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CUBA:
A SMALL COUNTRY, A LARGE AGRICULTURAL RESEARCH POTENTIAL

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SUMMARY

A brief overview of the development and performances of Cuban agriculture since 1959, allows us to understand the reasons, both economic and ideological, behind the surge forward in agricultural research from 1970. Today, Cuba, with her 2,500 scientists and an annual budget of 45 million pesos (or dollars), has one of the larger national systems of research in the Third World. Its brief existence and its excessively complex structure have had limited effectiveness, but Cuban Authorities are striving to rectify this through planning, coordination between institutions and formal links with production. The results achieved on the scientific and production levels are already significant. In the future, research, better structured, more experienced and more prospective, could play a major role in agricultural policy and become a driving element in Cuba's relations with the Third World.

1 A BRIEF OVERVIEW OF CUBAN AGRICULTURE

Given her relatively small land area (115,000 km^2 = seven tenths of Florida), and her paucity of raw materials, Cuba had no alternative other than to develop her agriculture both to feed her population (6.5 million inhabitants in 1959, 10 million in 1980) and to obtain the foreign currency needed to gradually diversity her economy and maintain full employment. Thus the emergence of an agriculture policy which, since 1959 has staked heavily on the intensification and modernization of production without forsaking the conditions specific to her political regime, i.e. the progressive and recently accelerated socialization of the private sector, the setting-up of large scale State cooperative farms (see Figure 1 and Table 1) and the narrowing of differentials in income and living standards between urban and rural populations.

The pursuit of intensification and modernization has been underscored by considerable human and material investment, and is in turn reflected in a steadily increasing use of industrial inputs (see Table 2) in which the new national chemical and mechanical industries play an ever increasing role. Positive results from such efforts were, however, slow to emerge as is shown in the evolution of the gross per capita agricultural product (GAP) (Figure 2).

During the sixties, Cuba's GAP fluctuated erratically and struggled to keep up with the then relatively high population growth (nearly 3% per year between 1963 and 1966) for a variety of reasons among which the following stand out.

- Changes in the strategy for growth from 1953-1963 there was indiscriminate diversification in the national economy and agriculture, followed by excessive emphasis on sugar from 1968 to 1970;
- A somewhat "romantic" economic policy which between 1966 and 1970 led to the suppression of material incentives for State employees, (the "new men" had to "create wealth through the raising of their consciousness") and to the loss of autonomy of State farms which were under the direct control of the National Institute of Agrarian Reform;
- An excessively mechanical conception of technical progress based on undue expectations from central economic direction and from technological transfer. We shall return to this aspect below.

Later, these failings were gradually remedied by a more realistic economic policy. Material incentives were restored in 1973, the first five year plan was drawn up for the period 1976-80, and from the 1976 State farms gained a degree of semi-autonomy. These measures, coupled with agricultural investment maintained at a high level, led to solid and regular growth of GAP (an average of 4.6% per year) and to a noticeable rise in productivity of factors (Table 3). The population, whose growth started to level off (down to 1% in 1984), enjoyed the gradual lifting of strict rationing and today looks forward to improved quality in diet (the 1984 figure was 2,900 daily calories per inhabitant) (Table 4).

Brief reference should be made at this point to the development of Cuban agricultural policy in the field of commodity options Sugar cane has maintained its overriding position since 1963, mainly because of the lucrative outlets in the Soviet Union Dairy cattle and poultry farming and sea fishing were also quick to receive special treatment to improve the food consumption of the population in low cost animal proteins. The rapid and extensive planting of citrus fruits was aimed at a long term diversification of exports. On the other hand, other products such as maize, beans and coffee were curtailed on the basis of compared costs - it paid to import them as they could be offset by a slight increase in sugar production. But since 1976-78 the downward trend in international agricultural prices (a lasting drop in sugar prices, a rise in grain and coffee prices) the high level of the country's national debt, and the disturbingly high level of imported animal feedstuffs (1), have led the Cuban government to systematically promote home production of all imported agricultural products.

2 THE DEVELOPMENT AND ROLE OF AGRICULTURAL RESEARCH

Before 1959, public sector agricultural research was confined to three small experimental stations (one for sugar and two for tobacco) with a budget in the final stages of 540,000 pesos (1 peso equals more or less US$ 1). Most of the recent technical innovations had been introduced by American industrial and commercial companies, very active in the 1950s. These innovations had been concentrated primarily on farmproducts enjoying a high elasticity of demand or easily processed by the food industry, such as poultry farming, milk, fruit, rice, etc. They were in the main directed towards medium scale farms close to the urban centers, and overall, had a large impact on production, which increased on average by 3.7% per year between 1950 and 1958, or by 1% per year per capita. The drawback however was a rapid increase in the import of inputs (farm equipment, animal feedstuffs, fertilizers, etc.) without creation of home-based industries. Another consequence was an increasing gap with the smaller farms, which suffered more and more from seeing their traditional outlets taken over by the medium size farms and the new commercialization networks.

The severing of relations with the United State in 1960 isolated Cuba from her principal sources of technological transfer. From that point on, the revolutionary Government had to secure other sources of technical progress mainly for the large-scale sugar cane and livestock farms which were nationalized under the agrarian reform laws of 1959 and 1963.

(1) In 1980, the import of 610,000 tons of maize, 57,000 tons of barley, 147,000 tons of feeding cakes accounted for 137 million pesos (1 peso equals more or less US$ 1) in hard currency, that is to say 16% of the currency earned in sugar exports to countries of the non-communist world.

Among possible sources, was the creation of a national research potential. As early as January 1960, Fidel Castro declared: "the future of our country will of necessity be a future of men or science." The Academy of Sciences was created in 1962, the National Center of Scientific Research (CENIC), the Institute of Animal Sciences (ICA) in 1965, and so on. Unfortunately, these ambitions came up against a shortage of national technical senior staff who were appointed to the most urgent tasks in State farms and Administration.

The other source of technical progress more readily available was the acceleration and broadening of technological transfer. In the wake of their revolutionary enthusiasm, the Cuban Authorities doubtless felt that many technical innovations tried and used elsewhere (especially fertilization, irrigation and mechanization) could rapidly be integrated to good effect at least in the State farms. The innovations were introduced on a massive scale (see Table 2) without sufficient experimentation, without adequate advice soundly based on local conditions of production, and without the proper involvement of farm managers and workers in the selection of production targets and in the performances. Hence, the impact of these inputs on production amounted to next to nothing.

It was not until the 1970s that research took a spectacular leap forward in every field)Table 5) in agriculture, the number of scientists working full-time or part-time (in the case of teaching researchers) rose from 230 in 1970 to 1,940 in 1980 and to more than 3,000 (of whom 2,500 full-time researchers) in 1965, and the total research budget reached 45 million pesos in 1983. These figures testify to Cuba's accession to the rank of major power in the field of agricultural science, among the leaders in the Third World after China, India and Brazil, and above Mexico and Argentina.

Such rapid growth in research was only made possible by relentless efforts in every education level since 1959. This dramatic increase was undertaken for economic, ideological and political reasons.

The economic reasons: we had a first glimpse of these above. Development must be backed by technical innovations capable of the following:

- Improving the productivity of inputs currently in use, particularly imported inputs with a view to their improved efficiency or better still to their replacement whenever possible by factors produced or to be produced within the country itself.
- Encouraging the development of national exportable produce or remedying shortfalls occurring over the whole year or during certain periods of the year.

The ideological reasons: research is considered to be an instrument for transforming society. This is the case in all societies, but in Cuba it is also expected to justify

transformations decided upon by government such as the collectivization of production, the setting-up of large-scale production units, the aligning of working conditions between town and country, industry and agriculture.

The political reasons: as with medicine, sport, etc., research is a means of extending influence in the international arena. Cuban researchers are expected to be seen as living examples of the dynamism of their country in international conferences, scientific publications and through their country's cooperation with an increasing number of developing countries.

3 THE NATIONAL SYSTEM OF AGRICULTURAL RESEARCH IN CUBA

3.1 STRUCTURES: AN INTRICATE AND IMPERFECT PUZZLE

Since 1962, and even more so after 1971, there was a proliferation of scientific institutions, occasionally even a subdividing or amalgamation of existing ones. Operating methods were modified, control shifted from one ministry to the other, and the national research body underwent various changes. Without going into the minute details of all these events, we shall simply give a brief picture of the present situation. There are about thirty scientific institutions which refer to various ministries of which two play a dominant role - the Ministry of Agriculture, and the Ministry of Higher Education. We will also broach the way they coordinate.

3.1.1 Institutions under the Ministry of Agriculture

The Ministry of Agriculture oversees all agricultural production with the exception of sugar cane which comes under the Ministry of Sugar, since 1981. It supervises 17 research institutes, centers and stations, each specializing in a particular commodity or resource (see Table 6). These institutions were for the most part created in 1976, although the most important ones existed before that date in the form of "technical teams," who benefited from the operating facilities offered by a few State pilot-farms, but without any research budget being allocated to them. In 1983, these 17 research institutions amounted to almost 1,000 full time researchers, of whom 70 had been awarded PhD's, and 300 were "candidates" awaiting their PhD's. There was a supporting staff of 3,000 workers and a working budget of 27 million pesos including 3.5 million in capital investment.

All these institutions refer directly to the General Directorates of the Ministry of Agriculture which supervises production and associated activities alongside research and administration. A new "Directorate for Science and Technology" was created in 1982 in order to insure the scientific and administrative coordination of the institutions; is particularly active in matters of:

- programming: it provides the secretariat for the preparatory meetings for the five-year plan of research of the Ministry

during which research and budget priorities of the 17 institutions are established; it organizes the follow-up and the assessment of their activities;
- scientific communications above all between the Ministry of Agriculture institutions, but also between these and other national scientific institutions;
- supervising scientific cooperation with foreign countries;
- linkages with farms (see Section 3h);

3.1.2 Institutions and research units under the Ministry of Higher Education

Here we find the four institutions grouped under the Higher Institute of Agricultural Science of Havana (CENSA, ICA, INCA, Indio Hatuey) which are responsible both for post graduate training and research in all areas. They are the oldest agricultural institutes in Cuba and they trained most of the researchers now working under the Ministry of Agriculture.

Also worthy of mention is the important Faculty of Biology at Havana whose 192 teaching staff and 28 full-time researchers carry out research directed principally at agriculture and fisheries. In the Provinces, several Universities have set up degree courses in agronomy with research interests into regional problems. Table 6 also mentions the CENIC for its research into agriculture and food technology. It is the largest national research center with over 1,000 researchers (of whom 300 have PhD's) working in various fields: biomedicine, microbiology, chemistry, metallurgy, electronics, etc.

3.1.3 Other institutions

Many of the 22 institutions which come under the Academy of Sciences have an interest of varying degrees in agriculture. Other institutions come under the Ministries of Sugar, of Food, etc.

Among all these, the Center for Biotechnological Research (CIB) set up in 1981, is directly responsible to the National Research Coordination Council which was recently placed under the Academy of Sciences. Such autonomy underlines the importance which the Cuban Authorities attach to biotechnology (genetic engineering, microbiology, etc., applied to the plant breeding, to human food and animal feedstuff technology, to immunology, etc.). What was sought was an institution enjoying flexibility and a freedom from The shackles of bureaucracy." 23 Cuban researchers, all with PhD's were currently working there in 1983, hand-picked from the most brilliant elements of the other scientific institutions.

3.1.4 Striving towards coordination at national level

The recent proliferation of scientific institutes reflected an attempt to meet objective needs either totally ignored or only partially catered for, such as the development of basic research necessary for applied research, and the decentralization of research institutes which had so long been concentrated immediately around Havana, etc. But such an increase was for a long time plagued by poor linkages between the existing institutions, between scientists and production, and between the different bodies

responsible for their supervision. An example illustrating this problem is that sugar cane alone attracts intervention from two major specialist institutes (IICA, ICINAZ) and from other non-specialist ones (INCA, CENSA, CIB, University of Bayamo, etc.) with frequent overlaps for a long time.

In order to eliminate as far as possible the problems resulting from this proliferation, the Government in 1974 set up the National Council of Science and Technology, replaced in 1976 by a State Council of Science and Technology. This, in turn, ceased to exist in 1980, since when the Academy of Science, on top of its own scientific activities, has taken over the role of Ministry of Research. Overall supervision and coordination is implemented by (Figure 3:

- 5 scientific departments, each with a vice-president in charge: one for agriculture and four others for chemistry and biology, physics and engineering, geosciences, social science;
- 1 department for equipment, providing informations for various institutions and responsible for the purchase of major items;
- 2 departments in charge of a) the National Plan for Science and Technology, b) international relations and post-graduate training.

In the field of agricultural research the Academy of Sciences has endeavored to foster coordination structures at several levels:

- for the main ministries concerned, it has helped to create Research Directorates (Ministries of Agriculture, and Sugar);
- on the national level, it has set up a scientific Council for agricultural research, with a membership representing various ministries, the leading national scientists, and various scientific committees specialized in commodities and topics. The Council and the committees have already adopted the following significant measures:
  - o the appointing, along the lines with the Soviet model, of institutions to act as leaders in research programs, responsible for research coordination and funds distribution;
  - o the setting-up in 1981 of the Integrated Development of Sugar Cane (CEDIC) at the Pablo Noriega agro-industrial complex (in the Province of Havana) where 200 researchers and engineers from four different institutions work together on all aspects of production, transformation, by-products, machinery, etc., in liaison with their respective institutions.

Such efforts show great merit, and should help to minimize the disadvantages resulting from the present excessive scattering of structures and researchers without forsaking the smooth management of limited scale research units. It is nevertheless reasonable to suggest that further simplification of the structures would be beneficial.

3.2 THE RAPID EXPANSION OF HUMAN RESOURCES

As we have seen, the number of researchers is very high for the size of the country, but the recent expansion has led to two

consequences. Firstly, most researchers have had only limited experience (the 1982 average was 5 years) and have not yet completed their training at the PhD level. Secondly, the longest serving amongst them are not the best qualified, given that they were trained during the first decade of the revolution when high school and university teaching was still of a fairly low standard, and research was carried out in adverse conditions. It is estimated that at present at least 20% of the 2,500 scientists hardly qualify as researchers.

As for the conditions affecting individual promotion, the salary differentials between the four grades ("aspirante, agregado, auxiliare, titular") are too small. The "aspirante" has a starting salary of 305 pesos per month (compared with 200 pesos per month for an unskilled State farm-worker) and the "titular" reaches the top of the scale at 400 pesos per month with a bonus of 75 pesos for those with administrative responsibility. Promotion from one grade to the next, as well as within any given grade, is based on qualifications obtained and work undertaken which is appraised every two years, with the possibility of demotion for the least competent. This situation is, however, reasonably well tolerated because of the prestige of a scientific career, without forgetting the attractive side benefits of missions abroad, the personal use of official cars for research directors and the most outstanding researchers.

3.3 RATHER SATISFACTORY WORKING RESOURCES

The research institutions on the whole enjoy quite favorable physical working conditions. Equipment exists in sufficient quantity and is sometimes highly sophisticated. They have large experimental stations and can use additional areas in State farms. There are occasional lacks of imported laboratory products or spare parts. For the latter the CENIC and the CENSA have set up specialized workshops for the repair or laboratory equipment, both their own and that of other institutions.

Documentation has until now been a weak point. Libraries are poorly stocked, foreign research periodicals obtained by subscription or exchange are too few and highly centralized. Leading researchers manage to keep more up to date thanks to foreign travel or contacts established with colleagues abroad. A new national library of science and technology currently under construction at Havana should from 1986 meet the needs of all institutions in bibliography, photocopying, etc.

International scientific relations are relatively well developed and efficiently organized. Bilateral relations on a significant scale exist with East European countries, and certain Western countries, notably the following:

- France which has trained 260 researchers since 1971 (in citrus and tropical fruit farming, vegetables, potato, soil science, pest control, plant breeding poultry, pig breeding, cattle reproduction, biometrics, production economics;

- Canada, which collaborates closely on matters of cattle genetics and animal health with a US$ 4 million IDRC loan to equip the CENSA;
- Sweden, in the area of dairy technology, etc.

Over the past few years there has been a rapid increase in relations with the International Agricultural Research Centers based in Latin America: CIMMYT (wheat and maize, in Mexico), CIAT (beans, cassava, rice, fodder resources in Colombia), CIP (potato, in Peru). For Cuba, these Centers represent openings onto the Western world, access to a wide range of genetic material, to scientific information and results, to additional training facilities and also the possibility of establishing means of indirect exchange with the Latin American scientific community. It is not surprising therefore the Cuban Authorities follow these developments with great interest, even to the point of publicly overestimating their value as with the recent case of the link with the CIAT. For their part, these international research Centers consider Cuba to be one of their most dependable scientific partners.

3.4 RELATIONS WITH PRODUCTION

First, we shall look at relations with production under the purview of the Ministry of Agriculture, and see how they have changed in nature over the years.

From 1971 to 1976, the "technical teams" worked under the direct questioning of the State pilot-farms accommodating them. They consequently laid the greater emphasis on the problems, generally short-term, posed by the State farms which in any case had much better human and material resources. Therefore a good many research results and production recommendations put forward by the researchers were of only limited interest for the remaining majority of State farms and for the private sector.

The setting-up of research institutions with their own resources afforded researchers a greater flexibility in identification production problems and allowed them to begin the basic research vital for the solving of certain applied problems. But faced with the risks involved in loosening links with production and in under-utilizing research results, the Ministry of Agriculture set up a "system of pre-extension" meant to select and test technical innovations prior to their large-scale application within the framework of the five-year or one-year production plan.

This system is represented in the graph 4 with commentary. What is apparent is the relative weight of the sector and regional production committees made up of qualified scientists and representatives of the Administration and of production (State farms as well as the cooperative and private sectors). This system, while allowing a normalization of the relations between research and production, is not without its weaknesses:

1) The system deals from the outset with those innovations which

the researchers develop usually on the basis of their own appreciation of production problems. Although such appreciation does take account of appreciation made by those in charge of state farms, it is not based on the scientific analysis of the way these farms function nor on research into farming systems likely to challenge research priorities already adopted.

2) The testing of technical innovations is always carried out in the best State farms which are held up as technical models for all other production units. It is far from certain that innovations which fit well into the former can be easily adapted to the latter.

3) Given the degree of commodity specialization in the State farms and in most research institutions, the innovations proposed turn out to be very specialized with little possibility of more global innovation relevant to the organization methods of the production units, the benefits of crop rotation or the combining of crop and animal production. Such global innovations could contribute much to an improved use of human resources, to a better presentation of soil fertility, to an improved exploitation of by-products, etc., and they point to the potential benefits of the farming system approach led in conjunction with general agronomists and rural socio-economists, an approach absent from Cuban agricultural research.

4) Finally, until 1983, this system excluded the research institutions from other Ministries which continued to maintain direct links with only a limited number of State farms and whose impact on production was by virtue of this fact modest. The more pragmatically minded Ministry of Sugar, established for sugar cane a system of pre-vulgarization on the same lines, in association, under the aegis of ICINAZ, with the scientific institutions of other Ministries.

3.5 A BRIEF SURVEY OF RESULTS

On a <u>scientific level</u>, Cuban research can already point to highly worthwhile results in various domains:

- in plant breeding, achievement of attractive varieties in vegetables, potatoes, etc.; pest control for citrus and coconut trees, etc.
- use of micchorysa in forest and citrus plantations on poor soils;
- animal health and production: pig genetics, reproduction physiology of dairy cattle (well established practice of embryo transfers), large scale interferon production, etc.;
- in microbiology: well-known advances in cell culture on sugar substrata used increasingly in animal feeding, etc.

On the <u>production level</u>, it is undeniable that research has contributed to the large increases in productivity recorded since 1971, but it is difficult if not impossible to evaluate its contribution relatively to that of other factors such as improved management and operation of State farms, better educated workers

and farmers, the introduction of material incentives, a better mastering of industrial inputs thanks to greater experience in their utilization, etc. It is nevertheless acknowledged that innovations introduced through research have played a decisive role in the very favorable developments of certain productions such as vegetables, potatoes, poultry and pig farming and on the improved use of input's such as fertilizers, irrigates, etc. One can also sense that certain recent innovations already reveal or suggest marked improvements in the production of beans, cassava, maize, coffee, fodder, cattle herds (reduction of the death-rate of calves, feeding), etc.

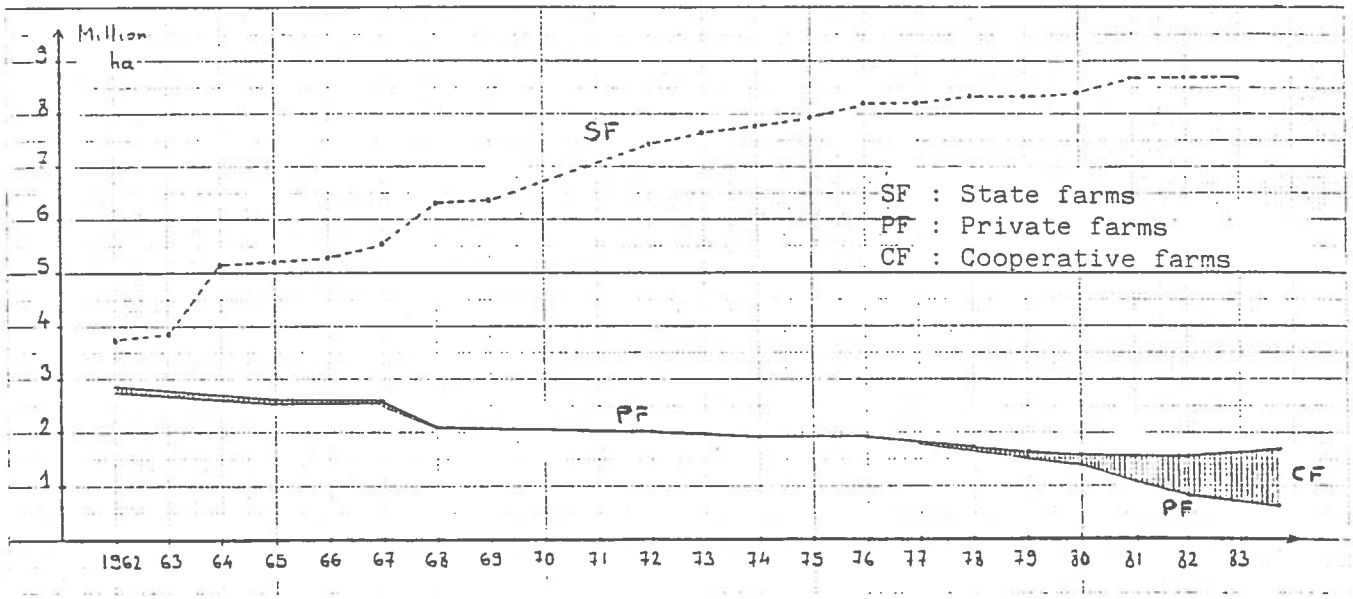
It must be pointed out that most of these innovations, both actual and potential, concerned primarily the State and cooperative farms. Therefore most of the annual crop varieties mentioned above were chosen among other criteria for their suitability for mechanized harvesting and single-crop culture; the poultry, pig and dairy farming targeted are also those of the large scale farms. The private sector whose future disappearance is publicly on record, has never been designated as a target area fro research; it would not be exaggerated to say that it has suffered from definite discrimination, and this for a long time, led to negative effects in certain research domains:

- the maize and beans produced for the most party by the private sector only attracted research interest after 1976;
- work on cattle genetics ignored the Creole strain bred by small farmers who had amply demonstrated its adaptability to the environment and satisfactory productivity, but whose performance seems to have been deliberately undervalued from 1968-70 in order to justify the preference for the holstein x zebu breed genotypes;
- there is no research on systematic crop rotation, associated crops combinations of crop and livestock farming which are implemented by private farms and could equally be of possible benefit to the larger production units.

4 CONCLUSIONS

Cuba has set up over the last fifteen years a national system of agricultural research endowed with impressive human and material resources. The past outputs of the system reveal that its impact on production was relatively limited on account of its brief existence, its complexity, its ideological limitations as well as the particular characteristics of production. One can legitimately expect that, in the future, research, more experienced, better structured and more prospective, will be a more effective instrument in Cuban agricultural policy and ensure the continuation of growth rates of production and productivity recorded during the seventies. It could also become both a major instrument of cooperation with the Third World and a means of extending political influence.

Graph 1 - AREAS OF THE AGRICULTURAL STATE, COOPERATIVE AND PRIVATE FARMS (1962-1984)



Sources : JUCEPLAN, CEE, ANAP, etc. (CASAS, 1985, p.11)

Table 1 - DATAS ON THE STATE, COOPERATIVE AND PRIVATE FARMS IN1984

	Units	State farms	Cooperative farms	Private* farms
Number of farms		430	1,420	52,000
Number of permanent workers		610,000	57,000	72,000
Total area	1.000 ha	8,500	1,070	640
of which agricultural area	%	68	90	
cultivated area	%	39	44	
Average perm.workers/farm		1,400	57	1.4
Average area/farm	ha	22,000	~~22,000~~ 750	12

Sources : CEE, ANAP, Author's informations o` estimations* (CASAS, 1985, p.11)

Table 2 - EVOLUTION OF SOME AGRICULTURAL INPUTS (1958/59 - 1980)

	Irrigation		Tractors	Sugar cane Mecanized Harvest	Fertilizers			Pesticids + Herbicids			Trained Graduate Specialists (1)
	Dam Capacity	Irrig. Area			Product.	Imports	Total	Product.	Imports	Total	
:s —	10^9 m^3	10^3 ha	1000	%	1000 T m.t.	1000 T m.t.	1000 T m.t	1000 T m.t.	1000 T m.t	1000 T m.t.	u/5 years
3/59	0,05	160	12 (1960)	0	195	43	238	x	x	x	243 (1961-65)
5	x	x	30	3 (1966)	473	432	905	3,3	3.3	6.6	739 (1966-70)
)	2,0	545	49 (1969)	1	591	975	1,566	3,6	13.8	17,4	2,131 (1971-75)
5	5,9	600	54	25	987	941	1,928	8,5	25.5	34.0	5,583 (1976-80)
)	8,3	850	70	45	1,405	1,186	2,591	x	26,9	x	

irces : JUCEPLAN, CEE, MINAG, etc. (CASAS, 1985, p.19)

) Trained on Agricultural and Veterinary Faculties, without counting those trained in other areas (Economy, Biology, Mechanics, etc.)

Graph 2 - GROSS AGRICULTURAL AND "FOOD" PRODUCTS PER CAPITA (1956-1984)
Indice 100 in 1959 (Casas , 1985, p. 24)

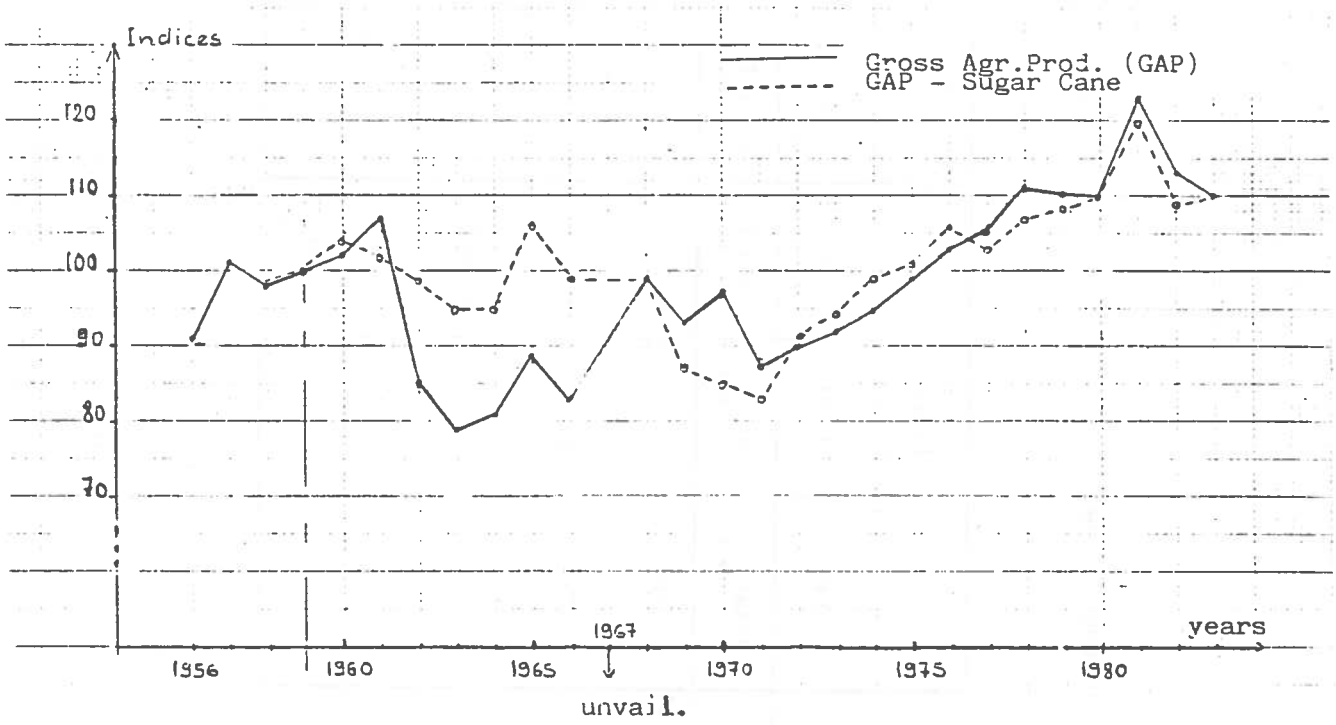


Table 3 - AGRICULTURAL GROSS PRODUCT, LABOR FORCE AND PRODUCTIVITY (1957/58-198[illegible])

(Casas, 1985, p.24)	Units	1957/58	1960	1962	1965	1971	1975	1980
Gross product	10^6 constant pesos	962	1,025	894	1,009	1,100	1,341	1,528
Permanent workers	10^3	789	789	841	762	924	917	844
Labor productivity	constant pesos	1,219	1,307	1,603	1,324	1,190	1,462	1,810
	Indice	100	107	87	109	98	120	148

Source : Casas, 1985, p 24

Table 4 - FOOD CONSUMPTION (1948/49-1983)

	Units	1948-49	1965	1970	1975	1980	1983
Cereals	kg/year	106	97	102	109	109	113
Dry beans	-	17	11	10	11	11	13
Root crops	-	91	58	35	49	80	82
Vegetables	-		48	27	53	52	65
Fruits	-	*	47	35	48	61	66
Sugar	-	40	57	58	46	52	56
Cooking fats	-	11	12	13	15	17	18
Meat	-	35	35	33	33	36	33
Dairy products	-	86	114	143	155	158	156
Eggs	/year	51	134	178	184	233	241
Seafood	kg/year	3	8	12	13	12	16
		(1951-57)					(1982)
Calories	/day	2740	2552	2565	2622	2867	2080
Proteins	gr/day	-	66	69	71	75	76

Sources : Banco Nacional de Cuba, MESA-LAGO, HANDELMAN, etc.(CASAS,1985, p.34)

TABLE 5 - NUMBER OF CUBAN SCIENTISTS AND ENGINEERS WORKING IN R AND D RELATED ACTIVITIES (a)

Year	Total	Natural Sciences	Agriculture	Eng. and Technology	Medicine	Social Sciences
1970	1 500[d]	520	230	250	240	260
1975	5 800[d]	2 000	900	1 000	900	1 000
1980	5 700[c]	1 420	960	1 280	680	1 360
	11 400[d]	4 120	1 940	2 120	1 380	1 840
1985[b]	17 060[d]	6 380	3 340	3 150	1 740	2 450
1990[b]	23 480[d]	9 160	5 400	4 460	1 880	2 580

(a) Scientists and Engineer having a professional qualification (First qualification of higher education awarded after five years in most faculties (six in medicine),
(b) Projection,
(c) Corresponding to full time scientists,
(d) Total number of scientists.

Source : Academy of Sciences, in GAILLARD J. (1983).

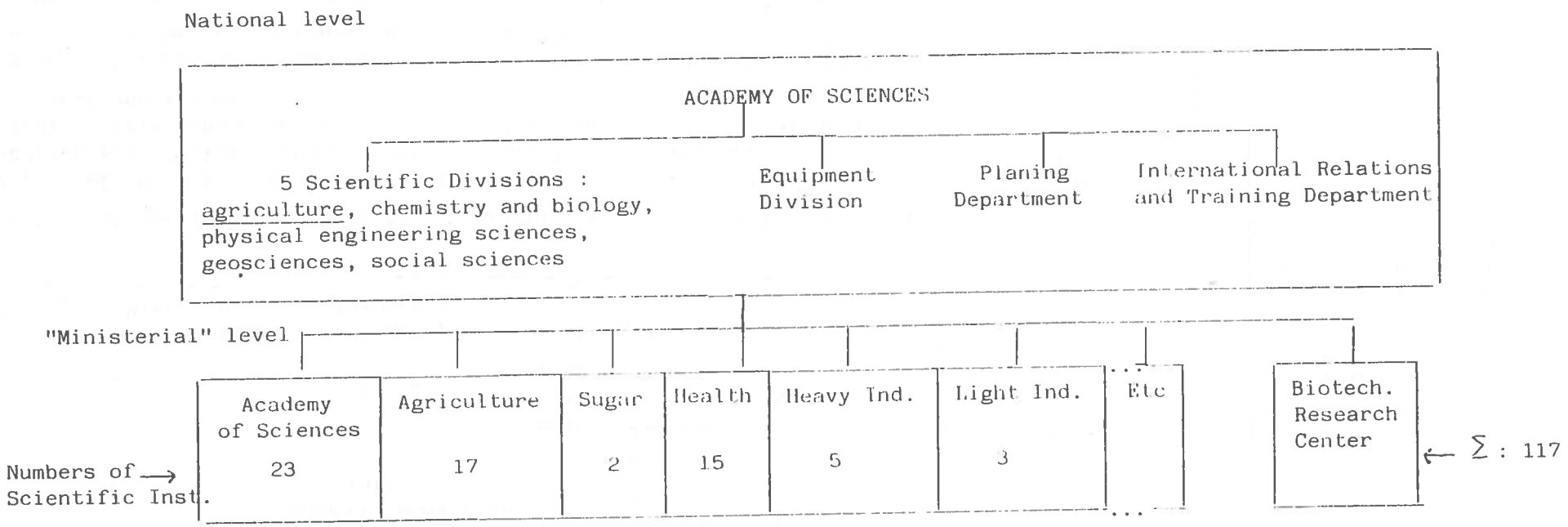
TABLE 6 - NUMBERS OF INSTITUTIONS AND SCIENTISTS RELATED WITH AGRICULTURE 1983

Ministries	Institutions and Fields		Number of Scientists
AGRICULTURE	- Institutions For Crops	Citrus and Tropical Fruit	80
		Rice	40
		Vegetable, Potatoe and other Cereals	20
		Tropical Roots	30
		Tobacco	40
		Coffee and Cocoa	20
		Pasture	60
	- Forest Research Institute		-
	- 4 Institutions For Animal Production	Poultry	100
		Pig	50
		Cattle	40
		Apiculture	-
	- 5 Sectorial Institutions	Soils and fertilization	150
		Irrigation	80*
		Pest control	180
		Mechanization	70
		Economy	20
	- Directorate for Science and Technology		20
HIGHER EDUCATION	- Higher Institute of Agr. Sc. (ISCA) Havana	National Center for Animal and Plant Health (CENSA)	160
		Institute of Animal Sciences (ICA)	120
		National Institute for Crop Sciences (INCA)	80
		Indio-Hatney Pasture Experimental Station	35
	- National Centre of Scientific Research (CENIC, Habana): some departments		50*
	- Faculty of Biology, Habana		120°
	- Other Universities: Las Villas, Santiago de Cuba, Bayamo, etc.		-
SUGAR	- Cuban Research Institute for Sugar Cane (ICINAZ)		75
	- Research Institute for Sugar Cane By-products (ICIDA)		140
ACADEMY OF SCIENCES	- Research Institutes	Tropical Agriculture (INIFAT)	100
		Sugar Cane (IICA)	50
		Soils	-
		Botany	-
		Zoology	-
		Geology	-
		Geography	-
		Etc.	
OTHER MINISTRIES	- Research Institute for Food Technology.		-
	- Research Institute for Agricultural Mechanization		-
	- Etc.		-
	- Biotechnological Research Center (CIB)		23

Data: - unavailable, * approximation, ° full-time equivalent

Sources: author's direct information, Cuban press, etc.

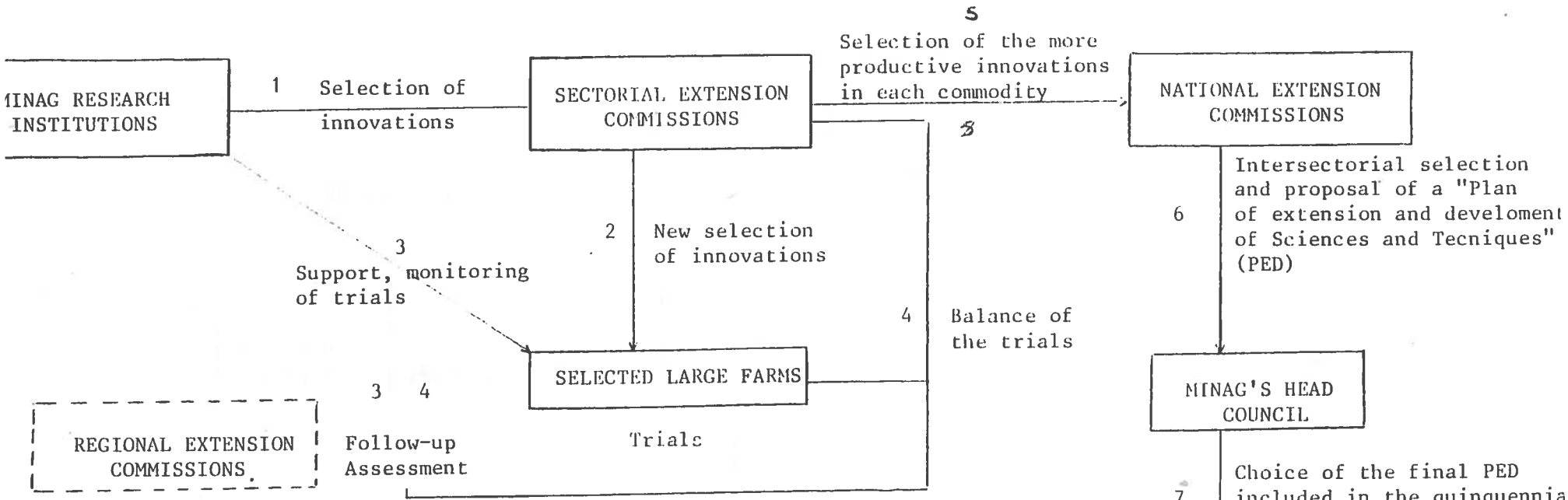
Graph 3. GENERAL ORGANISATION OF RESEARCH IN CUBA (1983)



RESEARCH BUDGET IN 1983 : - Total : 115 million pesos (approx. US $ 135 million)
of which 15 for equipment

- Breakdown : 33 % for agriculture
16 % for industry
...
13 % for "general advancement of knowledge"

iph 4 - THE PRE-EXTENSION PROCESS IN THE MINISTERY OF AGRICULTURE (MINAG)



Selection of applicable results by the Scientific Committeesof Research Institutions.

Analysis of these results by the Sectorial Extension Commissions; direct exchanges with concerned scientists; technical and economical assessment and final selection of results to test on trial bases in selected farms (representative of ecological conditions, good management and resources).

Agreements between selected farms and research institutions for implementing (and adapting if necessary) the innovations, follow-up by theRegional Extension Commissions.

Balance of each experience sent to the corresponding Sectorial Extension Commission..

Intersectorial selection of innovations by the National Extension Commissions ; major criterias : real applicability (inputs' disponibility, cohenrency between innovations, etc), economic rentability.

Extension of innovations can be national or regional.

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