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Agriculture and environmental sustainability: a business approach

Description of the firm and the its context

My experience in agriculture started soon after University, in the mid-80s, when I was entrusted with the management of a farm. The production was essentially cereals, with some industrial cultivation of poplar used for lumber production for the industry. The cultivation systems used were the traditional ones of that time, such as deep and repeated cultivations, massive utilization of chemical fertilizers and plant protection products. Quantity was absolutely the main goal and harmful environmental by-products, caused by such management practices, were not considered at all.

This was mainly due to the European Community agriculture policy that rewarded only quantity and took into no account the environment and the social cost of farming activities. The roots of such policy could be found in the second post-war period, years when the main priority was the feeding of all those people migrating towards the towns looking for a job in the industrial sector.

My university background had the merit to teach me that it was possible to farm in a different way, with big savings in terms of resources. In fact more accent was then put more on the possible savings at the cultivation input level than on environmental conservation or sustainability, a concept still vague at that time.

The Masters in Business Management I earned in those years put me in contact with management tools suitable to monitor and steer business choices opportunely. The subsequent ISO9000-2000 certification allowed a new suitable organization of the farm in order to make it transparent and conform to the client's expectations. The achievement of the ISO14000 certification is our next goal.

Soon I started some experimental verifications on the possibility of reducing the manipulation and use of chemicals and increase the firm's economic margin. To tell the truth, the first experiences were not all positive. A global vision on dealing with theorized changes was lacking. External information sources were also scarce and not really reliable. The Internet was still a dream. The decisive push to overcome the impasse, created in the fear of business failures, came from two concomitant facts: the new orientation of the European Community Farming Policy started in 1992, and a new personal ethics awareness in the business field.

The support to the farms income radically changed, slowing down the pursuit of maximum production. The goal of food self-sufficiency had been achieved and overcome. Now the European citizen's attention could and should take a further step toward the quality of life as general concept.

First, the Reg. CE 2078/92, and later, the more comprehensive 1257/99, invested in the change of the production activity in agriculture. We could discuss the nature of the choices made, and on the priorities decided, for a long time, but there is no doubt that those able to read and understand the innovative potential of the PAC measures had the opportunity to use financial instruments in order to improve their own business.

That was an occasion to embark on a path of ethical responsibility towards Man and the environment where he lives. A way to try to put into practice, in anyone's activity, the strong concept of Sustainability. No recipe or pre-determined solution, there was only the application of all possible available knowledge in pursuing the goal of a firm in harmony with the environment, social needs and future perspectives.

Factors optimisation

Choices adopted in farms should follow the logic of economic general mechanisms, but they also need to take into account the specific manoeuvring margins imposed by environmental, social, and normative conditioning. The real progression as it happened on the farm allows us to identify an order regarding such adjustments which, I recall, were conceived without losing sight of profit. The factors to be optimised, when taken singularly, don't present anything really complicated, but when analysed on the base of the result of their mid-/long-term interactions they can assume vague outlines. It is useful to distinguish the following sequential levels of intervention.

Level 1: internal factors (costs and organization)

- Creation of an accounting and management control structure: to know the firm, program the changes, and evaluate the results.
- Machinery and man-power: land improvements, cultivation reduction, machinery renovation, increase in professional competence, and workers education.
- Technologies: rational use and distribution of fertilizers, pesticides, and irrigation waters.

We can divide the management costs (short-term) in the above categories into:

- CESSANTI/fixed costs (directly linked to production)
- Non-cessanti/varying costs (linked to the firm organization and structure)

Possible strategies to adopt in costs controls must take this distinction into account. A fixed* cost, such as a simple production factor (fertilizer, plant protection product, etc.) can be simply eliminated or reduced with a technical change or optimisation. The reduction of a varying* cost (machinery, land investments) requires a long-term global strategy.

Level 2: attention to the market

- Productions with marketing security (under contract).
- New sale techniques (for example at term a certain or indexed price)
- Increase of the contractual ability in purchases (concentrated purchases, appreciation of professionals).
- New market opportunities offered by increased demand for specific products (i.e. organics) and land services with a perspective of sustainability.

Level 3: opportunities offered by new regulations

The mix of production and management factors is not aimed at production curve optimisation anymore, but also at the maximum economic benefit according to the agro-environmental constraints which we can voluntarily submit to and later be remunerated for. It can be noticed the voluntary nature of such constraints is decreasing and some limitations are going to become more and more obligatory.

Level 4: toward the future

- Organic cultivations
- Cultivations for energy production
- Territory protection services
- Not-alimentary industry cultivations.

In the future, the value of agriculture production shouldn't be determined only by the law of supply-demand for the satisfaction of easily identifiable primary needs. The moment has come for the evaluation of both the product and the whole process.

A value should be given not only to the products, but also to how they have been produced, considering all the environmental and social consequences. It is a matter of cultural growth in the comprehensive evaluation of the man-environment-health interaction.

Adaptations timing and progression

Starting from the mid-'80s, intervention programming focused on the optimisation of internal factors. It was based on the technical know-how then available, and supported by a suitable accounting system controlling both the project and control phases.

During the first years of the 90s a big push was given in this direction; the firm's fields were completely arranged with underground tubular drainage and prepared for sub-irrigation. The machinery equipment was renovated and an intense experimentation stage toward reduction of cultivation, and of all input in general, started. At the same time more attention was given to product marketing and the research of new market outlets. In the mid-'90s the farm was ready to grasp the profit opportunity offered by the agro-environmental measures.

As we can deduce from Chart 1, the incidence of such integrations results are very clear. The constraints imposed by the Reg. CEE 2078/92 are surely heavy, but modern firms, where an establishment of production processes are put in place are able to maintain satisfying production, with reduced cost and respect for the environment.

Those who saw in this Regulation a threat to business growth have looked only at those aspects limiting the degrees of freedom and not, instead, at the fact that it represents the birth of that "environmental contract" the farm will have to deal with in the future.

Each human activity is limited and has to move respecting specific norms: it is the manager's task to make the maximum profit within a correct relation with other production forces, with consumers, and with nature.

The second half of the '90s saw the consolidation of cost reduction and a more careful application of diverse agro-environmental measures. The elimination of ploughing and any other overly invasive cultivation has been accompanied by the use of intercalary cover crops. The use of techniques for chemical and pedological tests on a geographical information basis allowed the implementation of site-specific interventions started precision applied agriculture.

The new decade starts in the light of organic productions. On one hand the research on the traditional agriculture sector, focused on product quality and environmental impact (this kind of agriculture is still the most important since it involves big figures), will be continued, on the other hand the attention towards the new marketing sector of organic products is increasing. This market niche has been assigned to one part of the firm organized in order to benefit from opportunities that will result from environmental contracts and industrial cultivations.

Unfortunately, after a phase of stable or growing profits, in the upcoming years we will inevitably witness a period of discrete slow-down.

The policy of support implemented with Agenda 2000 is reducing the profit of cereal-production farms, which find in the accompanying measures of the Rural Development Plans just a partial compensation, and only in cases of proved readiness in subscribing to it.

Comments on the charts

Some chart results are really helpful in tracing the development path of the S. Basilio firm. Data refer to significant years under the point of view of managerial turns and they have been index-linked in order to make the reading easier. The values have not been adjusted for inflation yet.

Year 1990: PAC is still to arrive; the earnings from the agriculture activities comes completely from product sales (Chart 1). The profits are shrinking, the cost reduction phase has already started and it is also supported by huge land investments. Man-power and technological machinery costs are high (charts 2, 3, 4, and 5).

Year 1994: the consequences of the strong devaluation, which are going to greatly benefit Italian agriculture, still have to be felt. The PAC contribution to the gross income (before-tax income) can be measured at around 25% (chart 1).

Year 1998: under the entry "profits", we can add the agro-environmental contributions (Chart 1). Cultivation optimisation, low use of man-power, and drastic inputs reduction lead far from the maximum income (Chart 2,3,4,5).

Year 2002: the incidence of agro-environmental measurements grows (Chart 1). There are further savings on machinery, but the redemption figures increase since the firm must invest in technology (Chart 3,5). Profits suffer a discrete downturn (Chart 2). Cost compression,

attention to market, and compensation increases are able to compensate only the partially steady adjustment of products prices on the world market.

New challenges

The analysis of synthetic business parameters allows the clarification of the firm's development in adapting to economic and social changes. Such process offers valid indications of how we will have to move in the next future, provided that we consider the two different levels on which it is possible to act: control and optimisation of internal functional factors and interaction with new social requirements. If, on one hand, the critical review of the use of resources must be incessant, on the other hand, the availability and capability of establishing new contractual relations with the community assume more importance. It will be necessary to understand the expectations of the consumer (product health and quality) and of the citizen (environment salubrity and availability) and from there try to bargain with them on a just value to give to those goods. Agriculture development plans and the proposed PAC review move in this direction, dictating regulations able to facilitate the birth of more efficient firms and establish clear "production contracts" and "environmental contracts".

II

New Agriculture's responsibilities

The primary sector constitutes the economic section ruling, utilizing, and interpreting, more than any other, natural resources. Agriculture, more than any other sector, is then an activity integrated with the natural ecosystem, but since it is an economic activity it cannot be considered strictly "natural", like a forest ecosystem. To realize abundant (for the market) productions is surely not in harmony with a balanced ecosystem, and to make one's land a stable ecosystem (as an end itself) is not any farmer's primary goal. From this "no naturality" and conflict of interests come a variety of problems, points of view, and choices, which sometimes are even dangerous.

To this contrast with the environment we can add the inadequacy of the economic trading concept. The regulations on which the market economy is based are very strict, and the development concept, at the basis of our social organization, is totally founded on them. Only one good, limited in quantity and considered "useful" to satisfy a particular need, can be an object of economic interest, and therefore of trade, and sustain development. Unfortunately, this way of interpreting relations between man and environment is almost always considered an immediate or short-term time perspective.

Rarely will actions that bear fruit (or cause damages) in the long-term be given value; it is preferred to put them in the ethical sphere.

That is what has been going on up until today: the farm has had to produce economic goods, able to be immediately and surely converted into money, neglecting any long-term consequence of its action.

Something is changing

Today we can sense the great limitations of the concept of economic good considered only as conversion into money (since its utility in satisfying a particular good is perceived) in the short-term. When goods, such as the environment, traditionally unlimited, and therefore economically not interesting start to become scarce, and yet, those goods not considered necessary, like recreation activities, are deemed as irremissible, we have to face the failure of the classic system based on production and sales of material goods and/or related services. We witness the inability and impossibility of judging business strategies through traditional tools. It appears clear that the farm must continue to produce profit, but the actions to pursue it need to be modified and adapted to the new market and social needs. What today is not interesting from an economic point of view, can become so in the future quite even rapidly. To reason in terms of environmental impact and "sustainability" about our business activity means to try not to relegate the future fall-outs of our actions to the ethical

field again. The prediction economy must become the strategy that with time will allow us to be flexible in order to satisfy new market requirements.

Even neglecting the fact that the economy, in its most traditional mechanisms, should be only an organizational and social order tool and not the person's essence, the time for everyone to evaluate and enhance their own activity, globally in time and space, has come. Each action, in production or consumption, should be critically appreciated not only for the short-term effect, or in the micro-environment where it takes place, but in the complexity of the processes from where it comes and of which it will be the cause (think globally and act locally). The results of ecological relations must be seen as the sum of single actions, of micro-responsibility. The right attention toward important punctiform events doesn't have to make us forget all the diffuse activities. To think big doesn't have to be an alibi for limiting the commitment to introduce all those process innovations already feasible today. Regarding this, it is important to wonder if it is more worthy to drastically reduce by 10% the chemicals inputs in the firms than to encourage a generalized limitation policy in chemical and mechanical interventions. This would mean the promotion of a new cultural orientation.

The same sustainability concept, so full of practical meaning, doesn't easily find a place (=price attribution) in our actions. We talk more and more of sustainability, but too often only as a key word to obtain some financial support and not to identify projects and behaviours under this new light of responsibility.

Agriculture is fundamentally a land management activity, and it can and must make every effort to produce wealth that could last in time. This social service must be acknowledged and rewarded for it.

But to pay what and how much? Can, today, the classic market give a price to the care paid toward tomorrow?

The eco-budget will be the first tool we will need to get familiar with. Each activity, productive or recreational, will have to find justification and support not just based on the ability of generating income in a limited sector, but in the light of an accurate evaluation of all the interactions and induced costs, both in time and space. Starting from those farms certified on the base of qualitative and environmental parameters, and applying interdisciplinary knowledge (agronomic, managerial, ecological, etc.), single realities will have to be discerned on the basis of their ability to obtain real favourable eco-budgets (eco-conditionality).

The firm in front of the future

The businessman's job is to do the budget, but this doesn't have to be compiled in the simplest and least demanding way, without considering the several consequences of every choice, both technical and cultivation-related. This is true for ethical reasons, in offering an extensive justification to the support to the income as well.

Today typical simplification and standardization processes, especially in determined territorial contexts, risk result of a practical loss in, first, the capability to do business, and, later, political weight and social advantages linked to the quality of the figure of the entrepreneur. Cultivation systems that put together economic results, and sustainability cost commitment, and hard work, but combine profit and environmental protection with a process are destined to last in time. Such a phase of corporate responsibility "guided" by regulations doesn't necessarily have to result in smaller productions, but in a minor impact. The PAC agro-environmental measures should partially lose their nature of lost incomes compensation in order to become a sort of "Warrant" on the consequences of our interventions in the protection of the environment. It is very probable that, starting from 2007, all the agriculture supporting measures will be linked to specific commitments toward the environment to control and certify the processes.

In such a complex situation it is not easy to elaborate, scientifically correct and technically balanced strategies. The risk can be in considering extreme actions, very visible and therefore understandable, but that don't bring any benefit on a larger scale as the only useful ones.

For example, to propose organic agriculture as the only sustainable solution would lead us to at least three major mistakes. First: attention would be focused on a restricted sector offering an alibi to forget the great effort that could and should be put into traditional agriculture, as a sort of reserve to better tolerate any other intervention outside of it. Second: the attention would be overly orientated on the consumer and less on the global

environmental budget; a low impact can be achieved only with the reduction in the use of synthetic products.

Third: again it will be the consumer, and not tax contributor, who pays. He pays a high price for a product on which all the economic interests are concentrated and also risks is also that of possible illegal speculation.

The shift in the technical mentality

The farm must move at a different pace from the past and adapt to new requirements; getting ready, in the mean time, to play a more complicated role. It is not possible to submit "by law" to the evolution anymore. The flight from its responsibility makes agriculture technically easier, but it freezes firms making them unsuitable for the development development. In the future, we will be able to value our actions only working hard as principal actors in satisfying new requirements from the community.

It is necessary to reason in terms of cost reduction and subsidy increase, but this is not all. To increase the value of our important production we need to sell something else: the way these products are obtained.

This new product, the production process, is difficult to price, but it undoubtedly benefits of greater value, ever. It goes through the change in the traditional agro-technique, its transparency, and certification. Each operation doesn't have to be evaluated based only on the ability of having a good harvest in the short term, but also keeping in consideration all the related implications.

The key to success, for farms, is being able to anticipate. Not just a technological change, the whole farm has to be remodelled and adapted to new strategies. Mentality, time, equipment, technologies, and knowledge are the changing things. To change and innovate technology the first step is knowledge: exact evaluation of direct and indirect costs, understanding the chemical and biological mechanisms at the basis of fertility, the ability to profitably use all the tools available to innovate traditional techniques, and, demonstrating full knowledge of each intervention fall-out.

The road ahead

The path toward greater sustainability in agriculture passes through Conservative Agriculture (C.A.), the key-word of agricultural production today, anywhere in the world.

C.A.: doesn't mean only minimum tillage, but takes shape under a series of fundamental management choices:

- soil always covered with residuals, profit cultivation or cover;
- minimum disturbance of soil and always without horizon inversion;
- appropriate rotations;
- Integrated Pest Management (I.P.M.);
- Intervention only where necessary: site-specific agriculture (see experience described in the following pages).

The expected results are:

- constant productions at lower prices;
- less losses due to erosion and soil degradation;
- improved CO₂ balance;
- better water management with minor washing away of the water-bearing stratum;
- less use of fossil fuels;
- increase in biodiversity;
- sustainability over time.

It must be noted that not all the techniques useful to C.A. are applicable to organic agriculture.

III

Site-specific Agriculture: business experience

The introduction of a technological innovation is normally accompanied by a process that, starting from an economic or technical necessity, grows through phases that first allow a comprehension of the problem and then outline the methodological approach. Therefore the availability of equipment and innovative processes is normally linked and synchronous to the utilization systems suitable or at least strongly supportive to the achievement of the objectives.

When a piece of equipment or technology comes to life to answer a necessity, the end result is both technical (the realization of the machine) and methodological (utilization strategies). Tool and method develop from a parallel and interconnected process, with reciprocal setting-up.

It seems it won't be the case, though, for that technology, precise geo-positioning, in real time and at low cost, that will mark the beginning of the third millennium. In the words "agriculture of precision", or more accurately, "site-specific", are contained the idea of what is needed, in the right quantity and only where is worthy.

In this case the availability of DGPS sophisticated technology anticipated the perception of problems that, with it, are easily overcome. Aerospace engineering has put out an instrument, whose huge potentiality is easy to guess, but that has a hard time in finding a practical acknowledgement in applied solutions and, at present, doesn't conceive suitable procedures supporting decisions.

What is needed, in the right quantity, and only if economically convenient. In these words are the three fundamental phases of the "precise" decision process:

- first, to understand if there is a spatial variability and why (what is needed);
- second, when, how much, and how intervention is appropriate (to define the application modalities);
- third, to evaluate if the interventions are compatible with the objectives pursued.

The technical solution arrived before the need to solve a problem. This means that the analytic tools and the decision paths are often improvised as a result, and always inadequate.

Soon, the bearing structure of application procedure appeared rationally simple and clear:

Impeccable process, simple and sharable. Yet when numbers must substitute for ideas, everything seems to lose concreteness and to refer to "the agronomist's experience" reinforces the risk of improvisation.

Tools for spatially variable applications are always simpler and reliable, but the decision process is still too often neglected.

In Italy, the research studying agriculture-applied positioning technology has taken two main paths:

- statistical and experimental verification of variations in productions and the subsequent differentiated application of measurable factors (water, fertilizers, seeds, etc.)
- the application of automatisms to improve the equipment performances in particular situations.

In the second case, utility is often evident even if limited to specific applications. Instead the setting-up of methodologies giving meaning to observed data (detected variability) and concreteness to subsequent applications, more or less variable, is important and generally highly expected.

The first step is undoubtedly to statistically prove the variability. But having done this, we have to explain its origin, plan the possible integrations and savings on the production factors, evaluate the effects of the induced modifications and analyse everything through the lenses of the economy of the results. Up until now we have focused on the gathering and

statistic analysis of measurements presuming the ability to identify the cause of variability with either chemical analysis or evaluations of the soil water content. This is not wrong, but it is not simple. At the same time, it is necessary to evaluate the dynamics and the reciprocal influences of soil, weather, genetics, and cultivation practices. The soil doesn't have to be considered only a box containing simple chemical elements, but, instead under the complexity of chemical-physical-pedological interactions that interest all the soil strata greatly explored by roots (up to about cm 80) and not just the layer normally defined active.

Analysis of this kind requires an appropriate computer tool to act as a system supporting agronomical decisions. In our firm, in collaboration with VenetoAgricoltura, the Veneto Region office that deals with agriculture, we are using the DSSAT software, based on CERES models for cereals and CROPGRO for soy. DSSAT, based on the Minimum Data Sets concept, allows operation at the individual firm level, with traceable data in all the situations with minimum effort. Figure1 schematises the firm information flows around DSSAT and those processes where information and support are taken from.

Such software allows us to automatically analyse thousands of interactions among input elements and therefore enable us to identify those causes leading to a specific situation or foresee future case records, supposing different types of intervention or possible scenarios. Once we have enough data on soil (that are not going to change too much in time), weather (historical and seasonal) and genetic characteristics of cultivations, we will be able to compare on a table, in a fast and reliable way, different strategies determining the relative convenience. We'll be able to act, statistically optimising the interventions, planning ahead through a control of cultivation development and in real time analysis that allows specific tactical interventions.

DSSAT can use different inputs to simulate precisely both what is likely to happen and those past situations on which it is not possible to do any experiments. Particularly, I refer to environmental evaluations conducted through simulations on historical or hypothetical situations.

The capability of understanding multi-factorial processes through crossed integrations allows a use of the system for site-specific applications, particularly those conservative agriculturally oriented. The integration of data related to harvesting, soil characteristics, vegetation development, etc., allows us to identify areas with homogeneous characteristics. Using DSSAT for each treatment and for each area to be compared, we obtain indications useful to plan the most convenient interventions.

The tool appears to be very useful both in experimentation and in supporting decisions at the farm level. In site-specific agriculture it appears to be necessary in identifying variation causes and intervention strategies.

The accuracy in measuring agronomic interventions requires always greater precision because of both the decrease in the unitary income/factors cost ratio and the increase of the environmental compatibility level, a factor that agriculture cannot neglect anymore. "Responsible" traditional agriculture, site-specific agriculture, and agriculture willing to move along the path of sustainability, require technical evaluations that are beyond the ability of personal experience synthesis. It becomes necessary to use decision-supporting tools, able to integrate several variables and simulate dynamics aiming at agronomic management.