OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

08765

Distr.
LIMITED

ID/WG.293/37
16 March 1979

ENGLISH

United Nations Industrial Development Organization

Workshop on Fermentation Alcohol for Use as
Fuel and Chemical Feedstock in Developing Countries

Vienna, Austria, 26 - 30 March 1979

BRAZIL'S ENERGY ALTERNATIVES*

by

A.E. Inojosa de Andrade**

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Rua 7 de Setembro, 55, 13° andar, Rio de Janeiro, RJ, Brazil

1) The Brazilian Energy Problem

1.1) Miscellaneous

According to the National Energy Balance - 1976, released by the Energy Ministry, the Brazilian energy consumption in 1975 was equivalent to 92 billion tons of oil and might be reaching 189 billion tons of oil within 10 years. Table 1 shows the contribution of several sources of energy at the beginning and at the end of the aforementioned period.

Table 1

Participation of energy sources in the country's overall consumption - 1975- 1985

Energy Sources	Participation %		
	1975	1985	Difference
Petrol derivatives	44.3	36.4	- 7.9
Water power	23.2	30.9	+ 7.7
Timber, coal charcoal and vegetal coal	28.8	19.1	- 9.7
Mineral coal	3.3	8.6	+ 5.3
Others sources	0.4	5.0	+ 4.6
Total	100.0	100.0	-

Source: National Energy Balance - 1977 - Energy Ministry, pp. 18/9

The data shown in Table 1 let us know that the Brazilian strategy in relation to its energy supply will be based on the intensification of use of water power, mineral coal, nuclear energy and of alcohol, the two latter included in the item "other sources".

It is worthwhile mentioning that Brasil is practically poor in fossil fuels such as oil, shale, natural gas and coal therefore, does not have many alternatives to adopt for the increase of supplies to meet Brasilian energy needs.

1.2) Potential of Fermentation Alcohol

Alcohol can be used as fuel either in a blend with gasoline or by itself.

Engines were created in the second half of the past century and alcohol was used as fuel. However, they were developed in countries where oil was more abundant than alcohol and then made in such way as to consume oil derivatives rather than alcohol.

Another important characteristic of alcohol is its use in the chemical industry as a substitute for oil byproducts and its derivatives. Under these circumstances, it is worth considering alcohol technically as an oil substitute, notwithstanding the problem that large-scale production will be possible only in a number of countries.

This is due to the fact that alcohol might be produced by the transformation of solar energy into vegetal biomass via photosynthesis, according to an agricultural system that takes into consideration not only the most favourable plant but also a number of favourable natural, economic and ecological factors.

It is already known that a large variety of plants are able to produce alcohol, through a fermentation process.

Regarding Brasil in particular we can say that sugar cane is the most important of these plants, followed by saccharine sorghum, and corn, and manioc, respectively.

I will be referring mostly to sugar cane from now on not only because it is my field of main interest but also because it is so far the only green plant with definite and controlled technology under industrial management to produce alcohol.

1.2.1 Availability of Tillable Land

There are three main factors influencing the production of sugar cane: soil, topography and temperature. Soil is one of them despite the fact that sugar cane is not a very demanding crop in terms of soils, particularly if we consider today's advanced methods of soil preparation and fertilisation. It goes without saying that the richer the soil the better the agricultural yields, but even with minor yields it is possible to produce sugar cane in almost any type of soil. The fact that Brazil has a great variety of soils doesn't prevent us from planting cane successfully in almost every section of the country.

More important than that is topography because while soils can be corrected in terms of fertility, it cannot be influenced by man in any other way. Thus, if steep inclinations are found, mechanization of soil preparation, cane cutting and transportation is extremely difficult.

The last but not least factor is temperature. It should be between 15 and 40 degrees Centigrade (59° and 104° F.) and the level of precipitation should be over 1.200 mm annually.

Not many regions in the world present such suitable combination of soils, topography, temperature and water availability constituting the physical basis for a large-scale production of alcohol to substitute oil. Among the countries which have such adequate areas, Brazil is the one with the biggest potential in natural resources suitable for sugar cane production.

The cane activity in Brazil presently occupies an area of about 2.5 million hectares, that is, 25.000 km^2. This area provides the production of 100 million tons of cane which would produce 7 billion liters of alcohol annually if they were totally processed.

For you to have an idea of how significant these figures are let me inform you that our annual gasoline consumption is in the order of 15 billion liters.

A program planned to reach a production of alcohol two times the present gasoline consumption would require either a land area of 100.000 km^2 with cane plantations or much less because, being an additional production, it might be implemented with such productivity levels that the land area first needed could be reduced to 6.000 km^2. This is a small area if we compare it with the Brazilian potential to produce sugar cane.

Two sections of the country are still agriculturally virgin, so to speak: the Valley of the San Francisco and the Cerrados Region, the former in the northern part of our country and the latter located in the central region. Both offer tillable land not yet under cultivation of any kind, whose potential for production of sugar cane is the most valuable.

1.2.2 Manpower

Considering an average productivity of 1.5 man/day per ton for the production of 100 million tons of cane the volume of the employed manpower is in the order of 417 thousand workmen.

A program for the expansion of the sugar cane crop can be accomplished with a higher productivity level.

Under these conditions, in case we admit productivity of 0.8 man/day per ton of cane, the additional volume of the required manpower is about 952.000 workmen, as follows:

$$\text{cane volume} = \frac{30.000.000,000}{70} \text{ litors} = 428.571.000 \text{ tons}$$

$$\text{number of workmen} = \frac{0.8 \text{ man/day} \times \text{cane volume}}{360} = 952,000$$

This manpower contingent to be employed in the rural zone of the country is not incompatible with the economically active population living there.

As a matter of fact, according to the census data of 1970, there were approximately 26 million inhabitants living in the Brazilian rural zone in the age range from 15 to 60 years for both sexes.

The only problem concerning large-scale sugar cane plantatio.. is the need for a migratory flux of workers to the areas to be tilled; for example, the San Francisco Valley and the Cerrados Region where one can find a very low demographic density especially if compared with other rural zones.

1.2.3 Luminosity

Using sugar cane or any other green plant for the production of alcohol to substitute oil is the same as to use solar energy as a primary source of energy.

For you to have a better idea, consider the classification made by Ananichev in his paper "The Energy Problem and Sources of Energy". He classified these sources into 7 systems of which I will only mention the second one.

"System 2 - based on organic life, such as photosynthesis and the energy of microorganisms. Solar light, solar radiations as well as cosmic rays are sources of energy that operate over the living material".

In the light of the above, the utilisation of sugar cane corresponds to the utilisation of solar energy in the primary form of light which, via photosynthesis, is transformed into vegetal biomass.

Under these circumstances two elements ought to be considered. On the one hand, the vegetal matter that presents the best efficiency in absorbing such energy and on the other, the fraction of energy in the form of light, whichreaches the surface of the earth.

It is easy to understand that the tropical zone presents the best luminosity level on earth and the minimum level of cloudiness. Consequently, the maximum isolation is observed. In Brasil the region which presents the highest luminosity level is the Valley of the S. Francisco.

Figure 1 shows the thermal potential of that region called "BARRA-BA" in comparison with other sugar cane areas in the world. Once the thermal potential serves to measure soil temperature and this is closely related to the environmental luminosity, one can testify the superiority of the S. Francisco region in relation to the others.

1.3 Advantage and Disadvantages in the Alcohol Production

1.3.1. Effects on Balance of Payments

The purchase of imported oil has become a heavy burden for the national economy for two major reasons: First, the steady pace of price increases and secondly 30.1% of the exports income of the country is used to pay the bill of imported oil.

A program to substitute alcohol for oil has the advantage of reducing the burden that the importation of such fuel represents for the balance of payments of the country.

According to data taken from the National Energy Balance 1 liter of alcohol is equivalent to 99% of a liter of gasoline, in energetic terms. Under such conditions, 30 billion liters of alcohol represent an oil volume in the order of 186 million bbl, that is, US$ 7.3 billion at today's price.

Forecasts have been made that petroleum will be costing threefold by 1985 and in case they come true those 30 billion liters of alcohol will represent a saving in the order of $ 6.9 billion for our country.

1.3.2- Pollutant Effects

You might have heard of the so-called "Greenhouse effect" that occurs when CO_2 is released by a number of things including one that is the result of the gasoline combustion. CO_2 is then in the atmosphere forming a "blanket" that reflects heat and warms the earth. Just think of the effect it causes on our vegetation, on our health.

For a long time pollution has been one of the greatest concerns of our society; the excessive number of vehicles in the streets and the

excess of CO_2 released by them has been worrying scientists who have been doing their best to find out a satisfactory solution for the problem.

At the Aerospacial Technical Center in Brazil studies were carried out and the results showed that if alconol were added to gasoline in a 10% ratio, a fuel blend whose effects over pollution would be almost the same as those of the gasoline combustion could be obtained. However, an engine working solely with alconol would almost eliminate air pollution.

The only attendant problem concerns the disposal of a residue derived from the production of alconol, that is, vinasses. Nevertheless, this question should be faced by taking two different points into consideration: the pollution itself and the recovery of salt and organic substances.

A workshop has been recently held in Rio de Janeiro and 4 main solutions for the vinasses problem have come out:

1. In a short-term basis the best to do is to melt the vinasses in irrigation water so that it can serve as a fertilizer.
2. A byproduct can be obtained through evaporation and that may be used as manure or cattle feed.
3. Vinasses can be used as fungi substrate for the production of protein with low content of acidity.
4. The fourth solution is the production of methane by the aid of thermophilic bacteria.

In Campos, State of Rio de Janeiro some experiments have been carried on the use of stabilization and oxidation lagoons.

All of these solutions are expensive, however, and demand investment that has to be added to that for distilleries.

1.3.3- Comparative Cost

As it always happens when some product is liable to substitute for another in the marketplace, different opinions as well as opposing trends are formed.

Naturally the story repeats itself when we refer to alcohol and petroleum and I would say that among the items already discussed here this is the most controversial of all.

I will draw a parallel between both, and facts and figures will tell by themselves why I consider alcohol the best solution for our search for alternative energy resources and consequently why sugar cane is, in my opinion, the crop of the future.

The characteristics are the following:

1. In order to produce alcohol one only needs to make use of internal factors, that is, national currency as well as land and manpower that can be gotten at low cost, whereas we spend on oil about 30.1% of the exchange value generated by our exports, that is to say we depend on approximately 80% of imported oil. As a consequence that oil ought to be paid by the so called strong currency.

2. Nowadays petroleum is cheaper than alcohol due to the fact that the former already has an economic structure all adapted to its distribution, refinement, stocking, consumption, etc., whereas many adaptations are still required for alcohol production and consumption. Nevertheless, one should take into account the great potential some countries have to produce alcohol that may be abundant and cheap, at least cheaper than oil, in a near future. For all the reasons already expostulated previously Brazil is included in the group of countries where alcohol shall be produced at a large scale because of its privileged climate and abundance of green plants and water supply. On the other hand, it is well known that the petroleum beds have been far too explored and consequently become an increasingly dwindling resource.

2) Strategic Importance of Alcohol Production in Brazil

The main advantage of a program aiming the replacement of petroleum by alcohol, particularly that derived from sugar cane, is the

enlargement of agricultural borders.

Since it is impossible to think of such a program near big urban centers due to the inavailability of land area and its high cost, areas which are still depending on an economic utilization, would be naturally boosted.

Another consequence of this replacement would be the generation of stable agricultural jobs, thereby providing incentive for and strengthening the territoral occupation of rural areas.

2.1 Independence from Foreign Sources of Liquid Fuel

A difficult problem that Brazil faces and urges to solve is the question of its excessive dependency on imported liquid fuels, particularly on petroleum.

This dependency occurs mainly on the economic and political fields.

First, our oil imports are paid for in dollars thereby disturbing our commercial balance; yet the threat of a sudden increase in the oil price is all the time hanging over our heads.

Our political dependency is perhaps more serious than that. In case we do not manage to overcome the losses we have been facing due to the present dependent situation, our country will be for ever subdued by threats of oil restriction besides the liability of disagreements among those traditional national suppliers.

The problem would be at least partially overcome if a sound production of alcohol were started in the country, which might also become an exporter of oil substitutes to nations that do not have their own petroleum sources.

Studies carried out in Brazil show that it is possible to still 1.500.000 corn/ tons day with the waste of the resultant bagasse of a mill which operates with the capacity of 7,500,000 TCD and, as a consequence, get 1.000.000 liters alcohol/ day.

The result of corn stillage would allow the complementation of cattle feed for 200.000 heads.

3) Conclusion

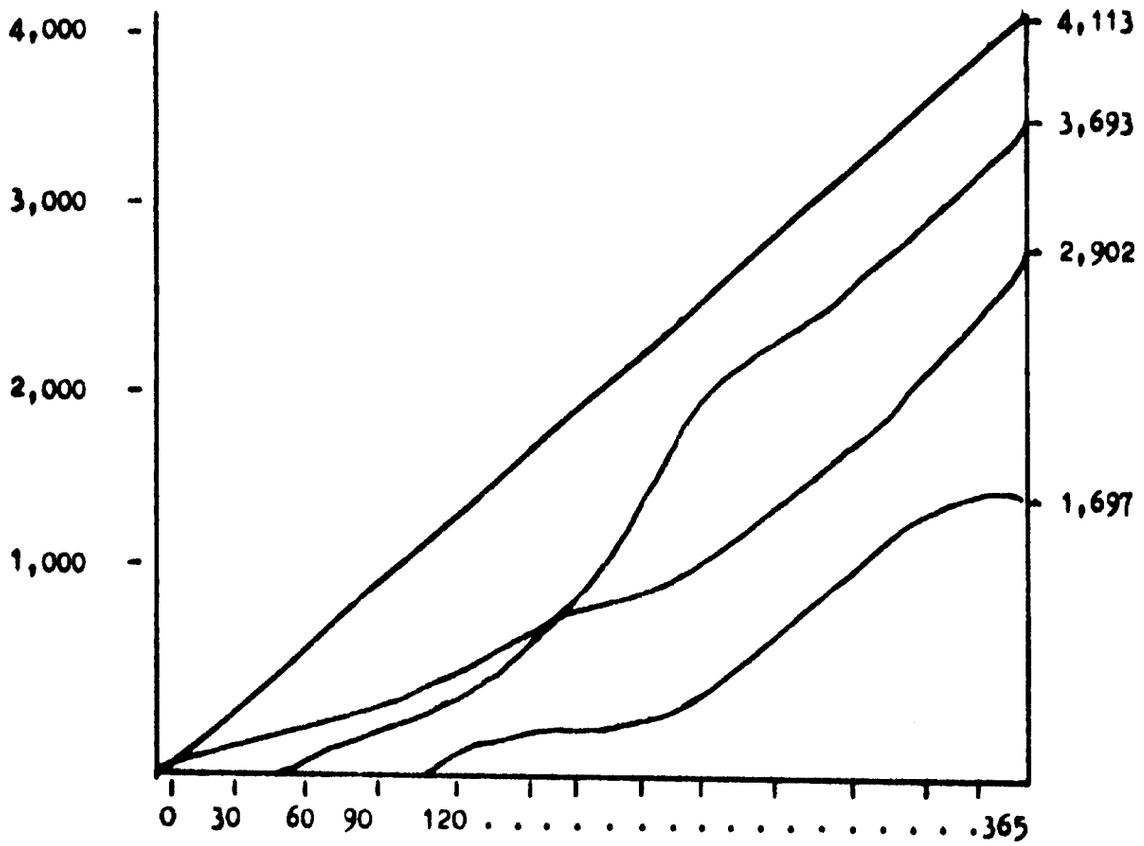
The long and short of it is that we Brazilians doubt there is any oil in our country but we are certain of our capacity to produce enough alcohol so as to meet our energy needs and therefore, substitute our oil imports; we are also positive that with such production of alcohol we will be able to generate new jobs - an important consideration for a country where population grows at a rate of 2.8% a year.

In addition, if we are able to produce as much alcohol as we need to match our consumption, we will not need to rush in the international market tendering the oil. In other words, we are helping the world community to cope with the terrible oil crisis.

Figure 1

Thermal Potential in Some Sugar Cane Areas
(in degree/days accumulated)

D= degree/days accumulated



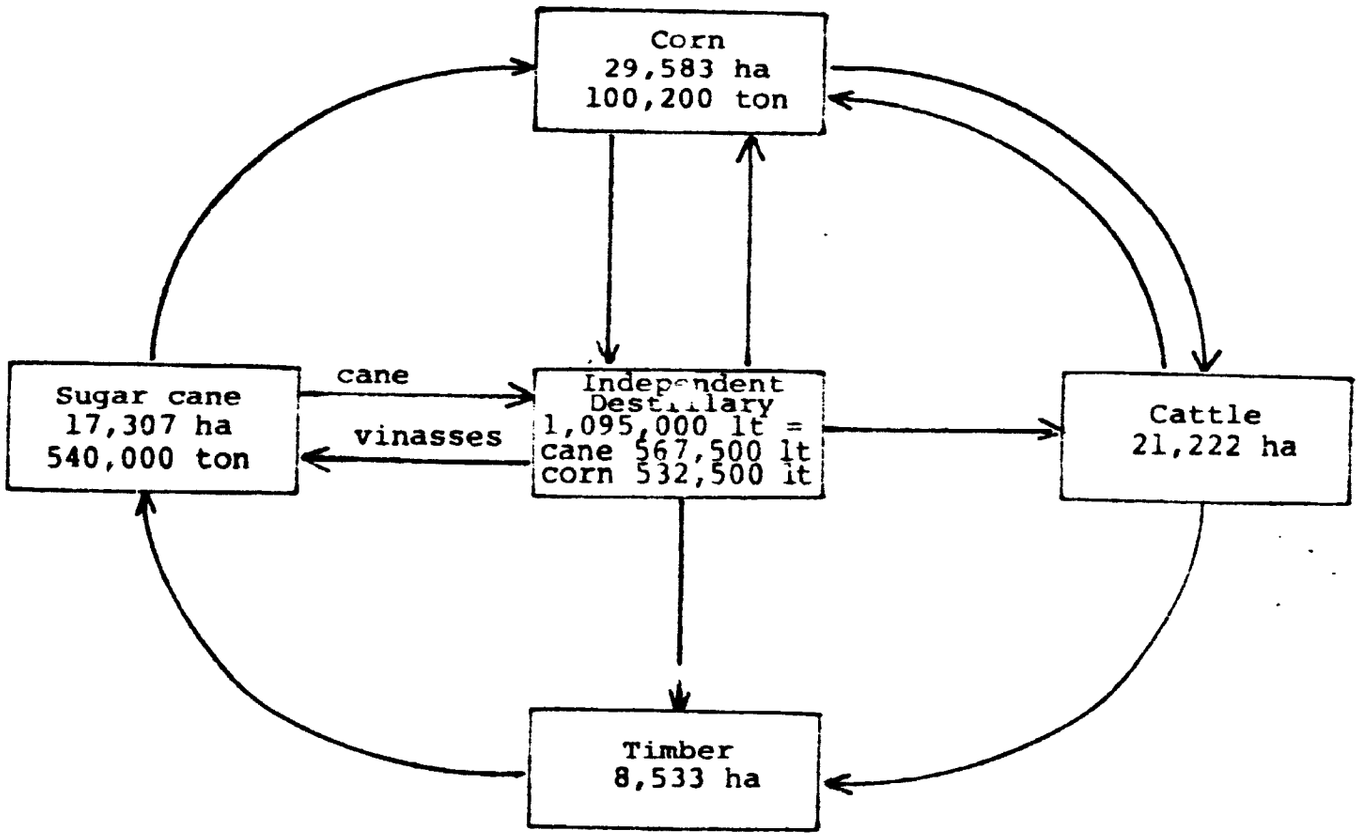
source:

D= degree/days accumulated were calculated by means of =

$$D = \sum_{i=1}^{365} (t - 15^{\circ}C)$$

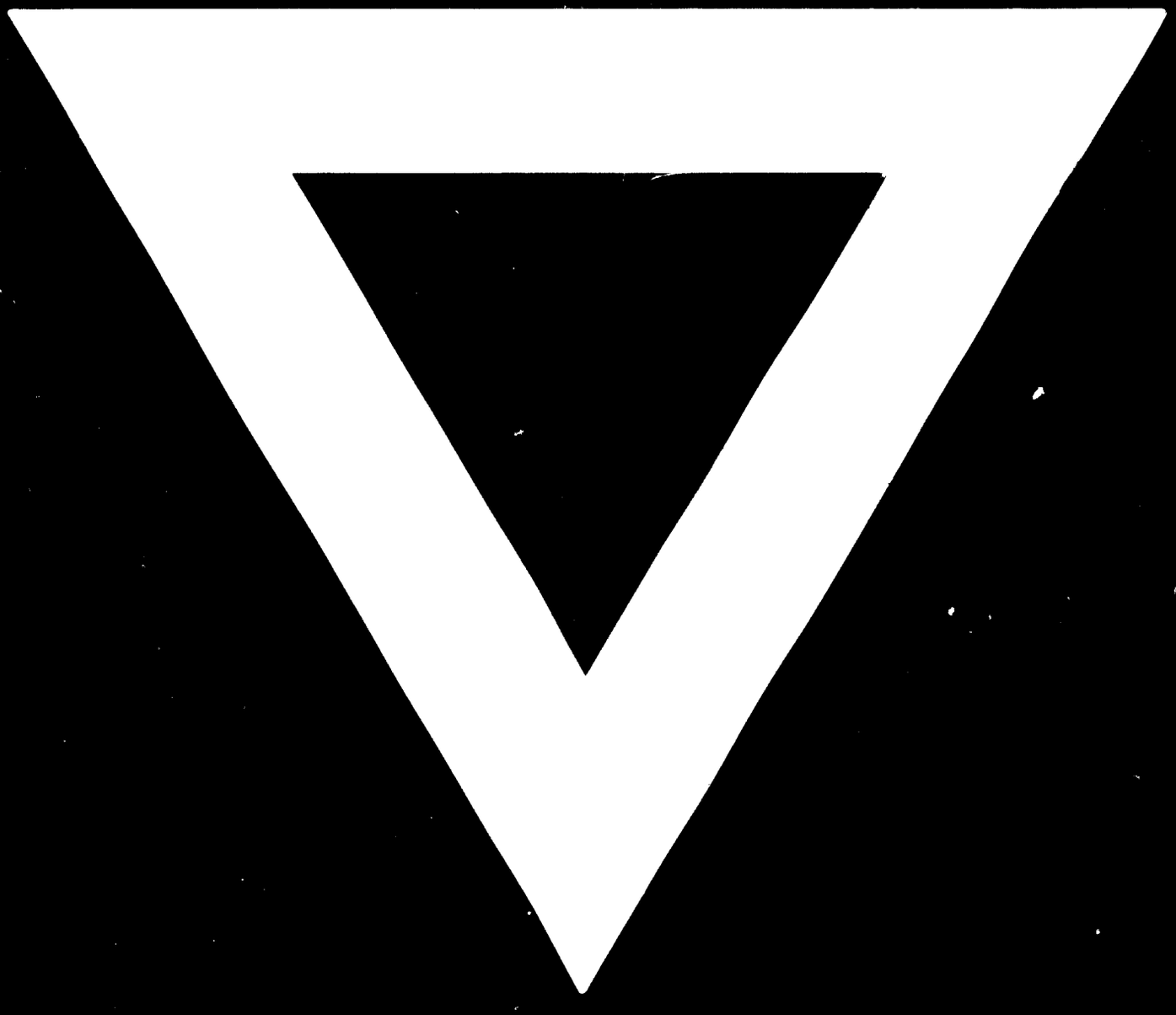
where t is the average temperature of the i day

Model of an Ideal agro-industrial complex



Cattle - 191.860 heads

B-81



80.02.04