THE USE OF DIAGRAMS IN THE SYSTEMS APPROACH TO FARM ANALYSYS*

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The need to view the farm as a whole placed within a regional context and relating its individual production units or agroecosystems to the region's productive process, has brought up a series of different procedures of farm analysis with a systems approach frame-work.

A diagram, when properly used, can be a very usefull tool in simplifying a complex reality, visualized as a system and, in spite of being a time consuming procedure, may, in the long run, be an efficient time-saving device.

The diagraming technique described in this paper was developed by Hart (1979), adapting the sysmbols used by Odum (1971) (Table 1).

To demonstrate the technique, a farm is used, but we could also diagram a region or the farm agroecosystem. Examples of these diagrams are contained in the appendix.

To start the diagram, we must first determine the limits to the system. The farms limits may be fences, ridges, rivers, roads, etc. and it is essential to count on the farmer's aid to define these limits. If the farm consists of more than one plot, but these plots are administrated by the farmer as a whole, we shall consider them as being within the farm's limits. In the diagram, these limits are represented by a rectangle which will surround all the farm's components and flows (Fig. 1).

The farm components are the socio-economic sybsystem and the agroecosystems. The first includes all the infrastructure and the family as such and is represented by a rectangle placed on the left hand side, inside the farm's limits, while the later correspond to all the ecosystems with populations that benefit or affect, in an economical biological or social way, the farm or the family. It is essential that a dynamic concept is present when defining each agroecosystem's limits. In other words, we must consider the change derived from asociations within an agroecosystem. As an example, we can state an agroecosystem in which maize and beans are planted together and when the beans are harvested, grass is placed while keeping the corn standing. This system is

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considered as one agroecosystem. The concept of time may be varied, for example, if we want to define the limits of a forestry agroecosystem, the time limit might go from 15 to 20 years. The purpose of our study may be another factor included in the definition of an agroecosystem. For example, if we are interested in dairy production, we will probably include living fence posts as part of the cattle + pasture agroecosystem, and include firewood production as an extra out-put of this system. If, instead we are working on an agorforestry proyect, we may wish to describe the living fence post system as a separate agroecosystem, and study in detail all of its in-puts, such as labor, new posts, etc. and out-puts such as animal feed, fruits, mulch, nitrogen fixation, etc. The components (the agorecosystems) are placed, for convenience, on the right hand side of the diagram (see Fig. 1).

The following step is to define the in-puts to the farm. Some of these may go directly to the agroecosystems (i.e. piglets), while others may be stocked for some time in the socioeconomic sub-system (Fig. 2). Money is an in-put to the system, and is represented by a dotted line. The flow from the money in-put symbol to the money storage symbol represents credit (Fig.3).

After the in-puts are registered, we proceed to determine the farm's out-puts, which are drawn on the upper left hand side of the diagram (Fig.4).

For representing the interchange of money for out-puts and in-puts, we use the economic transaction symbol (Fig.3).

To continue with the diagram, we now determine the in-puts to each of the agroecosystems. For example, the dairy cattle + oxen + pasture agroecosystem has agricultural in-puts for the pasture (fertilizers, herbicides, etc.), whey coming from cheese precessing, which is fed to the calves, labor, etc. (Fig.5).

The outputs are also defined and represented in the diagram (Fig.6). From this same agroecososystem we have the milk production, which is stored and part used by the family, some is used for cheese production, part of it is sold and some goes back to the agroecosystem for calf feeding. Other out-puts are calves, which are sold and ox-work, which is used in the maize + beans/pasture and maize + potatoes + bean/vegetables agroecosystems.

When we have completed all the in-puts and out-puts we have a qualitative diagram of the farm (Fig. 7).

To obtain a better tool, we may want to quantify each of the flows.

Quantification may be done in terms of energy, if we want to make an ecological type of analysis or we can put prices or values (opportunity costs) to make an economical evaluation of the farm. In the diagram, wheight and time volume measurements were used to quantify the flows.

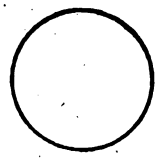
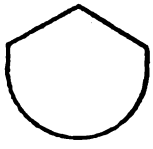
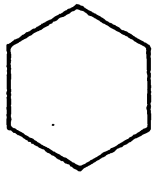
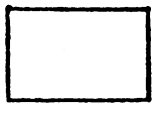
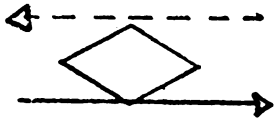
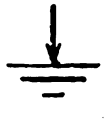
Going back to the cattle + oxen + pasture agorecosystem (Fig.8), we have monthly in-put flows equivalent to 41 liters of milk for calf feed, 75 labor days, 5 kg cramp-irons, 31 kg salt water, 1078 kg animal feed, 300 kg fertilizer, 15 lts herbicide, 2394 liters of whey and finally 500 kg of crop residue which is fed to the animals.

When all the flows are quantified, we have a quantitative diagram of a farm (Fig.9). When we are interested in a specific problem on the farm, it is not necessary to quantify all the flows, but we do need to qualify the flows that are directly or indirectly affected by a change in the component or flow we are working on.

In the same way we diagrammed the farm, we may diagram its agroecosystems and the region, of which it is a component. Figures 10 and 11 are examples of regional farm and agroecosystem diagrams (respectively). It is important, when working at farm level, to know how the changes in a certain agroecosystem we're working on, will affect the farm's productive process and consequently, the region's productive process. Diagrams of the three hierarchical levels will aid in visualizing and understanding the flows of a product along its whole process, from the agroecosystem to the consumer.

Figures 12 and 13 are examples of diagrams representing a subsistence type farm in Honduras and Cash-crop (coffee, sugar cane)/animal production farm in Costa Rica.

Table 1. SYMBOLS USED IN THE ELABORATION OF THE DIAGRAM (ODUM, In HART, 1979)

	Means "source". These are inputs that supply the elements of production. They are external to the farm system and outside its control. eg. the Sun, springs, etc.
	This symbol represents a reservoir of a product, water, etc.
	Represents the symbol for living beings. In the diagram it is used to indicate the family.
	The rectangle represents the components of the farm (our system) without entering into the internal processes of the component.
	This symbol describes an economic transaction and indicates the exchange of money in one direction, the discontinuous line, for materials that enter the system in the other direction (the contnous line). The relationship between one and the other is the price per unit of production.
	Indicates the losses that occur in the different processes.

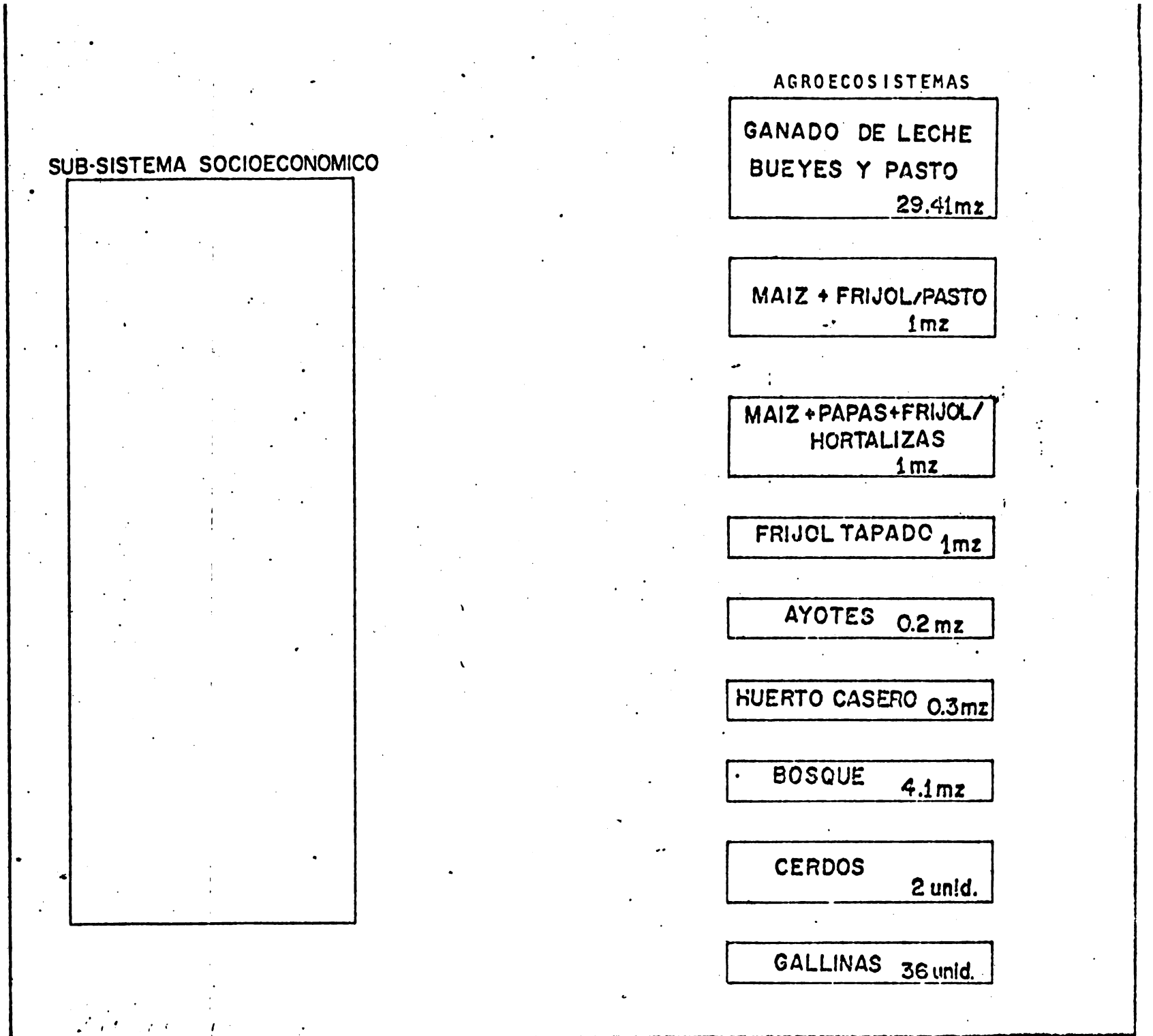


Figure 1. Farm diagram: limits and components
From: Rockenbach, 1981.

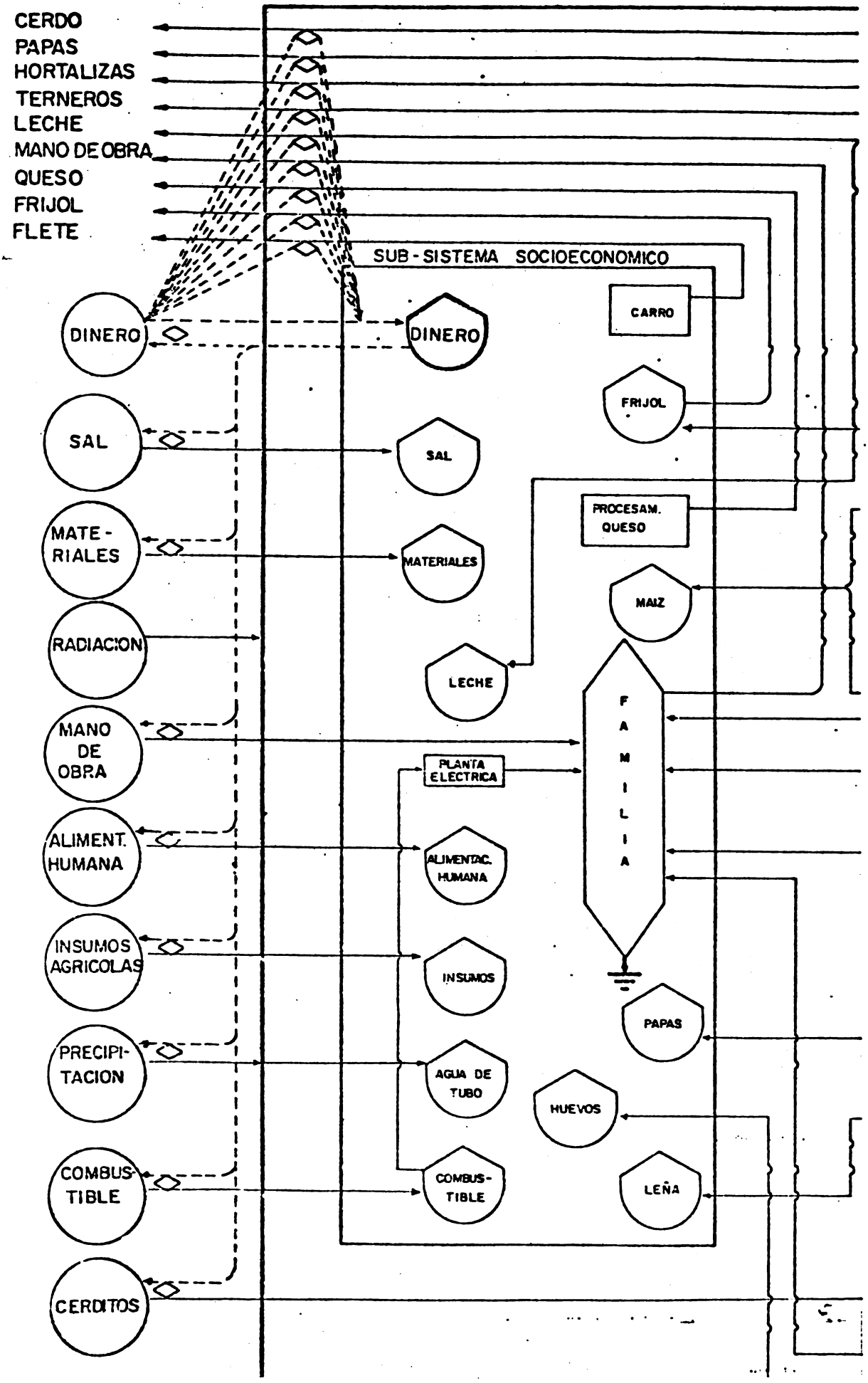
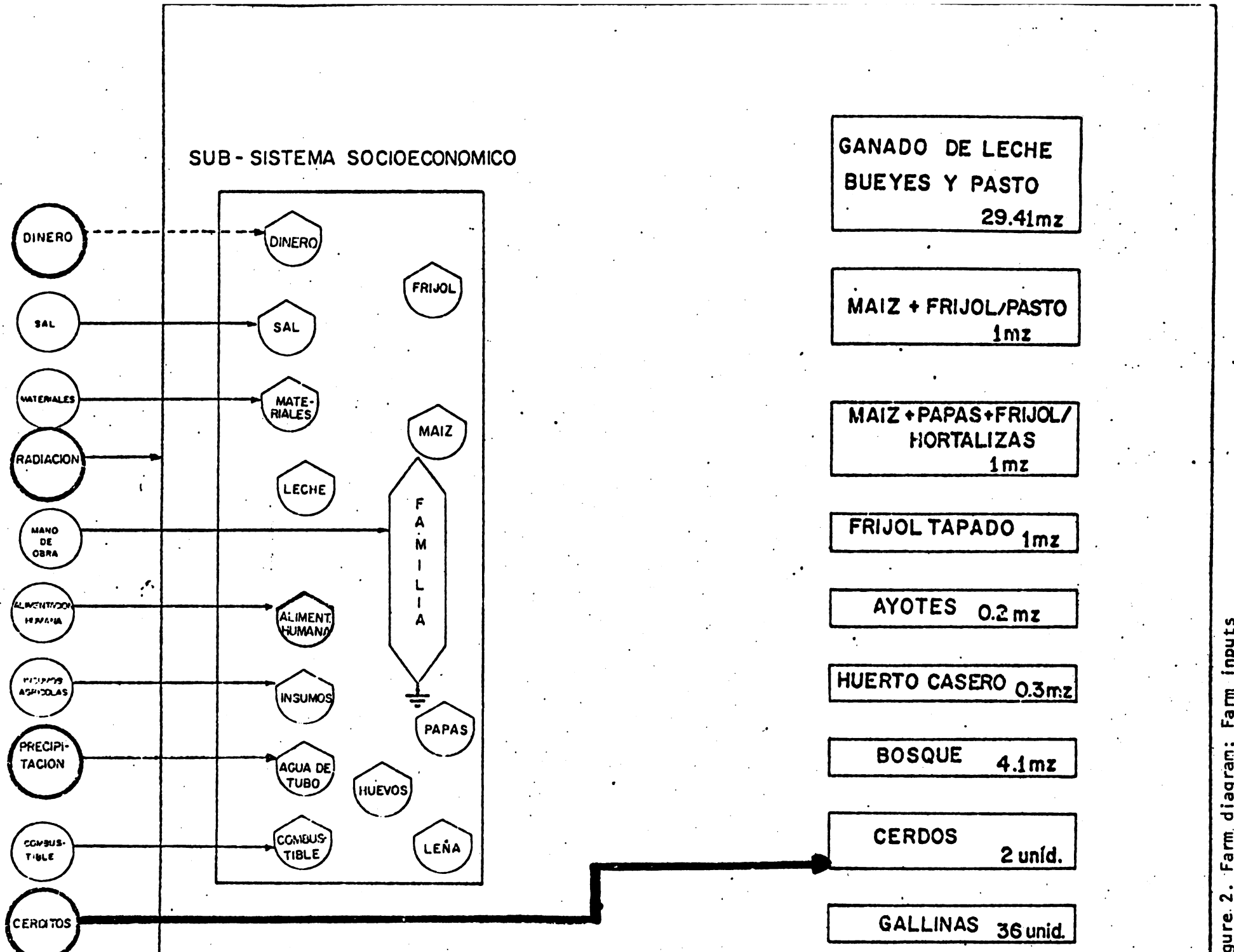


Figure 3. Farm diagram; Money flow.
From Rockenbach, 1981.



gure 2. Farm diagram; Farm inputs
om: Rockenbach, 1981.

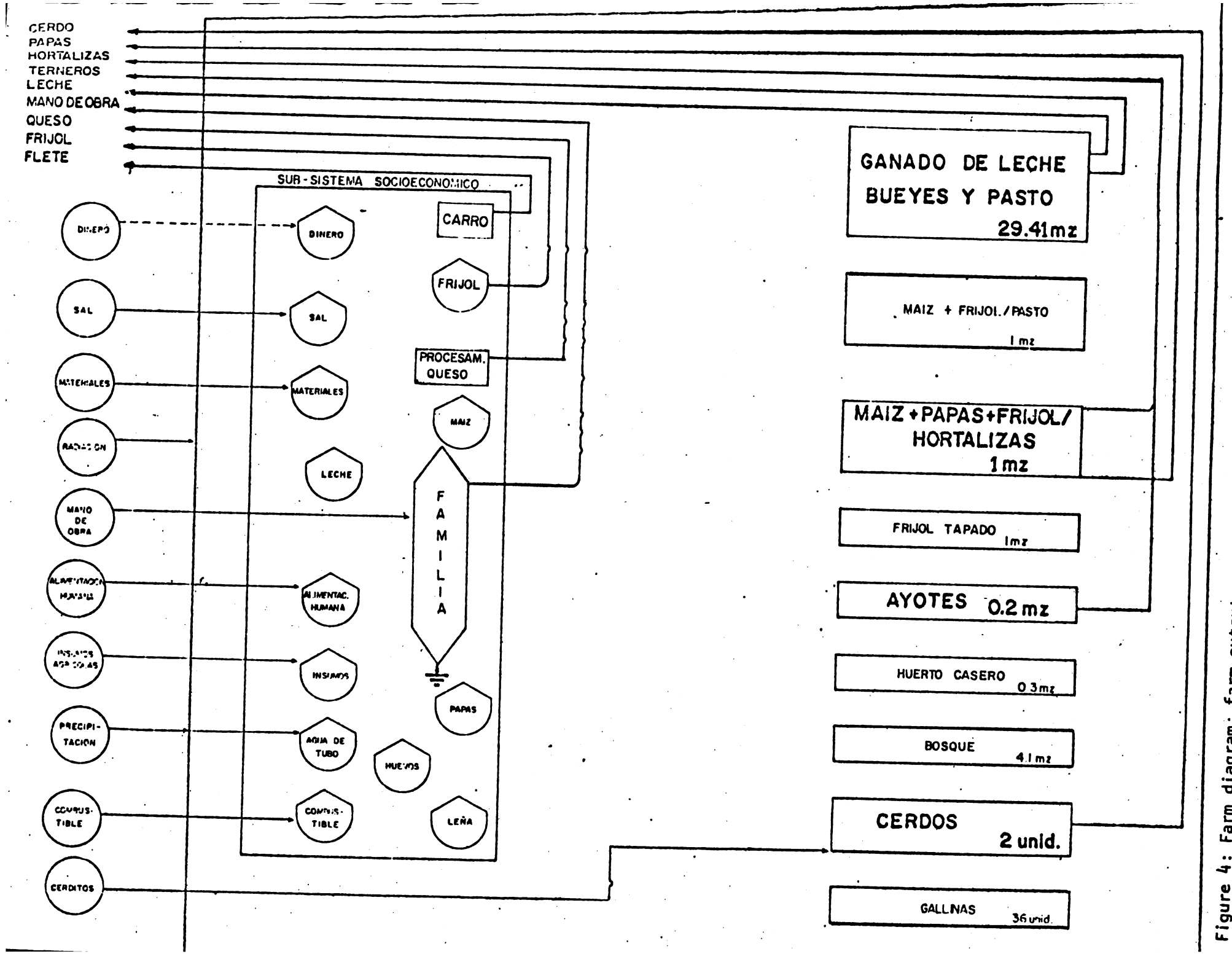


Figure 4: Farm diagram; farm outputs
From: Rockenbach, 1981.

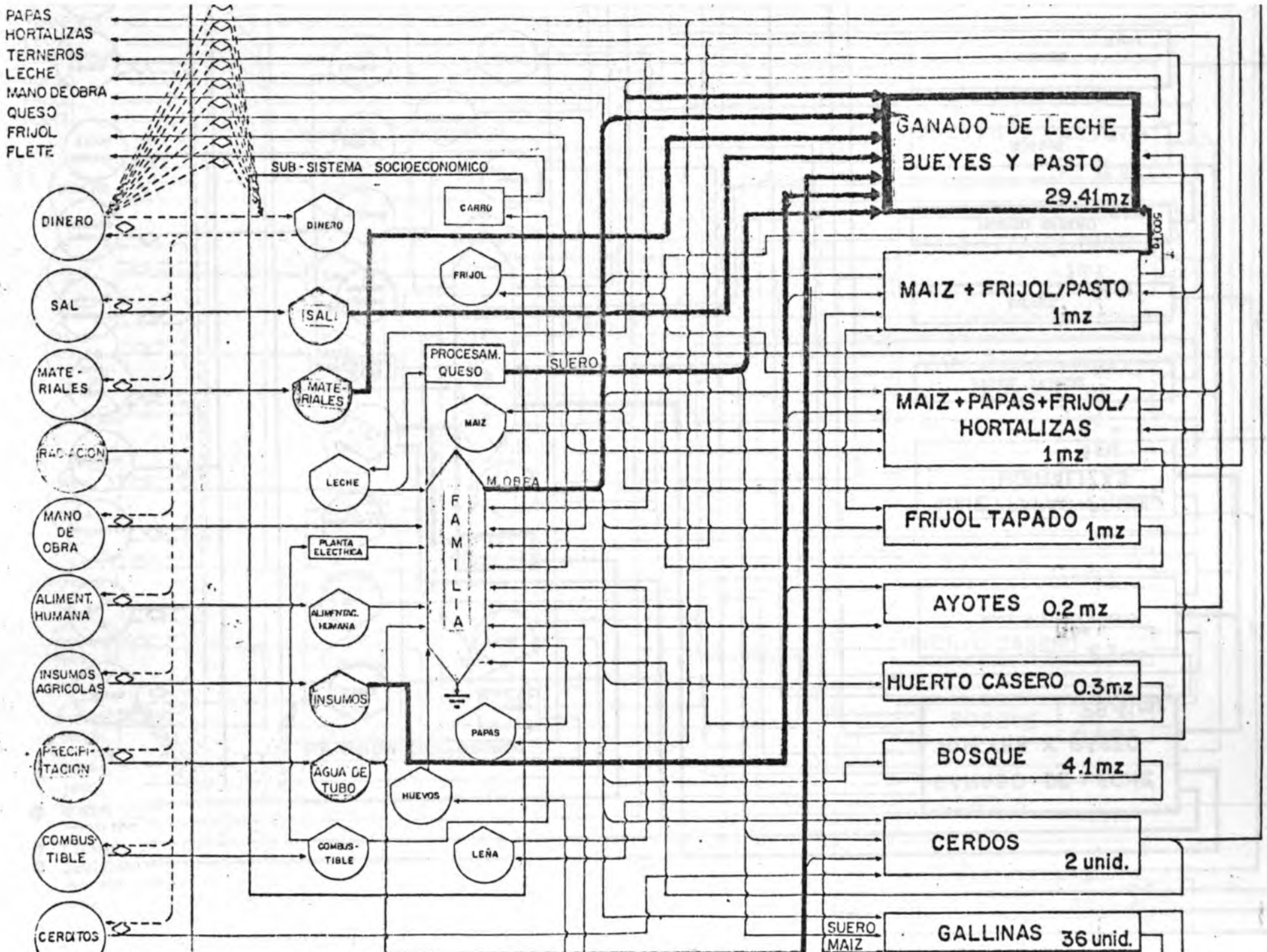


Figure 5: Farm diagram; Dairy Cattle + oxen + pasture agroecosystems inputs.
From: Rockenbach, 1981.

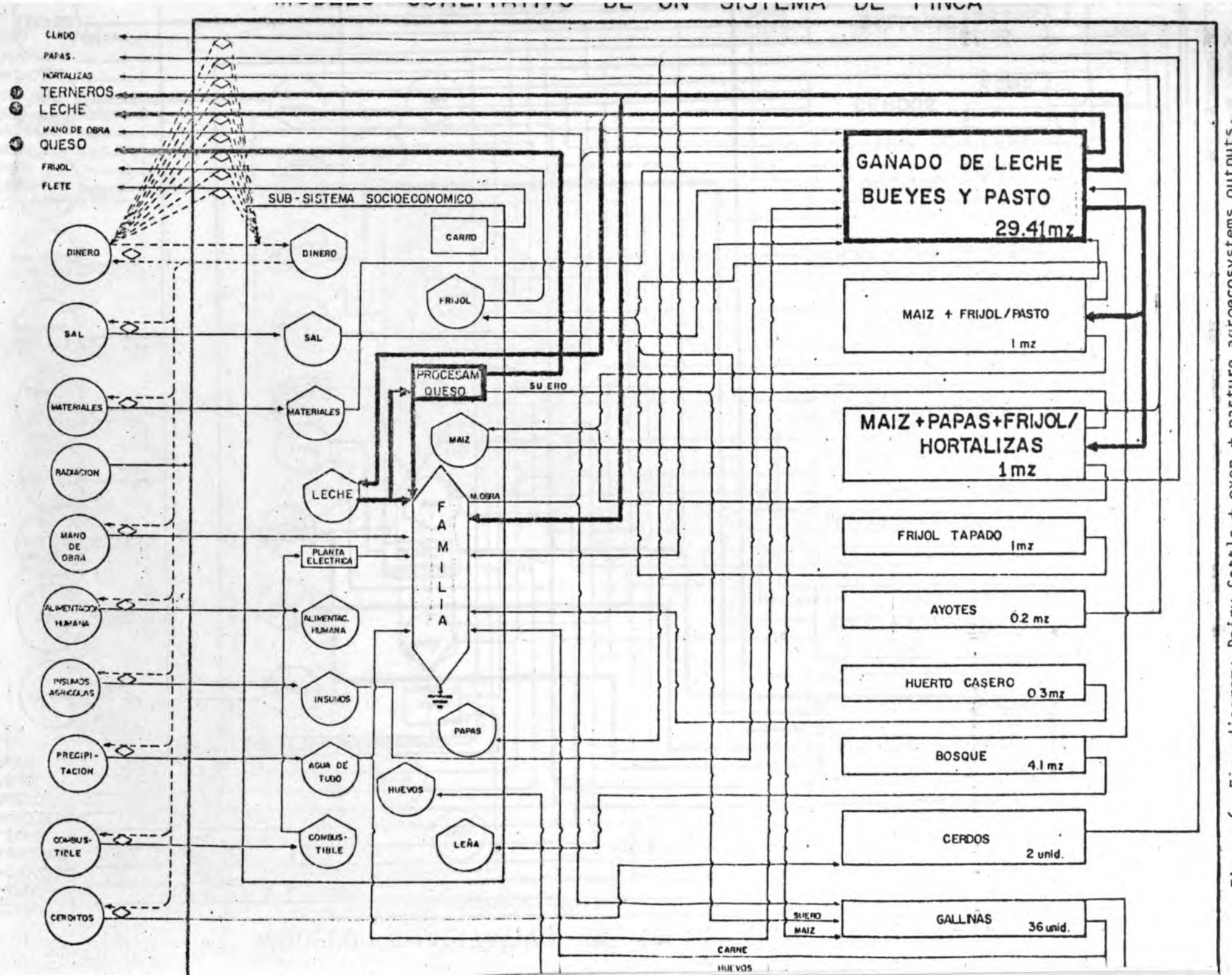


Figure 6: Farm diagram: Dairy Cattle + oxen + pasture agroecosystems outputs.

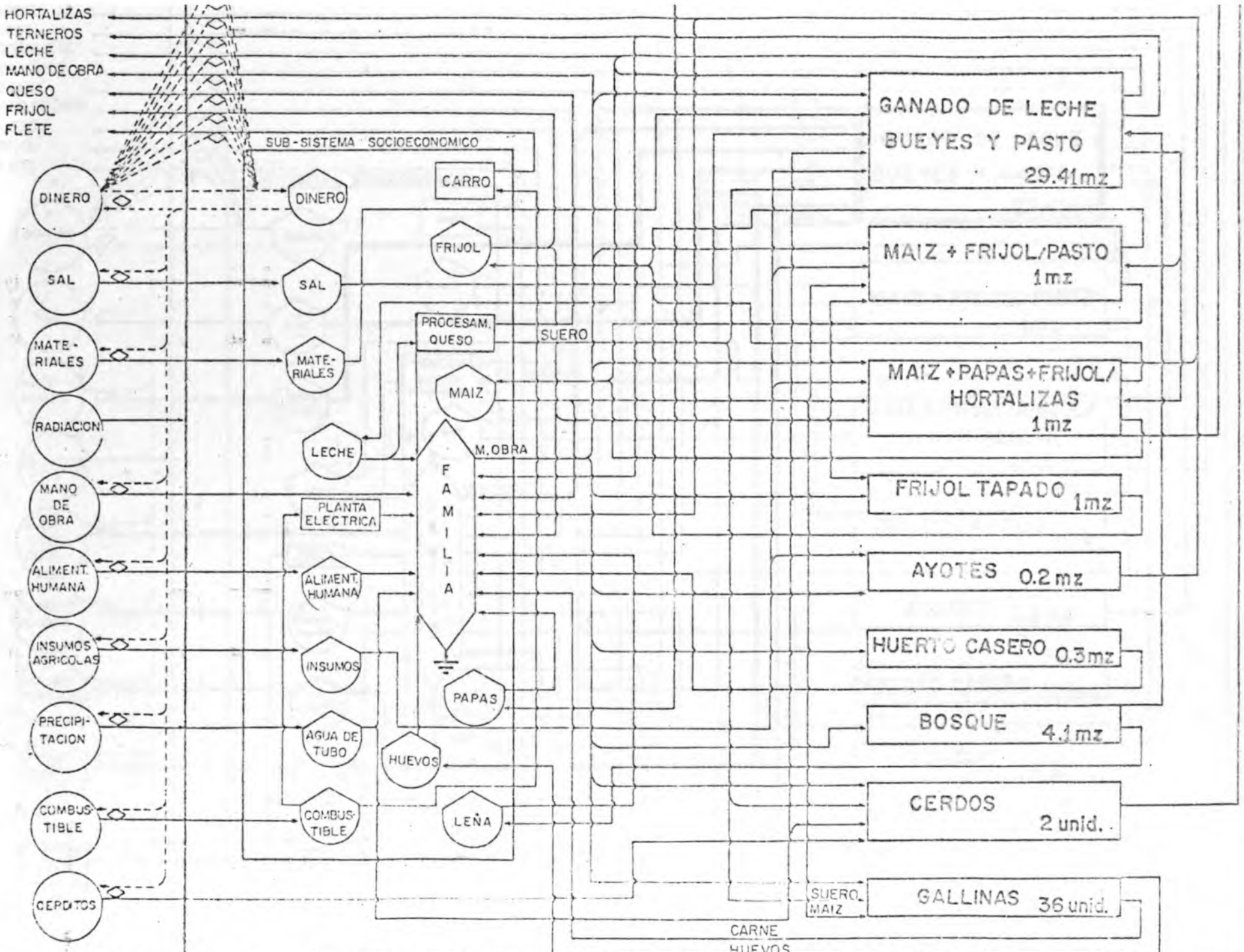


Figure 7: Qualitative farm diagram.
From: Rockenbach, 1981.

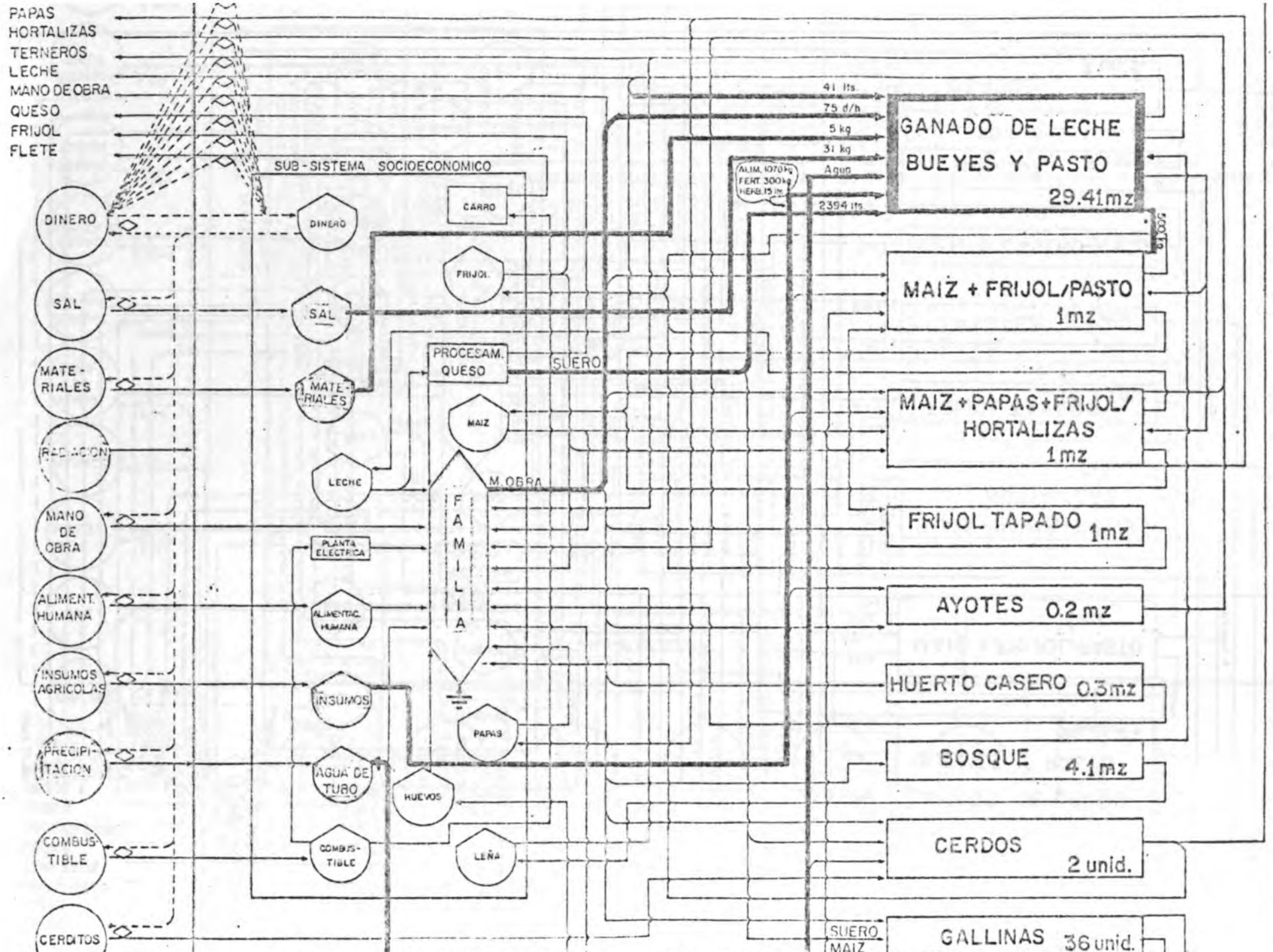


Figure 8: Farm diagram; Qualitative inputs to Dairy cattle + oxen + pasture agroecc
From: Pockenbach, 1981.

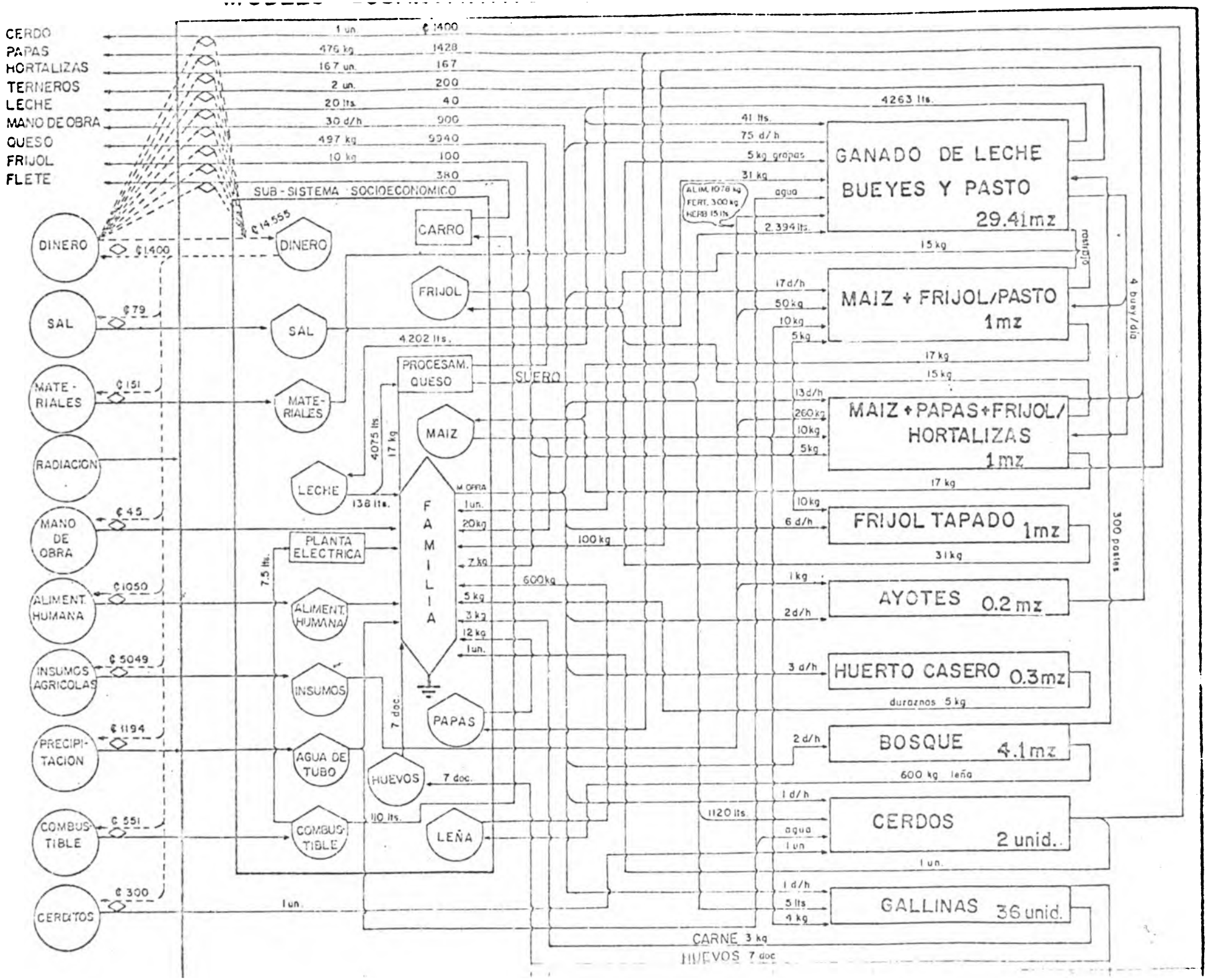


Figure 9: Quantitative farm diagram.
From: Rockenbach, 1981.

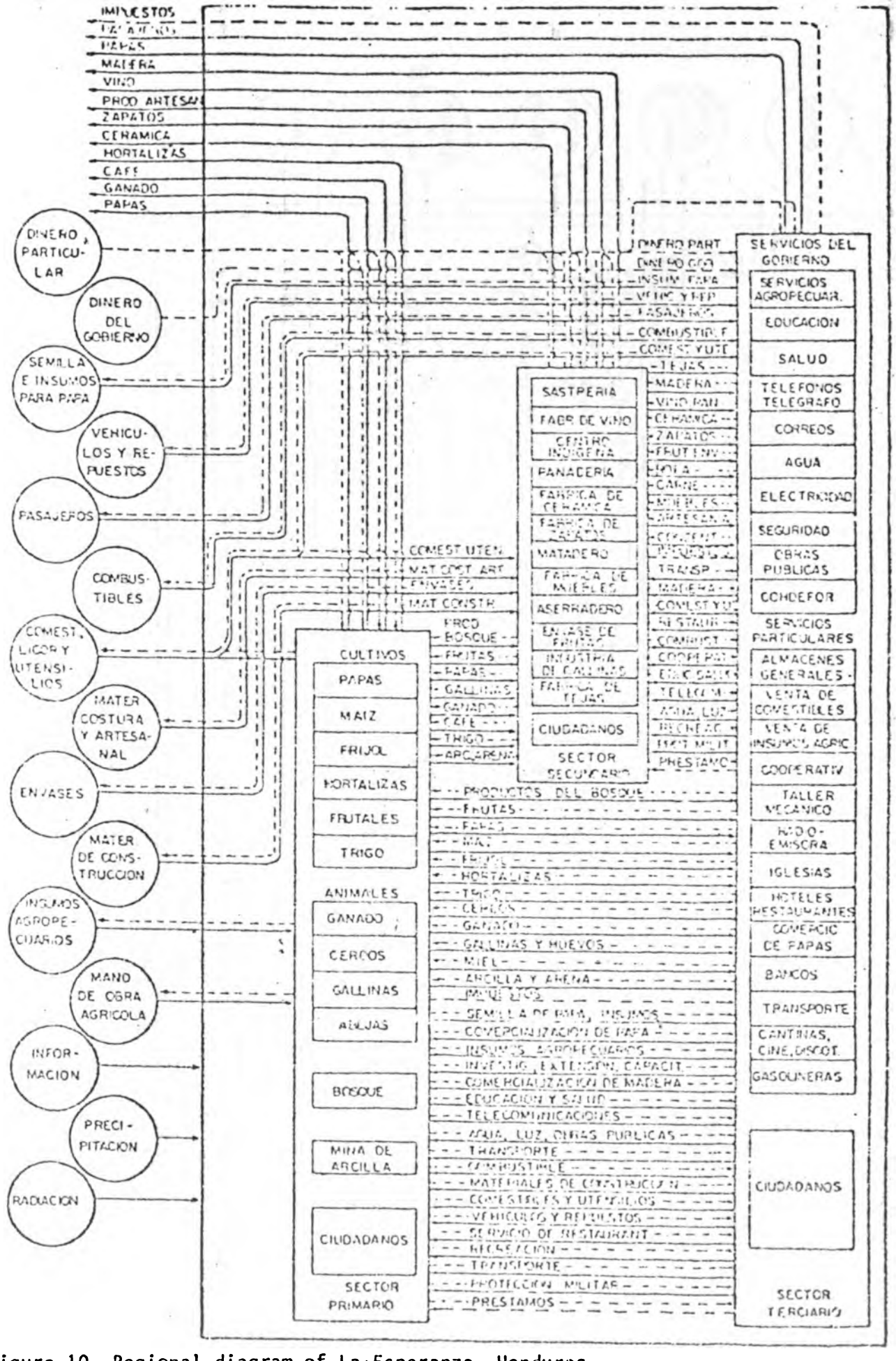


Figure 10. Regional diagram of La Esperanza, Hondures.
From: CATIE, 1981.

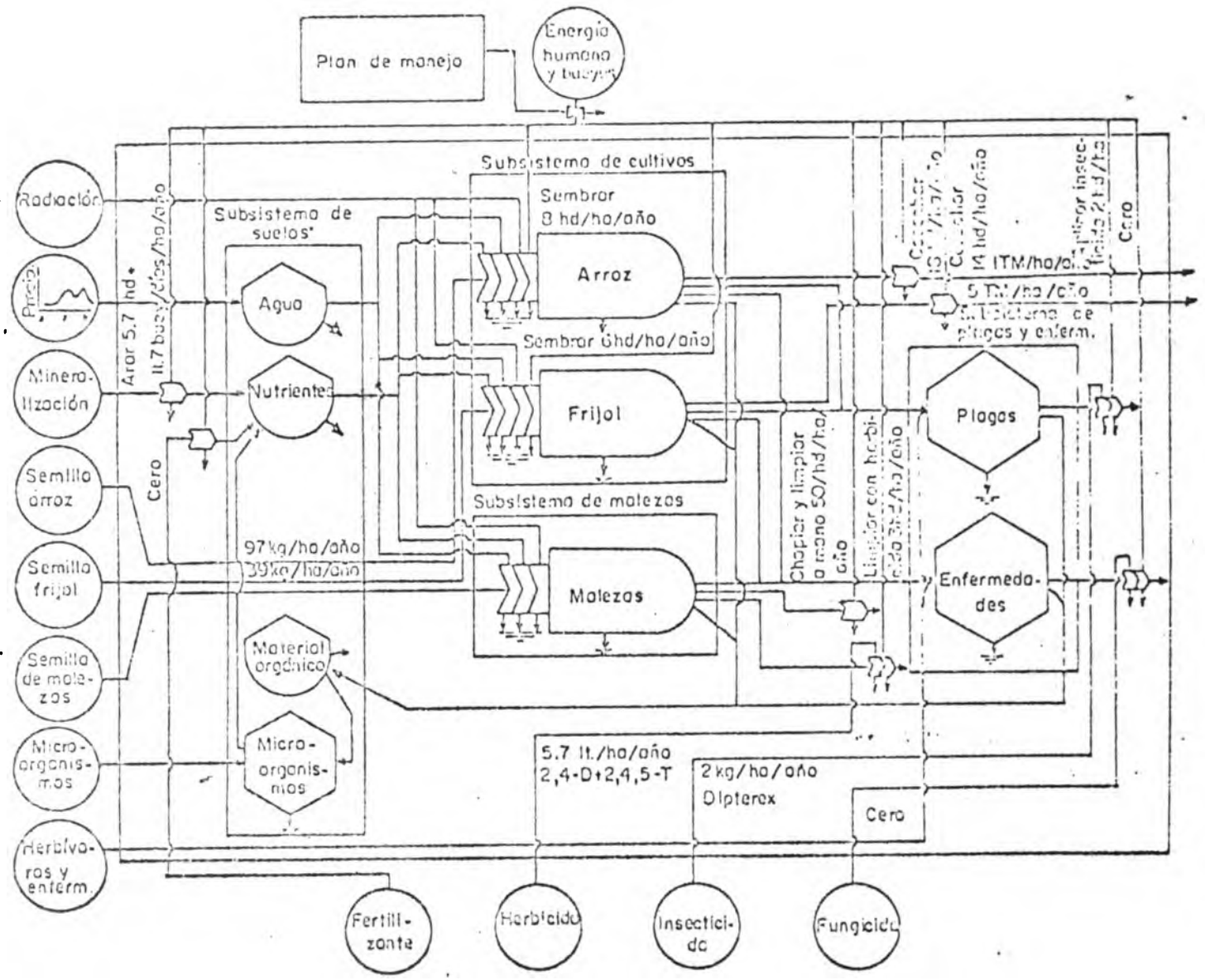


Figure 11. Semi-quantitative diagram of an agroecosystem with a crop sub-system composed of a rice and been rotation. The estimated flows are in units/ha/year.
From: Hart 1979

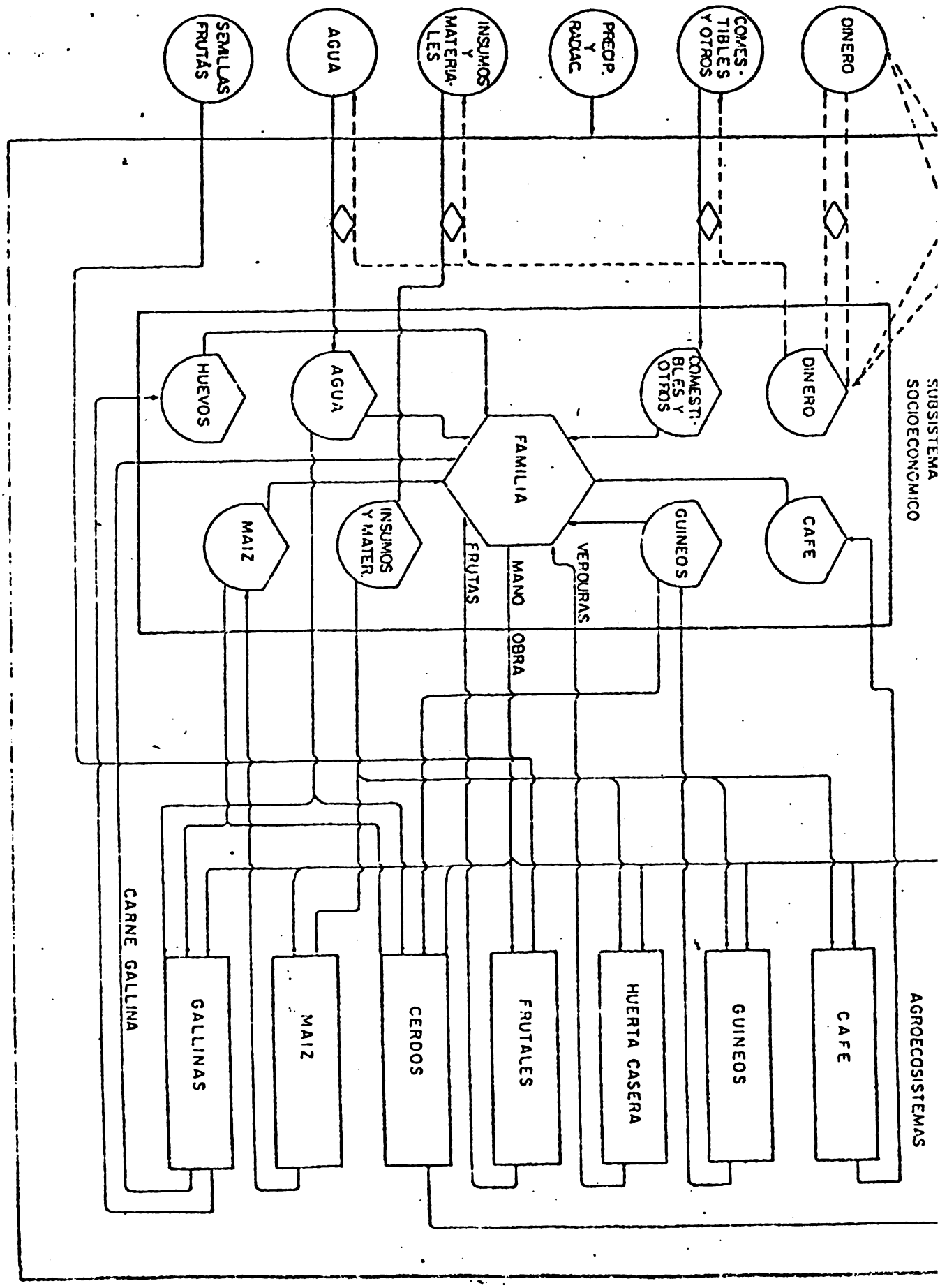


Figure 12: Qualitative diagram of a subsistance type farm in La Esperanza, Hon
From: CATIE, 1981.

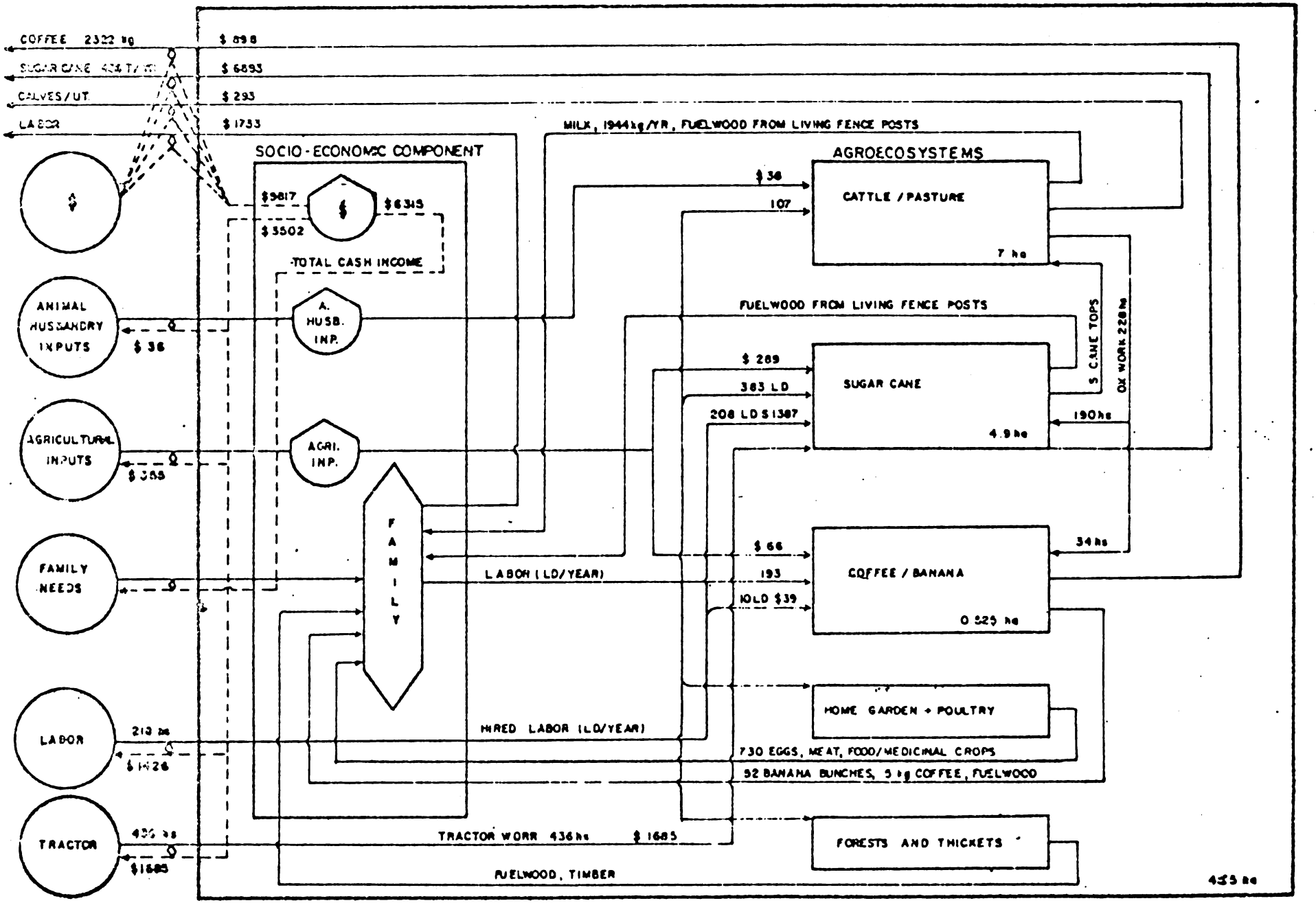


Figure 13: Cash crop/animal production farm diagram, partially quantified.

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