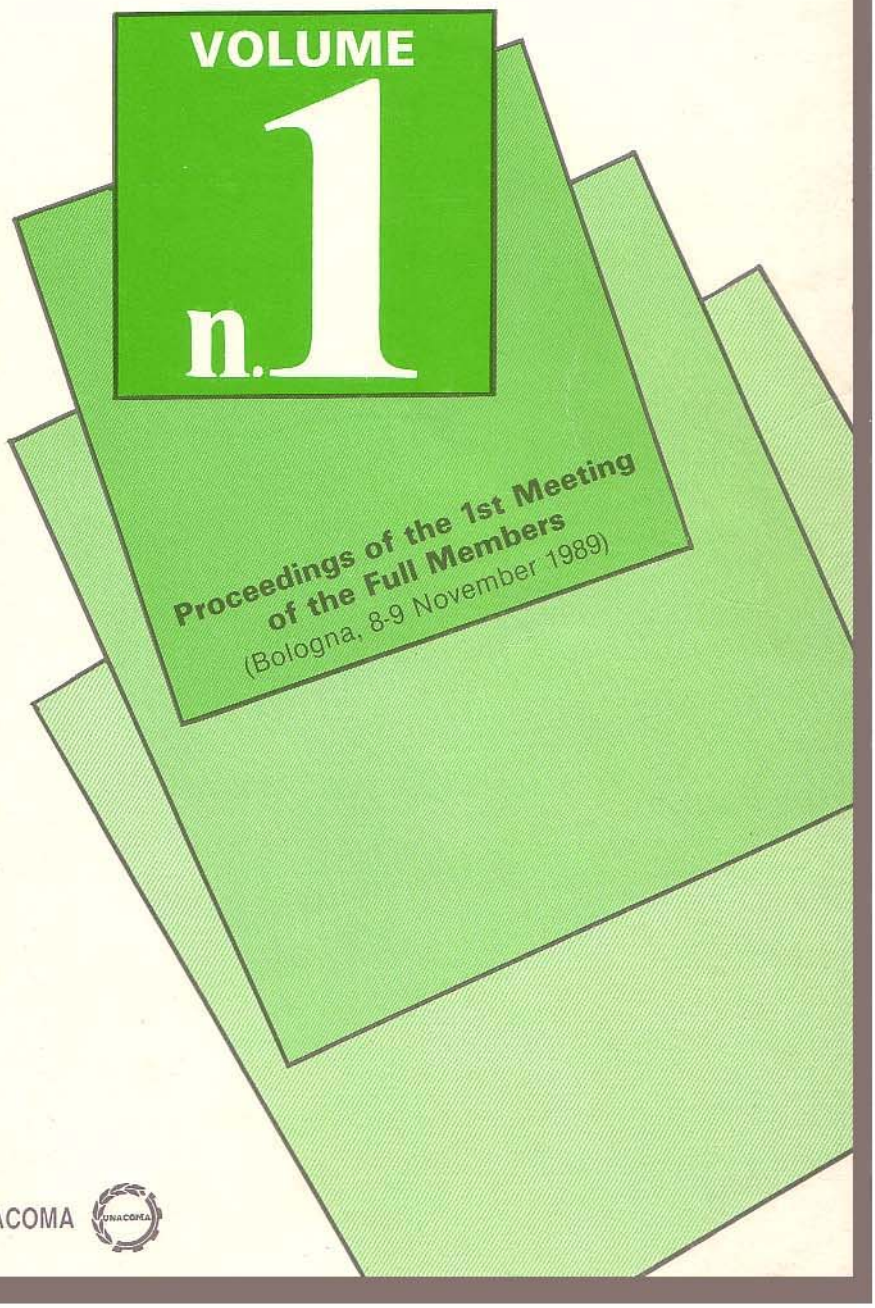
CLUB OF BOLOGNA



EDIZIONI UNACOMA

volume n.1

CLUB OF BOLOGNA

PROCEEDINGS

OF THE 1ST MEETING

OF THE FULL MEMBERS

OPENING SESSION

SESSION 1
Agriculture and mechanisation after the year 2000 (presentation of preliminary analyses)

SESSION 2
Process and product innovation
in the agricultural mechanisation

SESSION 3
Organization of the Club
and proposals for future activity

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XX EIMA

Edizioni UNACOMA

1 - Opening Session

Ing. Giancarlo Vezzalini
Chairman UNACOMA Rome - ITALY

Ladies and gentlemen, greetings. I am particularly happy to express to all those who are participating in the first open meeting of the full members of the Club of Bologna a welcome from UNACOMA, the Italian Association of Agricultural Machinery Manufacturers which I have the honour of representing.

This meeting is being held on the occasion of EIMA's twentieth anniversary, of the 20 years of life of this exhibition of the agricultural machinery industry, with 1440 exhibitors, including 312 from 29 different countries.

This initiative was conceived, planned and implemented by UNACOMA in 1969 to offer agents from all over the world the chance of assessing the widest possible range of machinery in an exhibition exclusively devoted to mechanical technologies for agriculture.

However, right from the start EIMA has been much more than a simple "shop window" of the sector's production. It offers above all a chance for an overview of mechanization, of investigating the problems it creates and discussing them with the scientific and research worlds, for a continuous innovation of processes and products.

I would like to remind you that as far back as 1970, and thus at its outset, EI-MA presented the results of the "National Project for Integral Mechanization of Farms", promoted by the Italian National Research Council (CNR) which at that time considered the goal — achieved in later years — of using machines in all cultivation and processing operations as a "new frontier" in mechanization.

Certainly at that time no one imagined the potential which electronics and information technology applications would have in our sector; however, the project had the merit of posing the problem and indicating effective solutions for the times in which they were proposed.

Another important moment in our relationship with research occurred in 1981, ten years after the first initiative, when the results of the "National Agricultural Mechanization Project", implemented over the five previous years, were illustrated in the framework of eight projects concerning "food sources", all financed by the CNR.

On that occasion, besides exhibiting at EIMA the prototypes of machines produced with that project, the CNR organized an international symposium for analysing and comparing research carried out in Italy and other countries, mainly involving the mechanization of harvesting agricultural products.

Finally, in 1987, in the absence of a coordinated research project on mechanization of a public nature like the two previous ones, UNACOMA took the initiative of organizing an exhibition on the re-search carried out by national university institutes, CNR and the Italian Ministry of Agriculture, and promoted the Inter-national Symposium on Research and its Publication. Hence the Club of Bologna, created to fill the need for a forum, in-formal and voluntary as it might be (but precisely for this more authoritative), for debate. A debate on the important issues we are faced with, on agricultural trends and thus on the role which mechanization must play in a political and economic scenario which has profoundly changed in the past few years, and which is certainly destined to undergo further changes.

This is not the place to anticipate the subjects which form the basis of your first discussion. I only want to stress the soundness of this method of approach, in terms of both nationalities and competences. I also want to congratulate everyone who has felt the need to compare their experience with that of others, to give their contribution towards solving common problems.

The world is, by now, considered a single

global entity, and if this is really so — and I believe it is — I think that putting one's knowledge at the service of all in order to achieve a common goal is the best way to prove that we are really citizens of the world. In our case, this means finding the most suitable machinery for enhancing agriculture in terms of income and quality, involving both the products and the agricultural entrepreneurs of the different countries.

It is with these sentiments and these ideas that I once again express my satisfaction and the gratitude of the Italian agricultural machinery manufacturers to you all for being here with us today, together with the best wishes for profitable work and the success of this initiative.

Thank you.

Prof. Giuseppe Pellizzi
President of the Club

Thank you very much Ing. Vezzalini to you and to UNACOMA. In effect, as Ing. Vezzalini mentioned, in November, 1987, an international symposium was held he-re in Bologna on the subject of agricultural mechanization. The symposium was en-titled "Research and Information-Spreading on Innovations for Agriculture and Industry in the Year 2000", and it was sponsored by EIMA and UNACOMA.

During the closing session of the convention, in which numerous foreign scientists participated, a proposal was made for the periodic exchange of information between countries on the state-of-the-art of agricultural mechanisation, examined from the points of view of manufacturers, farmers and the scientists. One of the objectives was to help define the industry's outlook for the future and its specific requirements.

This proposal was based on the following considerations: the deep evolution experienced internationally by productive agriculture, the increasing internationalisation of the market in terms of both animal and vegetable products and machinery, and the need to protect the rural environment. Consequently, there appeared to be a compelling need for improved and deeper understanding of the evolutionary process in course in various socio-economic, and hence agricultural, systems, as well as the development of mechanisation as an essential tool for agricultural production processes, though in different forms in the various areas involved.

The proposal was welcomed by UNACOMA, which represents all the Italian manufacturers and whom I wish to officially thank on this occasion. UNACOMA felt that it was capable of meeting this need by promoting the establishment of the Club of Bologna for the study of strategies for the development of agricultural mechanisation.

Today, the Club is holding its first open meeting, during which the initial contributions made on this subject will be discussed.

According to its internal rules, the Club is an independent association with two types of members: the first are full members, or high level experts from various countries who are willing to personally work on projects, as well as representatives of international, public and private organizations; and the second are associate members, or all those interested in keeping up with the strategic analyses that the Club expects to carry out (without being directly involved in them, however) and in freely discussing the various results obtained and drawing any useful conclusions.

Therefore, the Club of Bologna intends to be a permanent "observatory" for the study, analysis and investigation of the subject of agricultural mechanisation on the international level. The goal is to de-fine possible strategic paths of development as a function of various countries' current and future requirements and on the basis of alternative scenarios. Let me repeat that all of our work will be based on knowledge about the specific needs of

various agricultural situations, different manufacturing realities and markets and the consequent need for technical assistance. This with the aim to gain a clearer understanding of what can be done and of how and where to do it.

Clearly, UNACOMA has an ambitious and wide-ranging project to place at the disposal of the international mechanical-agricultural community. It requires voluntary commitment and dedication on the part of all members, without any other form of compensation than the satisfaction gleaned from having contributed to a more rational development of agriculture and machinery through the logical expression of one's research and knowledge.

With this goal in mind, invitations to join the Club have been extended to the most highly qualified experts working in various countries and in different areas of this field. They range from agricultural engineers to machinery manufacturers, from economists to agronomists and from those people responsible for agricultural policy to the farmers themselves.

Naturally, as preliminary activities we-re undertaken by the organizing Commit-tee, which later became the present Management Committee with members from prestigious research institutes in France, Germany, Japan, Italy, the U.K. and the U.S., the first question posed concerned whether the idea itself was justified or whether it was a duplication of activities already in progress. Specifically, this question regarded projects that had already been undertaken by various national governments and international organizations (the FAO, UNIDO, UNDP, W.B., etc.), which had been working in the field of agriculture for years. In other words, we did not want to "reinvent the wheel"!

An analysis carried out in this regard convinced us that there was no danger of duplication and that the activities conducted by agencies and organizations, whether national or supranational, had never espoused the goals of our "permanent observatory", even though numerous, valuable studies specially designed to assist developing countries, as well as several, more general analyses had been carried out. Furthermore, a thorough analysis aimed at reaching the same general goals upon which the Club is based has never been at-tempted, despite the fact that today, as a global vision of problems is becoming more and more essential, this analysis is more necessary than ever.

Once our worries in this regard had been put to rest and we became even more convinced of the need to fill this gap for the benefit of the entire world, the Management Committee began to invite experts with various especialisations in the field to join the Club and the numerous, often enthusiastic, positive responses, which gave us great pleasure, further strengthened our conviction to act. The Committee al-so began to discuss how to organize future activities on the one hand and on the other how to set up an initial analysis that would make it possible to take stock of the situation and make several forecasts about the future, within the framework of alternative scenarios for development.

The first such activity is today's meeting, which should help us get to know each other better and discuss some operative proposals, in addition to beginning debate on the issues which are the subject of the reports listed on the agenda.

While these reports will be discussed more fully later on, I would like to take a minute here to mention some preliminary, operative proposals that will be examined in more detail tomorrow morning and which concern the following points:

— the extension of Club membership to associate members, or to all those who, for various reasons, are interested in the developments of this observatory and would like to work with it by contributing any information they might have available;

– the establishment of a permanent technical staff made up of some young re-searchers and engineers whose task would be to collect and make available basic

documentation. In this regard, it would be very important to establish files containing all the studies conducted in this field, and especially those carried out by international organizations;

— the breakdown of research activities by geographical region with the appointment of area coordinators. One possible way of proceeding could involve division into the following four areas: America; Asia and Oceania; Africa; Europe, the Mediterranean and the Middle East;

— the definition of a research program-me to be carried out on the international level by following common methodologies to be determined.

I realize that these proposals are highly ambitious and difficult to accomplish, but I feel I should also emphasize their absolute necessity.

They will involve considerable initial effort on the part of full members, both in terms of the extension of Club member-ship to new full and associate members from various countries and the initial need for more frequent meetings.

All these problems, the structure and the organization of the Club meetings as well as the activity to carry out in the near future will be examined, discussed and de-fined in the 3rd session.

Ing. Vezzalini has now to leave us for other official engagements; let me express him once again, on your behalf, deep thanks for the hospitality offered and for the support of UNACOMA.

G. Vezzalini

I wish to renew my thanks to prof. Pellizzi and to all of you and to express the hope of a successful meeting and a pleasant stay in Bologna. Thanks for your cooperation in favour of a more rational development of the agricultural mechanization in the world.

SESSION 1

Agriculture and mechanisation after the year 2000

(Presentation of preliminary analyses)

G. Pellizzi

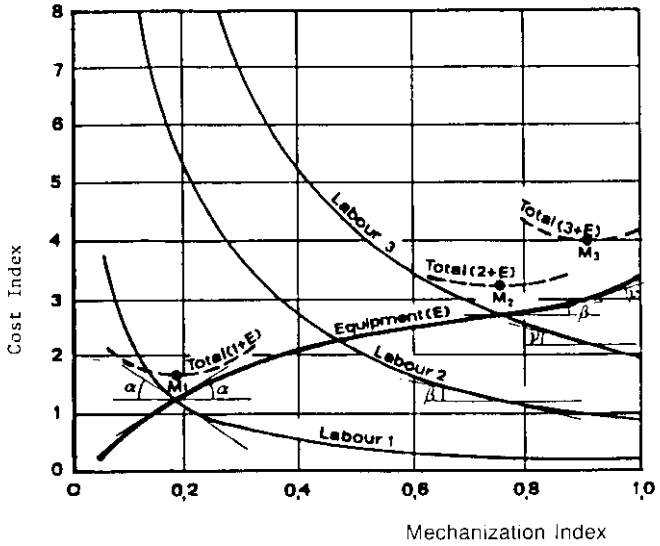
In the field of agriculture, machinery plays a service role which makes it possible to carry out the various operations that are necessary for the existence, development and improved quality of crops and animal productions.

In addition to the intrinsic technological quality of machines and their technical suitability for these operations (in relation to the type of soil involved and the biological, physical and chemical properties of the various products), machinery must meet specific economic requirements, the most important of which is accomplishment of agricultural operations in the least expensive way possible.

This is the reason why it is necessary to determine the work productivity of various machines, which, in relation to the cost of labour, can ensure the accomplishment of various operations at minimal costs. When the hourly cost of labour varies (this figure depends on the level of economic development in each country), the optimal levels of mechanization also change, and hence the most suitable work capacities and machine characteristics can be identified. In general terms, examples of these correlations are provided in the accompanying figure.

It was felt that a preliminary examination of some case studies, using a common approach that was as homogeneous as possible, would represent an initial contribution to increased knowledge about this problem, with an eye towards the development over time of a more complete research project involving the countries represented by active members of the Club of Bologna. The goal would be to create the proper conditions for an initial discussion on the subject, with the hope that all Club members would then want to develop similar analyses in their own countries. The ultimate aim is to have a general framework of comparable data that will make it possible to carry out a comparative analysis and reach conclusions which are generally valid for the future.

The four case studies presented here concern: France, Italy, Japan, and the U.K. The results of the analyses carried out will be illustrated by the individual authors.



Increasing the mechanization levels, the cost of the use of the machinery per hectare increases too (cur-ve E); at the same time, because of the labour productivity growing, labour costs decrease. Therefore, for every wage level (curves labour 1-2-3) it is possible to find the mechanization level minimizing the total costs (M_1, M_2, M_3).

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Agriculture and Mechanization: the Japanese Case

1.1. *Development Over the Past 20 Years*

1.1.1. The socio-economic development of Japan since 1970 is indicated in Table 1.1. in which all monetary values are expressed in 1970 prices.

In the last 18 *years,* the total population of **Japan** has increased by 17.7%. The number of farm workers has, however, decreased drastically: from 17.4% down to 7.9% of the total labour force. That is, 10% of farmers have left their farms and moved to other jobs. Meanwhile, the service sector has developed at a significant rate with an increase in employees of about 10%.

Farm mechanization in Japan has released more farm labour than the above 10% who left agriculture, because the number of part-time farmers in the 2nd category whose main income is from the non-agricultural sector has been steadily rising and is now about 70% of those on Japanese farms as shown in Table 1.2. Consequently, the ratio of agricultural income to the total fanner income has been decreasing.

The gross national product (GNP) at 1970 figures rose by 405% (in US$) and by 258% (in yen), while the gross agricultural output (GAO) rose by 146% (in yen).

1.1.2. The area used for agriculture (AUA) decreased by 7.6% from 5.796.000 (2205m^2/inhabitant) in 1970 to 5.358.000 (2709m'/inhabitant) in 1986. The present AUA consists of paddy field (54.7%), ordinary upland field (23.6%), orchard (10.0%) and meadows (11.7%).

In management terms, the area of 5.358.000 ha can be broken down into 4.222.850 farms with **an** average size of 1. 27 ha/farm. The distribution of farm size is as follows; 41.1% of farms are under 0.5 ha in size, 28.3% are 0.5-1.0 ha, 21.5% are 1-2 ha, 5.9% are 2-3 ha and 2.9% are over 3 ha.

Reduced rice consumption has caused a surplus of rice and the controlled production of this crop has been in effect for the last decade. Consequently, rice field area has decreased by 14%, and meadows have increased by 119%. Imported feed together with greater domestic feed production has stimulated the production of livestock. Rice cultivation has also shifted to other crops such as soybean, wheat, vegetables, flowers and fruits.

An increase of yield per ha has been achieved even for the surplus rice (by 14.9% over a 17 year period). During this same time, yields per ha of other crops rose as follows: wheat: 63.2%, potatoes: 55.6%, soybeans: 34.1%, tomatoes: 8.8%, mandarin oranges: 34.6%, and grass for fodder: 11.0%. These results were achieved by the development of cultivation technology in the form of high yield varieties, more effective fertilizer application, deeper tillage and the timely use of machinery.

Nonetheless, the self-sufficiency ratio of Japanese agriculture dropped from an 81% level in 1970 down to 70% in 1986.

In economic terms, mechanization was the key technology in solving the labour problem. Figure 1.1. indicates the index ratios of labour, energy and machinery prices fanners had to pay to the prices paid to them for their agricultural pro-ducts. The labour index rose quite steadily, whereas the machinery index generally decreased and remained under 100. The energy index was rather stable until the petroleum crisis, and then suddenly shot up, although it subsided to some ex-tent thereafter. In the cost of rice production in Japan, the sum of machinery and labour costs remained almost constant (about 70%) for the last two decades. La-

bour has been replaced by comparatively cheap machinery. However, the total production cost has gone up, and the price of agricultural products has increased by an average $117^{0}7o$ as a result.

The increased use of various production factors such as pharma-chemicals and machinery created a situation in which the 60.4% rise in net product was sharply inferior to that of GAO, which was 145.8%.

1.1.3. In rural areas, most young people do not want to succeed to their pa-rents' occupation. The increase in number of elderly men and women working farms together with the great number of part-time farmers has stimulated the pre-valence of small and light machine equipment with automatic control so that no difficult adjustments are needed.

On the other hand, full-time farmers now own larger machines and utilize their excess machine capacity either by renting other acreage and thus expanding their total area, or by custom operation; one example of this latter is the "machine-ring" system.

The ratio of machinery investment to agricultural income has increased considerably. However, the ratio of machinery investment to total farm income and to farm management expenses has gone down, as indicated in Table 1.3.

The increase of farm machinery represented by tractors and harvesting machines is indicated in Fig. 1.2. Power tillers or two wheel tractors were replaced by four wheel tractors which have rapidly in-creased since 1970. For rice harvest, the binder system with natural drying and a thresher was widely used in parallel with the combine system with an artificial dryer in the early 1970's. Thereafter, however, the increase rate of binder systems dropped, while the number of combine systems has risen sharply, and this has promoted the mechanization of rice cultivation in Japan.

Installed power in kW on farms is calculated from the number of machines and their average horsepower. Figure 1.3. shows the sum of the installed horsepower of tractors, power tillers, rice transplanters, binders and head-feed combines. There has been quite an increase in installed power in the last two decades. The energy expressed as a ratio of the energy cost of farming to the price index has risen only slightly. On the contrary, power utilization has dropped due to reduced operational hours (21.6%) and the increase in installed power (231%). Power utilization (h/kW) is obtained by dividing the annual operational hours by the installed power in kW. These figures suggest that Japanese farmers are today putting more power into their farming, but with less efficiency. A typical Japanese rice farmer owns about 504 kg/ha of machinery.

1.1.4. With the restriction of rice cultivation and depressed rice price, the farm machinery industry has been suffering from a recession, and the number of companies manufacturing farm machinery is now 10% lower than in earlier years. At present, there are 1,177 companies with 4 or more employees, and a company has 30 employees and annual production of 624 million yen in average.

Production of farm machinery is rather concentrated in the segment including tractors, rice transplanters and combines mainly for paddy fields. These machines are made by larger companies. Tractors are manufactured by 10 large companies and combines by 28 companies. Implements for upland crops have primarily been produced by smaller companies in re-cent years.

Export accounted for 23.1% of the annual farm machinery production in 1987. The main items were tractors (11.3%) mainly to the USA and Canada, lawnmowers (4.3%) mostly to the USA and other miscellaneous implements (7.5%). The ratio of imports to exports was 15.4% in 1970, and the main items were larger tractors from the USA, France, F.R. Germany and Italy.

1.1.5. Innovations in Japanese farm machinery in the last two decades occur-red in the field of automation and safety. Machines and facilities with microprocessors or computers have been introduced. Rice cultivation with transplanting is now fully mechanized and the labour requirement has been decreased by 57^{0}1o. However, Japanese rice farmers still put in 504 hours of labour per ha in 1987, and this was reflected in the production cost. Cost reduction by means of direct seeding and other techniques is expected.

Efforts have been made to mechanize upland crops by developing small-scale machines for soybean, rootcrops, vegetables and feedcrops. Machines and environmental control devices for green house cultivation have been developed, and are now used extensively. Energy saving devices in this area have also been deve-loped, and are in practice to some extent.

1.2. *Prospects for Future Development*

1.2.1. With the decrease in the number of individuals working in agriculture together with the increase in wage level in the years ahead, farm mechanization will continue to be the most important technology for Japanese agriculture. The number of part-time farmers may decrease slightly in the future, and the acreage per farm may increase to a certain extent. However, the basic characteristics of small-scale farming with a considerable number of part-time farmers is not expected to change.

In relation to this, the following is expected for Japanese agriculture.

— Increase of product quantity and quality to raise farm income.

— Lowered cost of machinery, facili-ties, chemicals and other inputs to increase profit.

— Improvement of cultivation and me-chanization as well as marketing techniques by means of information technology.

— Development agricultural processing in rural area to increase farm income.

1.2.2. The following are examples of R & D targets of the Institute of Agricultural Machinery, BRAIN, Japan for the coming decade.

— Development of machines and facilities for higher productivity such as more efficient tractors and engines, a tillage system to promote soil fertility, and implements with more accurate operational capability.

— Development of high capacity ma-chines for paddy, upland, meadows, hor-ticulture and *the livestock industry.*

— Development of machines and facilities for the effective utilization of energy as well as waste from livestock farming with the emphasis on environmental conservation.

— *Promotion* of safety and *amenities* in farm mechanization.

— Improvement of durability and *re-liability* of machines and facilities.

— Application of high technology to develop new machines: New materials, sensors, robotics and *autonomous travel-ling systems* for example.

- *Development of facilities for mechanical grafting of vegetable seedlings and an automated system of measuring plant growth.*

— Application of information technology to farm mechanization: technical data-bases, new instrumentation and data processing system as examples.

1.2.3. For the further development of agriculture toward 2010, the following points should be emphasized.

— Development of mechanization systems suitable for small-scale farming in various regions in the world, because this type of farming is predominant, with 3/4 of the world's population supported by small farmers.

— Development of new machines for new crops not only for food and feed but also for fuel, feedstock, fiber, fertilizer and even for fine chemicals. These crops also include forest and marine biomass.

— Development of new machines and devices to combine biotechnology with agricultural production.

– Development of information systems to optimize agricultural production and economy: by artificial intelligence, for example.

— Development of agricultural product processing technology in combination with agriculture for rural areas.

Table 1.1. - Japan: economic and social indicators

Indicator		Year 1970	1980	1987
Total population	(millions)	103.720	117.060	122.090
Labor force	(%)	49.7	48.3	49.8
Working population	(millions)	50.940	55.360	49.110
	(%)	49.1	47.3	48.4 (1988)
Engaged in				
— agriculture	(%)	17.4	10.4	7.9
— 2nd industry	(%)	35.2	34.8	33.6
— other activities	(%)	47.4	54.8	58.5 (1987)
GNP at 1970 prices	(billion US$)	203	501	1.246 (1986)
Agri area used (1000 ha)		5.796	5.461	5.35

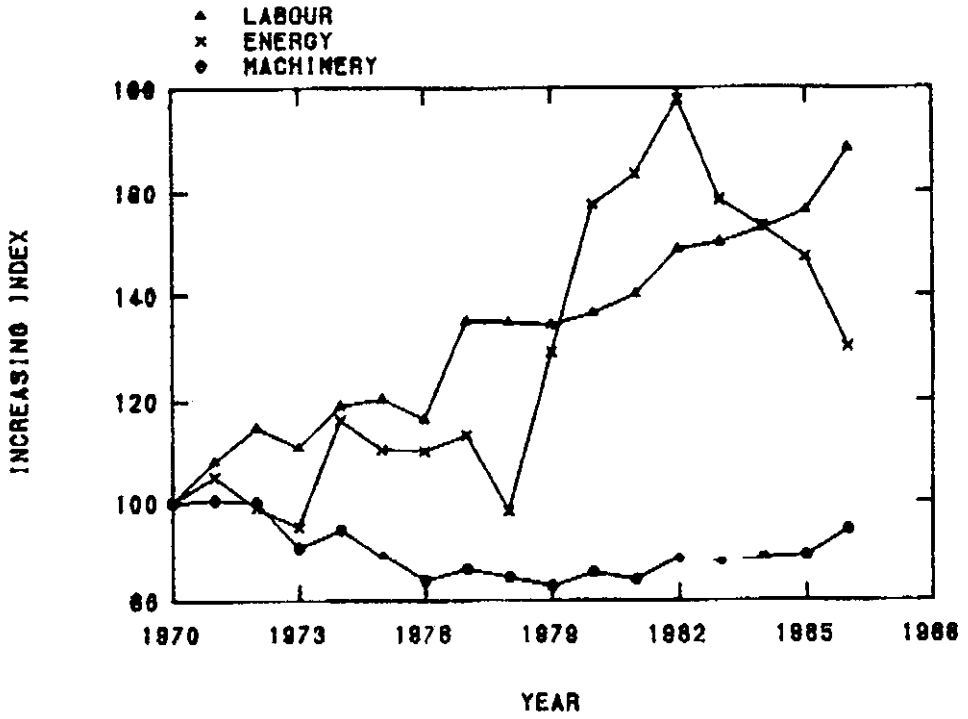

Fig. 1.1. - Increase/decrease of labour, energy and machinery prices in relation to the price of agricultural products