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Fifth Joint Conference on

Agriculture, Food, and the Environment

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

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

Agricultural Development Agency - Veneto Region

University of Perugia

University of Bologna - CNR

SESSION V: COMPUTER SCIENCE AND ENVIRONMENTAL MANAGEMENT

PAPER 1: COMPUTER SCIENCE FOR AGRO-ENVIRONMENTAL FARM MANAGEMENT

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FOREWORD

This volume contains the papers presented at the Fifth Joint Minnesota/Padova Conference on Food, Agriculture, and the Environment held at Abano Terme, near Padova in Italy, June 17-18, 1996. This conference was organized by the Center for International Food and Agricultural Policy at the University of Minnesota and the Dipartimento Territorio e Sistemi Agro-forestali at the Universitá degli Studi di Padova (University of Padova) under their international collaborative agreement, along with the Agricultural Development Agency - Veneto Region, the University of Perugia, and the University of Bologna - CNR. The first Joint Conference was held in Motta di Livenza, Italy in June 1989, the second in Lake Itasca, Minnesota in September 1990, and the third in Motta di Livenza in June 1992. The Fourth Joint Conference was held in September 1994 at the Spring Hill Center in Minnesota.

This conference focused on topics of mutual interest in the areas of (1) agricultural and resource policy, (2) land markets, (3) the food and agricultural industry, (4) agriculture and the environment, and (5) agricultural production and environmental quality and sustainability. Although the conference was not intended to provide a comprehensive coverage of all the issues, this volume hopefully represents a useful contribution to current understanding and debate in the areas of food, agriculture, and the environment.

Judy Berdahl, secretary for the Center for International Food and Agricultural Policy at the University of Minnesota, assisted with these Proceedings.

Benjamin Senauer
University of Minnesota

Danilo Agostini
University of Padova

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University of Padova
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5th Joint Conference on Agriculture, Food and the Environment
Abano Terme, Padova, June 17-18,1996

COMPUTER SCIENCE FOR AGRO-ENVIRONMENTAL FARM MANAGEMENT

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1-PREMISE

From a simple analysis of the deep transformations that have been occurring in the informatic and communication field in these last two years,. it can be realized how useful it is to discuss about the contribution of informatic supports usage to enterprise, territory and environmental management.
In the first place, why computer science? The world of today and especially of tomorrow will be characterized by an ever increasing relevance of communication and information process and support. Nowadays informatic supports allow to treat massive information data and their transmission from whatever computer - through network - to every part of the world in real time.
The agricultural and agro-industry sectors, like the entire world socio-economic order, are more and more correlated with the government of complexity, where the decision maker - for the choice of land policy - has to solve the widespread and persistent conflict between different position groups and in a holistic and no longer partial perspective.
Territory, too long thought of as a "gap to be filled up", with the increasingly clear affirmation of an indispensable "Strategy of Sustainable Development", is by now no longer seen for its partial option elements but in a holistic fashion, through a systemic approach that considers even lanscape as an economic good to be conserved, managed and enjoied.
Complexity and the holistic option involve that nowadays we cannot talk about sustainable firm managent without taking into account the territorial an environmental issues to which are connected and imposed by an holistic view.
Taking decisions at firm and territory level, that is giving concreteness to the evolving economic science, means to possess and deal with systemic and complex information, where the time variable is increasingly reduced.
If the means available to man were still exclusively those traditionally analogic, we would witness a rising dramatic temporal gap between changing situation time in act and decision making.
Decisions have to allow the reduction in continuous and modified external constraints that firm and land undergo from this "turbulence process", instead of suffering them.
To get to this position what is needed, for every choice and action on land and firm, is the possession of coherent and timely information to be managed with an adequate intellectual supremacy.

2-FIRM AND TERRITORY

2.1- Farm and Agroindustrial firm.

The agricultural and agroindustrial sectors are immersed into a worldwide socio-economic order characterized by:
- Complexity;
- Globality;
- Competion;
- Market liberalization;
- Sustainable Development Strategy;
- Environmental problems accentuation;
- Collapse of Eastern countries economies and their insertion in market economy;
- Traditional industry limitation and interests move to innovatory sectors towards Eastern Asia.

Worldwide, farm is increasingly immersed in a market characterized by "environmental turbulences" that make management a problem in a perspective of improving its vitality and competetiveness.
The sector as a whole is disruptively crossed from one side by environmental issues and from the other by the strategic lines of agricultural policies such as economic blocks (CEE, NAFTA, MERCOSUR) and recent Uruguay Round's decisions.
The problem of environmental and territorial resources management is by now imposing a worldwide strategic choice and a new development model.
In 1968 the MIT - with a contribution that threatened the future (nowadays) with the depletion of many natural resources - stressed the important role of intellectual investments in order to achieve development (one milion people undernourished). In 1972 the Club of Rome - with its contribution on the "Limits to growth" - made the world think about the need of reflection on the quantitative model of productive activities and a new relationship between the North and South of the world. During the same period, beginning from the essay "The quality of life " by Paul Sauvy, a large consensus started taking into serious consideration scientific and analylitic procedures based on the world society's new option. Brundtland Commision's conclusions with the report "Our Common Future" clearly outlined that the environmental and resource issues are

a matter of intergenerational equity.
All of this is taken to mean that the challenge we have to face is the government of complexity, for which the sustainable development model still seems a panacea for the future rather than a clear and certain direction. The debate goes from Vernon Ruttan's position who questions how far sustainable development is politics, science or poetry , to Giorgio Perotto's one who in its Economics' Paradox proposes the overcoming of the systemic prison of western development model and thus new institutional paradigms like the public appropriation of the more interesting environmental areas by getting over private property, to David Pearce who delineates - through quantitative analysis methodology - the procedures to verify and measure the sustainability of plans and programmes for vaste areas. A complexity that make dramatic, for many Southern areas, the operative and pressing combination of sustainable development, indispensable modernization, equity and relevant poverty.
Within this framework farm undergoes a destructuralization, and rather than agricultural enterprise tout court, nowadays we should talk about rural enterprise that besides basic productions achieves its budget through non-traditional activities (processing, direct marketing, integrative activities like agritourism, territorial services, even consultancy when possessing know-how in its role of local advanced factory)
Nowadays farmer has to take into account that market is characterized by rapid and remarkable dynamisms to be possibly dominated in order to safeguard firms' vitality. The time variable is increasingly shrinking while space is widening to world globalization levels. If farmers have till now been measuring their efficiency and efficacy through the capacity of producing according to quantitative targets, nowadays conditions impose farmers to face a demand for quality and low imput processes. Farmers have to become strategists able to understand market dynamisms and evolution.

2.2- Territory
Till the past decades, the traditional model of partial and sectorial analysis considered territory as a good of great substitutability. Many interventions on it have been then activated without considering the important role of soil and natural resources as depletable goods and thus to be managed very carefully avoiding waste. In the recent past, territory was also given the reductive role of support for productive activities and infrastructure. That without assigning to it - at the choice level - any relevance to its **total economic value and/or social use value** which in terms of land resource or complex system had and has for the strategy of sustainable development. Territory is subject to waste and degradation; it is crossed by vital interests for future generations in relation to the minum possible guarantee to be offered for population's survival that already live at their mininum level of subsistance.
Hence, land management means facing the concrete management of complexity and the solution of conflictual issues. Because of the time acceleration for choice options demand, the planning or programming expert, or the syntesis manager can no longer answer and operate with the traditional supports. Hence, the role of informatics for land management becomes nowadays and in perspective increasingly determinant.

3-MODERN MANAGEMENT OF FARM , AGROINDUSTRIAL FIRM, TERRITORY AND ENVIRONMENT.

Manager's dominion on firm activity is activated through the control of administrative facts. The control of their effect is reserved to Accounting, that in the classical approach only had an accessory role. This limitation has ever been carried into effect through the drawing up of final balance sheet for exclusively formal and informative purposes. On the contrary, the actual reality characterized by turbulence and great dynamism, requires a continual control that should be translated into **firm continual monitoring**

3.1-From an open scheme vision to an iteractive and interactive closed scheme vision .

The main purpose of Accounting and supports is to create a s**trong intellectual supremacy** on the firm's administrative problems. To this aim it is necessary to clearly identify the tools, their analysis and the method for using them. Farm's administration is **"intuitively" anchored to annual time datum**. **Scheme 1** shows the administrative role that has been traditionaly given to accounting .Within the vaster meaning of firm programming activity the position of accounting is conceived according the O**pen Scheme 2.**

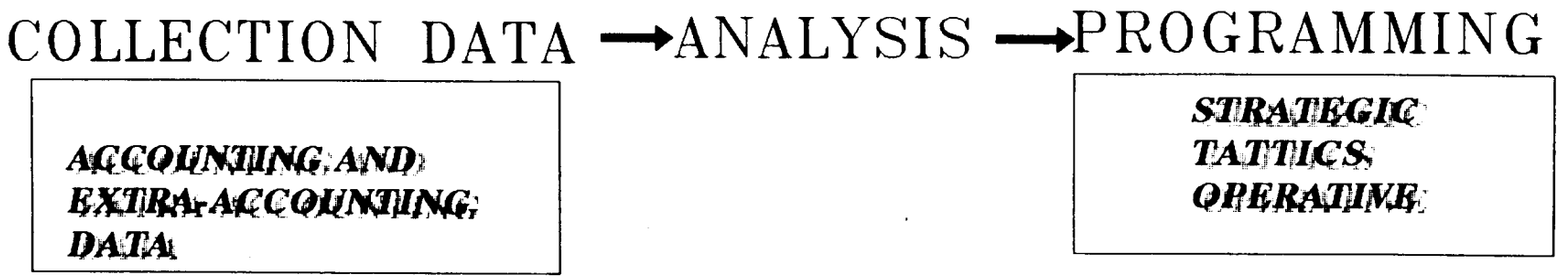

Fig.1-Open Scheme

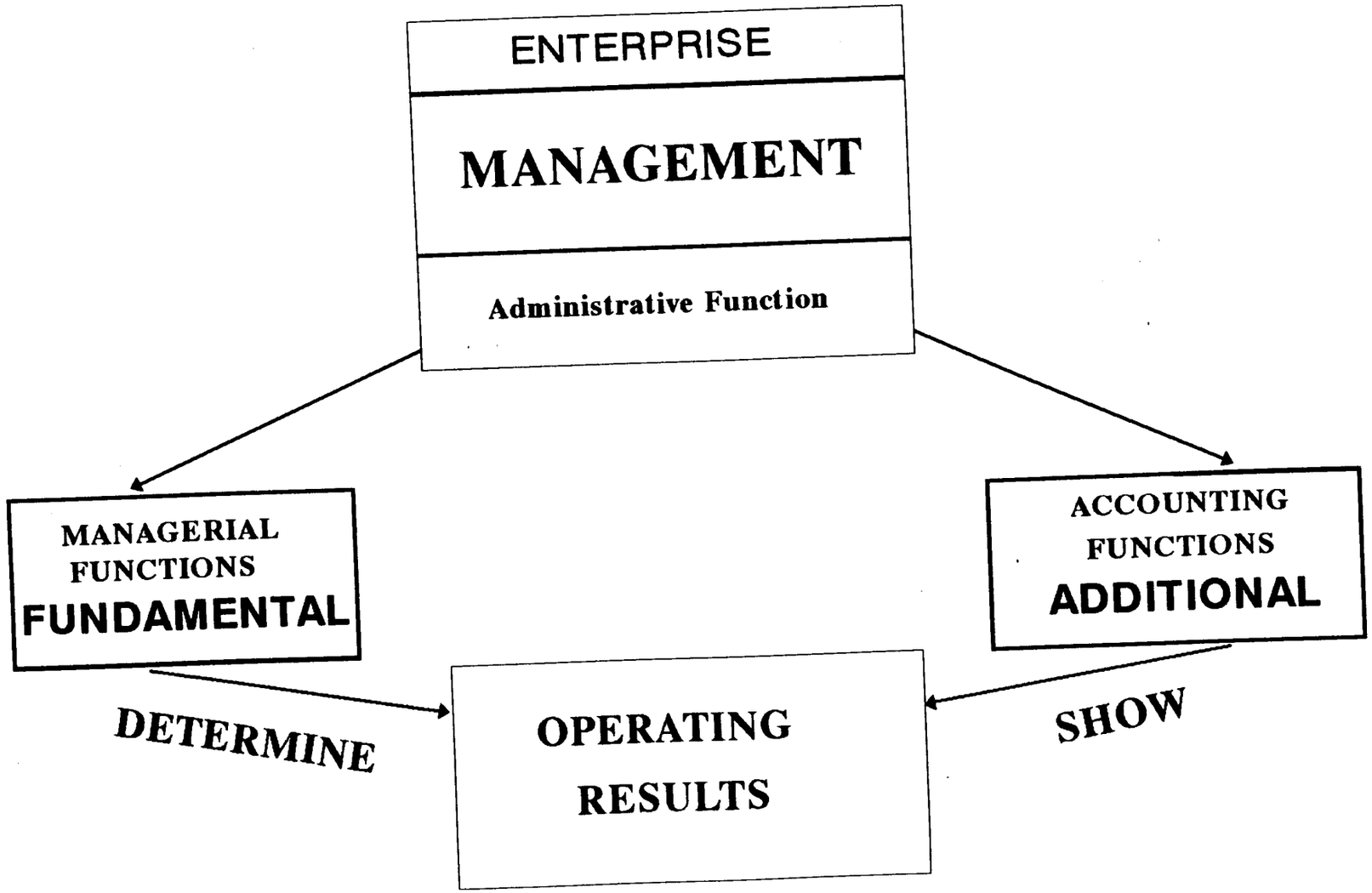

Fig.2-Scheme 2

The open schem constraints the role of accounting at the modest level traditionaly recognized: to **inform about the management's result at the end of the operation to possibly intervene with some changes in the next operation.**
The technical time, needed to fill the final documents, leads to allow the possible modification even at the next second year. Agriculture, increasingly immersed into the market system, pays an high cost for the delay on answering to price modification. Biological cycles and sector peculiarities make this delay be at lest one year. Example are sugar-beet and tomato. The year in which price rises is characterized by a trend due to little cropped surface and/or low production/ha. Hence, the following year will almost surely see a high production at low price.
This is taken to mean that delayed reactions are clearly contraddictory relative to market trend which is undergone, not driven or possibly determined. This behavior is due to traditional management where there is the tendency to take qualitative actions after the final balance and based on the analysis of only past processes. It is why, at the end of the season, farmer will choose such crop for next year without considering a minimum analysis of sectorial market change already happening at the beginning of the new operation, wich are determined by input price changes, new commercial agreement or new national or EC norms, etc.
Carring out administration and accounting according to these priniciples is like **producing accounting for itself and providing ex post information.**
Because of the dynamisms involving firm, such innovations will result unuseful since they are delayed relative to normative choices that economic, patrimonial and financial aspects require for a **"strong firm management".**
Proposing an **only informative accounting** can unconsciously favor a **farm's pseudo scientific and technical chloroformization .** Farm accounting must then be qualified in the <<**iteractive and interactive continual closed scheme >> (scheme 3).**
This scheme is meant to not confine the role of the discipline at the reductive requirements of General Accounting but rather to enphasize it in order to achieve the dominion on environmental turbulence through a continual monitoring of short, medium and long term programs. In this light the Acconting Function inside administrative functions makes scheme 1 modify in **scheme 4.** This involves the overcoming of the <<canonical>> level of <<informative accounting>> to move towards one of <<normative type>> that not only **display** but also **determines relevant administrative facts.** These general lines are based on two important element of theoretical and/or practical reference: THE CENTRE OF ACCOUNTING DOCUMENTATION and of EXTRA-ACCOUNTING RECORDING, and THE CENTRE OF MANAGEMENT CONTROL. From them, GENERAL and DIRECTIONAL ACCOUNTING generate and interact with.

From directional accounting, like a continual osmosis, many and vaster MICRO and MACRO accountancy functions depart and/or engraft **(scheme 5).** Managing a farm with this outline means to create the basis for **Firm Informative System .** This aspect was already singled out by Zappa in his treatise on Income System who pointed out the importance of the farm statistical taking. This entails a notable data collection which have to be processed and treated in short time in order to be used for the **options of continual management settling**.

4- MODERN LAND MANAGEMENT.
Territory is a complex system to be analyzed and managed through an olistic approach. Such vision does not exceed the approach by which territory has to be first read and interpreted and then to carry out on it the operative choices. **Land Capability** and **Land Use** , as a sequential approach , are still valid. Even territory, in the broadest sense, to be properly managed, needs to be included interactively/iteractively in a scheme of programming, execution and control.
In this sphere a **Territorial Informative System** may and have to find its coherence.
The multiplicity of information to be collected, systematized, verified and consulted cannot be entrusted to old instruments like cadastre but to supports having a great level of operative capacity. Cadastre itself, although only for fiscal and civil purposes, has activated a process of informatization at the national level through the use of numerical maps. However, the complexity of issues involved in the modern land management needs something more. Territory is a vary dynamic object/subject to which many issues are linked to, such us infrastructural and urbn policies, calamity defence, management and control of natural resources, development of weak internal areas. A proper land management requires more and more the adoption of digital supports with an high capacity of immage and data elaboration, that only specific software and hardware can guarantee.

5 FARM AND LAND MANAGEMENT TECHNIQUES.

5.1. Farm Management and Control Techniques.

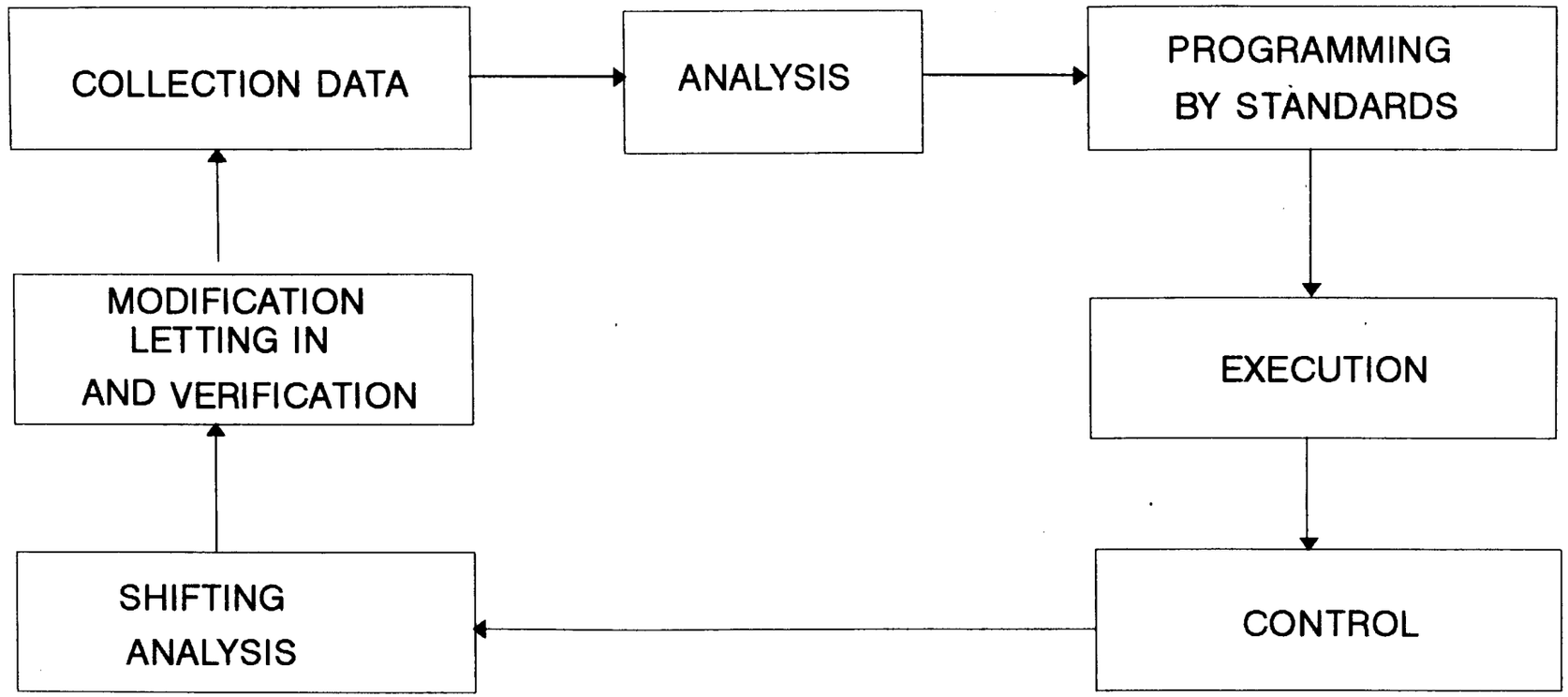

Fig.3-Closed Scheme

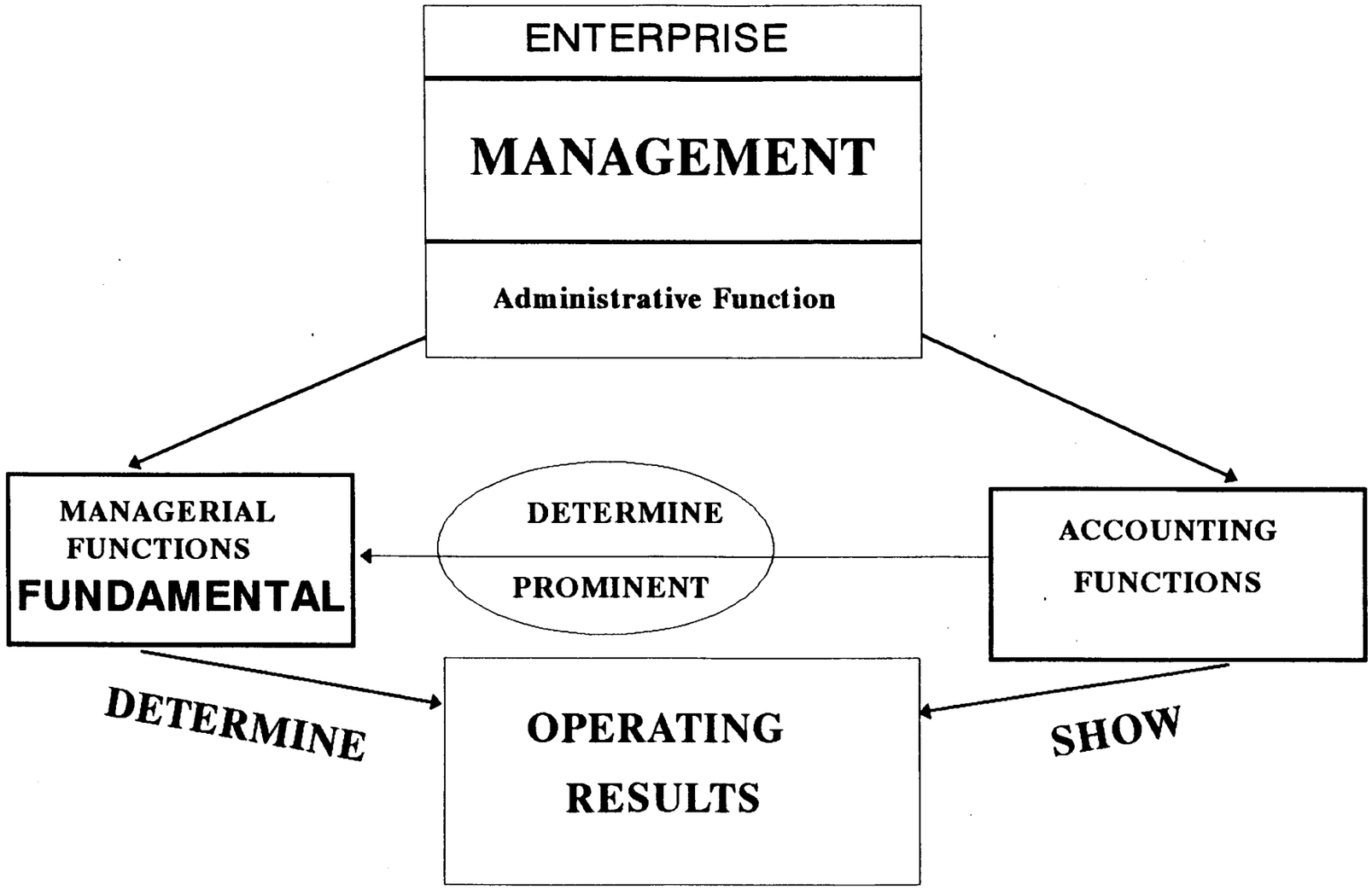

Fig.4-Scheme 4

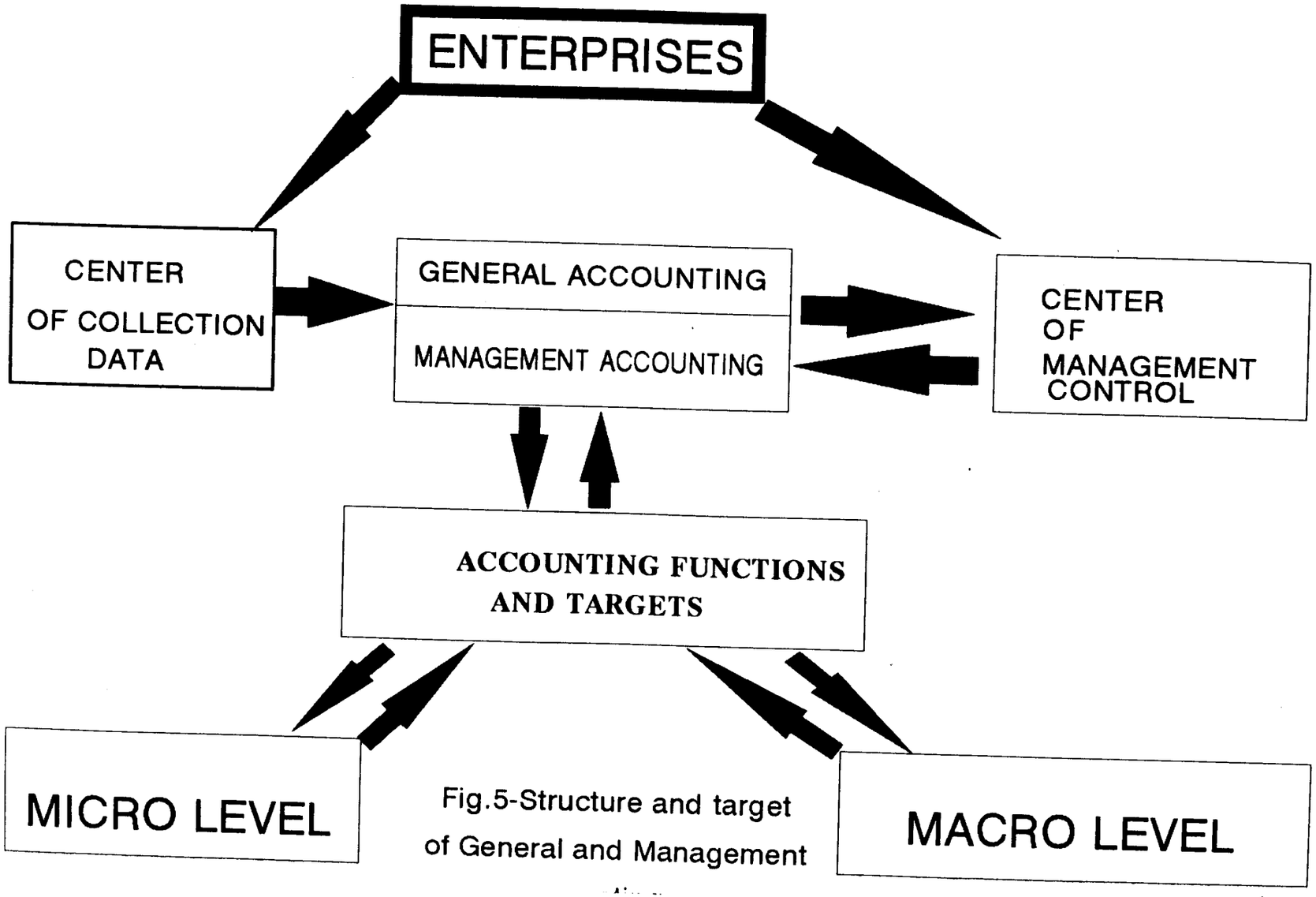

Fig.5-Structure and target
of General and Management

Accountancy recording can be carried out through different techniques; the introduction of new techniques is linked in historical terms to modern society progress.

Chronologically this century has experienced:

HAND TECHNIQUE, TRACED HAND TECHNIQUE, MECHANIZED ACCOUNTING, MECHANOGRAFIC SYSTEM ACCOUNTANCY, COMPUTERIZED ACCOUNTANCY.

The great quality jump of accounting techniques has been possible because it has been linked to the INFORMATIC WAVE. This can be easly seen by following the informatic evolution characterized at the beginning by big electronic calculators till current VI generation of mini and personal computers. Nowadays it is not rare to assume that each farmer - through an adequate hardware and specific software -might be able to collect, process and analyse in short time the effects that every administrative fact causes on farm management. With the evolution of operative systems and software applications, accounting has achieved a rising space in applied programs. In fact it is well known that computers have their main specific role in recording data which is also the main function of accountancy. From simple electronic sheet and simplified programs of general accounting, software market in the last fifteen years has increasingly supplied specific packages for specific firm types. Farm accounting as well is by now endowed with a plurality programs targetted towards agricultural enterprise, ranging from simple general accounting, V.A.T. accountancy, store ect, to integrated packages able to manage systemic and accountancy information. It is about programs that are usefull for the ex-post control but also for innovative management actions such as partial programming, analytic accountancy and operative research. There are many professional organizations, farm accounting centres, extention services that are endowed with this types of Hardware and Software. Computer usage begins to be quite accepted at the level of single farmer as well, either for the management of routine family programs or also for farm accounting and management. Nevertheless, italian market has not proposed to farms the specific software for periodic accountancy controll. Computer introduction seems to have facilitated the spreading of accounting in agriculture although still traditionally linked to the application of weak schemes like ex-post control. From France come instead usefull and opposite experiences, where since 1967 I.N.R.A. applies a budgetary accountancy control in agreement with management extention services. It cannot be denied that other countries'experiences and improvements strengthen the vision of a more modern accounting approach to be also applied in our agricultural sector

5.1.1.-FROM FIRST GENERATION INFORMATIC SUPPORTS TOWARDS EXPERT SYSTEMS IN ADMINISTRATION.

Telematic and informatic development of modules and informatic procedures have allowed technicians and farmers to achieve some improvements about some agricultural problematics

Integrated systems of agricultural analysis and management have become a valid decision support for the management and assessment of economic and environmental effects of farm activity.

The "obbligation of programming" - condition by which strategic planning is defined through the singling out of short-medium term objectives - offers a framework of reference within which farmer inserts choices and scenarios that better guarantee firm's decisions through which programming is carried out. Operative planning represents the stage in which operative choice are taken and quali-quantitative objectives are defined as well as strategic choice are carried out and possible alternatives are singled out and analysed.

In this context farmer's duty is that of moving himself on a multi-objective scenario, where,besides income maximization, resource conservation and optimization find their relevance.

Hence, since the great bulk of data and information to be analysed and used, informatic centres and informatic settings based on data and information exchange among different sites and organizations are increasingly taking place. From informatic supports of first generation - through the improvements occurred in the field of artificial intelligence - expert systems are quite successfully taking place especially for the operative management of single activity. The subject is intresting and appreciated in farm administration as well.

5.1.2.-MEANING AND PERSPECTIVE OF INFORMATIC WAVE IN FARM ADMINISTRATION.

The innovative process of informatic revolution open some perspective even on the unfortunately maltreated farm accounting. It is now possible to spread accounting forms characterized by a quite analytical power and know in right time the level of

cost and revenue sources, as well as sectorial cost and revenue in a very short operational time and by now affordable for every type of farm. If the picture of farmer with a computer at home for accounting is not still very common , however this represents the future that can be made real.
The informatic expansion allows the activation of accounting assistance and management analysis centers with notable slenderness, thus giving a strong impulse to strategy of consolidation and growth of services of integrated agricultural development.
At the "micro" level all accounting fuctions described above can have a greater possibility of diffusion. In detail, firm efficiency analysis, investment feasibility, strategic and operative planning can increasingly find a possible and economic access even in small firms. It becomes coherent even for farm the possibility of endowing an accounting system for intra-annual control. At the level of operative research, programming models suitable for uncertain and risky situations - like the Montecarlo one - can be calibrated on associate farms and thus becoming economically convenient. The expansion of softwarehouses' activity makes it possible to adopt progammes for specific management (statistic, economic, financial), for livestock, cropping, mechanical equipment, irrigation and so on. At the "macro" level it is possible to aggregate ,by "net", such numerous "micro" data and hence build up DATA BANKS of regional accounting and increasingly qualify the various policies to which accounting is functional. It is through the computer that accounting can achieve an higher quality in order to give more weight to managerial accounting and be more suitable for the modern features of firm management. While the spreading of work-stations and network program management are slowly transforming customs and practices in the tertiary sector, this will also affect agricultural enterprise. The neuronal network systems of farm service and the messages that firm collects will be more and more filled up with information from the firm to the centers. **The idea of living firm as a cognitive subject** seems to be in this light already the present and not a long future; it acquires a physical and not just conceptual formalization. It is about starting to look at the farm as a subject with a strong demand for information and learning, but also able to provide the same kind of information and learning to others centres and cognitive subjects. All of this in real time, that is in a temporal dimension which makes firm an active subject and market protagonist.

5.1.3- DECISION SUPPORT SYSTEMS AND ARTIFICIAL INTELLIGENCE

5.1.3.1. Monocriterial Models

These models are based on the principles of mathematical programming, with these common features:
-optimum solution determination;
-uniqueness of valuation and choice (max profit, minimun cost);
-presence of an ensamble of finite or infinite decisions
(according to the variables that can be discrete or continuous, in a certain admissible ensamble).
These models belongs to monocriterial planning (and to statistic and deterministic models) and are often known as "punctual procedures", such as partial and global budgeting, and programme planning; Linear Programming is known as a "continuous procedure" and it is particularly used for firm's global planning, recently also by applying alternative agro-technologies. Then we have dynamic deterministic models that basically are some adaptations of linear programming for medium-long term; models that operates in risky and uncertainty conditions like Quadratic programming that considers the variability of some parameters - like prices and yield - in its objective function. Moreover, there is also probabilistic simulation with Montecarlo Method. The main limits of these techniques can be analysed and considered as the motivation that have induced the research of new methodologies:
- the presence of a unique criterion - hence the name of Monocriterial Methods - in which the main determinant objective is profit maximization, while the other objectives are conceived as management constraints;
- the difficulty of giving a monetary value to costs and benefits of a choice, since the other criteria are hardly omogeneous and monetary, relative to profit maximization;
- the tendency of not identifying or even ignoring the conflicual aspects of a choice, since the mathematical program of maximization provides automaticaly the answer, while it would be much more interesting for farmer to know the conflictual aspects, to value them and find a solution.

5.1.3.2- **Multicriterial Models.**

In order to overcome the problems and limits mentioned above, Operative Research has developed multicriterial decisional methodologies to be able to apply a "**multi-objective optimization",** in order to allow the connection among completely

different purposes which some decades ago were considered incompatible like the ecological aspects and firms' economic dimensions. The expected value of these objectives have to be linked to the level of the different decisional variables which in turn are qualified by the technical and economical availability and constraints. Thus it originates the structure of **"Pareto admissible"** choices, that is a decisional matrix which, if used in an interactive fashion, can provide from one side the knowledge of the various possible options and from the other it allows firm to modify its choices according to more or new information. It is clear that its practical usefulness depends on the capacity of formulating the interrelations between decisional variables and objectives, with a model that determines the interdipendence among the objectives, often in a limited range of knowledge; however , the "impacts"analysis of the different options can be an instrument to fill the lack of information. This kind of programming provides a systemic structure for new information, and links the economists' **"optimazing approach**" to ecologists' **"systemic approach"**, which is relevant **relative to the new tendency towards an integrated rural development.**

On the whole, the approach of models and resolutive methods that explicitly takes into account the presence of different objectives is called **Multicriterial Analysis** (MCDM) and can be divided in two broad caterories: **Multi-Attributes Analysis** (that operates with discreete variables) and **Multi-Objectives Analysis** (that operates with continuous variables). These currently include numerous methods for constructing, solving and assessing models of **multiple finalities**.

Among multi-objective models there are some that seem to have the best potentialitites for the application of land planning and farm programming:

- programming with definite objectives, known as Goal Programming (GP);

- programming with more objectives known as Multiobjective Programming and also defined as Vectorial Maximization (Vector Maximization Problem).

With the GP method it is taken into account that the decision maker is able to provide the analyst -who sets the optimization model up-with an ensamble of information about its own preferences, seeking to achieve some determined level of each of his objectives instead of looking for an unlimited optimization of them.

On the contrary, with the MOP what is done is the contemporaneous and unlimited maximization of the considered miltiobjectives. With this formulation we do not get a unique optimum solution for more objectives contemporaneously, but a set of solutions characterized by the fact that none of them can reach the same or better level for all the objectives and a better value for at least one of them. The choice of this kind of analysis is essentially due to entrepreneur's informative situation. Since decision maker is not able to express his complete range of preferences and the expected values for single objectives, he can obtain in this phase usefull information in addition to those possessed and in particular on the exchange relationship between the different objectives. This procedure leads to the delimitation of efficient solutions. At this stage the nemerousness of solutions can makes it difficult to find the more satisfactory options. One possible way is that of reducing the range of preferences, through an iteractive procedure. An other method to select the more satisfactory option is to consider, in just one phase, the entire efficient frontier previously generated (or a part of it) and then to choose that solution that is closer to an ideal point whose co-ordinates are given by the optimal values that can be reached. This method is called **Compromise Programming** (CP). The results of the optimization - as much as the objectives are - allow the construction of a matrix that in its diagonal has the **"ideal values"**of the single objectives, the so called **pay matrix**. The **real solution** will be the closest to the ideal one. These two methods seem to be the best ones for their potential adaptation to farm programming and land planning; this kind of approach is coherent to the new farm reality relatives to the new environmental and natural resources issues.

However, these kind of supports is very usefull when entrepreneur can follow a systemic process to make his decision, thus by using the available information concerning the problem to solved, the environment, the model and the alternative solutions. This structured informative system is very usefull to provide information for routine's decisions, whereas it is less functional to support complex decisions relative to those that farmer is used to. For instance, to specify the existing **"trade-off"** between rentability and environmental impact, the bulk of quali/quantitative information required is

notably greater than that used in normal decisional process

5.1.3.3- Artificial intelligence

To give a support to complex decisions the techniques of Artificial Intelligence have been developed, which can be defined as that branch of computer science regarding the automation of intelligent behaviour, as an attempt to emulate human reasoning. It si worth pointing out that current development of this sector of informatic research are in full evolution. As for firm management problems , within Artificial Intelligence, an important role is plaied by both **Expert Systems** and **Decision Support Systems**, where the latter are meant to be complements to **Operative Research** for firm informative systems, since they do not deal with routine problems but however require entrepreneur's active participation.
As for **Expert Systems,** they can de described as systems of iteractive softwares that want to represent knowledge and way of reasonig of an expert on a class of problems. In practice, the Expert System uses the techniques recently developed to record specialists' knowledge, which are represented as a series of rules in order to be available through the computer.
An expert system structure is composed of two parts : the **development area** and the **consultation area**.
The former is used by the system constructor to introduce the expert knowledge, the latter is used by the non-expert user to obtain the base of knowledge and the expert's consultation.

5.1.3.4.Decision Support Systems

Decision Support Systems (DSS) are defined as interactive sofwares; they can provide decision maker with a valid support to value and choose optimal or satisfactory strategies in the sphere of complex decisional processes - like non-structured or semi-structured ones-where the system does not make the choice but represents an instrument to find data, examine alternative solutions for a complex problem, thus playing the important role of transforming data into information able to make complex decisions clearer.
Entrepreneur has then an active role in applying this informatic tool, and it is up to him the choice of the problem solution, even though with better perception of it.
The general scheme of a **Decision Support System** can be divided into the following main components:
*- a **"data modulus"** including one or more "data base" of internal or external origin, a database management system that is able to store, get back an control data transforming them in useful information to the process;*
*- a **"model modulus"** containing a model base where various kind of model are stored (strategic, tactical or operative; static, financial, mathematical programming) as well as a modelbase management system that generates, modifies uses and brings up to date the models through adequate interactions with the data modulus;*
*- a **"user interface"** which is the "dialogue" component (hardware and software) between DSS and user (entrepreneur, analyst, expert). For many people it represents the most important component of the system, since its capacity of resolution, flexibility and accessibility affect the level of adoption by potential users.*
There is also a fourth decisive component for **Decision Support System**'s running: the user, that is he who has to solve problems and make choices. The final receiver of the system is undoubtedly the decision maker, even if he does not have to be necessarily he who makes running the real informatic structure. In fact, in a modern configuration of agricultural extention services, the scheme decision maker - mediator - system might be experienced.

CONCLUSIONS

In order to face a strategy of complexity management, to give a serene prospect to future generations, it is essential to emulate also in agriculture and territory the advantages that the informatic revolution is offering. It is necessary to build, validate and manage some advanced management supports. They have to be anchored to iteractivity and interactivity principles and be able to guarantee a continuous monitoring of the environment in which we operate, with the objective of not undergoing but instead limiting or dominating the environmental turbulences.
The **strategy of sustainable development** proposes a new role for **agricultural activity increasingly linked to choices and trend of territorial type.** Territory requires a **dynamic management** characterized by choices that being linked to **public participation procedures -** like the environmental impact assessement - have to be objective and

possibly based on repeatable procedures.
Informatics has been able to solve and improve the option choices at territory level of private and public decision makers. However many of these are still at a theoretical level or initial implementation. Despite the advnced level of scientific development of informatic supports its spread at farm and public service levels is in our Country and Europe still weak and not homogeneous. As for the agricultural sector more work is needed as well as a reflection on the software for management. The low adpotion of these instruments in the agricultural sector is probably due to some causes such as a prevalent approach to economic and financial aspects, the ex-post view for control, the low spread of a minimum informatic education.
Public programming action has been weak as well, in the sense that it has not perceived, in our national reality, the decisive moments that nowadays imposes the indispensable growth and adaptation to network like **internet** and comunication systems like **intranet.** These options, that are modifying and will increasingly modify work and trasport systems as well as human relationships, have to be undoubtedly supported by strategic choices.
The topics to be discussed in this section will come into question the necessity of making some internal reflection about our Agricultural Faculties since it is the fiftieth anniversary of the Padova's one and the Perugia's centenary. In my opinion we need to verify what of the research on specific informatic, farm management, land planning, extention service activities (to be increasingly orientated towards an agro-environmental system) should rapidly represent the base on which students' education must be rooted, in a perspective of work that increasingly requires technicians and experts to be able to face the complex environmental and territorial issues related to presence of what can be defined a rural enterprise.
The challenge for us will be that of providing our youth with **curricula** that have to guarantee **three great capacities**: capacity of **analysis**, of **choice** and **operative** from which a s**trong intellectual supremacy** over problems must be acquired. The following communications will point out how the informatic wave by now involves the territorial and agro-environmental activities and the importance of using these supports, if we dont want to succumb like new illiterates. What **has not to be forgotten** is that what **we deal with are instruments that to be used they require man or better the determinat supremacy of his mind over the machine.**
Hence it is through our activity of researchers and trainers that we have to **recalibrate our disciplines with the objective of providing our students (our future agricultural technicians) with a strong knowledge of the instruments and the method of using them.**

BIBLIOGRAPHY

1)Adamowicz W. L., White W., Phillipps W. E. (1993), ***Forestry and the Environment: Economic Perspectives,*** CAB International, Wallingford, UK.
2) M.Aragrande, G.A.Malogiorgio ***"Infonnatica per l'agricoltura: i sistemi SMART e Finpack in Minnesota"***,Genio Rurale n. 9 1991
3AA.VV., (1973),***Verso un equilibrio globale,*** Mondadori, Milano.
4) Antonelli G., (1988),***Attivita' economiche ed ambiente:problemi e struttura di analisi,*** Materie Prime, n.1, Bologna.
5)AA.VV.(1976), ***Oltre l'eta' dello spreco,*** Mondadori, Milano.
6)**AA.VV.,(1989)**, ***Alternative Agriculture,*** National Academy Press, Washington.
8)AA.VV.,(**1973**), ***Verso un equilibrio globale,*** Mondadori, , Milano.
9) **J.P.Bard E.Gerelli** ***"Economia e Politica dell'ambiente",*** I1 Mulino ,Bologna, 1980
9)Biondi L.,(1982),***Contabilita' energetica,***Corso applicativo di energy management,Fast,Milano
10)Botta G.,(1974) ***Difesa del suolo e volonta' politica,*** Angeli, Milano, 1974.
11)Bresso M., (1982),***Pensiero economico ed ambiente,*** Loescher, Milano, .
12)BridgeT.C.,Smith E.M.,(1979),***A method for determining the total energy input for agricultural pratictices,***Transaction of the ASAE,n. 4.1111
13)Cannata G.,**(1974),** ***Saggi di economia dell'ambiente,*** Giuffre', Milano.
14)Caccamisi D.,(1993),***Trade moderno,scommessa del biologico,***Riv. Largo Consumo, N.11.,Milano
15)Carillon R.,(1978),***L'activite' agricole et l'energie,***Etude du CNEEMA,n 408.
16)CarillonR.,(1979),***L'analyse energetique de l'acte agricole,***Etude du CNEEMA,n.458.
17-Cecchi G.,(1986), ***La nuova teoria neoclassica delle forme di conduzione,*** Riv.E.A.,n.4., 1986
18)Ciani A. (1992), ***Contabilità e management delle imprese in agricoltura***, ETAS libri, Milano.
19)Ciani A., Vignaroli p., Boggia A.,(1989), ***Agricoltura inquinata o agricoltura inquinante?,*** Riv.Genio Rurale, n 7-8,
20)Ciani A., Boggia A., Marinozzi G. (1993), ***Metodologie di valutazione di alternative di parchi: il caso del Parco del Nera,*** Genio rurale, n.11,Edagricole,Bologna..
21)Ciani A.,Boggia A.,(1994),***Agricoltura biologica e qualita'***,RivistaBio-

Agricoltura,n.28.Vignola(Modena).
22)Clemente F. (a cura di) (1984), ***Pianificazione del territorio e sistema informativo***, Angeli, Milano.
23)Colbi M. E. (1990), ***Environmental Management in Development. The evolution of Paradigms,*** The World Bank Discussion Papers n.80.
24)Colorni A.Laniado E.,(1988),*VISPA*,CLUP,Milano
25)Costanza R. (1991), ***Ecological economics: the science and management of sustainability,*** Columbia University Press, New York.
26)Club di Roma,AA.VV.,(1972) ,*I limiti dello sviluppo,* Mondadori , Milano.
27)De Benedictis M., Cosentino V.,(1979),*Economia dell'azienda agraria,* Il Mulino, Bologna.
28)Espinosa J.A.,Smith V.K. (1994), ***Implementing Thatcher's Full Repairing Lease: a CGE Analysis of the Role for Environmental Resources in Adjusting GDP,*** ASSA meeting, Boston, 3-5 January 1994.
29)Freeman C.,Luc Soete,L'Onda informatica,Ed. Il Sole 24 ore,Milano,1986.
30)Minnesota Extension Service,Center for Farm Finacial Management ,University of Minnesota,FINPACK,A computerized Farm Finacial Plnning and Analysis Package,S.Paul,1985.
31)Ferro O.,(1986), ***Agricoltura ed ambiente:alcune riflessioni ed alcune proposte,*** Riv.Politica Agraria, n.4.
32)Fusco Girard L. (a cura di) (1989), ***Conservazione e sviluppo: la valutazione nella pianificazione fisica,*** Angeli, Milano.
33)Giles T.,Stansfield M.,(1990),*The farmer as manager*,CAB International,Wallingford.
34)Gerelli E.,(1974), ***L'Economia dell'ambiente,*** Angeli, Milano,
35)Georgescu-Roegen N.,(1982), ***Energia e miti economici,*** Boringhieri, Milano.
36)Goering C.E.,Daugherty M.J.,(1982),*Energy accounting for leven vegetables oil fuels,*Transaction of the ASAE,n.2.
36)Gordon P. L., Prince. R. (1994), ***Incorporating Environmental Quality and Natural Resource Availability into the National income accounts,*** ASSA meeting, Boston, 3-5 January 1994.
37)Gregersen H., Contreras A. (1992), ***Economic assessment of forestry project impacts,***FAO,Forestry Paper, n.106.
38)Hemidy L,La gestion, l'informatique et les champs,Inra ,Grignon,1992.
39 **R. Huirne** ***"Basic concepts of computerised support for farm management decision"***, ERAE, 1990
40)INRA,Atti del Seminario E.A.A.E, 12-14 Sett.1991,L'intelligence artificielle in agriculture,Grignon,1992.
41)P. Kennedy (1993), ***Verso il XXI secolo***, Garzanti.
42)J. M. Keynes (1930), ***Esortazioni e profezie.***
43)Jacoponi L., Andreoli M.,(1987), ***Le implicazioni microeconomiche dell'introduzione di tecniche agronomiche alternative***, in Agricoltura e ricerca, Maggio,Roma.
44)Jacoponi *L.,Distretto industriale mrshalliano e forme di organizzazione elle imprese in agricoltura,* Riv.-Economia Agraria,n 4,1990
45) L.Iacoponi, L.Raffi, ***"La teoria delle decisioni in agricoltura. Le scelte in condizioni di incertezza",*** Roma, Inea 1993
46)Montana P.,Charrow B.,*Management*,Barron's Educational Series,new York,1987
47)Jarack M.,(1985), ***Sui valori di equivalenza per l'analisi ed il bilancio energetico in agricoltura,*** Riv. Ingegneria Agraria, n 2.
48) M.Lazzari, F.L.Ricci ,*" I sistemi esperti",* Firenze, NIS, 1985
49) F.Marangon, ***"Agricoltura a minor impatto ambientale ed economia dell'azienda agraria: un approccio multiobiettivo"***, REA, 1992
50) L.Mariani, ***"I sistemi esperti in agricoltura da mito a realta'operativa",*** **IA, 1990**
51)M. Mesarovic, E. Pestel (1974), ***Strategie per sopravvivere,*** Mondadori. Milano.
52)Miele M., Jacoponi L., Rovai M.,(1988), ***Strutture e tecniche produttive nell'agricoltura intensiva e riflessi ambientali,*** Atti del XXV Convegno SIDEA , Ancona ,
53**)Muraro G.,(1984) ,*Criteri di efficienza per la politica ambientale,*** F. Angeli, Milano,
54)Naisbitt J.,(1994),*Global Paradox*,William Morrow and Company,New York
55)P. Nijkamp (1974), ***A multicriteria analysis for project evaluation***, Paper of the Regional Science Association, vol.35.
56**)Noorgard R.,(1984),*Coevulutionary development potential*,**Land Ecomics , n.2.
57) D.J. Pa n nel ,*"The Place of Expert Systems in Agricultural Economic"*, RMAE, 1988
58)Panattoni A., (1987),*Sintesi delle implicazioni macroeconomiche ,* In Riv. Agricoltura e Ricerca
59**)Pearce D. W. (1991),** ***Blueprint 2: Greening the World Economy***, Earthscan,London.

60)Pearce D.W., Turner R.K. (1990), ***Economics of natural resources and the environment,*** Harvester Wheatsheaf, London.
61)Perrings C.,(1987),*Economy and Environment,* Cambridge University Press.
62)Perotto P.G.,(1993),*Il paradosso dell'economia,* F.Angeli,Milano
63)Pulitini F.,(1976), ***Divergenze fra costi sociali e costi privati:alcune implicazioni per l'analisi economica del diritto,*** In Note Economiche n 4-5,
64)Raffaelli R.,(1994),*Qualita' e politica nel settore vitivinicolo italiano,* Riv. Politica Agraria,N.5,Edragricole, Bologna
65)Romero C.,Rehman T., (1987), ***Natural resource management and the use of multiple criteria decision-making techniques: A review,*** European R. of Agricultural Economics n.14.
66)Romero C., Rehman T. (1989), ***Multiple Criteria Analysis for agricultura l decisions,*** Elsevier, Amsterdam.
67)Ruttan V.,(1991).,*Sustainable Growth in Agricultural Production:Poetry,Policy and Science,* in CNR,Centro di Studio sulle Rilevazioni Contabili Aziendali,Lo Studio dei Sistemi Territoriali,Bologna,1992.
68)Salomone L.,(1993),*Ora il biologico alletta il mercato,* Riv. Largo Consumo,n7-8,Milano.
69)Sauvy P.,(1974), ***Crescita zero,*** Garzanti, Milano.
70)Schumpeter J.(1984),*Capitalismo,Socialismo,Democrazia,* Franco Angeli,Milano
71)Simonotti M., (1982),*Introduzione alla valutazione del danno da inquinamento all'agrosistema.,* Catania,
72)Smith V.K., Desvousges W.H., Fisher A. (1986), ***A comparison of direct and indirect methods for estimating environmental benefits,*** American Journal of Agricultural Economics, May.
73) Smith, "*The Potenzial Application of Expert Systems in Dairy Extension Education*", J. Dairy Sci, 1991
74**) Sotte F.,QuatriniL.,Rupoli S.,** ***Indagine sulle tipologie aziendali nell'agricoltura delle Marche,*** Quaderni Dipartimento di Economia,Universita' di Ancona,n.6,1985
75)Tellarini V., Caporali F.,(1989), ***Proposta per un modello di contabilita' energetica:il caso di due agrosistemi a diversi input di fattori esterni,*** Genio Rurale, n. 7/8,Edagricole,Bologna.
76)Tinbergen J.(1977), ***Progetto RIO. Per la rifondazione dell'ordine internazionale,*** Mondadori.
78)Trapani F.,(1994),*Il bilancio energeticodi due aziende vitivinivole coltivate tradizionalmente e vendemmiate a mano e a macchina,* Riv. Sviluppo Agricolo,N.5-6,,Palermo.
79)Van Ierland E.C. (1993), ***Macroeconomic Analysis of Environmental Policy,*** Elsevier.
80)Zanoli R.(1993)(a cura di), ***I numeri del biologico,*** Il Pungitore Editore,Ancona.
81)WCED,(1987), ***Our Common Future,(The Bruntland Report),*** Oxford,World Commission on Environmental and Development/Oxford Univeristy Press.
82)Young M. D. (1992), ***Sustainable investment and resource use,*** UNESCO, Man and the biosphere series.
83)Winpenny J. (1991), ***Values for the environment a guide to economic appraisal,*** ODI -HMSO, London.