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ESTACION EXPERIMENTAL "NAPO"

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AGRO-FORESTRY SYSTEMS FOR THE HUMID TROPICS EAST OF THE ANDES: I. Integrated Foodcrop, Swine, Chicken and Fuelwood Production.*

by

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Introduction

Each region of the developing world has unique nutritional-demographic problems and potentials. Such problems are compounded in the central Andean region because its population has the highest density and birth rate in South America while consumption levels of protein and calories are among the lowest in the Western Hemisphere. Traditionally most people of Colombia, Ecuador, Perú and Bolivia have lived in highland areas.

These countries also contain vast humid tropical lowlands east of the Andes (Figure 1) into which highways are being built due to petroleum discoveries and colonization plans. Such highways are leading the poorest of the rural poor away from over-populated highland areas to establish small farms in the eastern lowlands (8). A sizeable part of each family farm is utilized for products of primary need such as foodcrops, swine, chickens and fuelwood.

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* Paper presented to International Conference on Amazonian Agricultural and Land Use Development, sponsored by ICRAF/CIAT/RF/GTZ/NCSU, Cali, Colombia, April 16-18, 1980. English translation of Spanish manuscript.

** Member of INIAP/UFLA/IBRD Technical Assistance Mission. Author acknowledges assistance given by Summer Institute of Linguistics.

*** Average annual precipitation 3102 mm, elevation 243 masl, latitude 0°24'S.

A shifting form of agriculture is practiced by small farmers east of the Andes (25,26,32). As human populations and expectations increase, rest periods in shifting cultivation are shortened, accelerating in an alarming rate soil deterioration and weed/pest invasion, and critically decreasing yields precisely as needs are increasing (25, 30, 32).

One promising solution is to intensify the rest period with swine, chicken and fuelwood production (1,2,3,4,6,17, 19,21,28). Forage and fuelwood legumes increase soil aeration, organic matter, nitrogen and available phosphorus, as well as control soil erosion and leaching (4,5,20,27). Swine also improve soil fertility by depositing organic matter which stimulates legume/*Rhizobium* symbiosis and by supplying fecal microorganisms which mineralize crop residues (4). In addition, swine can improve small farm income (7) and produce low cost animal protein without cereal grains (29).

The American lowland tropics have the highest per capita swine population in the world (Table 1), more than five times that of tropical Africa and Asia (33). Most swine and chickens in the tropical lowlands east of the Andes are produced on small farms (Table 2) utilizing an open range production system with banana as the principle swine feed and corn as the supplemental chicken feed.

Integrated Foodcrop, Swine, Chicken and Fuelwood Production

In Amazonian Ecuador, studies are being realized to intensify open range swine husbandry utilizing the following mixture of perennial species in a multi-strata production system: *Desmodium ovalifolium* (trébol tropical), *Canna edulis* (achira), *Musa acuminata* x *M. balbisiana* ABB (orito) and *Inga edulis* (guaba).

The umbraphilus legume *Desmodium ovalifolium* constitutes the ground floor (19) as forage legumes are more palatable and more efficiently utilized by swine than are grasses (10,14). The root forage Canna edulis and banana Musa acuminata x M. balbisiana ABB are local perennial crops with low labor and soil fertility requirements and produce low cost feeds for direct consumption by swine (11,15,16, 18,24,31,33). The fast growing native legume tree Inga edulis improves soil fertility and structure (22) as well as produces fuelwood (1,2,3) on an eight year rotation cycle (Figure 3).

Initially, conventional agriculture is practiced on a new plot each year: land clearing and production of short cycle species in conformity with one or another classical multiple cropping system. The perennial species of the future multi-strata system are interplanted during short cycle cropping (Figure 4). Following a two year period of short cycle cropping, the mentioned perennial components will have reached a vertically stratified state of development. Four distinct strata are rapidly differentiated and the resultant multi-strata structure and multi-species composition ecologically and biologically approaches a sustained yield forest ecosystem (9,12,13).

A ten hectare family unit (Figure 5) is divided into eight lots (1 ha. ea.) which are used following field crops (Table 3) for weanling pigs, fattening pigs and breeding sows. Also, eight lots (0.2 ha. ea.) are formed and used following garden crops (Table 4) for individual farrowing pens. Six strands of barbed wire and closely woven living Jatropha curcas (piñon) posts are used as fencing (23). Internal swine parasites are chemically controlled (levamisole) every three months synchronized with alternate grazing. Also, a 0.4 ha. lot is used for the farm home, chicken house and fruit trees (Table 5).

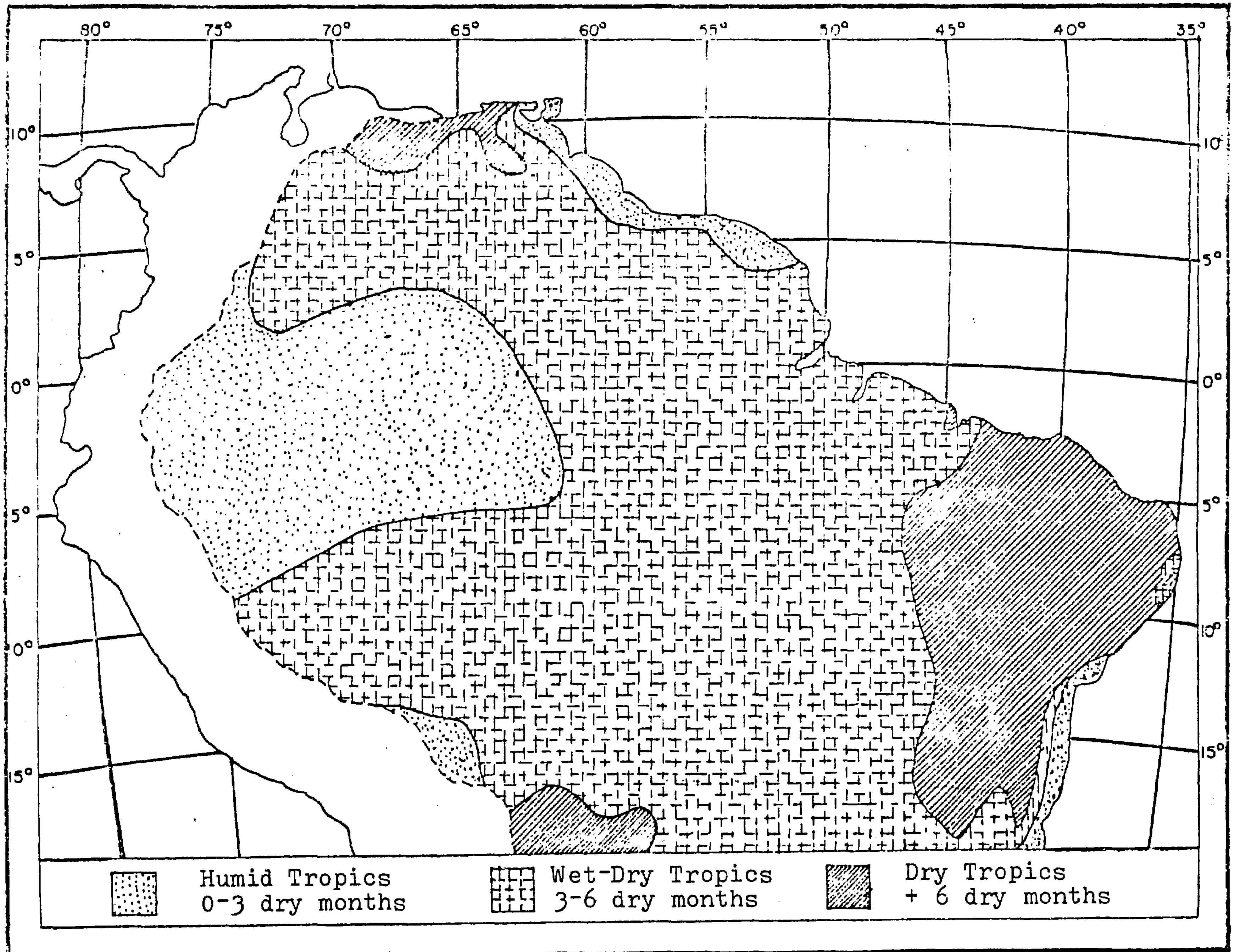

Figure 1. Dry months in the tropical lowlands east of the Andes (SOURCE: 1978 CIAT Annual Report).

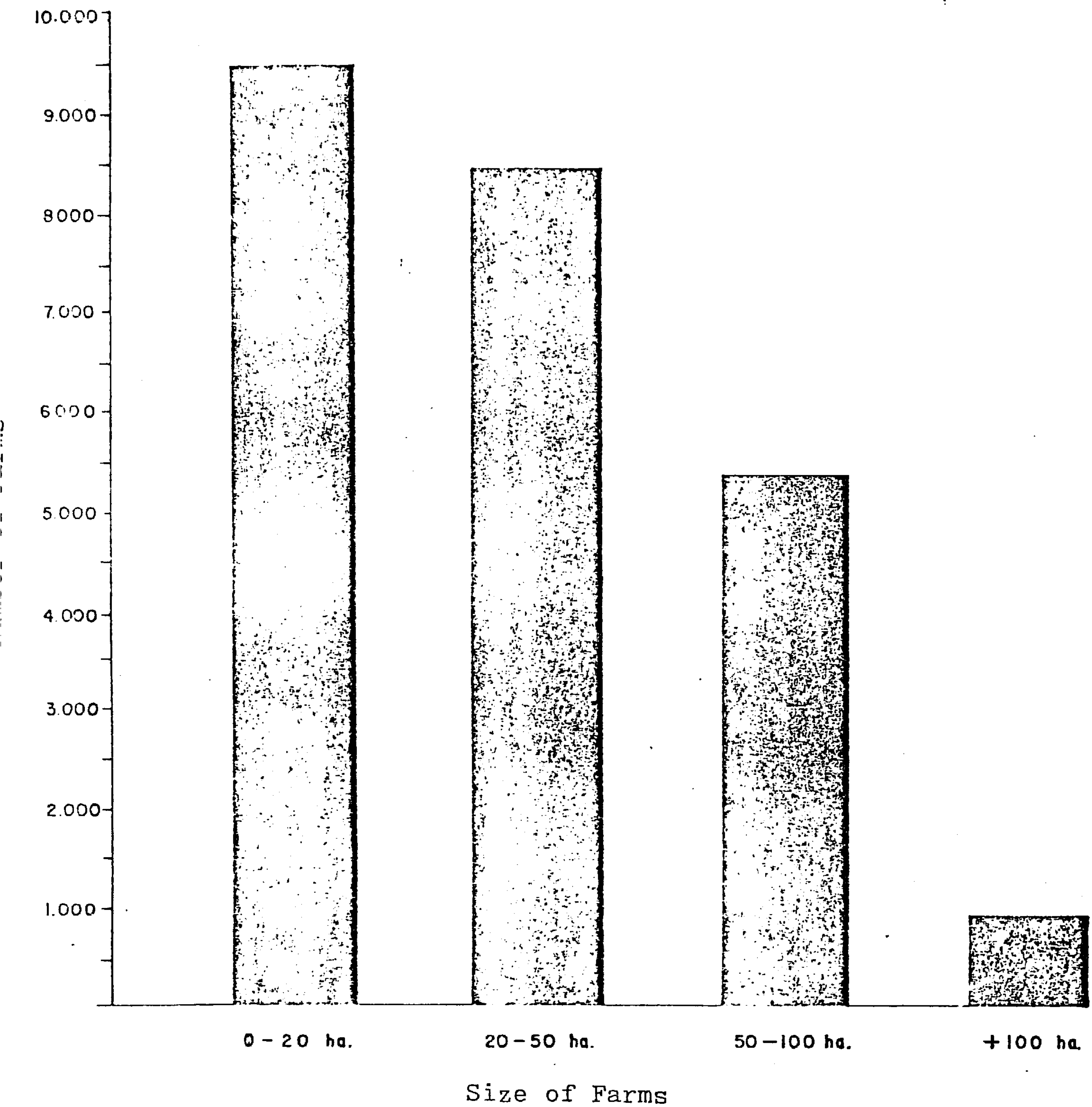

Figure 2. Number of farms by size in Amazonian Ecuador (SOURCE: Ministerio de Agricultura y Ganadería, 1978).

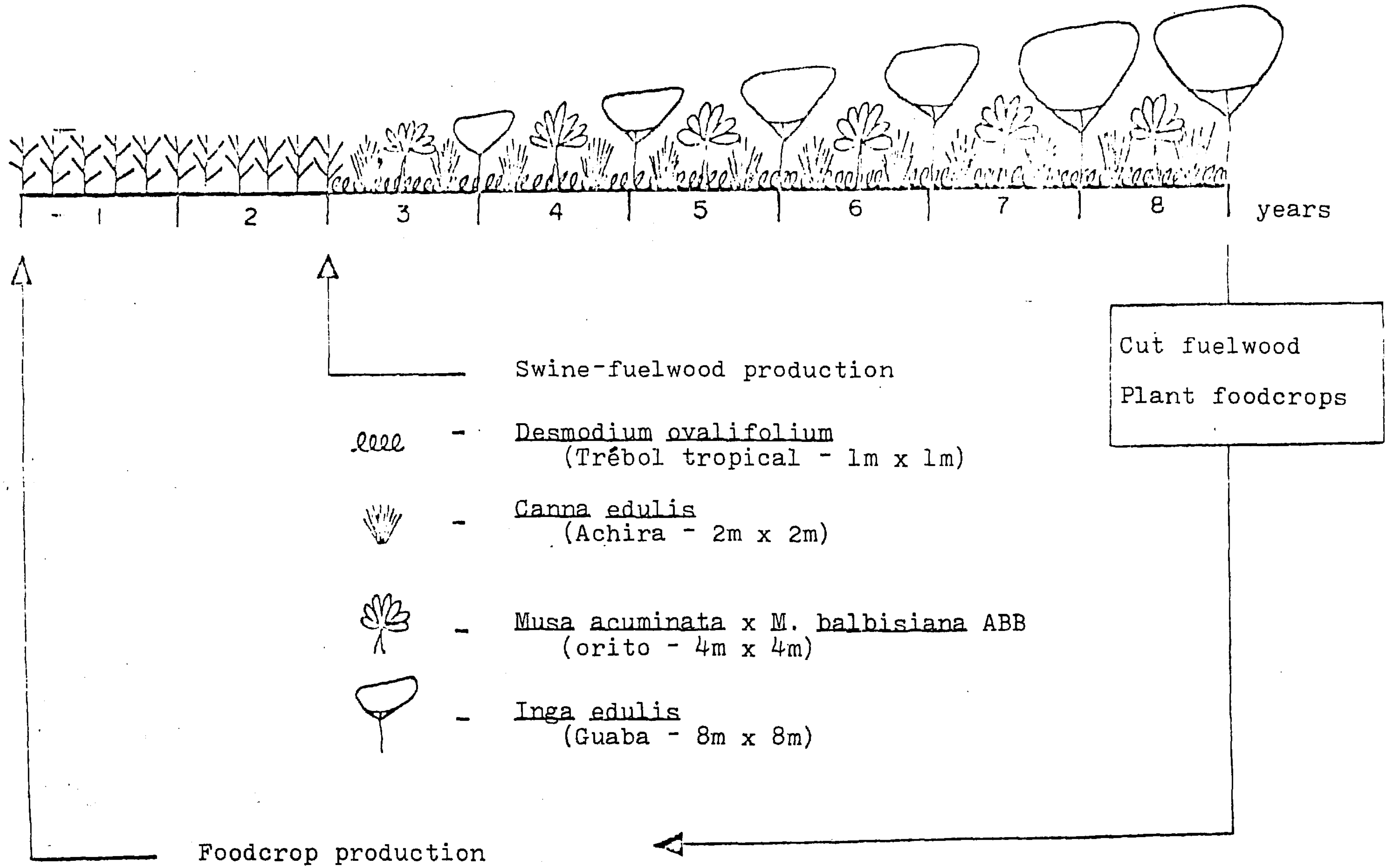

Figure 3. Integrated foodcrop, swine and fuelwood production.

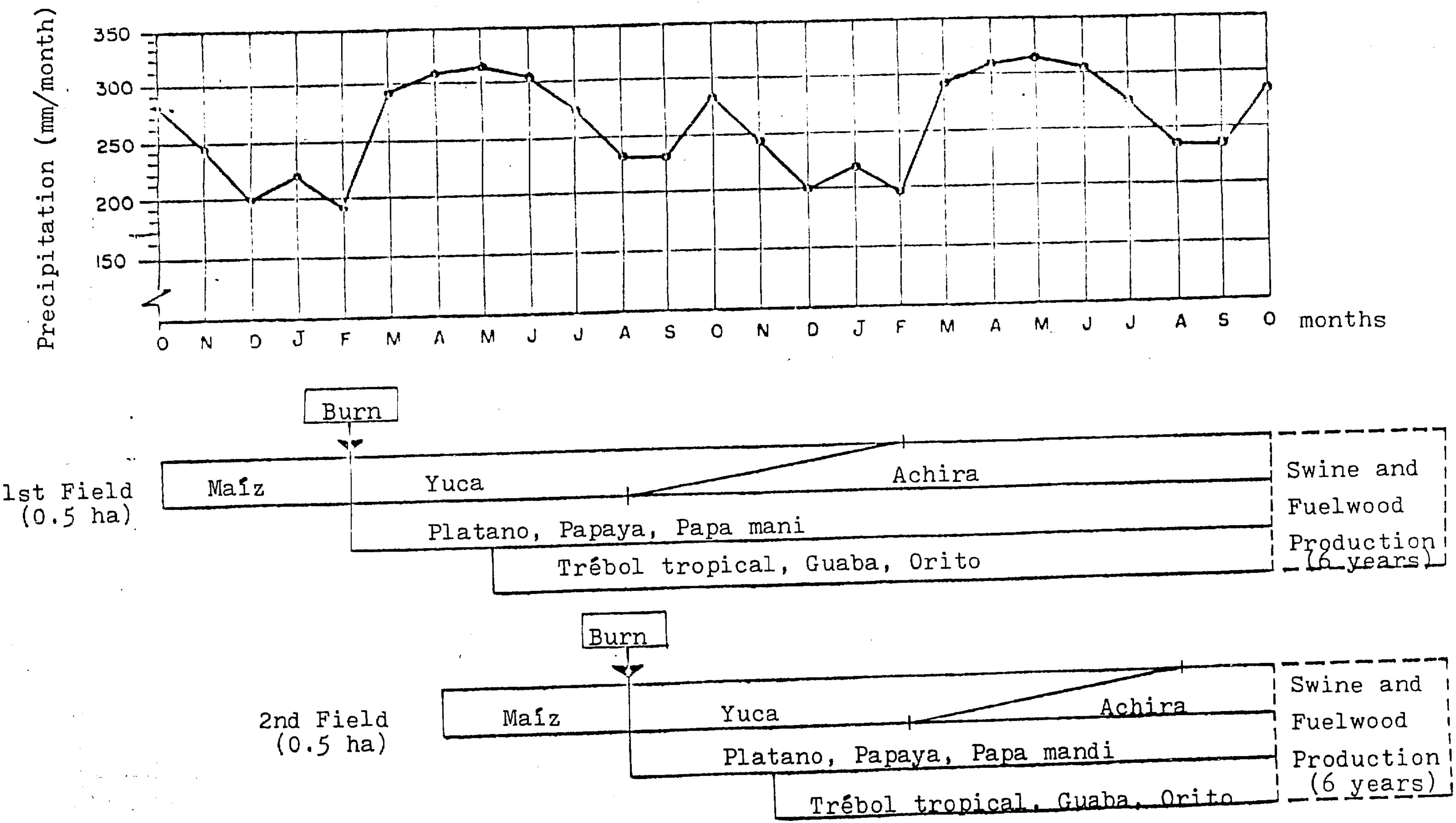

Figure 4. Average precipitation (15 years) and cropping practices in the Centro Amazónico Limoncocha

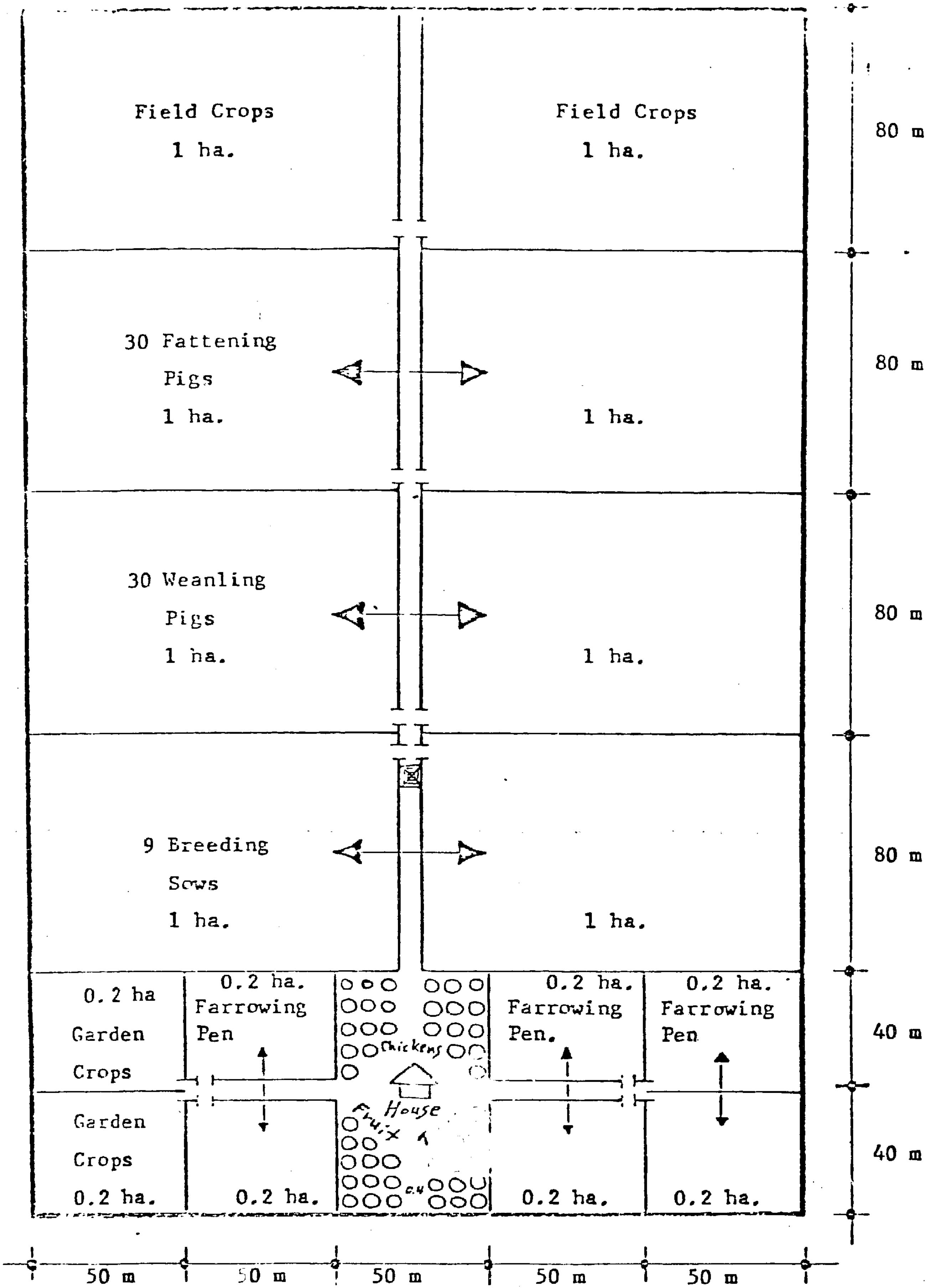

Figure 5. Integrated foodcrop, swine, chicken and fuelwood production in a 10 ha family unit.

Table 1. American countries with large swine populations (SOURCE: World Almanac, 1978).

		Number of people per hog
1.	Brazil	2.3
2.	Ecuador	2.7
3.	Haiti	2.8
4.	Nicaragua	3.3
5.	U.S.A.	3.9

Table 2. Percentage of swine by farm size in Ecuador (SOURCE: Ministerio de Agricultura y Ganadería 1978).

Farm size	% of swine
0 - 20 ha.	81.7 %
20 - 50 ha.	10.7 %
+ 50 ha.	7.6%

Table 3. Major foodcrops in Amazonian Ecuador.

Local name	Scientific name	Variety
Maíz	*Zea mays*	INIAP VS-2
Yuca	*Manihot esculenta*	Native
Plátano	*Musa acuminata* x *M. balbisiana* AAB	Local
Papa mandi	*Xanthosoma sagittifolium*	Native
Papa china	*Colocasia esculenta*	Local
Papaya	*Carica papaya*	Native

Table 4. Minor foodcrops in Amazonian Ecuador

Local name	Scientific name	Variety
Maní	*Arachis hypogaea*	Native
Fréjol común	*Phaseolus vulgaris*	Local
Fréjol ratón	*Vigna unguiculata*	Local
Fréjol vainita	*Vigna sesquipedalis*	Local
Habas nativas	*Phaseolus lunatus*	Native
Haba blanca	*Canavalia ensiformis*	Local
Ashipa	*Pachyrrhizus tuberosus*	Native
Piña	*Ananas comosus*	Native
Cocona	*Solanum topiro*	Native
Badea	*Passiflora quadrangularis*	Native
Granadilla	*Passiflora edulis*	Native
Maíz pequeño	*Zea mays*	Local
Camote	*Ipomea batatas*	Native
Papa de soga	*Dioscorea trifida*	Native
Pujín	*Calathea allouia*	Native
Achocha	*Cyclantera pedata*	Native
Tomate criollo	*Lycopersicon esculentum*	Local
Zapallo	*Cucurbita sp.*	Native
Cuchicol	*Alternanthera sp.*	Native
Cebolla criolla	*Allium capa*	Local
Caña de azúcar	*Sacharum sp.*	Local

Table 5. Fruit trees in Amazonian Ecuador

Local name	Scientific name	Variety
Limôn mandarina	*Citrus limonia*	Local
Lima	*Citrus limettoides*	Local
Naranja criollo	*Citrus sinensis*	Local
Manî de ârbol	*Caryodendron orinocensa*	Native
Guaba Ilta	*Inga densiflora*	Native
Arbol de pan	*Artocarpus alfilis*	Local
Cacao blanco	*Theobroma bicolor*	Native
Zapote	*Calocarpum sapote*	Native
Abiyu	*Pouteria caimito*	Native
Anona	*Annona squamosa*	Native
Uvilla	*Pourouma cecropiaefolia*	Native
Guaba comûn	*Inga edulis*	Native
Guaba machetona	*Inga spectabilis*	Native
Aguacate	*Persea americana*	Native
Guanâbana	*Annona muricata*	Native
Chonta duro	*Guilielma gasipaes*	Native
Guayaba	*Psidium guajara*	Native

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AGRO-FORESTRY SYSTEMS FOR THE HUMID TROPICS EAST OF THE ANDES: II. Integrated Cattle and Timber Production.*

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Introduction

The humid tropics east of the Andes are presently undergoing large scale deforestation in favor of cattle development. Forests are substituted with pastures following short-term cropping. Such development has provoked severe criticism as there occurs serious soil deterioration and few pastures persist. Today many of these pastures are found abandoned (1, 9, 13).

One suggested solution is to associate forage grasses with forage legumes and timber trees (2,3,4,5,6,7,8,10,11, 12,14,15,16). Forage legumes and timber trees can fulfill the following functions: a) significantly increase soil nitrogen by root associations with bacteria and fungi, b) significantly fertilize soil through leaf-fall, c) notably improve soil texture and aeration by physical and chemical effects, and d) substantially increase income from small farm pastures by sale of timber.

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*** Average annual precipitation 3102 mm, elevation 243 masl, latitude 0°24'S.

Integrated Cattle and Timber Production

In Amazonian Ecuador, studies are being realized to evaluate the forage grass *Brachiaria humidicola* (kikuyo amazônico), legume *Desmodium ovalifolium* (trébol tropical) and timber tree *Cordia alliodora* (laurel) in a silvo-pastoral system (Figure 1).

At the beginning of the rainy season the *B. humidicola* and *D. ovalifolium* are established using vegetative material and planting stick. The *C. alliodora* is also transplanted (400/ha) at this time using rootstumps (Figures 2 & 3).

The newly established pastures are not grazed for one year or until timber trees are three meters high. Two years after reforestation, trees are thinned to 200/ha and again after four years leaving 100 high-grade trees per hectare (Figure 4).

The Benefit

One hectare of pasture maintaining two bovines with 25% extraction per year will produce ten bovines in twenty years. Estimating each adult bovine at US $300, cattle income per hectare in twenty years will be US $3000.

One hundred *Cordia* trees per hectare can produce 100 m^3 of timber in twenty years. Estimating each m^3 of *Cordia* at US $30, forest income per hectare in twenty years would be US $3000.

Therefore, timber production has great potential to improve the economic productivity, ecological stability and sociological viability of small cattle farms in the humid tropics east of the Andes.

For technology transfer to the rural masses, small farmer training materials are being prepared for use in local adult education classes, regional radio education courses and practical classes in rural schools.

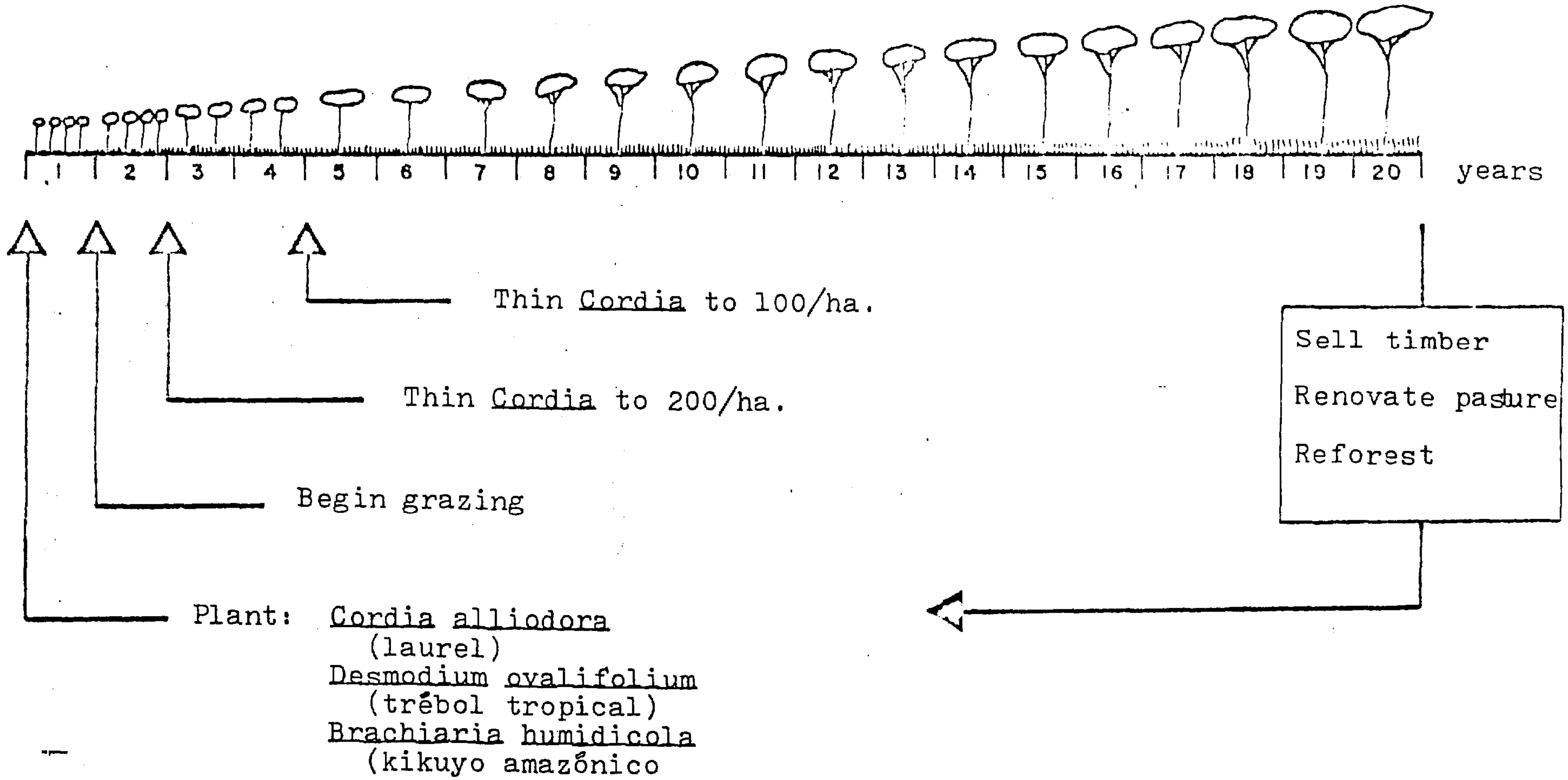

Figure 1. Integrated cattle and timber production.

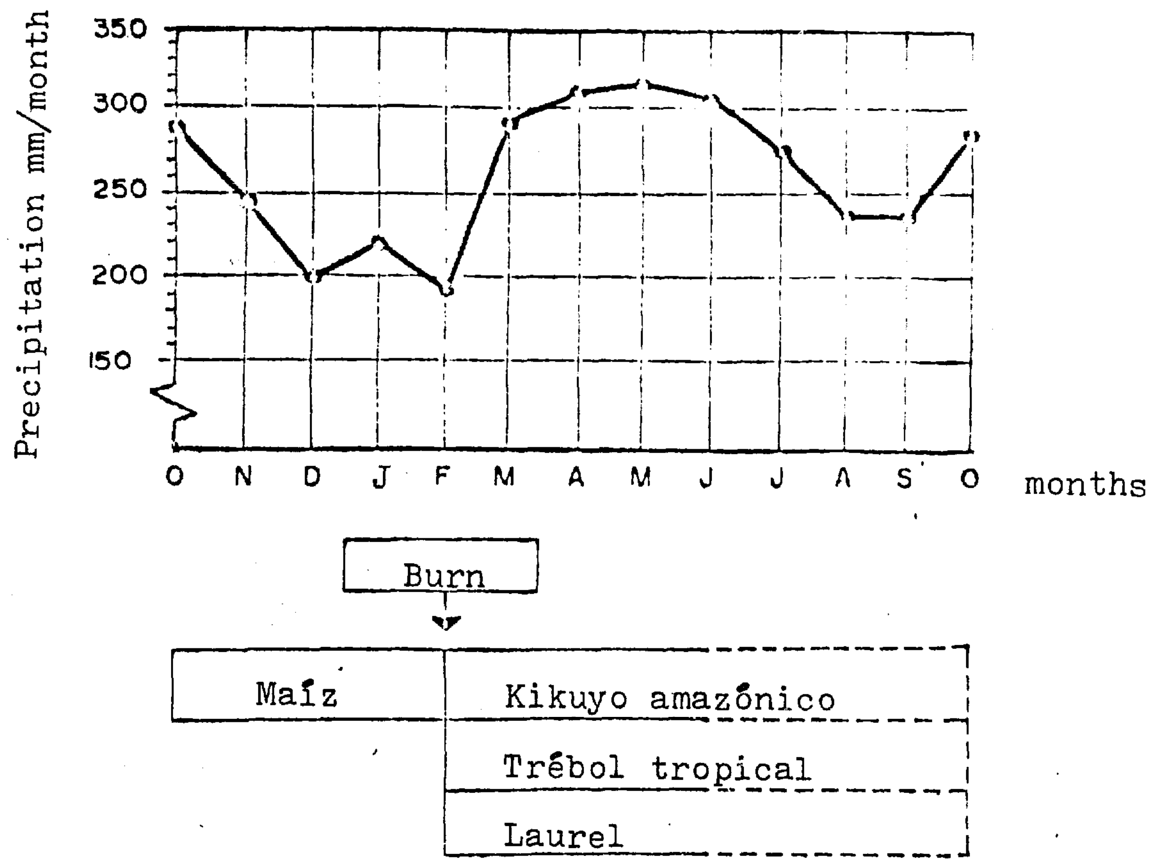

Figure 2. Average precipitation (15 years) and planting sequence in the Centro Amazónico Limoncocha.

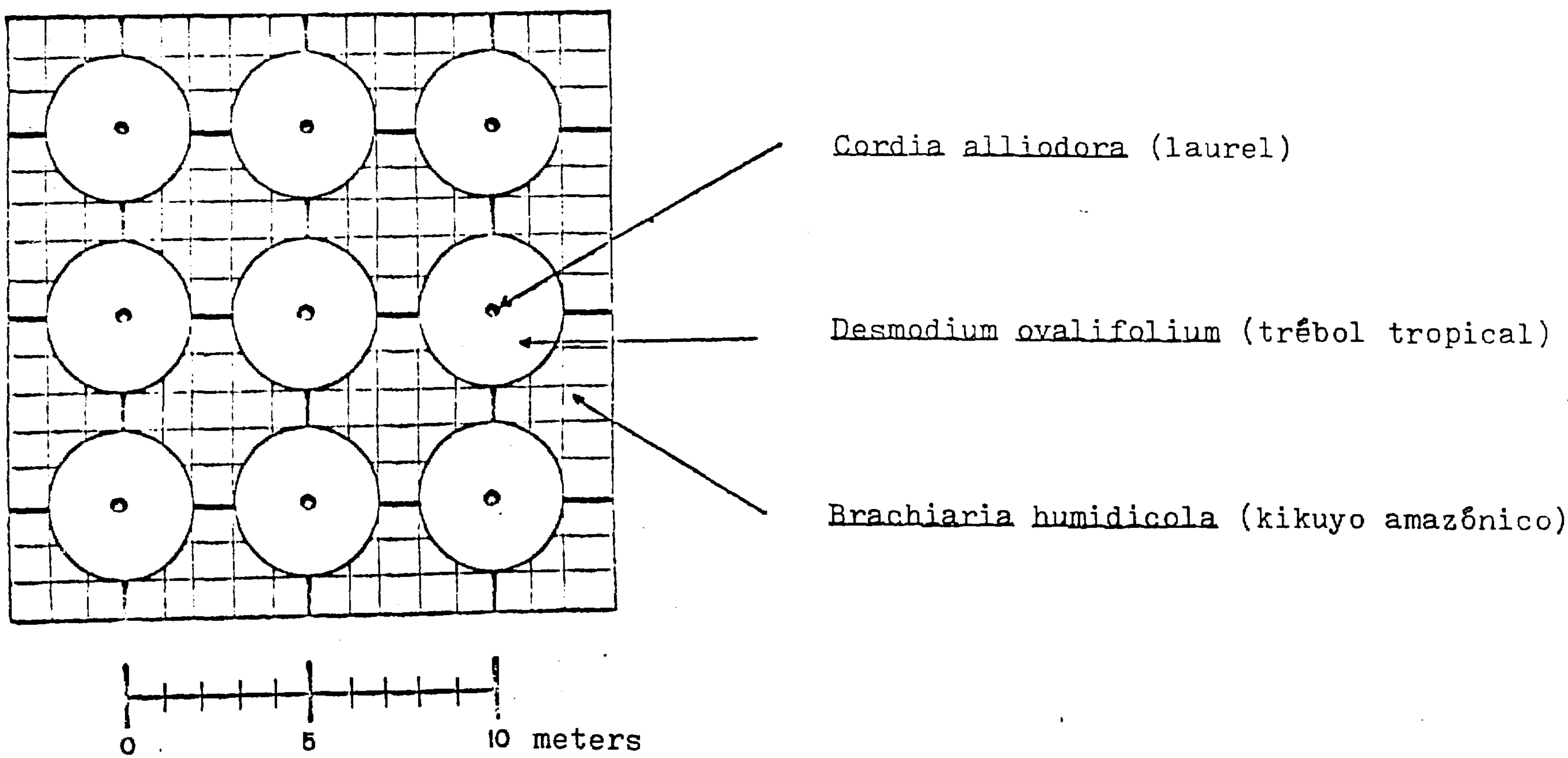

Figure 3. Planting diagram.

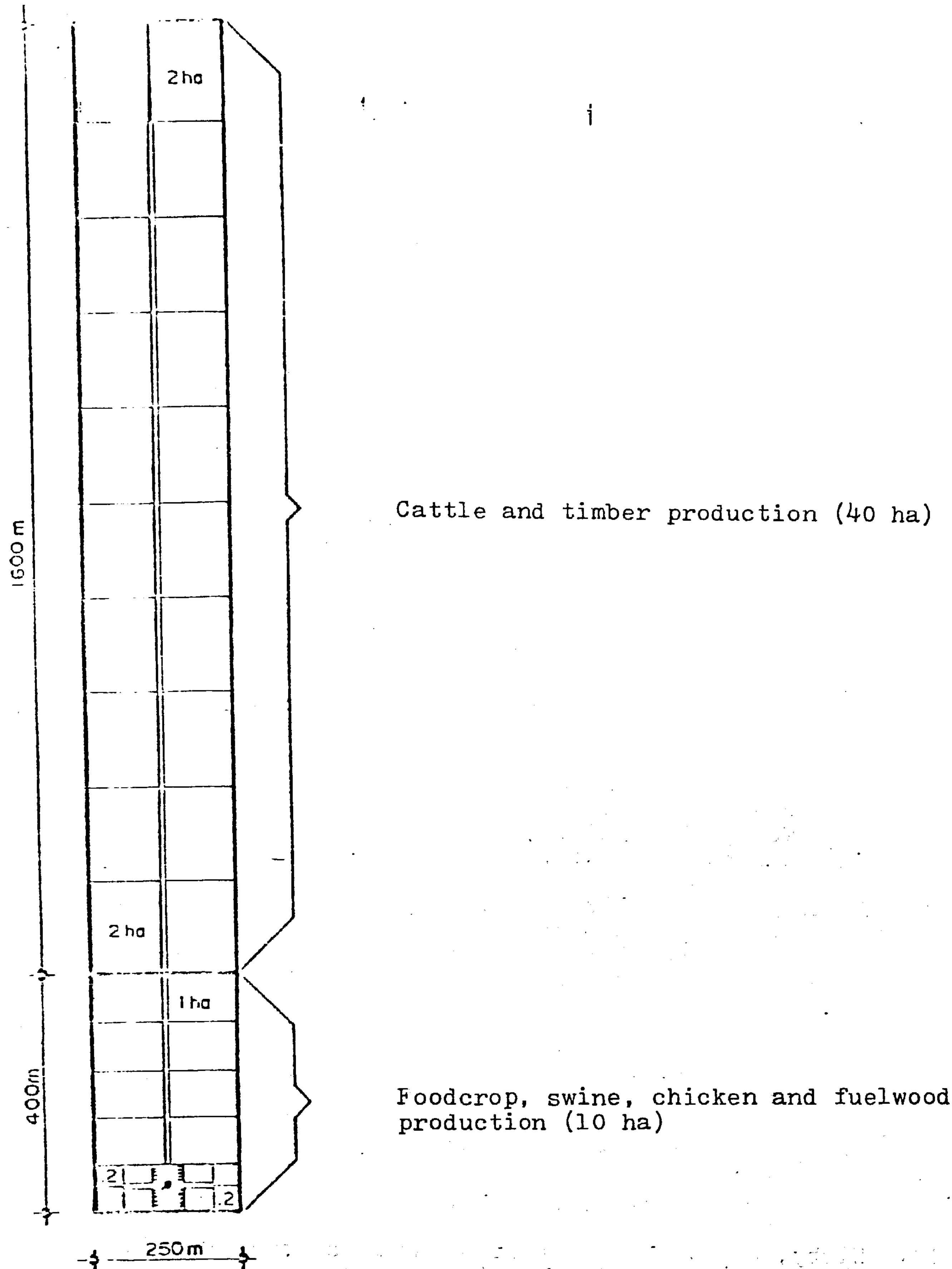

Figure 4. Mixed production system for 50 ha farms.

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