S.F.) are for an anaerobic/aerobic compost module which will produce approximately four tons of compost per day from the cafeteria waste of 6,000 students. Fourteen units representing 12,600 square feet use bio-intensive methods following Jeavons' methods[10], equivalent to about nine acres of conventional farming, and which can support the organic vegetable needs of a population of about 200 to 300 people. Two units equivalent to 1800 square feet, about the size of a single-family home backyard, are reserved for multi-canopy permaculture techniques, and should provide enough food for several families. Three units are reserved for specialty crop growing on a vertical tube growing stand filled with organic soil. During summer months, these tubes and the greenhouse that surrounds them are converted to an 1800 square foot solar air heater that is operated with a fan so that hot air can be blown into the drying chamber for drying the previous season's crops. This component is one of several demonstrations showing the very small farmer how to increase profit by adding value to the crop. The dryer will dry up to 1/2 ton of produce a day and, in real conditions, could be a paying business just for drying during summer months thus giving season spread to the small farmers' capability. Three units are used as a seedling area for field type organic farming interspersed with fruit trees for shading. Three units are used for the packing shed. The building is efficiently cooled using downdraft evaporative cooling towers modeled after those in the mid-East, and is built with plastered straw bale walls, a folded sheet metal roof, and stabilized earth floors.

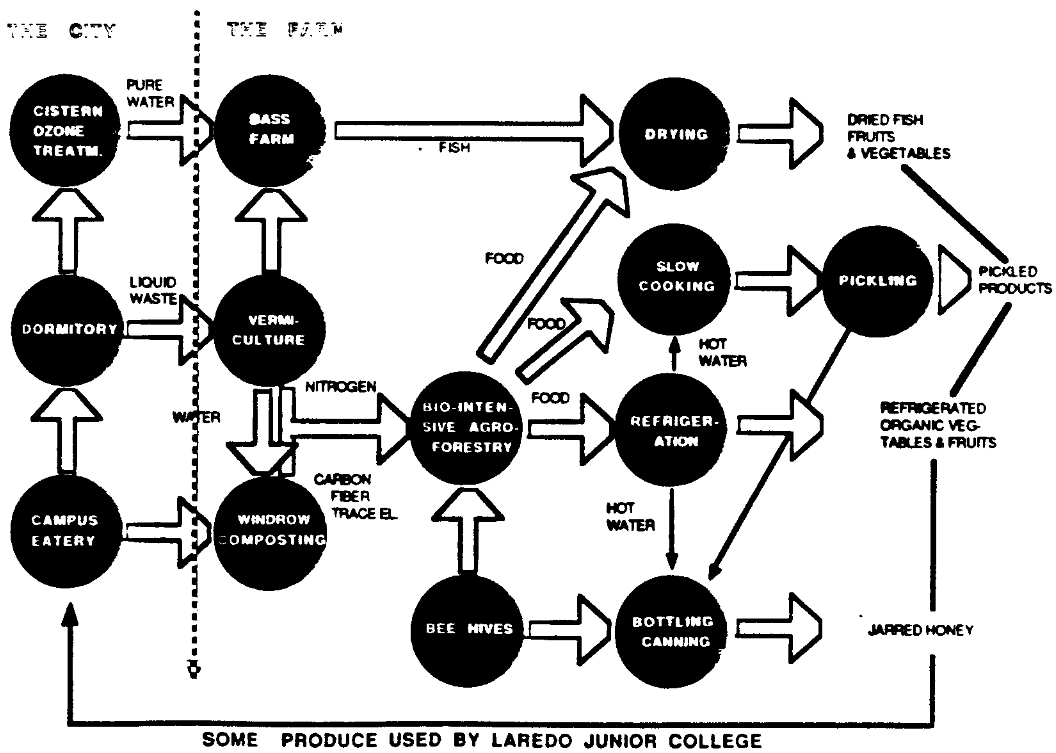
5. <u>BUILDING SYSTEMS</u>

The Laredo Demonstration Farm's initial needs include the support structures for storing equipment, sheds for packing vegetables, food storage sheds and silos, food preserving areas, dryers, water holding cisterns and ponds, stable road and flooring surfaces, offices, and living quarters. Today, it is rare that these facilities are supplied by the farm itself. Instead, they are supplied by specialty businesses within the neighboring town or city either as a pre-manufactured item or as a business that supplies these services. However, as one investigates the actual availability of these items, one finds tremendous dependency on energy intensive transport from areas, sometimes as high as 1000's of miles away. To develop **added value** to locally-based goods and services on or near the farm site means more money in the farmers' pocket, thus the term added value. This is true as much for produce as it is for the structures.

FARM EQUIPMENT OPTIMIZATION WITHIN BUILDING PROCESS

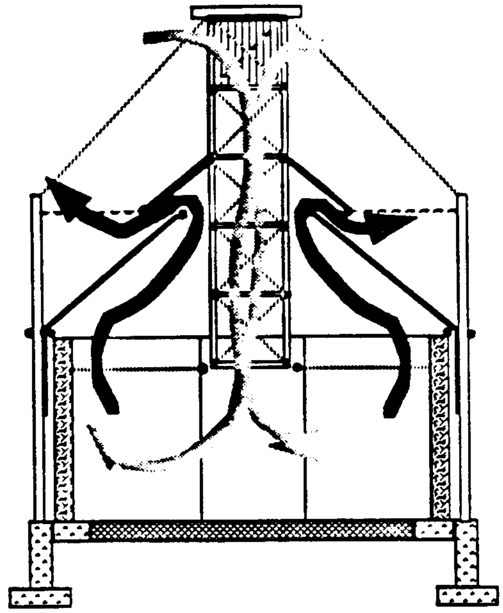


INTEGRATED METABOLIC UNIT DEMONSTRATION FARM



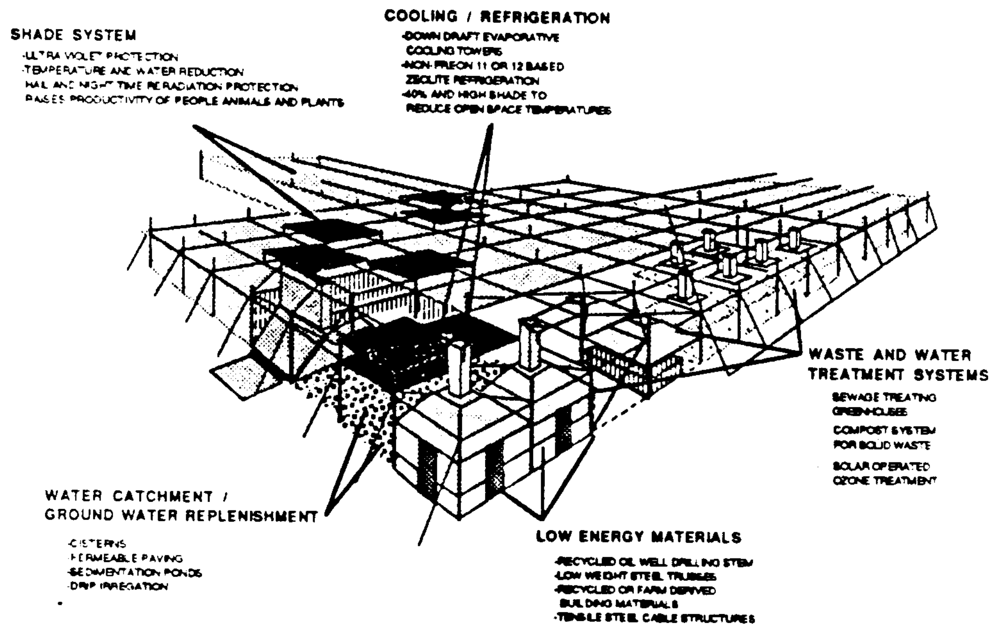
There are five basic material systems used on the Demonstration Farm: biologic, mineral, soil, recycled, and high efficiency strength to weight. While most structural members are made of metal, usually associated with energy-intensive building, it should be noted that the south Texas region does not produce any lumberable wood. The metal that is used is in some instances recycled oil field poles, or is thin folded sheet metal made into structural components, an extremely efficient use of the material.

At one level, the Farm was developed in a three dimensional manner responding primarily to the effects of light and wind in this semi-arid environment borrowed from a long, global history of arid lands farming. The shade in part is meant to make the City of Laredo think of itself as part of a major trend that will continue and which holds importance to the viability of open space, streets, parking areas etc., as in many ancient cities. At another level, the pole and cable system offers a haven for nature's protective ways to be managed and used in simple, low energy farming, and becomes the predominant superstructure for all Farm activities. As such, the Farm's physical structure addresses many issues of future farming practice close to urban environments in our part of the world. The diagram below summarizes many of these approaches.



PACKING SHED
USING DOWN DRAFT EVAPORATIVE COOLER
UPDRAFT THERMAL CHIMNEY
STRAW BALE STUCCO WALLS
STABILIZED EARTH FLOOR
RECYCLED OIL DRILLIN ROD POLES

THE LAREDO DEMONSTRATION FARM



6. ACKNOWLEDGEMENT

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7. FOOTNOTES

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