

## **AGRICULTURAL ENGINEERING EDUCATION PROGRAMS IN BRAZIL**

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### **INTRODUCTION**

#### Historical Background

Historically, the economic cycles in Brazil were, in many ways, taking advantage of the existing abundant natural resources. Vast territory, tropical climate, sunshine, and a relatively good amount of rainfall also contributed for the existence of a complex ecosystem indicating an important agricultural potential. First, the use of Brazil trees for dyeing purposes, then sugarcane plantations along the coast, later coffee and rubber marked Brazil as a promising land as food supplier in a hungry world.

These features, immediately made the agricultural careers necessary for its technological development, although Brazil started late the establishment of universities even compared with its neighbor countries in Latin America. At the end of the XIX century only a few schools were graduating professionals, primarily law, medicine, geology and civil engineering. Only, at the beginning of the XX century schools of agriculture in different parts of Brazil began to flourish. The most important were the São Paulo School of Agriculture, which later became the Luiz de Queiroz Superior School of Agriculture of the São Paulo University; the Rio de Janeiro School of Agriculture, which later become the Agriculture School of the Rio de Janeiro Federal University; and the Agriculture School of Viçosa, Minas Gerais, all at the first two decades of the 20<sup>th</sup> century.

These agricultural schools followed the model established in the United States. Agriculture schools were created resembling the American Land Grant Institutions, having their campuses built close to where agriculture was being practiced. Their programs covered a broad range of subjects, and in some respects it is possible to say that the agronomist was able to deal with most of the technological challenges in the agriculture of their times. Looking only at the “engineering” part of their curricula, it is possible to identify some basic courses on Mathematics, Physics and Chemistry, preparing them for intermediate and application subjects. Among the intermediate courses we can pinpoint courses like Topography (Surveying), Electricity, and Mechanics. The more applied courses represented the core of the Agronomy program. It included courses in mechanization preparing students to operate tractors, implements and other auxiliary devices.

Energy related subjects, either for generation and/or distribution (rural electrification) supplemental mechanization or machinery courses. Also, in the application courses there was strong emphasis on construction techniques because the agronomist had to

help to built the necessary infra-structure which included simple building projects, silos, and also rural roads and small dams. There was also the need for irrigation and soil conservation, but the engineering aspects of these areas came relatively late in the agronomy programs in Brazil. A possible reason there was little need to irrigate, except in the Brazilian Northeast, and that soil conservation became a more important procedure as more intensive agriculture was practiced in the country, particularly with annual crops such as corn, sugarcane and soybeans cultivated in hilly areas leading to serious soil erosion.

As contrasted with the US model, Agricultural Engineering programs started late in Brazil. For many decades agriculture was the fundamental part of Brazilian economy but, particularly after the 1929 stock market crisis, coffee was considered responsible for the economic difficulties in the country and was considered as a brake or the economic development. Particularly during the World War II and thereafter, the country started a serious effort to promote the heavy industry, particularly steel (after 1945) and petroleum industries (after 1954), and an important program to promote the development of the domestic market (after 1956). The 50's and the decades to come were marked by important accomplishments in the automobile industry<sup>1</sup> which coincide with significant economic progress and a change in the economy and important population movement within the country. The growth of industry coincides with a rural exodus towards the cities and the belief that Brazil ought to become an industrial power and focus on production of manufactured goods rather than agricultural commodities. Huge investments were made in the country related to infra-structure for energy, roads, airports, schools until the end of 70's and beginning of 80's. However, the country's economy suffered important drawbacks during the oil crisis in 1973 and again in 1979 when its foreign debt multiplied five fold.

The introduction of the Agricultural Engineering programs came in a difficult period when the investment capacity was diminishing. This scenario was influenced by the belief that agricultural investment could not generate enough resources for Brazil to accomplish its growth targets. The military government continued to prioritize the country's industrial basis, except in the energy area. In that particular area, a considerable governmental effort was made to alleviate the burden caused by the impact of high oil prices. Agriculture was called again to cooperate and to produce new fuels to boost the Brazilian economy. Sugarcane was planted on nearly 5 million hectares and ethanol was produced in huge volumes, achieving today around 15 billion liters, or 200 million bEP per day. Although the initial intention was to produce multiple positive impacts with the Ethanol Program, only a few targets mainly related the ethanol production were attained.

Again, during the 80's and 90's, with a stagnated economy, industry was nearly paralyzed. The agriculture, although suffering from lack of investment, subsidies and the depression of commodity prices, was responding favorably generating revenues to cope with international and domestic needs.

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<sup>1</sup> Also the national agricultural machinery industry benefited from government incentives. The 60's were marked by the introduction of several companies including Ford and Valmet for tractor manufacturing. There was also a local manufacturer named CBT, the Brazilian Tractor Company.

## Present Situation

These last two decades have been extremely critical for the Brazilian economy and the necessary modernization of all productive sectors in Brazil is a slow process. One effect of the globalization in agricultural production is that underdeveloped countries will be even more technologically dependent on developed ones. Modern agriculture requires a strong technological background and countries must purchase both equipment and technology to compete. The direct result on farmers is the requirement to produce at lower costs to compete in the international market. This is certainly a major challenge for the graduates in Agricultural Engineering.

The most important agricultural engineering programs in the country today are no doubt the earliest ones: Pelotas Federal University/UFRS (1972), UNICAMP (1976), Viçosa Federal University/UFV (1976) and Campina Grande from Paraíba Federal University/UFPa (1976).

Although these programs originally tried to define their curriculum based on their own needs, in general their success was below the expectations. There are several possible reasons that may explain the difficulties. Agricultural Engineering as a profession world-wide suffers the same difficulties to overcome its challenges and to guarantee the availability of good jobs. In Brazil, the possible reasons may be that professions dealing with rural problems are less recognized in importance, and there has been a lack of scientific and technological background to solve existing and present challenges.

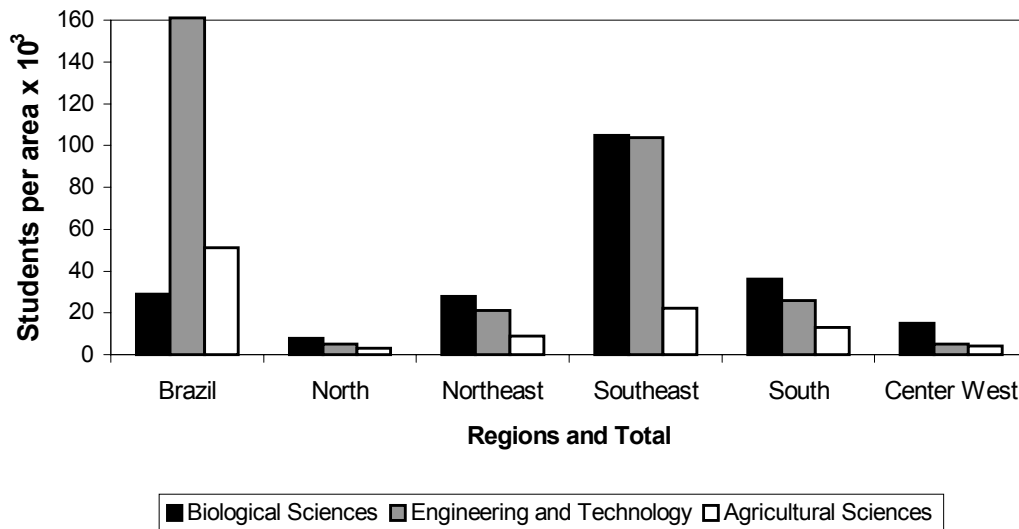
Engineering accreditation is carried out CREA-the Engineering and Architects Council, and it is a straight forward procedure following graduation.

## **UNDERGRADUATE AND GRADUATE PROGRAMS IN AGRICULTURAL ENGINEERING IN BRAZIL**

### Brazilian Education System

The Brazilian education system consists of Federal, State and Private Universities, according to the funding support. The Agrarian Sciences related courses formally train professionals Agronomy, Forest Engineering and Agricultural Engineering. Graduate courses are also offered by the same institutions at the levels of Masters and Doctoral degrees. Even though there are courses available in all regions of the country the major concentration of both courses and students is in the Southeastern and Southern regions. Figure 1 shows the number of undergraduate students in the related areas related to agriculture in 1996 (mec.gov.br, 2000).

Agricultural Engineering students are included in the Agricultural Sciences segment. There are 12 undergraduate programs in Agricultural Engineering in the country supported by the State and Federal Universities and 2 in private institutions.



[Adapted from mec.gov.br, 2000]

**Figure 1.** Student enrollment in Brazilian universities in areas related to agriculture in 1996.

Graduate courses in Agricultural Engineering are linked to both undergraduate colleges and to Department of Rural Engineering or equivalent, within the College of Agronomy. Some of those courses are offered in a specific area of knowledge such as Irrigation or Mechanization or even Energy in Agriculture. Table 1 presents data on graduate students presently enrolled in courses related to agricultural production, by region.

It is in the training at the formal academic level, especially in graduate courses, that most international cooperation occurs. This tendency appears to be compatible with the nature of the educational activities where curriculum and courses are directed to themes where professional regulation is required. Motivation and personal relationships are still the main factor associated with cooperation rather than institutional initiatives. Even though the Ministry of Education had a cooperation program with a few Land Grant Universities in the USA in the 70's, that particular action was the only one known in the field of formal agricultural training.

Historically the tendency is that the government supports training mainly at doctoral level, especially in areas of knowledge that the country either does not have formal courses or there is insufficient competence in developing a research project.

The Southeastern region has nearly 80% of the masters students, and 92% of the doctoral students at the Agricultural Sciences courses. Formal training abroad also has a large number for students from in this region.

Even though the main goal is to have only Doctors teaching at graduate degree courses, still instructors with Master's degree are admitted. As can be seen in Table 2, 96% of the instructors involved in graduate degree courses are Doctors. These data are related to research work in mechanized agriculture and its interaction with crop

science, food science, food engineering, mechanical engineering and other course work related to the food chain.

**Table 1.** Graduate students per area of knowledge

<i>Region</i>							
	Level	North	Northeast	Southeast	South	Center West	TOTAL
	MSc	31	183	870	245	53	1382
<b><i>Exact Sciences*</i></b>							
	PhD	4	24	444	46	19	537
	MSc	34	110	699	184	72	1099
<b><i>Biological Sciences*</i></b>							
	PhD	15	12	402	36	7	472
	MSc	11	142	1297	369	53	1872
<b><i>Engineering*</i></b>							
	PhD	-	3	421	68	-	492
	MSc	23	165	819	337	51	1395
<b><i>Agric. Sciences</i></b>							
	PhD	-	-	346	28	2	376
	MSc	138	1320	7693	2157	617	11925
<b><i>BRAZIL</i></b>							
	PhD	19	108	3149	285	43	3604

[Adapted from mec.gov.br, 2000]

\*Some research related to Agricultural Engineering basics are related to those areas

**Table 2.** Instructors involved in graduate programs by region and area of knowledge (1997)

<i>Region</i>	<i>Exact Sciences*</i>		<i>Biological Sciences*</i>		<i>Engineering*</i>		<i>Agric. Sciences*</i>		<i>Total</i>	
	<i>Total</i>	<i>Doct.</i>	<i>Total</i>	<i>Doct.</i>	<i>Total</i>	<i>Doct.</i>	<i>Total</i>	<i>Doct.</i>	<i>Total</i>	<i>Doct.</i>
<b><i>BRAZIL</i></b>	2304	2276	1656	1637	1893	1837	1798	1701	14060	13443
<b><i>NORTH</i></b>	19	18	63	63	15	14	36	36	155	152
<b><i>NORTHEAST</i></b>	352	338	138	136	188	179	188	165	1728	1592
<b><i>SOUTHEAST</i></b>	1493	1483	1144	1136	1347	1309	1182	1145	9534	9196
<b><i>SOUTH</i></b>	356	347	222	215	301	293	339	305	2091	1969
<b><i>CENTER WEST</i></b>	84	84	89	87	42	42	53	50	552	534

[Adapted from mec.gov.br, 2000]

\* Some research related to Agricultural Engineering basics are related to those areas.

### Undergraduate Programs in Agricultural Engineering

Probably facing the same kind of problems as in the US, Agricultural Engineering in Brazil needs to establish more effective links with the private sector and to attract more interested students more oriented to agricultural challenges.

Another actual tendency is that higher GPA students are choosing more fashionable careers especially related to Information Technology such as Computer Engineering for example. Even though this is an on going problem within traditional Engineering programs, it appears critical for the Agricultural Engineering programs.

### Graduate Programs

In general, the graduate programs in Agricultural Engineering have a better performance record than the undergraduate ones. Here the integration of Agronomy and Agricultural Engineering is more effective and productive. Programs such as Animal Sciences and Forestry are more related to Agricultural Engineering in graduate programs. Most M.Sc. and PhD candidates select a university to complement their knowledge. They expect to get a higher degree as well as technical knowledge in areas that are not traditionally covered in other agricultural professions.

Its clear there is country wide demand for Agricultural Engineers with graduate degrees.

### **WHAT BRAZILIAN GRADUATES DO?**

Where do they go? What they do?

During their academic years Agricultural Engineering students are introduced to several different fields of knowledge. These skills are often transferred by professionals that are not necessarily agricultural engineers. The majority of professionals working as professors in Brazilian universities have a strong agronomy background. This results in few well qualified engineers that can transfer the necessary knowledge to solve agricultural engineering problems.

During the 80's and beginning of 90's many of the good students were hired by their own universities. However this situation has changed rapidly. Today, many private universities are hiring agricultural engineers and developing new programs. Agricultural engineers nowadays are mainly involved with sales, working in technology transfer or teaching.

### Working in Decision-key Positions

Brazilians based companies do not very little research and development in country. They usually buy or obtain their technology elsewhere. The multinational companies usually develop their technology in their home countries and transfer what is ready to use or readily applicable with minor adaptations. Because only a few companies will actually do any research or development in the country, the role of Brazilian agricultural engineers is usually restricted.

The employment market is usually greater in machinery and in irrigation than in construction, for example, where civil engineers and agronomists may be considered adequate for the market needs. In postharvest processing, for example, the situation may be different because the needed expertise depends on the specific product. With

cereal grains it is quite correct to say that in Southern universities (Pelotas and Cascavel) and Viçosa more specialized professionals are graduated and positions are generally filled with these professionals. However, regarding the fruit and vegetables area there is still an important technological gap which is not being supplied by the universities

Another interesting area to look at is the energy segment. Brazil, unlike the US, does not have electricity availability everywhere. In fact only a small percentage of the territory is connected to the electricity network. Although this constitutes an important obstacle to development there is no apparent market to hire professionals specialized in energy generation or rural electrification. This overall picture may change as farming communities become more aware of the need to plan and adjust for energy demands problems.

The lack of business and economics related courses in the Agricultural Engineering curricula limits the ability of the recently graduated professionals to start up new businesses.

Many private universities often with lower academic standing are more successful in positioning their alumni than the highly qualified government institutions. Many times a larger number of professional alumni from private institutions are found in decision-key positions than it would be expected. The reason may be the lack of entrepreneur values found in government universities.

#### Work in Technology Innovation

The São Paulo Sugar and Alcohol Producers Cooperative – COPERSUCAR has a center of technology, the CTC, located in Piracicaba, SP that includes an Agricultural Engineering department for technological development. There, around 50 professionals, mostly with agricultural engineering background working in mechanization, irrigation, and land development related to sugarcane production. This is probably the only example in the private sector. All other innovation in agricultural engineering is conducted either in government controlled universities, either at state or federal levels or by research centers, also government controlled.

#### Who Else is working in Agricultural Engineering?

Several other professionals are involved in typical agricultural engineering activities in Brazil. The most common professional is probably the agronomist. The reason is possibly because the academic background allows this professional to understand the basic agricultural engineering areas since the curriculum involves many courses related to machinery, irrigation, construction and postharvest technology. The primary Agricultural Engineering areas the agronomists are working in are agricultural machinery and irrigation.

The professionals market should create mechanisms to recognize skills and identify the most adequate professional for their purposes. The market should also be able to influence the programs to adapt them according to their needs. Likewise, civil and mechanical engineers are commonly found working in Agricultural Engineering

activities. This probably happens mainly because of their knowledge in at least two areas such as buildings and machinery, respectively.

A common wisdom is that the agricultural engineer expresses the connection between agronomy and the engineering areas. Today, there is a trend to change this classical definition. Particularly influenced by the changes in the US, it is found that Agricultural Engineering is turning towards both Biological or Environmental Engineering. Although Brazil has not, at least up to now, assimilated the American insight it is clear that new efforts are necessary to promote the career to recruit better and more highly motivated students.

#### Comparing Progress Relative to other Related Professions

Some professions, like Food Engineering, were established at the same time as Agricultural Engineering in Brazil. They were subjected to the same difficulties caused by the Brazilian economy, however their performance was completely different. Using as a basis for comparison the two most important exhibitions in food and in agricultural engineering, the FISPAL and the AGRISHOW, respectively, the difference is clearly seen when analyzing the professional position occupied by the agricultural engineer. Most food engineers already occupy decision making positions while agricultural engineers are just part of the crew.

Many other engineering careers are relatively new in Brazil. Production Engineering, Forestry Engineering, Aeronautic Engineering are good examples. However, most engineering careers dealing with agriculture such as Agricultural Engineering, Forestry Engineering and others are subjected to the same difficulties as discussed above.

### **BRAZILIAN POLICY IN TECHNOLOGY**

After achieving independence in 1822 Brazil had a turbulent development path. The XIX century could be simplified for Brazil in terms of what the coffee brought to the country with its economic and social impacts. During this period of Brazilian history the government created few agricultural research centers. The monarch D Pedro II was impressed by the successful technological investments that changed the US and decided to invest in science and technology in agricultural in order to achieve the same progress.

Pedro II was a clever man and his ideas flourished. Several agricultural schools were created in the early XX century as a result of these ideas, although the monarchy ended in 1889. The subsequent regime, dominated by coffee growers and milk producers, achieves high good agricultural production levels but invested relatively little to diversify the economy. The 1929 economic crash made the turning point, as pointed before.

The military regime (1964-1984) provided strong support to industry, particularly these industries related to infra-structure such as civil construction, petrochemical, naval and electrical sectors. Agriculture received little attention. Possibly the only two major actions in agriculture were the creation of the Alcohol Program where nearly



US\$ 10 billion was invested in the 10 year-period (1975-1985) and the promotion of EMBRAPA, a federal research network which includes 25 research centers all over the country. EMBRAPA's budget is also quite high, with nearly US\$ 500 million representing around 25% of the government investment in R&D.

Although EMBRAPA was a success, the relationship of investments in agriculture and in Agricultural Engineering was declining. In fact the federal investments in Agricultural Engineering were significant during the late 70's and early 80's when the Ministry of Agriculture coordinated the CENEA- National Center of Agricultural Engineering located in Iperó, SP. The center was established in 1972, it expanded and grew in credibility in 1978 after a cooperation project with Germany. That project had the objective to train and recycle agricultural engineers to work on machinery performance testing. The activities of the CENEA were concentrated in that area and as the project came to an end CENEA assumes its activities.

The Ministry of Science and Technology-MCT of the federal government has historically technology in agriculture to be the responsibility of the Ministry of Agriculture. The MCT was responsible for all other sectors, mostly related to industrial activities. Today's key element in the MCT technology policy is the CNPq – the National Research Council, the equivalent to the NRC in the US. The CNPq has been successful in funding training of professionals in Brazil and abroad. Another institution from the federal government supporting education is CAPES – The Higher Education Improvement Coordination from the Ministry of Education.

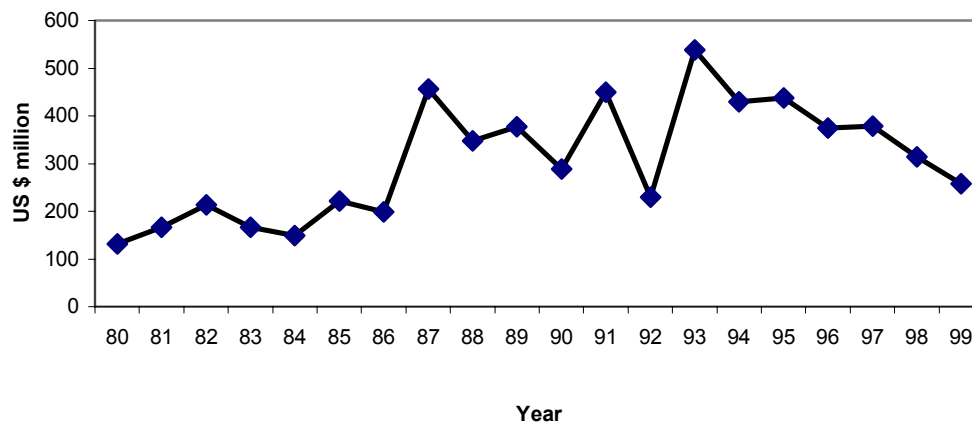
The emergence of a global economy has resulted in new competitors and new opportunities for mainly developed countries companies and workers. Today, for instance, the industrialized nations, such as Germany and Japan, Italy and United States face fierce competition from both advanced, as well as from newly industrializing nations, such as China, South Korea, and Indonesia. At the same time, new markets are emerging as trade barriers fall and millions of people are lifted out of poverty. International accords, such as GATT and NAFTA, are fostering competition, opening new markets and expanding existing ones, and bringing consumers more choices and higher quality at lower costs ( Science Coalition, 1977).

Nations around the world are planning to boost their national science and technology investments, some astronomically, while the underdeveloped countries are barely living above poverty line. The investments in R&D in Brazil for agricultural development are mainly distributed in the chain of educational system as well as in research institutes and the EMBRAPA Research Centers. Overall investment barely averages 0.2% of the total GNP. **Figure 2** summarizes the investments in R&D showing the resources available at the Ministry of Science and Technology as well as at the CNPq – National Council for Research and Development for all areas of knowledge ( [ipea.gov.br](http://ipea.gov.br), 2000).

Another source of funding for R&D in Brazil is through the State Foundations. These institutions linked to the Secretary of Science and Technology of the Federation states has a role of implementing actions towards funding projects at the researcher or institutional level. The state foundations are supported by a percentage of the taxes paid in each state and is legislated by state laws. The wealthier states certainly have

more available funds for investment than the poor ones. Unfortunately Brazilian investment in R&D is very limited, considering the trained personnel available all over the country.

### Investment in Science and Technology in Brazil 1980-1999



[Adapted from [ipea.gov.br](http://ipea.gov.br), 2000]

**Figure 2.** Overall investment in research in Brazil from 1980 to 1999.

Even though the industrial sector in Brazil is established as a multinational investments most of the agricultural machinery sold in the country is designed overseas. Up to the early 80's the machinery sold in Brazil was submitted to testing for efficiency following standards and normalization rules established by ABNT, Brazilian Association of Technical Norms and Standards (MANTOVANI et al, 2000).

Some effort is being made to concentrate governmental funding on “centers of excellence”, but most of the investment ends up financing basic scientific studies. The federal government also has supported the FINEP – Studies and Projects Investment Fund from the MCT, investing in “more applied” projects. The larger and more mature types of projects may be ineligible for BNDES – the National Bank for Social Economic Development funds. Although the BNDES is not a research funding agency it plays an important role in the implementation of the Brazilian technology policy practiced by the government.

The EMBRAPA system has also its own budget. In the recent years it has financed the creation of “centers of excellence”. The basic idea is to promote research clusters that mature and return positive results to the society.

At the state level the most successful financing agency for research purposes is the São Paulo agency named FAPESP. With a budget dictated by 1% of the State of São Paulo gross tax income this agency supports a substantial part of the research conducted in the state of São Paulo with corresponds to around 50% of all its accomplished in Brazil.

FAPESP funds the São Paulo State universities and other research centres. Although only UNICAMP has an agricultural engineering program in São Paulo State, some other institutions do limited work in agricultural engineering related areas. This is the case of ESALQ/USP, Jaboticabal/UNESP, Botucatu/UNESP with its Rural Engineering Depts. Although these rural engineering departments don't have agricultural engineering programs they conduct graduate studies involving engineering subjects. More specifically they work on machinery, energy, and construction for example.

Also, some states in Brazil have their own agricultural centers. Although the IAC – Agronomic Institute of the State of São Paulo located in Campinas has a long history of more 100 years of agricultural research, its agricultural engineering department has almost closed its doors. Yet in Parana State the IAPAR located in Londrina still is active in agricultural engineering research.

### **THE DIFFICULTIES AGRICULTURAL ENGINEERING FACES**

When the profession started its programs in Brazil in the early 70's there was plenty of optimism in the air. The 80's were very difficult times to find formal jobs and the professional market was demanding salesman while the universities were graduating engineers. The market simply did not flourish as expected and the demand was more concentrated in the sales departments and in teaching careers, and the agricultural engineer was not well prepared for that. The market was looking for a very practical engineer who could solve real world problems with competence.

### **PRESENT AND FUTURE CHALLENGES**

The EPCOT Center at DisneyWorld in Florida back in the 80's was one place that had a prospective vision of the agricultural production in the future. An example was the use of computerized greenhouses for producing vegetables. Today that greenhouse technology with hydroponics and temperature control is no longer new. But professors still lack in teaching the students to design control systems and optimally operate them. Part of this problem remains in the Brazilian education system which does not allow timely modifications in the curriculum, that are necessary in order to lead technological changes, mainly in the area of information systems.

Emerging ideas for curriculum modification include the areas of environment, computers etc. However those changes may face many hurdles as they move through the conservative academic bureaucracy.

### **CONCLUSIONS**

Despite all has the problems and limitations Brazil has developed an infrastructure capable of supporting the agricultural expansion to supply the internal and export market demand. The level of research and technology development for different regions as well as the local environments was met for most cases. There is an installed chain of trained professionals able to respond to an emerging demand for agricultural products in both research and educational systems. This is probably more due to a personal initiative than to universities, or even the country's training policy.

International cooperation is still needed in the areas of knowledge related, for instance, to precision agriculture especially in data acquisition and decision-making.

There are many challenges in Brazil nowadays. The country is already a large food producing area but our brands are not in the shelves elsewhere. What is the Brazilian share in the present “global economy”? Certainly a bigger share of the agribusiness should be Brazilian but apparently the country has reached the limit in producing coffee, soybeans, and oranges. Engineers who understand agribusiness, who can produce valuable goods and sell them are needed.

There is also a need for appropriate technology in Brazil. Appropriate in the sense of using more efficiently the scarce resources like energy, appropriate in the sense that adds more value into an existing product. Brazil was for long time an important cocoa producer and today the culture has declined with only few producers remaining Southern Bahia. Likewise natural rubber and Brazilian nuts.

The curriculum is overly tied in the basic areas such as rural construction, machinery, irrigation and post harvest, and it needs urgent update. The challenge Agricultural Engineering schools face nowadays is to obtain feedback from the professional market and see what needs to be taught.

## REFERENCES

- \_\_\_\_\_. 2000. <http://www.ipea.gov.br/>
- \_\_\_\_\_. 2000. <http://www.mec.gov.br/>
- \_\_\_\_\_. 1977. <http://www.sciencecoalition.org/>
- \_\_\_\_\_. 2000. SBEA. Brazilian Society of Agricultural Engineering. SBEANews #8. Jaboticabal. SP. Brazil.
- CORTEZ, L.A.B. & P.S.G. MAGALHÃES (coord.) 1993 “Introdução à Engenharia Agrícola” – Editora UNICAMP, Campinas, SP, Brazil.
- MANTOVANI, E.C., NÄÄS, I.A. and HERMMANN, P. R. 2000 The future of mechanization: trends and requirements for the Latin-American countries: Brazil case. Paper presented at the First Latin American Meeting of the Club of Bologna.
- RÍPOLI, T. C.C. 1998 “A SBEA e a Engenharia Agrícola” Editora Engenho da Terra, Piracicaba, SP.

## Terminology

AGRISHOW – Agriculture Fair in the State of São Paulo  
 BNDES – National Bank of Social Economic Development  
 CAPES – High Education Improvement Co-ordination  
 CBT – Brazilian Tractor Company  
 CENEA – National Center of Agricultural Engineering  
 CNPq – National Council for the Development Research and Technology  
 COPERSUCAR – São Paulo Sugar and Alcool Producers Cooperative  
 CREA – Regional Engineering and Architecture Council

CTC – Centre of Technology from COPERSUCAR  
EMBRAPA – Brazilian Agriculture Enterprise  
ESAL – Lavras Higher School of Agriculture  
ESALQ – Luiz de Queiroz Higher School of Agriculture from USP  
FAPESP – São Paulo State Research Fund  
FINEP – Studies and Projects Investment Fund  
FISPAL – Food Fair in the State of São Paulo  
IAC – São Paulo Agronomic Institute in Campinas  
IAPAR – Paraná Agronomic Institute  
MA – Ministry of Agriculture  
MCT – Ministry of Science and Technology  
UFPA – Paraíba Federal University  
UFRJ – Rio de Janeiro Federal University  
UFRS – Rio Grande do Sul Federal University  
UFV – Viçosa Federal University  
UNESP/Botucatu – Paulista State University – Botucatu Campus  
UNESP/Jaboticabal - Paulista State University – Jaboticabal Campus  
UNICAMP – State University of Campinas  
UNIOESTE – University of West Paraná in Cascavel  
USP – University of São Paulo