Working Paper WP95-3 April 1995

Fourth Minnesota Padova Conference on

Food, Agriculture, and the Environment

Proceedings of a Conference Sponsored by
University of Minnesota
Center for International Food and Agricultural Policy

Universita degli Studi di Padova
Dipartimento Territorio e Sistemi Agro-forestali

Regione Veneto

Ente di Sviluppo Agricollo

SESSION III: THE FUTURE OF AGRICULTURE IN THE U.S. AND E.U

PAPER 3: INTERNATIONAL RESEARCH IN CHANGING AGRICULTURAL SYSTEM: THE ROLE OF ITALY

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Spring Hill Conference Center, Wayzata, Minnesota
September 4-10, 1994

International Research in Changing Agricultural System: The Role of Italy*

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This paper is concerned with the evolution of the agricultural system and its consequences for the international research. In particular, the gradual liberalization of international markets, the changing in consumer's preferences in western countries, the increasing in concentration in food distribution and industry, and the economic and demographic problems of developing countries are affecting the demand and supply of agricultural and food products. Consequently, also the agricultural research has to follow or, even better, to anticipate the changings in order to answer to the different and new demand of technology and information.

Keywords: international trade, demand of technology, developing countries, developed countries.

1.1. International trade, GATT agreement and implications for agricultural research.

A detailed analysis of GATT agreement is referred to more specific studies. Any way, just few implications can be drawn for the topic of this paper, as following:

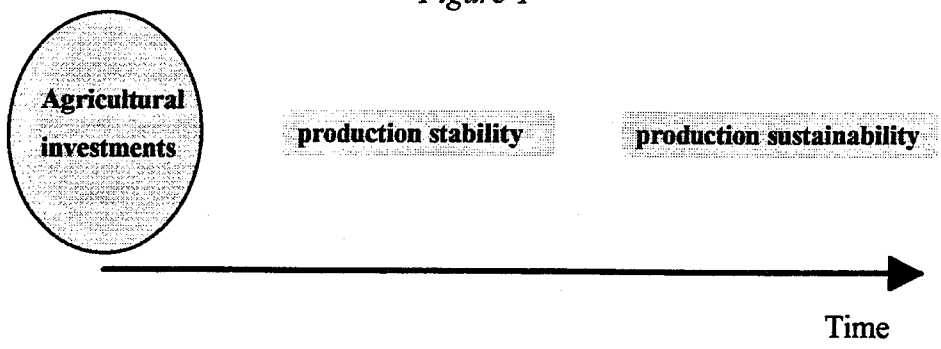
1. direct traits: the cost of research is not considered a subside so it is included into the "green box" of unbound interventions;
2. indirect traits:
    a. decline of research as "output expanding";
    b. control of production and environmental quality are new aims;
    c. public and private demand of food quality and low environmental impact.

Consequently, also the innovation has to be devoted toward *estensification* of agronomical technique to obtain the public support. However, this trait opens the problem of the recognition and certification of technology and food product.

Liberalization of the staple food market should ideally stimulate increased food production and investments in private marketing services; unfortunately, these benefits only occur in the long run. In the short run, liberalization is often thought to result in declines in real income, rapid fluctuation in price and possible political chaos (Pinckey, 1993). Production variability combined with the usual inelastic demand curve for the primary staple leads to high levels of price fluctuation from year to year unless

availability is affected by changes in stocks or foreign trade. But storage and trade, due to costs of transport, are expensive propositions. Although past government policies have generally been costly while in many cases failing to stabilize parallel market prices, a system of *laissez-faire* is unlikely to be improvement, since a high level of production instability and large differences between import and export parity would lead to wildly fluctuating staple food price. Consequently, the direction towards free market must be undertaken with the role for a government marketing organization in pushing price to stability (Pinckney, 1993). Production stability in the short run and production sustainability are now targets of national and international agricultural investment, research and extension institutions (figure 1). Some increase in food security is suggested by the increasing volume of food supplied to the global market and the larger number of countries participating in the trade, making domination by a single country or narrow coalition more difficult (Ballenger and Mabbs-Zeno, 1992).

Figure 1



According to the neoclassic economic theory, nations are better off increasing liberalization of trade and specialization of domestic production. By this theory, comparative advantages derive from the availability of production factors: in that case many developing countries, being rich in natural resources, would be advantaged. However, research and technology play a great role in changing comparative advantages (Coscioni, 1993) both in production and in demand functions. In fact, other theoretical models on international trade stress the role of demand in attracting farmers towards opportunity of profit (Sillani, 1993).

1.2. Developing countries and demand of technology

Since 1980 average commodity prices have dropped by more than half in real terms. This represent an annual total loss to developing countries of $100 billion in 1993 (source: World Bank), almost twice what they receive in foreign aid. This is the consequence of the fact that world trade in commodities has grown far more slowly than trade in manufactures and services:

- as countries get richer, the share of income spent on food shrinks;
- shift within economies to activities that use fewer raw material.

Many of today's successful developing countries used to be heavily dependent on primary products. For example, in 1965 commodities made up 89% of Malaysia's

exports; today their share is only 28%. However, Malaysia's agricultural output has boomed: palm-oil has risen 16 fold since 1970 and cocoa 75 fold. Indonesia, Thailand and Chile are other examples of expansion of farm exports at the same time as their reliance on commodities fell. Rising productivity in agriculture, spurred by new technology and more efficient marketing methods, allowed countries to produce more with fewer workers, releasing labor into manufacturing.

Policies which boost efficiency in production and marketing are likely to achieve more lasting gains in net revenues than export quotas or taxes. These policies, however, are limited by countries' low levels of physical and human capital. Indeed, the satisfaction of a food need implies the achievement of a sufficient bargaining power of consumer in developing countries, that, in turn, requires the achievement of a job with sufficient earning (Swaminathan, 1994). In a study of WIDER (World Institute for Development Economic Research, Helsinki), Yoginder Alagh claimed that an higher growth of agriculture is necessary for a faster employment strategy: from two thirds to three quarters of job growth would be due to higher production in agriculture. However, due to the shortage of capitals, technology and know-how should be more and more considered as a production's factor.

The link between agricultural development and sustainable exploitation of natural resources is increasingly emphasized, most eminently by the 1992 United Nations Conference on the Environment and Development and the resulting *Agenda 21*. Over the past two decades, agricultural growth has relied heavily on intensification (mechanization, fertilizer and high ratio of value of input to output). Within the developing countries, mainly of Northen Africa and Western Asia, the agricultural resource base is highly susceptible to degradation caused by overexploitation (excessive grazing and depletion of ground water resource for irrigation). Consequently, international research has to solve the problem of reconciling limited natural resource base with a rapidly growing population and the need for agricultural growth. The role of agriculture should change in two major ways (Janssen, 1993):

1. agriculture should make an independent contribution to economic development, rather than merely reflecting trends in the rest of economy;
2. intensification model alone could not address equity and environmental issues.

The potential of agriculture should be considered not only in terms of production, but also of its contribution to the generation of employment opportunities and to rural development. This potential will be developed by stressing the interdependence of agriculture with other sectors of the economy, to pursue the comparative advantages of the region, both in term of human and of natural resources.

Political constraints to agricultural development can be added to the other limits and can be summarized as following (Janssen, 1993):

- output control;
- lack of structural strategies (infrastructure, resources' allocation, ecc..), and
- instability of the regions.

These constraints led to some problems like:

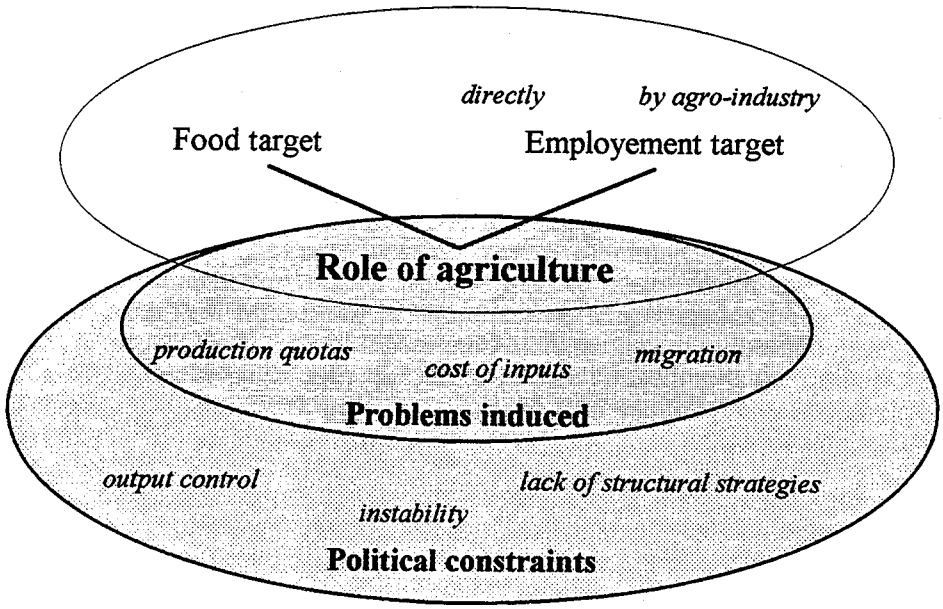
- high output prices combined with production quotas;
- high costs in terms of input use (excessive water) and fragility of land where prices were high without quotas;

- rural-urban migration where agricultural prices were low.

Under all these considerations, the main challenge for agricultural development is to provide not only food but also employment (figure 2):

1. food target - making agriculture more market oriented in order to improve self-reliance of a region, more than self-sufficiency with the respect to sustainability and resource conservation;
2. employment target -
   - direct contribution by creating more employment (high labor to land suggest that the comparative advantages will lie with labor intensive agriculture;);
   - indirect contribution by enhancing the linkage with agro-industry. This point requires a development of an efficient marketing system.

Figure 2



In conclusion, a global agricultural development requires innovative ideas on managing efficiently natural resources within appropriate agricultural policies; in other words, effective research and technology are required. Research priorities should be identified into their contribution to productivity, sustainability and balanced rural development:

- resource management - Crop improvement strategies usually take the agricultural resource base as a given and not as a further subject of research. However, durable gain in productivity or an higher stability of production can be achieved if also the resource management is improved. In particular, stability can be improved by recovering genetic biodiversity of plant and by appling *in situ* genetic improvement and selection . In fact, a phenotype's performance, high or low, in particular environment, good or poor, determines the level of stability acquired (figure 3). Selection of plant for yield in a favorable environment will produce selections with

lowered stability (greater variance). Consequently, the genetic technology and innovations can not be just transferred simply from a developed or advantaged country to a developing one but the innovation should be developed *in situ,* directly in the area of growth.

- commodity choices and sustainability - agricultural research can effectively contribute to development by researching a portfolio of different commodities, each addressing different criteria but globally improving the stability of production and sustanaibility of resource's use. These concern water use efficiency, wind erosion, conservation of indigenous germoplasm and rangeland degradation. The choice between favored and marginal rainfed areas is quite complex: favored rainfed areas have more productive potential, and developing this potential will reduce the pressure on the marginal land; the susceptibility of the marginal lands to degradation warrants a conservation rather than a production approach. Furthermore, the degradation processes are often associated with the decline of traditional social and institutional arrangements.

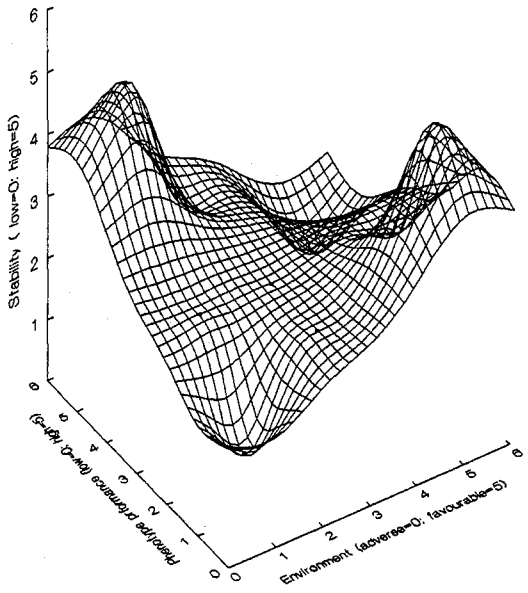


Figure 3. Simulation model of environmental stability (low=0 - high=5) related to phenotype performance (low=0 - high=5) and environment (adverse=0 - favourable=5). Source: Bagnara G.L. et al., 1994.

1.3. Changing in food market in Europe

Western European consumers are more and more looking for a range of food products that are convenient to prepare and eat, fresh, healthy, with distinct taste that are compatible with their life style and ability to pay. Food have social and cultural meaning and psychological significance beyond their nutritional value. Consequently, food preferences are influenced by a wide range of factors related to the food product, the individual or group consuming the food, and the socio-economic environment.

There have been shifts in the type of products being consumed within broad groups (tables 1.1 and 1.2): i.e. increasing demand for meat but reduction for beef and mutton; although there has been a reduction in the demand for fats and oils, there have been increases in the demand for margarine and olive oil that implies a resource reallocation from dairying towards production of oilseeds. An other aspect is concerned to the shifts in food consumption patterns that can have a significant impact upon trade in food products: i.e. increasing demand of fruits, vegetables and olive oil in Northern Europe; increasing demand for sugar and meat in Southern Europe.

From a marketing point of view, other traits must be pointed out:

- growth in the power of the food retailers - Through control of quality, own label, new technology in logistic, organization in store and markets;
- increases in eating out;
- segmentation of consumer demand;
- raises concerns about food safety and demand for guarantee.

All this points are affecting the traditional mechanism of passing signals and information back and forth along the supply chain; consequently, a greater vertical coordination and integration is required.

The demand for raw materials by processing industries pushes the agricultural research to match raw material and end use properties. In fact, environmental condition and genetic control affect quality characteristics of final products. Furthermore, a multiplication of end uses associated with different raw material characteristics will require a specialization of agricultural production.

Table 1.1. Growth rate (%) in consumption per capita for selected foods, 1970-90 and 1990-2010. (source: FAO Food Balance Sheets and AT 2010 projections)

	Western Europe		Eastern Europe	
	1970-1990	1990-2010	1970-1990	1990-2010
Cereals and products	0.2	-0.2	-0.5	-0.2
Potatoes	-0.4	-0.4	-1.4	-0.3
Sugar	-0.5	0.0	0.5	0.0
Pulses	1.4	0.0	1.3	0.1
Vegetables and products	1.3	0.5	1.3	0.2
Fruit and products	0.8	0.8	0.5	0.2
Vegetable oils	1.3	0.8	1.4	0.3
Milk and products	0.7	-0.3	0.0	0.1
Eggs	-0.5	-0.2	1.5	0.1
Meat and products	0.8	0.4	1.3	0.1
Population growth rate	0.2	0.1	0.6	0.4

Table 1.2. Growth rate (%) in consumption per capita of meat and meat products, 1970-90 and 1990-2010. (Source: FAO Food Balance Sheets and AT 2010 projections).

	Western Europe		Eastern Europe	
	1970-1990	1990-2010	1970-1990	1990-2010
Beef	-0.4	0.0	0.7	0.0
Mutton	-0.7	0.3	-0.6	0.4
Pigmeat	1.2	-0.2	1.2	-0.3
Poultry	2.6	2.2	3.2	1.4

1.4. Innovations in the food industry

The food industry shows a very low level of research and development intensity in comparison to other economic sectors (Venturini, 1987). The evidence relative to non-price competition and rivalry among food firms indicates that such competition is very intensive and, within it, in addition to advertising and subjective product differentiation, innovation strategies play a great role.

Studies on consumer's behavior confirm the importance that final consumers attribute to food innovations (Senauer, 1991). Probably for this reason, the established food industries are more oriented towards an innovation of incremental type (step by step), while new firms are likely to dominate radical innovation (Galizzi and Venturini, 1994). Indeed, consumers reveal a specific form of risk aversion in their choices of new food products but they are more willing to pay for incremental innovations led to convenience or health or diet. Packaging is a further aspect which helps to explain the incremental nature of product innovation (Galizzi and Venturini, 1994). Packaging represents a major focus not only for presentation and protection, but also as a marketing medium and it is therefore an instrument for horizontal product differentiation. In conclusion, in the food industry, the innovation process is part of a broad marketing process together with branding, packaging and advertising.

1.5 Implications for agricultural research

According to Giampietro *et al* (1994), who applied energy analysis, the food system can assume a completely different meaning depending on the characteristics of society:

1. in developed societies the density of the energy throughput sustaining society is much higher than the density at which energy flows in the agroecosystems, hence the food system can be considered a service sector and a net consume of resources;
2. in developing societies the energy throughput sustaining the society is lower than the density at which energy flows in the agroecosystems, hence the food system can be considered an economically productive sector, a net producer of wealth.

Consequently, also research has to take these aspects into consideration combining research approach oriented to both product and service. Consequently, also stretegies in resource efficiency should be considered.

In terms of research approach, Fleming (1990) distinguished between "farming systems research" (FSR) and "marketing systems research" (MSR) approach. The first is defined as "a research methodology for understanding the real-world economic system that farmers operate" and it is divided into: examination of the stock of materials and techniques accumulated from technical component research; feedback on unsolved problems to technical component researchers; and nurturing of research links with farmers and extension staff in local farm situation. On the other hand, the MSR is a research methodology devoted to understand the real-word economic systems that marketers operate; the differences from FSR are identified into the role to read marketers and markets for farmers and farms, respectively, and to add knowledge of services and models of behavior to the knowledge of materials and techniques. However, whereas FSR is concerned with the farmer, MSR should start with the consumer of agricultural products as the first and last contact.

In terms of objectives, strategic research that is to serve both agriculture and its environment should not so much direct towards the search for marginal returns of variable production resources, as towards the search for the minimum of each production resource that is needed to allow maximum utilization of all other resources (de Wit, 1992). In other words, the law of Liebscher, formulated at the end of the 19th century, is still up to date because agriculture requires the management of growth and production processes in a partly controlled environment. This law states that a production factor which is in minimum supply contributes more to production, the closer other production factors are to their optimum.

The agricultural production, both in developed and developing countries, is mainly product oriented (figure 4): the product is the pivot of the activity, and the only strategies adopted are devoted to reduce the costs of production in order to compete at low price. However, such an approach, applied also in the research activity, is more and more separating the agricultural sector from the more complex economic and social world. The food market is subject to many factors forcing towards a global linkage with the general economy of a region (figure 5):

- micro-environment, defined by input-suppliers, producers, consumers, and distribution;
- macro-environment, including natural resources, technology, regulations, infrastructures, financial market, and policy.

This changing is also affecting the research activity that, in turn, should anticipate not just follow the trends. Beyond the specific orientation of research, the final user is the major source of innovations (Hipple, 1988). Through the user (that includes producer, processor, distributor and consumer) is possible to identify the need and undertaken the research and development (figure 6). In other words, research should be an inductive process (Ruttan, 1982) but, unfortunately, it is quite often more involved in catching ideas among institutions through a process of imitation (figure 7).

Figure 4

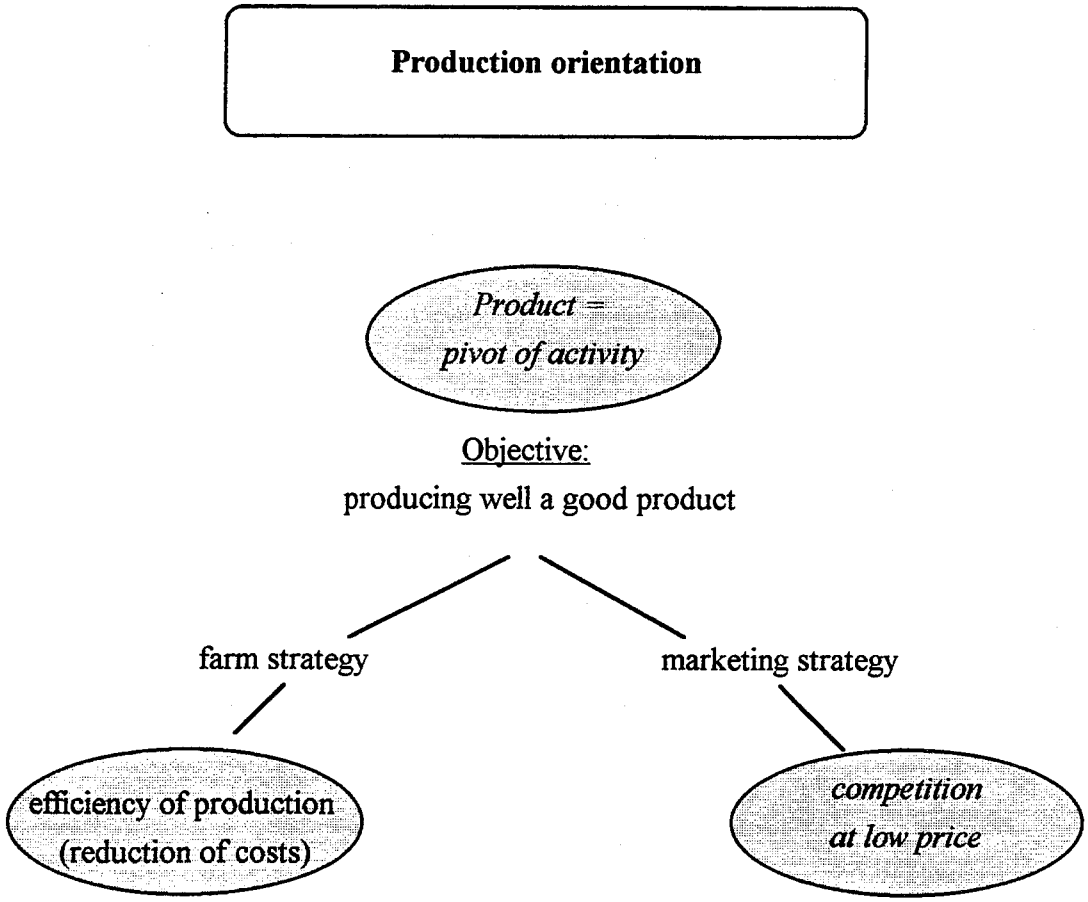

Production orientation
Product = pivot of activity
Objective:
producing well a good product
farm strategy
marketing strategy
efficiency of production (reduction of costs)
competition at low price

Figure 5

Factors affecting the agri-food market

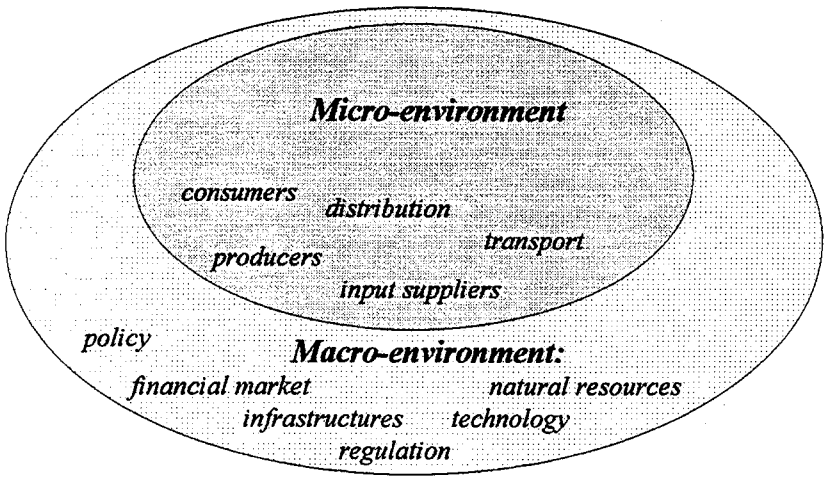


Figure 6

Innovation and research process

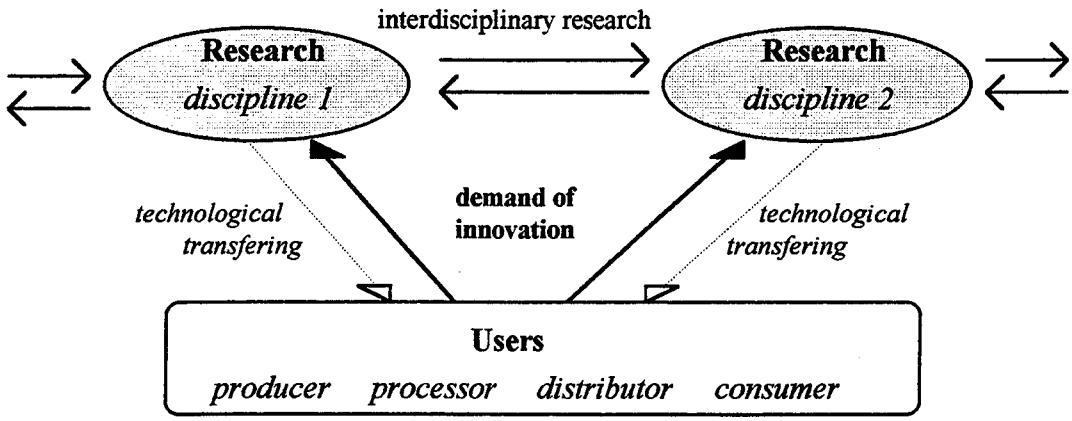
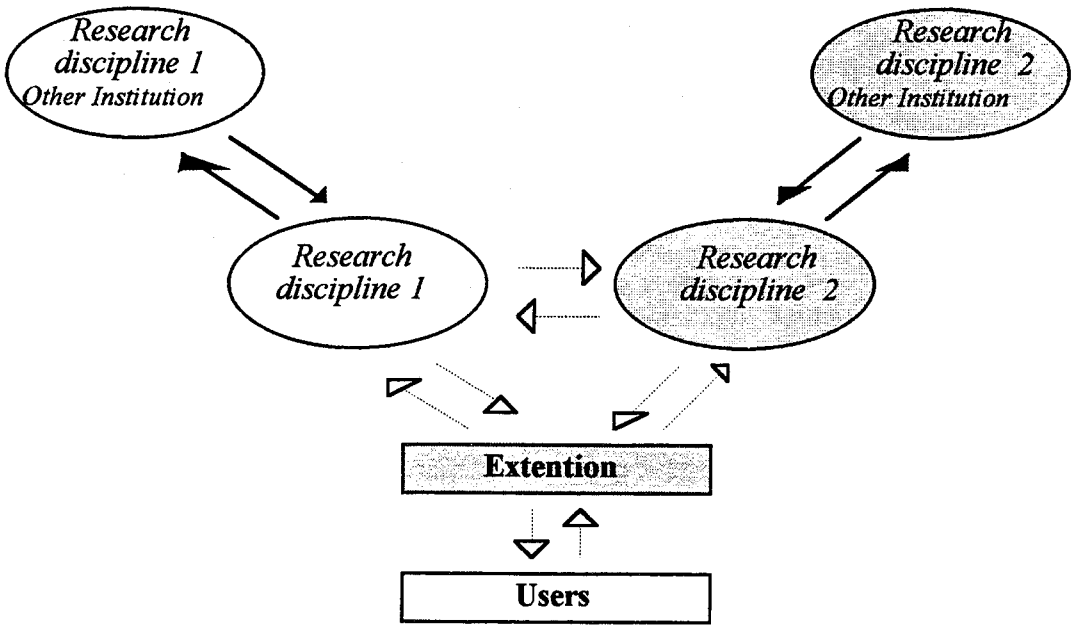


Figure 7

Actual research in agriculture



2. The role of Italy in the advancement of the agricultural research in developing countries.

Ours are times when, in certain countries, one sixth of humankind will spend everyone of their days in a desperate search for food in order to survive. Besides, flocks of mostly illegal migrants leave their homeland and knock at the door of industrialized countries in search of a job. All this has its roots in a relentless population increase which cannot be matched, for the moment, by an adequate development in food production and job creation.

More and more, those problems don't belong exclusively to developing countries: due to their consequences, they have become everybody's concern.

Italy belongs to a region, the Mediterranean and West Asia, which is emblematic of many others around the world, and therefore worth considering in some detail as an example.

In addition to being one of the cradles of the civilization, the Mediterranean region is where many of the crops now taken for granted were first domesticated, including wheat, barley, chickpea, lentil, fababean and grapes. Today, the area faces a profound crisis of unprecedented population growth and lagging agricultural production. The region has one of the highest population growth rates on earth: the population of Jordan, for instance, is growing at an annual rate of 4 percent. High rates of urbanization further compound the problem. Egypt's population grows by a stunning one million every ten months. The FAO estimates that, by the year 2030, the region's population will reach 1.5 billion, as compared to 420 million in 1985 (van Schoonhoven, pers. comm.).

Agriculture, as in most developing countries around the world, is the single most important regional activity, but the natural resource base, already tenuous, is dwindling at an alarming rate. Only about 8 percent of the land is arable, and this fails to meet local demand. Farming on arable land is made difficult by low and erratic rainfall, fragile soils and agricultural practices which pose threats to land's long-term productivity. Governments are compelled to rely heavily on imported food, a burden which diverts part of the already scarce resources away from social and economic development.

Support of Italy to agricultural research in the region can be considered traditional inasmuch as this research is highly relevant to all countries belonging to the region itself. In fact, agriculture in the Italian Mezzogiorno is constrained by many of the same factors just mentioned above.

Not different is the situation in most African regions. Between 1965 and 1973, the agricultural production increased in Africa at a yearly rate of 2.4 percent, as compared with a rate of population increase of 2.6 percent. Such quasi-equilibrium broke down in the following period, from 1973 and 1980, when a yearly rate of population increase of 2.8 percent was coupled by a practically stagnant food production (+0.3 percent). But the situation became dramatic in the course of the 1980s, when a slight improvement of

food production (+1.2 percent) was largely offset by a rate of population increase of 3.1 percent (Porceddu, 1990).

As a consequence of this trend, the African continent is at present unable to feed its populations. But agriculture is not only food. It plays a manifold role in the economy of most developing countries: it is a source of income, as well as a stimulus for all other economic activities, based on the fact that the economy of such countries is mostly an agricultural one. In several Asiatic countries, for instance, it has been observed that an increase of every percent point in the growth rate of the agricultural production stimulates a parallel increase of 1.5 percent in the growth of non-agricultural sectors. The agricultural development has, therefore, a multiplying effect, to be related to the trade and transformation of all agricultural production not directly consumed in the farm. Job creation, higher income levels and intensification of national and international exchanges are the most visible and important effects (von der Osten, 1990).

Facts have shown, however, that no increase of the agricultural output is possible without introducing more advanced technologies and improved germplasm: i.e., without agricultural research. Nor is it possible to meet such technological demand by simply transferring the output of research carried out in developed countries, since their agricultural production is realized under substantially different agroecological, social, political and economic conditions.

Thus, developing countries must establish and consolidate their own agricultural research. Costs are and will be high, but the results have been so far rewarding, as was the case, for instance, with the selection of modern, high-yielding wheat and rice varieties at the end of the 1960s ("Green Revolution"). It happened in Mexico, India, Turkey, Pakistan, Philippines. In those countries, modern rice and wheat varieties are grown, at present, on about 115 million hectares, which is equivalent to more than one half the total acreage for the two species (CGIAR, 1989).

Undoubtedly, those results were obtained mostly where fertile and irrigated soils were available, and were made possible by the adoption of a whole package of inputs (fertilizers, pesticides, herbicides, irrigation) essential for modern varieties to express their potentiality.

It also became gradually clear that the exceptional performances of modern germplasm were often accompanied by high environmental costs and phenomena of genetic erosion. Thus, the need of further, better focused research became apparent, if the best achievements were to be retained and consolidated without harmful side-effects on environment. Also, such updated research strategy has acknowledged a few realities. The first is that the gap between global availability and demand of food is bound to increase still for a long while, even if effective demographic policies, not in sight at present, were planned and implemented. The second is that it won't be possible anymore to expand food production by reclaiming new lands to cultivation. In fact, total supply of arable land not only will not increase, but is destined to dwindle further, due to a series of factors (urbanization, desertification, erosion, salinization, etc.).

In conclusion, an increased food availability can only be achieved, now and in the future, by both intensifying agriculture in the best areas, and rationalizing it in the more

marginal and fragile ones. Thus, a larger agricultural output from the former can compensate a shortage in the latter and alleviate the pressure (overgrazing, monoculture, wild deforestation) on it. The overall outcome may well be a reconciliation between two imperatives: to produce more food and to safeguard, at the same time, natural resources and environment.

2.1 The agricultural research in emerging countries

In most developing countries, national agricultural research systems (NARS) are in place. In some case, however, countries too small, with limited resources, or facing problems common to a whole agroecological region, have joined other countries and given birth to regional initiatives.

Research capacity of NARS may vary largely. In the mid 1980s, more than 80 percent of Thirld Word agricultural researchers was concentrated in just 12 countries: India, Brasil, Pakistan, Bangladesh, Thailand, Indonesia, Mexico, Nigeria, Argentina, Philippines, South Corea and Malaysia. In addition to that, only 10 percent of developing countries can count on adequate scientific structures and equipment. In fact, many of them, especially the newly-independent ones, had to create those structures *de-novo*, being the old ones, inherited from colonial times, scarcely adaptable to the present production and research strategies.

As far as financial resources are concerned, developing countries, although covering about 60 percent of world land and hosting 75 percent of world human population, contribute only 20 percent of the global annual investment (about 5 billion dollars) in agricultural research (Scarascia Mugnozza, 1983).

Italy's, as well as other donors', support to agricultural research in developing countries may follow bilateral or multilateral channels. In the former case, there are direct relationships between donor and recipient country, not only at governments' level, but also between scientific institutions and private, as well as public, enterprises. In the case of multilateral cooperation, resources are donated by many countries or organizations to a central, international agency. The latter is then in charge for the collection and distribution of them to national and international research institutions active in agricultural research for developing countries.

Although the main, ultimate goal of Italian cooperation is a strengthening of the NARS and the establishment of an effective, autonomous national research capacity, interventions to that end are often, but not always, direct, or bilateral. Many NARS still suffer from long-lasting organizative, political, financial, professional troubles that impair their ability to respond quickly and effectively to a direct injection of financial support. And the overcoming of those problems requires medium- to long-term interventions. The adoption of a multilateral, international channel of support to agricultural research is therefore intended to generate *in the immediate future* all the technologies and the improved germoplasm needed to re-vitalize and boost the agriculture of developing countries and the production of food. As much important, however, among the terms of reference of the international agricultural research institutions is the establishment of intense and fruitful relationships of collaboration and

complementarity with the NARS, so as to help them in the training of skilled personnel and the development of their own programs of applied and adaptive research.

This paper will particularly refer to the Italian support to international agricultural research institutions.

2.2 Italian support to the international agricultural research

The best known system of international agricultural research is the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of over 40 countries, international and regional organizations, and private foundations, established in 1971 to support a system of agricultural research around the world. At present, there are 16 international agricultural research centers or institutes in the CGIAR, most of them located in developing countries.

Thirteen centers have mandates covering food commodities, agroecological zones, or both. Their research includes improving plant varieties and methods of production, farming systems, plant protection, control of animal diseases, post-harvest systems, management of aquatic and forestry resources, as well as various aspects of food policy. Another center, the International Food Policy Research Institute (IFPRI) deals with economics and food policy, and yet another, the International Service on National Agricultural Research (ISNAR) provides advice to developing countries in the organization of their national research systems. Each of the 16 centers, on the other hand, maintains close and collaborative relationships with these national systems.

Other basic functions of the CGIAR centers, besides research, are information, dissemination and genetic resources conservation.

As a matter of fact, the latter task, genetic resources conservation, is the special mandate of one of the centers, the IPGRI (International Plant Genetic Resources Institute), located in Rome. Since its establishment in 1974 as a FAO project with the name of IBPGR (International Board for Plant Genetic Resources), IPGRI has a long tradition of close cooperation with Italy and Italian scientists, in acknowledgment also of the exceptional richness in native plant species (more than 25,000) that characterizes the Mediterranean basin. The old IBPGR heavily relied on the Italian Germplasm Institute of the National Research Council in Bari, for early exploration and germoplasm collection missions in the whole Mediterranean region, as well as for storage and evaluation of collected materials, training of developing countries' scientific personnel and advising for the establishment and operation of gene bank structures.

At present, Italian financial and scientific cooperation with IPGRI is centered on a series of projects, including: training of researchers from developing countries; study of genetic diversity of the world collection of *Triticum* and *Aegylops* species; documentation of genetic resources by means of image processing; impact assessment of IPGRI activities on plant genetic resources; assessment of genetic erosion in gene banks.

But the most important of these projects is by all means a research financially supported by the Italian Government and carried out in cooperation with the University of Naples.

It deals with the study and conservation of a long series of Mediterranean neglected plant species threatened by extinction, and involves the cooperation of institutions of practically all the Mediterranean countries. Italy is also present with a scientist in the IPGRI Board of Trustees, and with four more scientists in the IPGRI professional staff.

Due to the close ecogeographical affinity between Italy and the West Asia - North Africa (WANA) region, Italy strongly supports, and cooperates with, another CGIAR institute: the International Center for Agricultural Research in Dry Areas (ICARDA), based in Aleppo, Syria. This scientific cooperation dates from 1983, with a joint research project between ICARDA itself and the University of Perugia, on pastures in the Mediterranean region. The agreement included the hiring of four Italian scientists, to carry out activities both in Italy and Syria. In the same year, Italy started to finance the construction of a building with laboratories, offices and conservation facilities for the safeguard of plant germplasm. The building was inaugurated in 1989 and dedicated to an eminent Italian agricultural geneticist: N. Strampelli. Thereafter, the Italy-ICARDA cooperation expanded, and still goes on, relative to the evaluation of germplasm of *durum* wheat available at ICARDA and in Italy, in order to document and disseminate information to be utilized in *durum* wheat breeding programs. Italy also finances an ICARDA project for the improvement of yield and yield stability of barley in semi-arid environments. Other objectives pursued have been: the improvement of yield and cold resistance of lentils and chickpeas; the use of wild wheat relatives in wheat breeding; and farming in mountainous areas. Finally, participation of Italy was instrumental during the early phase of yet another ICARDA project, designed to transfer agricultural technologies to the Nile Valley region.

Equally intensive has been, and still is, the cooperation between Italy and another CGIAR institute: the International Livestock Center for Africa (ILCA), located in Addis Ababa. To better focus the Italian cooperation, ILCA created a special section: *"Animal Reproduction and Health"*, counting today 11 graduates and 32 technicians, which has seen in most recent years the direct work of 5 full-time Italian scientists. As a research support, a histopathological, parasitological, haematological and biochemical laboratory was realized, along with an experimental station for research on sheep and zebu reproduction, and facilities for the embryo-transfer techniques. Central issues in the activity of the section were the problems related to the reproductive pathologies of sheep and zebu, and the factors causing prenatal death and affecting "heat" synchronization and superovulation in the same species, as well as the optimization of embryo-transfer technology to speed up breeding procedures.

Very intensive, although not so vast, is the involvement of Italy with the CGIAR-affiliated International Laboratory for Research on Animal Diseases (ILRAD), based in Nairobi. Main theme of such cooperation is the immunogenetics of cattle. Specific projects are: the immunogenetic characterization of cattle; the induction and *in-vitro* control of the immune response in cattle; an evaluation test of the "cell-mediated" immunity, as compared with the "bovine lucosis"; the effects of tripanosomyasis on reproductive performance of zebu; the correlation between some immunogenetic types and infection by protozoary and viral agents.

Of different nature is the cooperation between Italy and the International Service for National Agricultural Research (ISNAR), an institute based in the Hague, which, on

behalf of the whole CGIAR system, trains the future scientific and administrative managers of the agricultural research institutions in developing countries. Research projects particularly assisted by Italy have been: the constitution of a database on financial and human resources in over 100 countries worldwide over the last 30 years; a study on on-farm and client-oriented agricultural research in developing countries; and an assessment of the interface between research and extension. Still in progress is a research on small-size agricultural research systems.

The Italian cooperation with five other CGIAR centers is mainly, although not exclusively, focused on the development and utilization of biotechnologies.

The project carried out with the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), based in Mexico, concerns studies on the epidemiology of the Barley Yellow Dwarf Virus (BYDV), aimed at reducing losses caused by this virus disease, and involves 5 Italian institutes and as many scholarship holders.

The *in-vitro* culture of beans, and the evaluation of *Phaseolus* germplasm in general, are the themes of the cooperative research carried out at the Centro Internacional de Agricoltura Tropical (CIAT) of Cali, Colombia. Involved are 6 Italian institutes, many of them hosting scholarship holders. The project has also provided funds for the construction and upgrading of germplasm storage facilities.

With the Centro Internacional de la Papa (CIP), based in Peru, Italy is carrying out a cooperative program on production of improved potato germplasm, with emphasis on *in-vitro* culture. The project includes research, information and training components. Four Italian institutes are involved, with six scholarship holders.

The International Rice Research Institute (IRRI) of Los Banos, Philippines, has organized with Italian cooperation training courses on the conservation of plant genetic resources and the technology of seed production. Research is centered on a hybrid rice improvement program. Also, with Italian financial support, new labs have been built, and some old ones renovated.

The cooperation with the International Institute for Tropical Agriculture (IITA) of Ibadan, Nigeria, involves four Italian institutes and is focused on *in-vitro* culture and germplasm improvement of the genus *Vigna*. Also, Italian financial support has allowed the construction, just terminated, of new lab facilities for biotechnology research and the local genetic resources unit.

A CGIAR center with headquarters in India, the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), in recognition of the very serious problems affecting African agriculture, has recently opened, with Italian aid, a branch at Niamey. Italians also cooperate at a research program on sorghum resistance to high temperature.

This survey can be concluded by mentioning the joint research project carried out by the International Food Policy Research Institute (IFPRI) of Washington and the Italian National Institute for Nutrition, on work seasonality and its impact on workers diet and fatigue.

To be mentioned, also, is the fact that Italy supports the whole CGIAR effort of raising its public awareness in Italy and Europe, by entirely funding and staffing a documentation and information unit based in Rome: the International Agricultural Service - European Service (INTAGRES). The project is destined to cover all Europe, as soon as other donors will join Italy in its financing, and is aimed at promoting a better flow of information and scientific data between European institutions and CGIAR centers.

Finally, it is appropriate to recall the Italian efforts in capacity building at the level of African universities. Three countries (Somalia, Mozambique and Ethiopia) have so far been concerned by these initiatives. Italian scientists visit (or used to visit, in the case of Somalia) local universities on regular basis, organizing courses and training local scientists and professors destined to take over in the next future.

Limiting our consideration to the CGIAR system, the Italian financial contribution, started with very modest amounts in 1976, increased steadily, to reach a peak in 1989 with about 10 million dollars donated to the CGIAR core budget. This made Italy ranking 10th among the CGIAR donors. Due to national economic problems, not exclusive to Italy, such amount decreased somewhat in the following years. Italy now ranks 12th among all CGIAR donors, with a significant shift of its total contribution towards the International Plant Genetic Resources Institute (IPGRI) and its activity in favor of genetic resources and environment conservation.

In recent years, an increasing share of the Italian contribution to CGIAR, more than 70 percent, has been allocated to "restricted core" projects, while the rest has been assigned to selected projects mostly carried out in cooperation with the above mentioned centers. Also, a large part of funds is allocated to WANA and African centers, in compliance with the Italian development policy.

In Italy's view, priority challenge of the CGIAR institutes should be the implementation of suitable farming systems in Africa and S.W. Asia, as well as a stabilization and further increase of the high productivity levels reached by some agro-ecosystems especially in Asia, coupled with the control of the risk of environmental degradation. CGIAR institutes and centers should be increasingly involved in studying and solving all problems which, due to their complexity and general lack of scientific information, represent the major limiting factors for a full exploitation of crop production potentials in developing regions. A few examples are: the reconstruction of the natural fertility bases in regions of ancient agriculture (S.E. and S.W. Asia, North Africa) which face now a demographic explosion; the fragility of tropical soils; biological N-fixation; animal nutrition and diseases; control of biotic and abiotic stresses; prioritary collection and conservation of genetic resources of several species (e.g. leguminous forage species); the soil-plant-nutrient relationship; the role of water as a vector of such processes.

However, it is essential that the production of interdisciplinary scientific knowledge and methodologies, and the implementation of projects of applied research, be seen in the frame of a development and intensification of complementary relationships with the National Agricultural Research Systems (NARS). This is *conditio sine qua non* for reaching the ultimate goal of the international research system: the building of solid,

effective and productive national (or regional) research institutions in developing countries, manned by capable and skilled scientists, able to guarantee a future flow of locally developed technologies. It is according to these principles and priorities that, in the future, the CGIAR programs will be evaluated and eventually given Italian support.

References

1. Bagnara G.L., Rivalta L., Laghi M., 1994. Miglioramento genetico del pero per la resistenza a stress biotici ed abiotici. Frutticoltura, 1: 65-68.
2. Ballenger Nicole, Mabbs-Zeno C., 1992. Treating food security and foos aid issues at the GATT. Food Policy, August: 265-276.
3. CGIAR Secretariat, Washington. D.C., USA, 1989.
4. Coscioni L., 1993. I prodotti agricoli nelle teorie del commercio internazionale. Rivista di Politica Agraria, XI, 1:49-52.
5. Fleming E.M., 1990. Proposal for marketing systems reasearch approach in agricultural development planning. Agricultural Systems 32: 97-111.
6. Galizzi G., Venturini L., 1994. Product innovations in the food industry: nature, characteristics and performances. Fourth International Conference "Economics of innovation: the case of food industry", Cremona-Piacenza, 10-11 June.
7. Gianpietro M., Bukkens S.G.F., Pimentel D., 1994. Models of energy analysis to assess the performance of food system. Agricultural Systems 45: 19-41.
8. Hipple von E.,1988. The source of innovation. Oxford University Press, New York.
9. Janssen W.G., 1993. Economic and agricultural development in West Asia and North Africa. Food Policy, December: 507-522.
10. Pinckey T.C., 1993. Is market libaralization compatible with food security? Food Policy, August: 325-333.
11. von der Osten A., 1992. Ricerca agricola e sviluppo.In: "La ricerca agricola internazionale fattore di sviluppo delle aree emergenti: il Gruppo di Consulenza per la Ricerca Agricola Internazionale (CGIAR)". Proc. of a Meeting held at the Tuscia University, Viterbo, Italy. 1-2 February 1990, p. 13-32.
12. Porceddu E., 1992. Il contributo italiano alla ricerca agricola internazionale. In: "La ricerca agricola internazionale fattore di sviluppo delle aree emergenti: il Gruppo di Consulenza per la Ricerca Agricola Internazionale (CGIAR)". Proc. of a Meeting held at the Tuscia University, Viterbo, Italy. 1-2 February 1990, p. 33-48.
13. Ruttan V. W., 1982. Politica per la ricerca in agricoltura. Pubb. Dipartimento per l'Informazione, Venezia.
14. Scarascia Mugnozza G.T., 1983. Ricerca e valorizzazione agricola nei paesi in via di sviluppo. In: "Guida alla valorizzazione agricola nei Paesi in Via di Sviluppo" (a cura di Carlo Barberis). F. Angeli Ed., Milano, p. 313-318.
15. van Schoonhoven A., 1992. (personal communication).
16. Sillani S., 1994. Reddito po-capite e commercio internazionale di prodotti agricoli. Rivista di Politica Agraria, XII, 1: 35-46.
17. Swaminathan M.S., 1994. L'agricoltura nei paesi asiatici in via di sviluppo: il caso dell'India. Rivista di Politica Agraria, XII, 1: 47-51.
18. Venturini L., 1987. Indicatori di non-price competition a posizione competitiva dell'industria alimentare italiana. Atti del XXIV Convegno di Studi della SIDEA, Il Mulino, Bologna.

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* This paper has been presented at the Fourth Minnesota/Padova Conference on Food, Agriculture and Environment " S.Paul-Minnesota, September 4-10, 1994

The Authors contributed to the paper as following: Gian Luca Bagnara paragraph 1; and Domenico Bagnara paragraph 2.