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THE CACAPAVA PERMACULTURE PROJECT

How the project came into existence:

In April 1981 Declan and Margrit Kennedy, architects and urban planners with a major interest in ecology were asked to design a small settlement of houses for workers of firm "Sanfonas Industriais" in Caçapava, State of Sao Paulo, Brazil. The firm produces expansion joints for trains, busses, trams, and jet-ways mostly for export to Europe and North America. It is a labor-intensive, low-capital operation which depends mostly on semi-skilled and skilled labor. After a move of the firm from Sao José dos Campos to larger premises in Caçapava (about 1/2 an hour by bus) the industrialist offered to provide housing for those workers willing to move with the firm. About half of the present work force of 20 people accepted the offer. The houses are planned to be built in two stages. Six are to be built immediately, additional ones somewhat later.

The architects designed the houses according to ecological principles aimed at autonomy and self-sufficiency. While the principles and techniques for autonomous houses based on the use of natural resources, and decentralized, small scale, circular systems are well known in Germany and Europe, the principles and techniques for food self-sufficiency are not. The architects, therefore, asked Bill

Mollison (Australia) to become a consultant for the integration of self-sufficient gardening systems.

In the course of their joint work and some lectures (given in San José, Sao Paulo, Curitiba and Rio de Janeiro) it became clear that the experiences of ecological concepts are of great interest in Brazil, and, therefore, setting up an information and resource center would become a necessary part of the project.

With the help and interest of the client as well as various local experts, architects, gardeners, and ecologists, the project would then encompass two parts, which could work separately but located next to each other would mutually benefit and support each other:

I. the Demonstration Building Project:
six self-sufficient worker's houses and gardens which will be part of an integrated land use development in the area, based on mixed zoning for light industrial, agricultural, and residential uses, as well as commercial, social, and technical infrastructure; (pp.3 - 16)

II. the Permaculture Information and Resource Center:
comprising a library, office, visitor's accomodation, work space, meeting rooms, and director's and gardener's houses as well as an orchard, nursery, tree crop aboritem, Fukuoka Grain Crop System, seed exchange and a surplus produce and plant market area including a self-service restaurant/cafeteria (which may also deliver food to nearby industrial plants). (pp. 16 - 21)

The purpose and scope as well as the conditions for implementing both parts will be described in more detail in the following.

Part I. THE DEMONSTRATION BUILDING PROJECT: SIX AUTONOMOUS SELF-SUFFICIENT WORKERS' HOUSES AND GARDENS

In order to create an autonomous housing system a design must work with rather than against local conditions such as: climate, sun, rain, wind, topography, soil, water, and vegetation. But just as important as these conditions is the wish of the future users to acquire and actively participate in the development and maintenance of autonomous, self-sufficient housing.

The first step, therefore, has been to talk to the people and explain some of the differences between todays "traditional" and the planned "self-sufficient" houses. This clarified their opinions and needs in respect to food production, size of house, social and aesthetic standards. The second step was to collect and analyse the local environmental data.

Participatory process:

Following a first meeting in the factory where all the workers were informed about the project and a discussion of the basic goals and principles of the scheme took place, Margrit Kennedy visited all but two families to talk to the women and children (old enough to articulate their

wishes) to get an idea about their perception of their future houses and also about their present living conditions. The quality of their present housing varies greatly from one family to the next. The most well-off family lives in a one family house of about $60m^2$ for five people (here the wife earns a part of the living by sewing curtains and she plans to continue her work if possible in the new house). At the opposite end of the scale the lowest paid night watchman supports a family of ten in about $25m^2$, a favela house, which can be barely termed a roof over the head of the family. Similarly different were the perceptions of what would be possible for them in terms of design & size.

One of the difficulties, therefore, was to create a type of house which at the same time was acceptable to the well-off family as well as cheap enough to buy over time for the largest and lowest paid. In addition, most families are young and will grow, which means possibilities for self-help expansion had to be built into the design, and a financing scheme had to provide enough flexibility for all to be able to acquire the property at their own pace, and according to their own means.

For all of the workers the self-sufficient garden was a new prospect and task, which they approached with some apprehension. The offer of support and help from a professional Japanese gardener, therefore, was very well accepted. This gardener is to be an employee of the firm who will assist in planting the gardens in the initial phase. He will also plant and maintain the gardens around the factory.

One worker decided against having a garden, thus he will only get a house. (See site plan).

Local Conditions

The climate in Caçapava is sub-tropical with hot, humid summers and cool, dry winters. Temperatures range between 30-35°C in the summer with an average monthly percipitation of 0,2m and drop to 10°C (exceptionally to 0°C) in the winter with an average monthly percipitation of 0,025m.

Situated almost exactly on the Tropic of Capricorn about 850m above sea level. The summer sun is at an angle of 90° on the 21st of December and the winter sun at 47° on 21st of June. Moderate monsoon winds in the southern hemisphere are modified by a parallel mountain range (the Serra da Mantequeira and the Serra do Mar) and blow from south east to north west, except for the winter when they change into exactly the opposite direction about 1/3rd of the time.

The topography is almost flat with high mountain ranges (about 1200m) to either side of the 50km wide valley. The soil has turned sandy and is exhausted by the typical sequence of eliminating all trees, planting coffee first, then sugar cane, and thereafter, burning the plants in order to keep the land accessible. The ground water is still unpolluted and available in large quantities.

Site, Location and Access

The housing site is a narrow parcel of land (170mx54m), situated about 3km from the center of Caçapava, an expanding small town of about 30 000 inhabitants. Although other houses and gardens line the adjoining road leading up to the "Dutra" (the major highway between Sao Paulo

and Rio de Janeiro) the area is zoned "industrial" and houses are being bought up increasingly for industrial uses. Neighbouring industries are relatively "clean", i.e. manufacturers of beverages and glass. But already the site for a foundary has been cleared only one km away and other heavy industry plants may follow. This happens in spite of studies which show that Caçapava's climate and location cannot take any more pollution than presently produced by a large oil refinery at one end of the county and a somewhat more distant lead factory at the other end.

Planning Proposal

At present the municipal planning authorities in the State of Sao Paulo follow the European and North American pattern of exclusionary zoning. The tendency in Europe and in the USA, however, based on the negative consequences of monofunctional, separated uses, eg. in terms of energy consumption, is to reintegrate various functions such as housing, work, leisure, education etc. in decentralized multi-functional or mixed-use developments. This means not only shorter distances between place of work, housing, shopping, education, recreation etc. but also a more lively and socially acceptable environment.

In Caçapava the present mix of uses is exactly what "industrialized" countries try to achieve, there are agricultural, residential, commercial and light industrial uses next to, and mutually benefitting from each other. There are also warnings from studies and experts which advocate "no more heavy industry". Therefore it seems feasible to suggest to the planning authorities in Caçapava to change the present exclusionary zoning into mixed use zones, allowing more residential developments close

to light industry and the continuation of agricultural production as well as the settlement of other public and private services.

In respect to this objective of the project the autonomous houses may also show that the centralized provision of water and sewerage, electricity and food as well as liquid and solid waste removal, which is the basis of ever larger and more energy consuming urban systems, is indeed an unnecessary and illogical trend.

Autonomous Technical Systems

In the Caçapava project we propose to use mainly the rain water, collected from roofs of the factory and houses. Estimated catchment from present factory roof 1,500,000 liters per annum. Tanks can be filled on the first floor, at the east end of the factory to supply to first six houses and factory showers and toilets. Ground cisterns (40,000 l.) can be used as emergency top-up for 20,000 l. storage on first floor. Any future factory can be filled with larger cistern storage and provision for tankstorage on first floor, below eaves.

Two dry toilets (aerobic composting processes) and four septic tanks will produce humus as fertilizer, biogas for cooking and grey water for watering plants. A simple solar water heater (pipes buried in glass-cases filled with black sand) and wind energy for pumping water, if needed, can provide the energy through renewable natural resources on a totally decentralized basis.

The two dry toilets and the hot water for dish-washing will also save water. For dish-washing the water used now is usually cold and flows as a constant stream. The

heating and ventilation of the buildings, furthermore, will be taken care of by natural means such as a simple addition of shaded covered and trellised areas to the south and glasshouses to the north (Section A-A). The shaded area produces cooler and dryer air which is pulled through the house by the rise and exit of hot air through high level vents in the glass house. In the winter when temperatures decline to 10°C (occasionally to frost level) the same system is used for heating. In this case, low level vents in the living room allow cool air to enter the glass house and high level vents allow hot air to circulate back into the living area, thus creating a constant flow of warm air in the house. In addition the roof overhang to the south will shade and protect walls from heating up in the sun during the summer, but during the winter the overhang allows the sun to reach the wall and provide and store energy for cooler nights and rainy days.

All liquid wastes will be recycled to feed the productive gardens either directly like water from the shower and washhandbasin or filtered through a septic tank like water from the kitchen, "lavanderia" (washbasin for clothes) or washing machine or flush toilet.

All solid wastes will be collected separately and recycled: organic materials (fertilizer), wood and paper (mulch or outdoor stove), glass, metal, textiles and plastics (workshops or respective industries).

The Prototypical Low Cost House

The design of the house is based on existing minimum standards in Caçapava which - in comparison to present housing conditions - provide larger and better accommodation for each family.

All houses include a kitchen/dining room, living room and bathroom, while the number of bedrooms varies between 1 and 4 according to family size.

Construction methods and materials take into account locally available -if possible- biological materials (such as hand-made bricks for the walls, wood and clay tiles or grass sods for the roof) and their suitability for future expansion through self-help or mutual help. The trellises will be constructed with bamboo.

The ground water seams have been surveyed in order to place wells and houses. Mainly bedrooms must be situated away from water lines in order not to interfere with the body functions of the inhabitants.

The "Permaculture" parts of the housing project include:

a.) a roofed area with an outside kitchen, storage and dining area, and trellises to either side which will be covered by vines and provide the production area for lettuce and other crops as well as a clear water pond with water chestnuts;

b.) a glasshouse for growing special herbs, and fruit throughout the year.

Both additions provide a permanent, no-energy, cooling system in the summer and the glasshouse alone all the necessary heating needed during the winter months, according to the natural laws of aerodynamics.

c.) a domestic garden which together with the above provides almost all the vegetables and fruit needed for the family, creating a surplus as the trees mature;

d.) a communal pond with ducks and prawns provides together with chicken and rabbits grown in the gardens and a geese and guinea fowl run at the factory for the additional protein needs.

The aims are: to provide staple foods, some edible oils and through fruit and vegetables as well as animals a high level of nutrition; to produce manure from plants and small animals and to save water through irrigation into ring gardens by drip line rather than sprinkler or hose.

Although modest, the first six houses should test several things

- function of glasshouse in energy
- ability of residents to garden for self-sufficiency
- interdependence of factory area and houses for food self-reliance
- value of crops selected.

The gardens as designed will work if carefully installed. This "installation" should be an integral part of the house, being built in the first place by hired labour, and handed over only after it is functioning, or within 6 months.

A family giving minimum time (3 hours per week) to maintainance should be food-independent from such a garden, but will need some grains, which can be produced on factory grounds or in the Permaculture Resource Center (Part II).

For a detailed description of the design including animals see Annex , "Domestic Gardens" by Bill Mollison.

Costs and Financing

Upon the request of the client it was agreed that the total costs for the houses and gardens (excluding the price of land and planning costs) should not exceed twice the costs of standard housing locally available at about $ 5000 (June 1981). The total building cost of the project, therefore is estimated at $ 60 000,-. The respective share of the land is about $ 1200,- (price paid in June 1980) and planning fees which will amount to about $ 15 000,- (plus the travel costs and fees of the overseas experts which amount to about $ 10 000,-, to be borne by German private funds (see p. 21).

Three models for financing the houses have been considered: a rental model, based on the total provision of houses and gardens by the firm; an ownership model based on the provision of an embryo-house (kitchen, bathroom and living room) through a government or bank loan and the development of the finished house and gardens through self-help or mutual help; and a mixed model which starts as a rental model (as above) and will be given over to the tenant on a mortgage basis after 3 years if the maintenance and up-keep of the house has been born by the tenant. After a further 1 4 years (depending on the exact conditions of repayment) the house will belong to the worker. During this time and thereafter, however, the firm has the option to buy the house at the market value if the worker should decide to move and/or sell the house.

The following calculations are not taking into account the increases due to inflation, as they are balanced by parallel increases in salary, nor do they take into account the interest for a loan as this will remain below the rate of inflation for low income groups.

(The exchange Cruzero/Dollar is based on the rate
8000,-Cr. = loo,-$ in June 1981)

rental model		
land (about 600m^2)	16 000,-Cr.	200,-$
house & garden	800 000,-Cr.	10 000,-$
	816 000,-Cr.	10 200,-$
average rent (which goes into maintenance) 4000,-Cr./month over 10 years	480 000,.Cr.	6 000,-$
ownership model		
land	16 000,-Cr.	200,-$
embryo house loan	400 000,-Cr.	5 000,-$
	416 000,-Cr.	5 2oo,-$
average monthley repayment 4000,-Cr./month over 10 years	480 000,-Cr.	6 000,-$
mixed model		
land	16 000,-Cr.	200,-$
house & garden	800 000,-Cr.	10 000,-$
	816 000,-Cr.	10 200,-$
average rent 4000,-Cr./month over 3 years	144 000,-Cr.	3 000,-$
average mortgage 4000,-Cr-/month over 14 years	672 000,-Cr.	70 200,-$
	816 000,-Cr.	10 200,-$

Each model offers different advantages and disadvantages to the firm sponsoring the housing development and the workers benefitting from the offer.

The "rental model" is at present the only simple legal arrangement for building houses as the site is located in an industrial-use zone - thus only the fact that the houses belong to firm makes it possible to build for residential purposes. In addition, it gives the firm more control over who the beneficiaries will be. However, Brazilian laws protect tenants more than the lessee in that it is very difficult indeed to cancel a lease and enforce an eviction if the tenant is unwilling to move and can prove that he has nowhere to go. Therefore, the rental model may in fact create more difficulties than an ownership model for the firm in the long run.

In addition, the motivation of the people to actively participate in the maintenance up-keep and development of the autonomous houses and gardens is lower if they are not the owners.

The second "ownership model" would certainly create more motivation to develop the houses and gardens among the workers from the start. But it would also encounter difficulties in obtaining building permission from the municipal planning office. While this may be overcome in that the firm could remain the owner of the land and secure its rights to buy the houses back - if a worker should leave the firm and/or leave the house - it also leaves the burden and the risk of the unusual ecological development entirely on the shoulders of the people who are too poor to take any risks. While all of the technical and natural systems used have been tried out and work in various parts of the world - they are new in this area and, therefore, potentially a risk at least from

the point of view of those who have never used them.

Therefore, a "mixed model" seems the best in that it provides the families with adequate facilities from the start, including the services and expertise of gardeners and technicians as well as it creates the motivation to cooperate in the scheme. The firm, on the other hand, takes the possible risk of the new development and at the same time reserves temporarily - for the first three years - the right to cancel a lease in case of severe non-compliance with the goals and rules set up by the community.

One aspect which is not taken into account in the various financing schemes, but affects the financial situation of the families substantially, is that the food from the self-sufficient gardens will practically pay for the houses in about 4 to 5 years. Any earlier completion of the gardens as in the rental or mixed model, therefore, can help the economic situation of the family at an earlier point in time.

Summary of the Caçapava Permaculture Project.

The goal of the project is to show that a sound ecological approach to planning and building is not only possible today but also more economic in the long run.

Ecological planning means getting away from linear, centralized delivery and disposal systems and creating small, decentralized circular systems which make the most efficient use of energy and all natural resources entering the system.

Furthermore, ecological planning means getting away from the separation of functions in towns and cities and re-integrating housing and industry, agricultural production and commerce, education and recreation, administrative and institutional uses. The mix and overlap of various functions reduces the need for transport, i.e. energy, and each use enhances the function of the other.

Planning for self-sufficiency is based on suitable sizes of sites for gardening and keeping small animals. This means a drastic reduction of the numbers of houses on the available site. Instead of 32 houses recommended by the local real estate agent on the 8000m^2 only about 15 houses can be built.

The design must be based on the participation of the user and local climate, topography, soil, water, vegetation and wind conditions, on the use of locally available - biological materials for construction, and on future expansion through self-help.

The use of solar and/or wind energy through simple inexpensive systems and the separate collection and recycling of solid and liquid wastes will reduce energy cost and produce organic material for the production of biogas and/or humus, waste water and grey water for watering and feeding plants and glass, metal, paper recycling to new uses and/or the respective industries.

The financing scheme and social organization allows people to become the owners of the houses and gardens and, therefore, develop a responsible attitude toward maintenance and improvement of the scheme.

Part One of the Caçapava Permaculture Project: the Self-Sufficient Workers' Houses and Gardens, will be funded

entirely through private means, but in order to make the information and experience available to others initial funding is sought for Part Two: the Permaculture Information and Resource Center.

PART II: A PERMACULTURE INFORMATION AND RESOURCE CENTER

The experience with experimental projects such as the autonomous "Naturhuset" in Sweden or the "Farallones Institute" in California has shown that the need for information on demonstration projects is enormous. Already, the first five lectures on the design of natural and urban systems given by Margrit Kennedy and Bill Mollison in Rio de Janeiro, Sao José dos Campos (2), Sao Paulo and Curitiba following their design work in Caçapava have created a network of interested groups and individuals who are presently setting up Permaculture Training Courses and experimental projects in their respective areas.

This overwhelming interest shown, coupled on the other hand with the difficulties experienced in getting the right seeds and trees or information on the necessary technical systems and building materials seem to make it mandatory to expand the scope of the Caçapava project beyond its original purpose. The experimental housing project, therefore, may become the starting point for a "Permaculture Information and Resource Center" encompassing several - possibly independent - operations which will mutually enhance each other:

1. a nursery orchard and tree crop arboretum
2. an experimental Fukuoka grain plot
3. a seed exchange
4. an information center and library
5. visitors accomodation and training facilities
6. offices and housing for director and staff
7. a surplus produce and plant market including a self-service restaurant/cafeteria

Various facts make it feasible to plan this project:

- first and foremost, a group of skilled, interested and dedicated individuals in the Caçapava/Sao José dos Campos area who are presently involved in the housing project and wish to continue and expand their involvement in practical implementation of Permaculture concepts;

- secondly, the availability of land and traditional agricultural production in the area;

- thirdly, a small innovative and far sighted business-enterprise sponsoring the operation, and possibly producing ecologically supportive products at a later (compost toilet, grey water filters etc.)

- fourthly, a network of similar experimental and research centers in Brazil and other parts of the world which will contribute materials, seeds, technologies, and know how. (see Annex...)

In order to be able to disseminate the information, seeds, and technology as cheaply as possible and thus make it available to the lower income groups, for which the initial project is an example, the center should become a non-profit organization which will pay for its operation in a two years time.

For a start, however, until the sale of trees and seeds as well as training courses will pay for maintenance and running costs, capital funds and initial running costs are sought as a loan or gift from outside funding agencies.

The following proposal and plans will need expansion in more detail, but should be sufficient to clarify whether interested funding agencies can sponsor all or parts of a Permaculture Information and Resource Center in Caçapava.

Building Program

Built upon the same ecological principles as the autonomous, self-sufficient workers houses (Part I) the spatial needs for the Permaculture Information and Resource Center will be the following:

information center and library	20 m^2
offices for director and secretary	20 m^2
housing for director	80 m^2
housing for gardener	60 m^2
visitor's accomodation (30 people)	300 m^2
cafeteria and kitchen	100 m^2
seed exchange and surplus produce market	100 m^2
toilets and laundry area	20 m^2
wood and metal workshops	100 m^2
alternative technology store	100 m^2
storage rooms (seeds, produce, machines)	200 m^2
TOTAL	1100 m^2

In order to turn the center itself into a small Permaculture demonstration plot the site should be about 2000 m^2. There are various possibilities for acquiring a site of this size - the best (see site plan) would be across the street from the workers' housing project (Part I) and next to the orchard which joins the nursery and tree crop aboretum site behind the factory. The orchard and the site for nursery and aboretum have yet to be acquired in order to assure production as well as demonstration.

Costs

Capital Costs:

At an average price of 170,-$/$m^2$ for construction (June 1981) the building costs for the Permaculture Center will be	$ 187.000,-
10% are need for planning and administrative fees	$ 18.700,-
5% for fees and travel of outside experts	$ 9.300,-
furniture and equipment	$ 60.000,-
site costs incl. acquisition (2000 m^2) estimated price June 1982	$ 10.000.-
existing orchard with mature trees presently for sale (15 000 m^2)	$ 150.000,-
the site for nursery and tree crop arboretum (2000 m^2)	$ 10.000,-
TOTAL CAPITAL COSTS	$ 345.000,-

Running Costs:

	1 year	2 years
Maintenance & supplies	$ 2.400,-	$ 4.800,-
office overheads	$ 4.800,-	$ 9.600,-
representation/travel	$ 2.400,-	$ 4.800,-
salary director	$ 9.600,-	$ 19.200,-
" gardener	$ 4.800,-	$ 9.600,-
" secretary	$ 4.800,-	$ 9.600,-
2 apprentices	$ 4.800,-	$ 9.600,-
TOTAL RUNNING COSTS FOR 2 YEARS		$ 67.200,-

PLANNING COSTS TO DATE

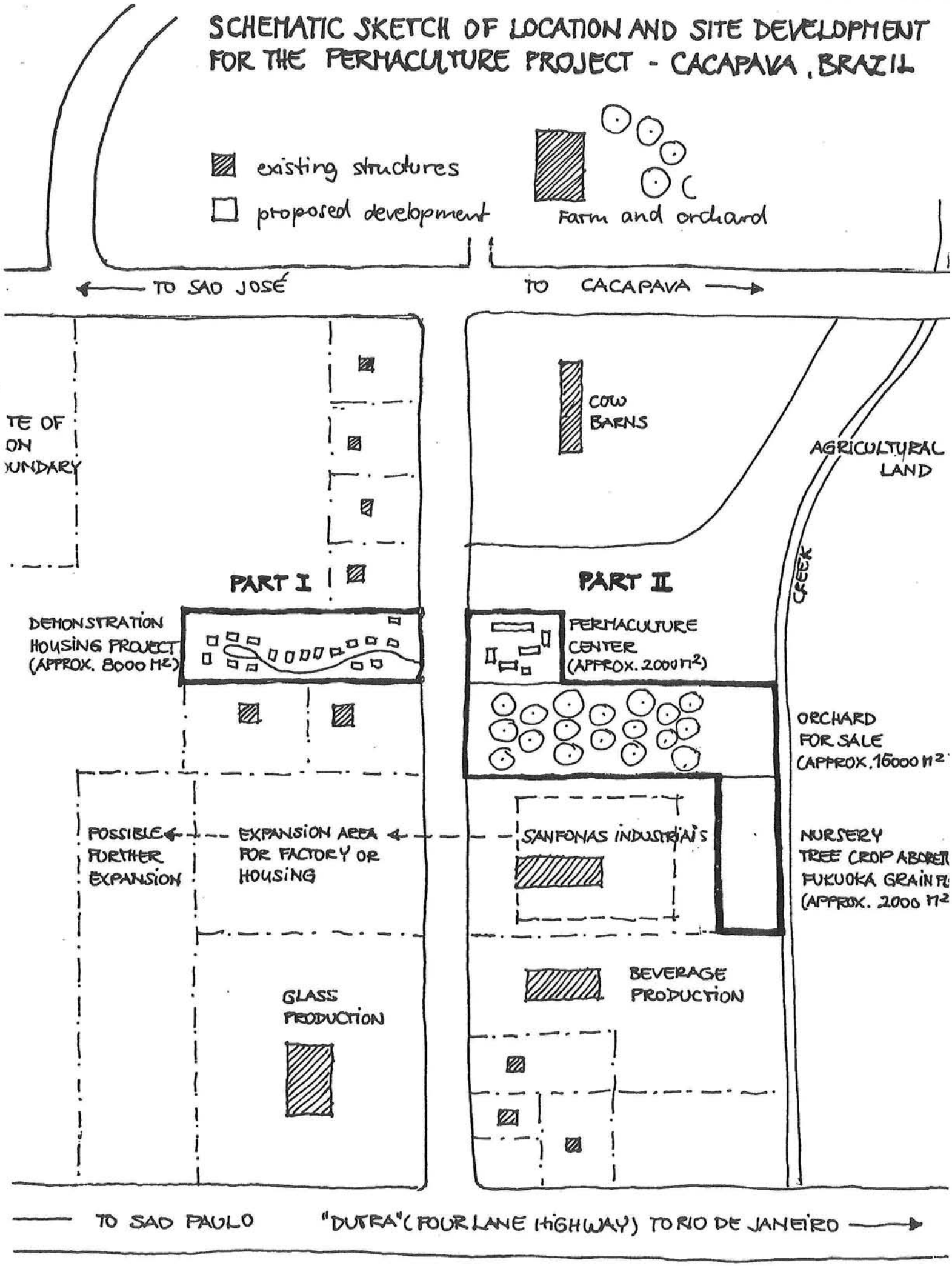
borne by Dr.Margrit Kennedy(M.K.) and Prof.Declan Kennedy(D.K.) Berlin, West Germany		borne by Dipl.Ing.Reinhard Hübner(R.H.) Sanfonas Industrias Ltda., Caçapava, Brazil	
Travel costs M.K. May/June 1981	$ 1080,-	Accomodation for M.K.	$ 1480,-
Taxi,Bus,Hotel	200,-	Car rent	275,-
Travel costs for Bill Mollison	1500,-	Accomodation,fees Bill Mollison	1565,-
Material,films,etc.	650,-		
	$ 3430,-		$ 3320,-

IMMEDIATE FUTURE COSTS to December 1981

Travel costs D.K. Aug.-Oct.1981	$ 1865,-	Accomodation for D.K.	$ 1955,-
		Garden consultant	1045,-
		Site architects	1955,-
		Engeneering	1305,-
		Planning permission	435,-
		Gardener	780,-
Travel costs M.K. Dec.1981	1505,-	Accomodation for M.K.	1355,-
	$ 3370,-		$ 8830,-
Direct work costs 4 months M.K./D.K.	15000,-	(R.H.) Estimated part-time work costs,8 months	10000,-
TOTAL	$ 21800,-	TOTAL	$ 22150,-
GRAND TOTAL		US	$ 43950,-.

Continua na página 15

SCHEMATIC SKETCH OF LOCATION AND SITE DEVELOPMENT FOR THE PERMACULTURE PROJECT - CACAPAVA, BRAZIL



ANNEX

by Bill Mollison

DOMESTIC GARDENS

The aims are:-

- to give staple foods
- to give high levels of nutrition
- to provide manures from plants + small animals
- to save on water
- to give some edible oils.

An essential is to bring in mulch as grasses and leaves and not to cultivate the ground beyond the establishment phase, to direct all roof and wastewater to productive use under trellis and in pits, and to irrigate into ring gardens by drip-line rather than by sprinkler or hose. Below tree crops, Desmochim or ground legume such as Dolichos lab-lab can be planted.

All species chosen except for a few minor elements are growing well in the district. Those not yet tried are not important foods. Thus, with care, there is no risk of "failure". Some elements such as ponds under trellis are also emergency water storages, fed from roof water only.

Bamboo is provided to keep trellis and chicken fence in order. Chickens should be partly local but crossed with hens of a good breed to increase egg-laying. Chicken food should be mainly household scraps plus some barley or rye (produced in the factory rice plot in winter).

Domestic animals are chicken + rabbits only, but perhaps geese or guinea-fowl could be run at the factory. Geese

could be tried for infected citrus crop, or dropped citrus included in compost, where pests are killed by heat.

The essential domestic crops (see plan...) are basic foods (staple foods) plus high-vitamin greens and vegetables. Acceptable staple foods are:

STAPLE (BASIC) FOODS (ALIMENTOS BASICOS).

Sweet Corn	Milho Grains		
Rice, Rye	Cerroz, Centeio		Grains
Wheat, Miller	Trigo		CEREALE
Sweet Potatoe	Batata dolce		
Potatoe	Batata Inglese		
Yam			Roots
Manioc			RAIS
Taro	Inhame	Colacasia esculenta	
Jerusalem Artichoke			
Banana	Nanica,	Musa spp.	
Plantain	Sao Tome		
Papaya			Tree Crop
Avocado			ÁRVORES
Guava			
Chestnut			
Beans,Pigeon Pea	(CASTANOS),Peas in ring gardens. Trellis Beans.		Legumes

Close to houses, the area is expanded for food crop by the use of trellis and vine crops, as follows:

TRELLIS (LATADA) and Vine (VINHA).

Passionfruit	Maracuja	Passiflora spp.	
Choko	Chucha		
Kiwi Fruit			
Luffa	Bucha		
Grapes	Uvas		
Scarlet Runner Bean	Feijao alpinismo		
Winged Bean	Feijao alata		Domestic

Lima Bean	Feijao de Lima	Bean Crop
Yardlong Bean	Feijao de metro	
Dolichos Bean	Feijao dolichos	
Blackberry	Rabus spp.	

Treatment of Trellis, see plan

T_1 = Trellis over door entrance. Aromatic evergreen vines (for example). Palm shading, some ferns below. Water in "stone beds" from NW roof section.

T_2 = Trellis to NE corner. Ferns below. Deciduous vine (grape) to provide summer shade. Watered from roof and glasshouse.

T_3 = Trellis above shower and handbasin water outlet. Small pond below grows water-cress for salad greens. Fully-mulched (90-200mm) straw bed produces strawberries on mounds, mint, parsley, chives, summer lettuce.

Vines above produce choko (chuchu), grape, and trellis at sides produce a variety of climbing beans. Mulch is watered by wastewater from shower. Excess water is led to taro bed outside trellis, banked by manioc crop. Wastewater first led to pebble-bed mound near wall.

T_4 = Trellis above SE corner. Different grape varieties over, mulched below and watered by roof downpipe, waste water from rear kitchen. Clean pond below for chinese water chestnut, frogs to eat garden pests. Pool filled from outside kitchen roof. Soft herbs such as parsley, chives, lettuce in summer. Side trellis for cucumber, climbing beans, luffa over area of summer kitchen. All sidecover vine crop are grown on a mulched mound to retain water. Blackberry

may do well on this relatively cool corner.

Side trellis is leant outwards from the roof.

Staple Root Crop.

The Taro bed is about 0,3m below grade, fills from the shower and handbasin water, and from the SW roof. It need not be kept flooded but needs to be damp, thus a thick grass mulch helps. Excavated soil is mound-planted with manioc, and also mulched. Edible leef taro + 2 or 3 other varieties are recommended.
The Manioc Crop. Two rows of manioc are planted around the perimeter of the taro bed*. These, like taro, are dug or renewed only every 18 months to 24 month, but some are replanted at any time after 12 months and may be staggered in age.
Sweet Potatoe is pit-planted in mulched beds outside the manioc crop. Beds are kept mulched in dormant periods.
Potatoe** is planted in one or two mulch-filled and side--boarded boxes, filled with hay or crop spaced at

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*taro = wet place

**put top green ones aside and use for new planting

0,3x0,3m placed in pit. Each potatoe seed is wrapped in a comfrey leaf, then the pit is filled with grass to a depth of 0,5m to top of boards, which are 180mm above grade. Crop is replanted 3x per year and pit re-filled level with mulch. On earth renewed, Jerusalem artichoke is grown. 2 beds of 10sqm are grown as staggered crop all year.

Jerusalem artichoke is mound-planted and mulched as a border-breakwind for potatoe plot. Mound is mulched. If beds are

Comfrey. Comfrey surrounds potatoe used as manure and can be used to help mulch manioc or to pit-mulch for sweet potatoe. It is dressed with chicken manure and/or urine from house, and used as green fed for chickens and rabbits.

"Weeds". Amaranth and Beldroega can be used as "encouraged weeds" for people and chickens, rabbits.

Maincrop

Crops of relatively low yield, or needing a great deal of space to be planted in the garden of the factory. These can be:

Pumpkin
Rice & cereals
Manioc
Water Melon

Manioc and Leucaena can be planted on the bunds of rice and taro beds, which may be flooded as needed. Leucaena is used as mulch in taro fields. Azolla, the small floating fern, should be kept in small ponds in rice patches for floating manure.

Milho is an important main crop to be grown on raised beds, sunflower as shelter and beans as companion or interplant.

Glasshouse

Glasshouse should be used for special crop e.g.

(1) Water convolous
(2) Orchid
(3) Ginger
(4) Chilipepper
(6) Turmeric
(8) Vanilla Bean (Orchid)

(see plan for numbers)

Cactus Garden

In the dry front area, efforts at less water use can be achieved by the use of edible and fruity cactus:

Opuntia
Pitaya — all cacti with edible fruits
Cereus

Annual Garden

I strongly recommend a "ring garden" approach to the sandy acid soils, (see plan). This has the following advantages:

- mulch is easily applied to the central hole, and can be sprinkled with lime to adjust pH;
- 4m of circumference is achieved for only 1,5m diameter, and this is a long "row" of vegetables;
- only one drip of water point per ring is needed, at

the centre of the mulch;
- cylinders of bamboo or cane will support vine crop
- in circles (snow or snap peas, cucumbers etc.);
- lines of circles are easily and economically watered by dripline;
- domestic paper and refuge may be mulched in the centre of the garden. Even cans and bottles may be included without harm.

For ring gardens, an area not exceeding 4 feet (1,3m) diameter is excavated, as much as one meter deep. Mulch as grasses, coarse palm or bamboo fronds, domestic waste and leaf litter is added in layers, and each layer sprinkled with lime or chicken manure if the ground originally lacks nutrients. Plants are set in or seeds rown on the inner slope of the circle, and a circular basket trellis may be added for climbing species. As mulch subsides, more may be added. A single drip at center provides water in dry periods. Roots have access to cool and damp compost, and water use is minimal. Such systems also suit flower qardens. Special borders of pigeon pea around sweet potatoe provide human and animal food (DAHL).

A single dripline, serving about 30 ring gardens of 1,5 meters should keep the family in vegetables. All of these border the path, and on the path side are planted to "plucking" crop:

celery
broccoli
leaf lettuce
snap peas
snow peas
chinese cabbage etc.

While on the "inner" side, they are planted to small root crop and to head "cutting" crop:

carrots
cauliflower
cabbage
head lettuce etc.

Centres of the ring-garden beds can contain one or two ring-garden pits planted to a runner squash or pumpkin, to zuccini, or water melonwhich are allowed to roam. Also in centre beds should be a few compositae (fennel, quillaja) for predatory wasps to visit.

Manure plants

Leucaena hedge supplies nitrogen in mulches and ring gardens, and comfrey provides potash to root crops; both can be supplemented by chicken manure, manure from rabbits and pigeons.

Animals

I have shown 3 pens of rabbits, and the area below the tree crops is chicken run. There needs to be two laying hens per person, and food is mainly from comfrey crop, Leucaena, some grain, and household scraps. Manure is returned to ring gardens and comfrey plots.

Investigations of pigeon houses locally may reveal a good varieties. If so, I would certainly add a pigeon loft to all houses (a small but tall structure) for egeg and squabs, but more particularly for manure. These would need some pigeon pea, but will freerange for food at most times.

Rabbit cages need a bag-covered and damp worm bed below. These convert droppings to manure and compost for the glasshouse, and provide worms for pond fish or shrimp,

chickens, and the ring gardens.

Along the motel wall, a mixed crop of sugar cane, beans milho and cucurbits can be made.

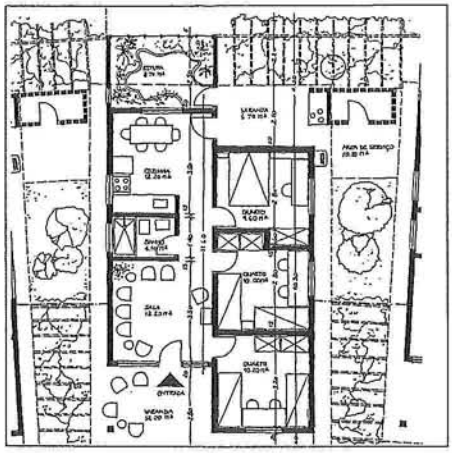
The communal pond

The pond needs careful excavation, with earth mounded at edges to take a few mulberry trees, some shallow areas, but mainly 1,0 to 1,5m deep; if one duck flock were allowed access to this pond, shrimp (Malayian prowns) could be grown.

If this trial proves successful, ponds of 400m^2 could be constructed below the present factory, or a larger variety site selected for prawn production. Ducks give essential manure to such ponds. Pond shape can be somewhat as suggested below:-

352–355 *Permacultura*

Ein Projekt von Declan *und* Margrit Kennedy *für Cacapava in Brasilien umfaßt 15 Einfamilienhäuser mit Intensivnutzgärten. Die sorgfältige Behandlung der Klimaprobleme, die möglichen Wachstumsstadien und die Hügelbeete mit der Irrigation stempeln diese Arbeit zu einem Vorbild einer human-ökologischer Annäherung.*



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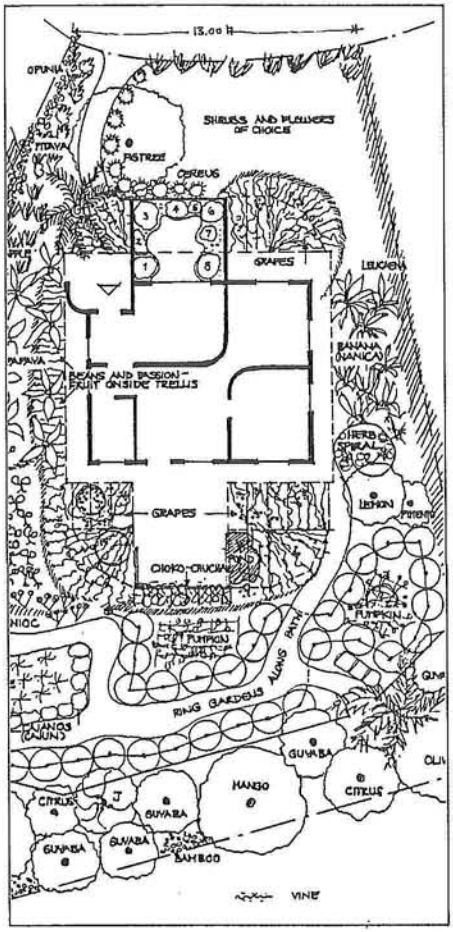

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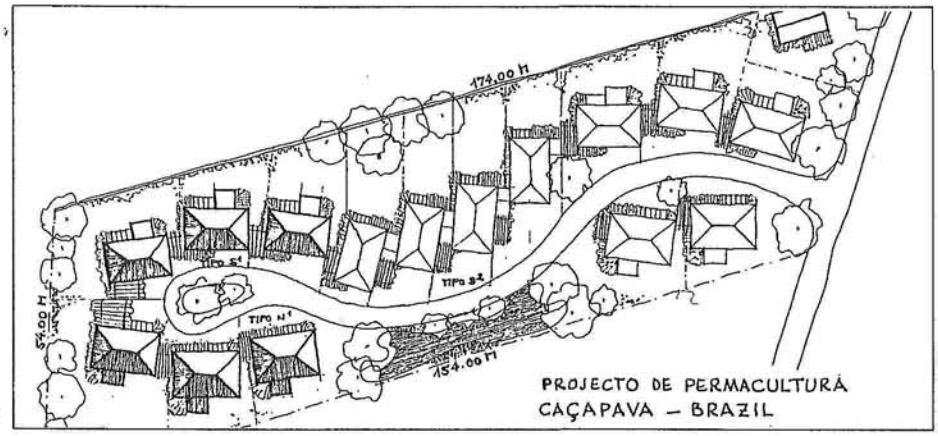

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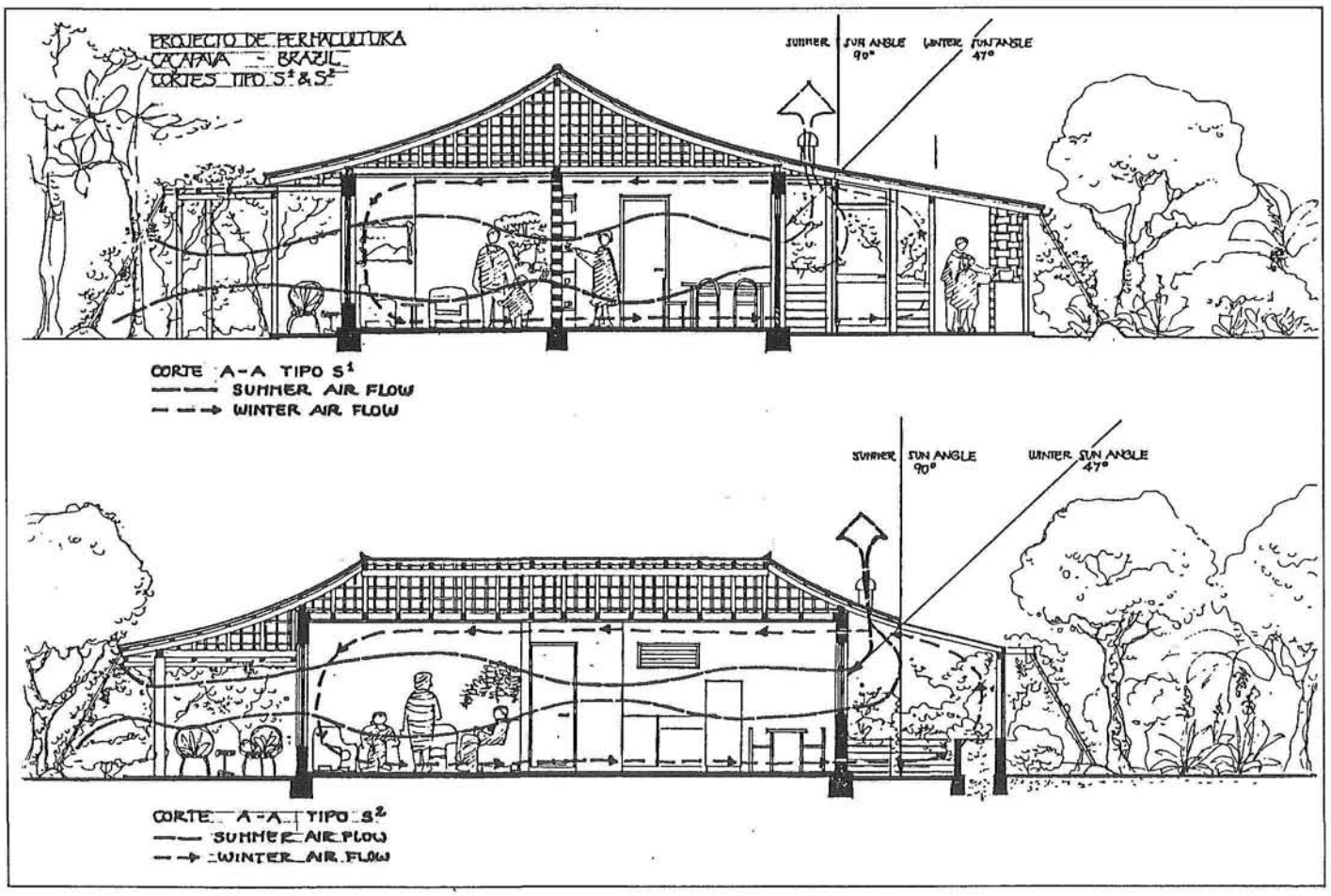

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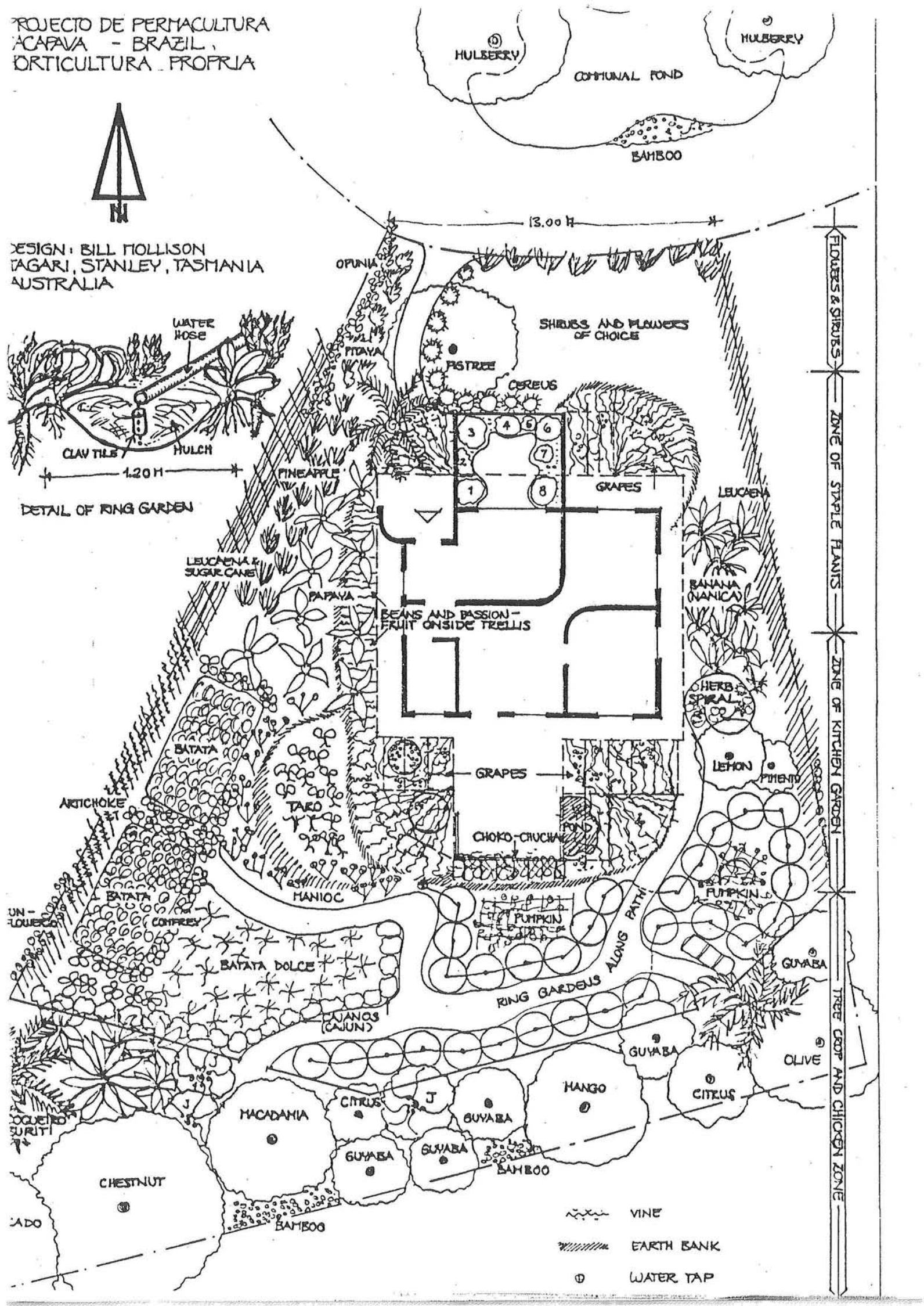
ROJECTO DE PERMACULTURA
ACAPAVA - BRAZIL.
ORTICULTURA PROPRIA
N
ESIGN: BILL MOLLISON
TAGARI, STANLEY, TASMANIA
AUSTRALIA
HULBERRY
HULBERRY
COMMUNAL POND
BAMBOO
13.00 M
FLOWERS & SHRUBS
ZONE OF STAPLE PLANTS
ZONE OF KITCHEN GARDEN
TREE CROP AND CHICKEN ZONE
OPUNIA
SHRUBS AND FLOWERS OF CHOICE
WATER HOSE
PITAYA
PISTREE
CEREUS
CLAY TILE
MULCH
1.20 M
DETAIL OF RING GARDEN
PINEAPPLE
GRAPES
LEUCAENA
LEUCAENA & SUGAR CANE
PAPAYA
BANANA (NANICA)
BEANS AND PASSION-FRUIT ONSIDE TRELLIS
HERB SPIRAL
BATATA
GRAPES
LEMON
PIMENTO
ARTICHOKE
TARO
POND
CHOKO-CHUCHA
MANIOC
PUMPKIN
BATATA
COMFREY
PUMPKIN
RING GARDENS ALONG PATH
GUYABA
BATATA DOLCE
JANOS (CAJUN)
GUYABA
OLIVE
MANGO
CITRUS
MACADAMIA
CITRUS
GUYABA
GUYABA
GUYABA
BAMBOO
CHESTNUT
BAMBOO
VINE
EARTH BANK
WATER TAP

31 36 71 Raimal + Fr. Vicuña

	26-	Mamão	Papaya	Semente
	27-	Maria Preta		Sem.)Muda
2	28-	Oliva	Oliven	Comprar
1	29-	Fruta do Conde		Semente
	30-	Coqueiro Burite Jerifa	Kokospalme	Comprar
	31-	Bananas	Banana	Muda
	32-	Bambuzão	Bamboo(gr.)	Muda
	33-	Romã	Pommegranet	Comprar
Ilhabela Tabatê	34-	Ervas Medicinais	Med. Kräuter	Muda
	35-	Bambu commun	Bamboo(kl.)	Muda
	36-	Pimentão	Pfefferschooten	Semente
	37-	Bambu- canada índia	Canadian bamboo	Muda
	38-	Pinho Araucária	(Chile)Tanne	Semente
	P -	Parreira	Weinlaube	Muda/Comprar
→	Ch-	Chuchú	Shou-shou	Semente
	M -	Maracujá	Passionsfrucht	Semente
	C -	Cana de açúcar	Zuckerrohr	Muda

Carlão / Declan, August 1981

Linhaça	Leinsamen
Agriões	Kresse
Funcho	Fennel

= Acera Paulista = 24 000 m2

HUBNER

Estrada Municipal do Tigrão Km. 02, n.º 412
CAÇAPAVA - SP

Para cada casas	Nr.	Nome	Name	
3	1-	Castanha Portuguesa	Port. Kastanie	Semente
3	2-	Nos Pecan	Pecannuss	Comprar
2	3-	Cajú	Kajunuss	Semente
2	4-	Abacate X	Ananas	Semente
1	5-	Jacá	Brotfrucht	Sem.)Muda
1	6-	Manga	Mangofrucht	Semente
2	7-	Caqui	Aprikose	Comprar
2	8-	Pera	Birne	Comprar
1	9-	Jatobá PANDA		Semente
2	10-	Jabuticaba	Schwarzkirsche	Comprar
3	11-	Maçã	Apfel	Comprar
5	12-	Limão	Zitrone	Comprar
5	13-	Laranja	Orange	Comprar
5	14-	Tangirina	Tangarine	Comprar
2	15-	Mixirica		Semente
1	16-	Araçá	Arrak	Semente
1	17-	Urucu		Muda
3	18-	Goiba	Guavenbirne	Muda
2	19-	Maria Cabeluda		Muda
	20-	Ume		Muda
	21-	Banchá		Muda
	22-	Amora X	Maulbeere	Muda
3	23-	Pitanga X		Semente
2	24-	Pêssego S. Antonio d.P.	Pfirsich	Comprar
2	25-	Ameixa X	Pflaume	Comprar