LONGJU CHINA SUSTAINABLE VILLAGE: DESIGNING & PLANNING A CULTURALLY & TECHNICALLY FLEXIBLE VILLAGE ENVIRONMENT

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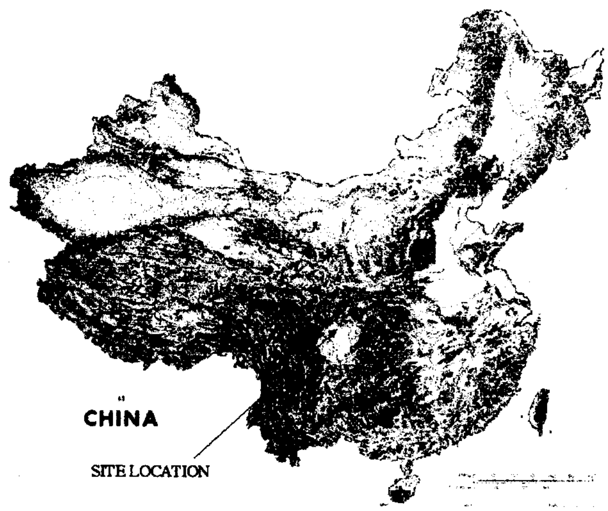
ABSTRACT

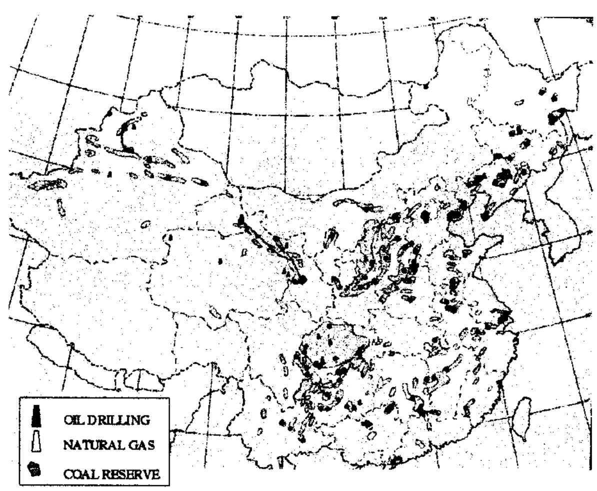
The mayor of Guanghan City located in the Szechuan Province of China requested assistance from the U.S. Department of Energy (USDOE) for the planning, engineering and design of a model sustainable village for farmers, with an objective to entice farmers to stay on the land. China's struggle for food is now two-fold: not only can the country barely feed itself but, due to open trade with the rest of the world, there are no longer incentives for farmers to remain on the small plots of land allocated to each family because they are unable to be competitive. A team was assembled and included staff from the Sustainable Communities Program at Denver Service Center and consultants representing Center for Maximum Potential Building Systems, Rocky Mountain Institute, Civil Engineering Research Laboratory, and Cascade Earth Services. This team was joined by a Chinese contingent, and the two groups worked collaboratively for a week developing the policies, procedures, and conceptual designs described below.



1.0 CHINA CONTEXT AND STATISTICS

China presently is home to 21% of the world's population and represents 11.5% of global energy demand, with approximately 62% of its current energy production derived from coal. If one were to balance the 3.3 x 10(9) amount of CO2 with forests alone the country would be 5.6 fold in imbalance (only 21.6% of China's original forests still exist).

The Szechuan province is located in central China and is considered the nation's breadbasket. The region's geography shows a large round valley with the proposed site for Longju Village on the north side of this region. In evaluating regional resources, we discovered that in addition to being a major food-producing region, it also contains some of the country's major gas and coal deposits as shown in the second map. I address the inherent challenges posed by the strong presence of gas and coal while working towards sustainable development later in the paper.



2.0 OBJECTIVES FOR LONGJU SUSTAINABLE VILLAGE

Project objectives were driven by a desire to enhance the well-being of the area's farmers. The U.S. and Chinese counterparts decided on a series of objectives and incentives to ensure that a proper understanding and transition take place due to the somewhat unusual needs of living sustainably. These included:

1) Farmer Skills: Support methods that incorporate the farmers' inventiveness and ingenuity by promoting diversified uses of agricultural products and practices (e.g., plants for wastewater treatment, plant systems for erosion stabilization) in place of imported large scale wastewater plants or concrete embankments.

2) Farm Products: Offer farmers comparable range of farm-based opportunities as an urban person has in the city by supplying multiple outlets for plant based products (e.g. plant fibers for lightweight insulating panels in building, plant-based road stabilizing fluids) in place of energy intensive, petroleum-based insulation or concrete road surfaces.

3) Farmer Efficiency: Improve farmers' efficiency in time and resources by using solar dryers to accelerate drying time while protecting crops from frequent rains, in place of government-subsidized fossil fuel-based drying.

4) Farmer Health: Improve farmers' health through improved drinking water using solar distillation for all potable uses, instead of chemically treating water.

5) Farmer's Freedom to Adapt: Develop flexible architecture to adapt to various farmer needs (e.g. microindustry - micro-commerce - home expansion).

6) Farm's ability to convert non-renewable coal resources for soil mineralization: Research the potential for the use of coal as a trace element and mineral supply to regenerate the soils of China.

The group acknowledged that incentives must be integrated into the village's financial and general operations for the proposed objectives to be adopted by the local villagers. These incentives are listed below.

3.0 SUSTAINABLE INCENTIVES PROGRAM

Incentives were developed as a transitional means for evolving an economic structure that enables sustainable technologies to compete fairly with conventional technologies. Two types of incentive programs were proposed:

1) To parallel the present governmental financial support of centralized infrastructure that uses

- a) non-sustainable methods such as fossil fuel energy by also partially supporting decentralized renewable methods and some of the labor costs for the manufacturing of these technologies
- b) non-sustainable water and wastewater technologies by also financially supporting water and wastewater technologies based on decentralized plant-based methods
- c) replacement of portland cement which is a high greenhouse gas producing material with both coal-based flyash cement and high biomass based C02 sequestering materials, as in-fill within the building system

2) To initiate through everyday trade within a sustainable village environment a system in which true (unsubsidized) values of products are advocated by

- a) supporting the informal farming economy of trading the real farmer's embedded in one product directly for the value of another
- b) deepening economic stability by bridging topics within sustainability through equivalent values (e.g. organic food produce for trip miles on sustainable forms of transport, or the recycling of organic waste into the land in trade for a solar dryer for better production)

3) To replace government support of large scale infrastructure by a decentralized physical support system that functions as a simultaneous armature for sustainable technologies and as a building structure to support in-fill walls

4) To support methods of sustainable transportation and replacement of moving people with more electronic communication

5) To trade-off space allocation along a commercially based promenade from conventional sales of nonsustainable products to one of 1) solar products 2) added value farm products or 3) organic food restaurants and eateries and to receive tax incentives for doing so

4.0 OPEN BUILDING SYSTEMS AS MULTI-USE SUPPORT SYSTEMS

Emphasis was placed on developing a continuous superstructure as a structural framework for adding or subtracting in-fill walls, or for attaching a variety of sustainable technologies. Walls were proposed using a range of agricultural waste products. The structure was to be manufactured using flyash cement from coal fired power plants, with the eventual transition to manufactured bamboo columns and beams. Utility oriented technologies that could also fit into this structure included water-related needs (water purification, water pumping, water heating), food preparation (solar dryers, solar stills, solar cooling, solar ovens), and intensive specialty food production (snails, grubs, insects, and other creatures that would quickly propagate within a small space. Local manufacturing procedures were proposed for both materials and labor. For example the solar pump, since it only had to pump from 30 feet, could easily be manufactured using ferro-cement tank technology. This was because the proposed solar pumping process was based on the diurnal heating and cooling of an atmospherically-closed tank system that would fill to 2/3rds its volume each night as cooling occurred. The goal was to give the farmer access to a variety of vocational and small business options that would take advantage of their keen skills and inventiveness in the context of sustainable technologies.

5.0 COAL AS SOIL MINERALIZATION VS. FUEL

The issue of whether to burn coal or to pulverize it and use its mineral content as a partial soil amendment seems to be without precedent. We know the immense dire consequences associated with burning China's vast coal reserves but seldom suggest an alternative for its use that could help a country go through the necessary transition to sustainability. The problems arising from using coal as a fertilizer amenity are also considerable due to the quantity of toxic substances that may occur such as cadmium, mercury, arsenic, to name a few. The proposal is to look at the feasibility of bio-remediating these substances before the finely pulverized coal is mixed in a high rate composting system to produce an organic fertilizer. Some plant species, such as the ubiquitous reed phragmites have been proven to accomplish this bio-remediation task. Due to 1) the extreme loss of productive soils throughout China along with a high degree of demineralization, 2) the dire consequences of burning coal and 3) the nation's need for food, makes this option worthy of investigation. The chart below compares some of the positive ingredients of coal relative to a high mineralization soil additive called green sand.

MINERALS FOUND IN 50# BAG OF GREENSAND	#/TON (approx.)	TRACE ELEMENTS IN COAL	(# / TON)	RANGE (# / ton)
		ALUMINIUM	280	(160-280)
		ARSENIC	0.572	(.2-.6)
		BARIUM	2.006	(.2-2)
BORON	0.4	BORON	0.58	(NA)
CALCIUM	NA			
		CADMIUM	<.001	(NA)
		CHROMIUM	0.436	(NA)
		COBALT	NA	(.02-.18)
IRON	NA			
		COPPER	0.37	(.06-.4)
		LEAD	0.228	(.24-.54)
MAGNESIUM	1			
		LITHIUM	0.54	(NA)
MANGANESE	0.8	MANGANESE	0.58	(NA)
		MOLYBDENUM	0.092	(NA)
		NICKEL	0.338	(.06-.4)
PHOSPHOROUS	4	DIPHOSPHOROUS PENTAOXIDE	7.6	(NA)
POTASSIUM	NA			
		SELENIUM	0.022	(.01-.06)
		SILVER	0.028	(NA)
		STRONTIUM	NA	(.4-5.2)
SULPHUR	NA			
		TITANIUM	17	(NA)
ZINC	0.2	ZINC	0.508	(.4-.9)

6.0 ACKNOWLEDGEMENTS

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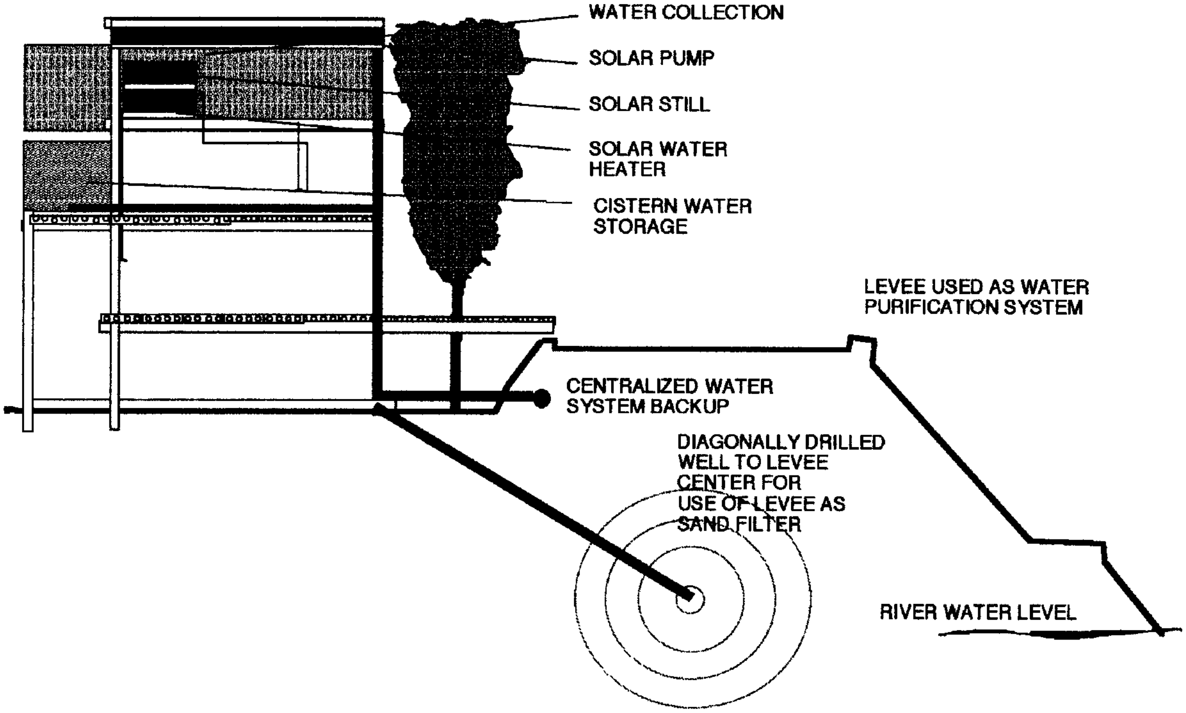
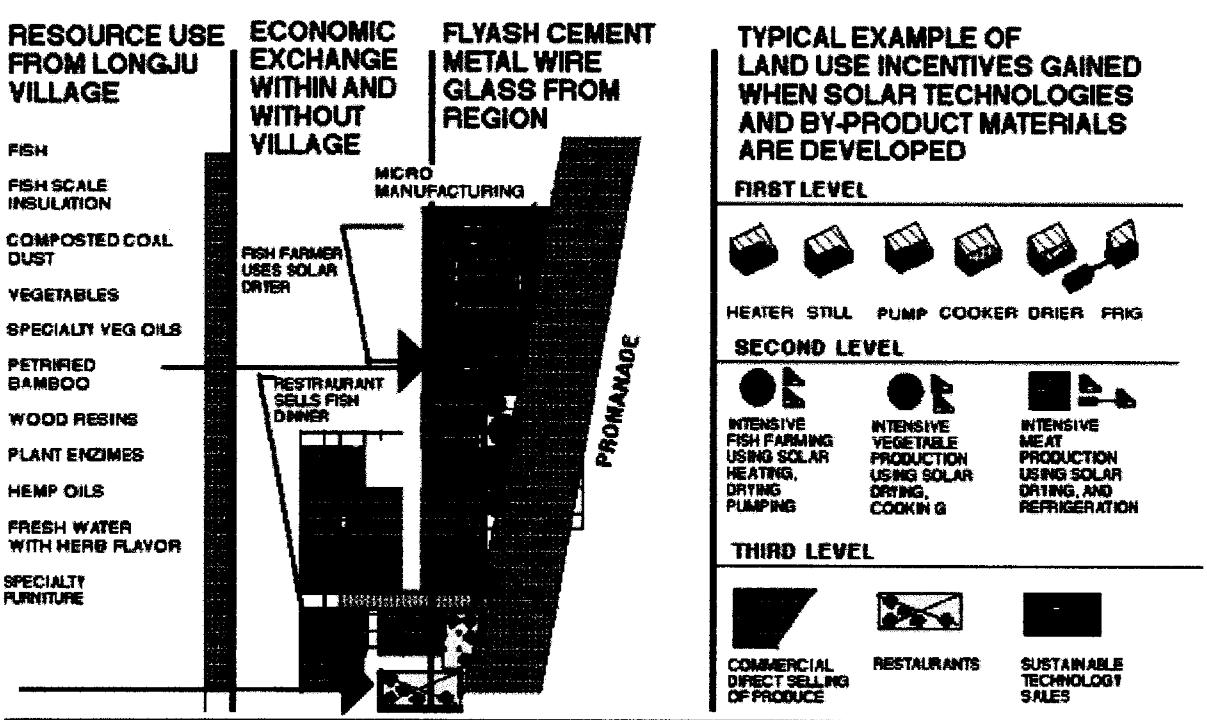
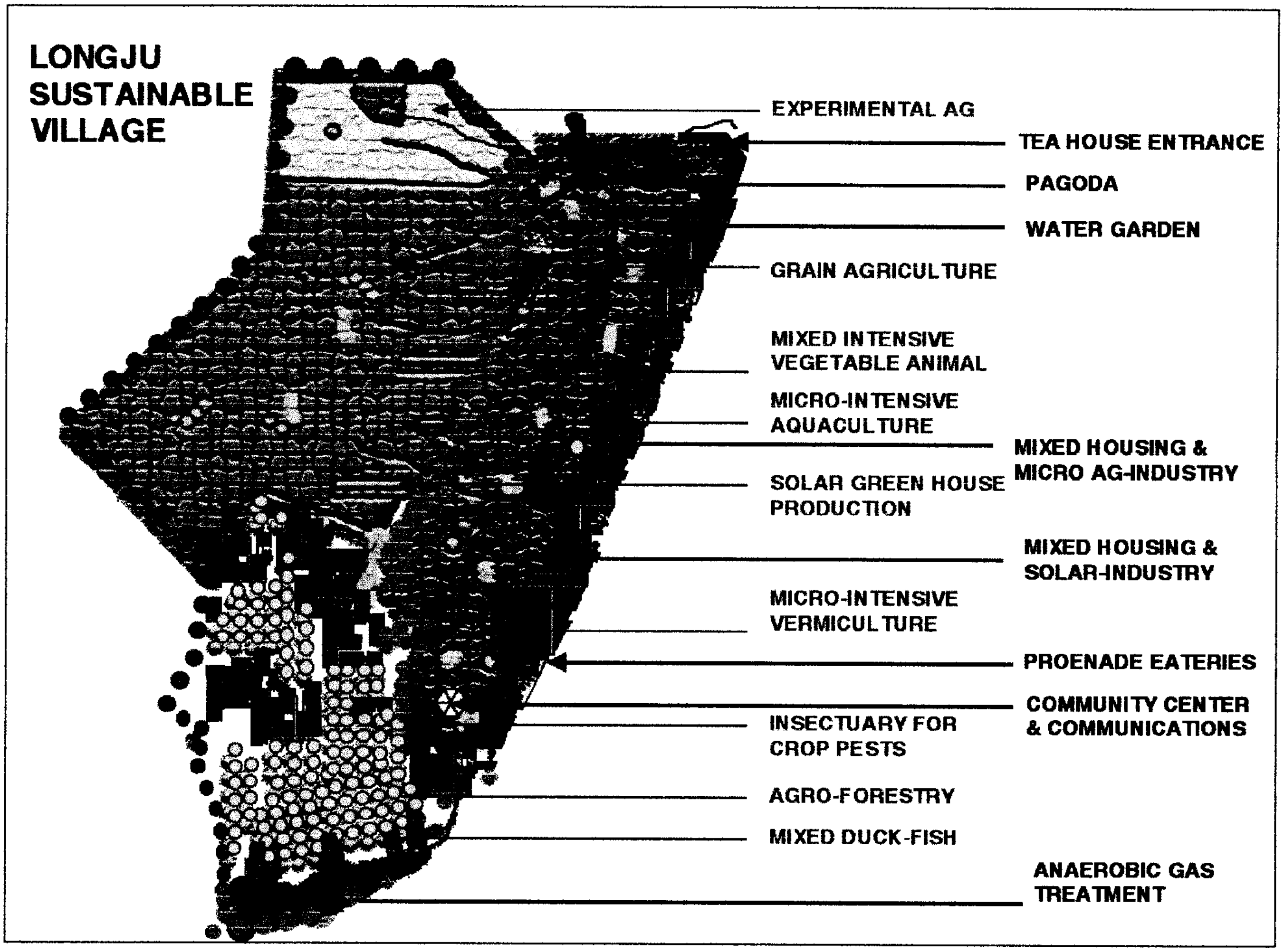
BUILDING FRAMEWORK AS ARMATURE FOR SUSTAINABLE INFRASTRUCTURE



SUSTAINABLE ENTERPRISE SPACE USE - TYPICAL EXAMPLE OF PROMANADE





LONGJU SUSTAINABLE VILLAGE ELEVATION