

Water management and environmental awareness: a case study on nursery gardening in Tuscany, Italy

T. Bozzoli, G. Brunori and M. Rovai*

Abstract

The problem of water use in irrigation and dispersion of fertilizer-derived nutrients is of great concern in Tuscany and, in particular, in the nursery garden sector. IDRI is a research project on the rationalization of the use of water resources and fertilizers in nursery gardening in Tuscany. Through business surveys carried out in farms in the four main nursery gardening zones in the region, it has been possible to analyse the various aspects concerning the importance given by the farmers to the problem of water and the understanding that these farmers have of their own role in the qualitative-quantitative impact on the resource. This paper reports the results of the investigation, and discusses how, with differing amounts of technical understanding, producers can have diverse expectations and perceptions of the technological innovations which save water resources and fertilizers.

Finally the study tries to trace a possible differentiation in the strategies to adopt in regional agro-environmental politics regarding water resources based on the different levels of understanding in the businesses.

Water and fertilizer use in nursery gardening in Tuscany: from understanding to action

Nursery gardening is one of the leading sectors in the Tuscan agricultural economy and is important, in some cases, even at national and international level. Due to the intensiveness of cultivation or “out of soil” cultivation techniques, this sector is one of the most demanding in inputs and particularly in water supply. This makes it particularly sensitive to water shortage and puts it water as the key problems in environmental sustainability.

Nursery businesses are concentrated in a few specialized areas in the region, so that the sector has, on one or two occasions, been the cause of water pollution and the target for suspicions from the general public. The result is a growing conflict between the interested parties of a productive sector essential, in many cases, to the economy of the area, and the legitimate requirement to make this activity environmentally sustainable.

Although the problem greatly worries the institutions, producers seem less concerned, except for the situations of emergency.

Since actions are never unrelated to understanding, the choices made by the farmers regarding environmental aspects derive also from the perception that they have of their own impact on the environment. In presence of an environmental problem, it seems a very useful step to investigate the cognitive aspects of the problem in greater depth, concerning ourselves with *reasons rather than causes* (Röling, 2002).

* Dipartimento di Agronomia e Gestione dell'Agroecosistema, Sezione di Economia Agraria - Università di Pisa. Via S.Michele degli Scalzi, 2 – 56124 Pisa, Italy.

Maturana and Varela (1992) report on how diverse phenomena are “filtered” by our understanding and how understanding and actions are inseparable, since knowing does not only mean accumulating objective knowledge about the external world, but rather that understanding is the result of effective interaction of one organism with its environment.

Röling and Wagemakers (1998) hold, for example, that, faced with an agro-environmental problem, two of the different possible positions are: one, positivist-realist, the second, constructionist.

According to the first approach, reality exists independently of the human observer and through scientific research we can leave reality for a generalization of principles already present within it. According to this view the aim of research is to increase the understanding of human beings and *to create* innovations to be transferred to users. According to this view, innovation originates in science and is realised through transfer and adoption by farms.

But by now the conviction is ever more widespread that such an approach is not the best, and that in fact innovations occur as a result of the interaction between different actors. Local knowledge, experimentation by farmers and their inventiveness are just as important as knowledge of the experts. According to constructionism, reality exists not as “fact”, but as a result of the continuing “construction” on the part of people.

This approach implies that, rather than looking for sophisticated technical solutions to environmental problems, it might be more useful to act on the causes of these phenomena, or on the behaviour of farmers. How beneficial would be, in fact, to suggest technological solutions to an environmental problem, if farmers were not aware of its existence or relevance?

In the face of the often irrational use of water resources that occurs in the nursery gardening sector in Tuscany, our research looked at the perception that producers have of the water problem, the motivations that drive farmers to perform in certain ways as regards water use, the obstacles they envisage in order to make more efficient use of the water; it also looked into their understanding of their own performances in terms of consumption of natural resources and consequently generates answers on how to orientate the strategies of intervention.

To investigate the motivation factors that guide *decision making*, the research group could have formulated the study with a “cold” quantitative survey methods such as prepackaged questionnaires. The problem is that “top-down” methods like these do not allow to bring out the complexity of human behaviour, and often do not even reach the objective. For example they overlook the influence of the networks of social relations that exist around the agriculturist.

Individual perception is indeed the result of interaction of the individual with the reality that surrounds him, and above all with his own peers (Retter C., Boland H., 2003). Think of the effects of “social control” arising within a community when everyone becomes aware of an environmental problem (Brunori, Galli, Rossi, 2002).

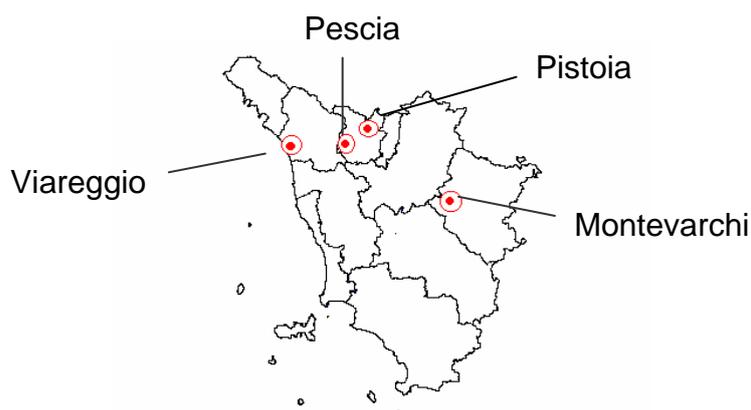
Our research has therefore sought a more qualitative approach for carrying out research into the farms. Thanks to the presence of a few nursery gardeners who joined the research group from the beginning, it was possible to overcome the suspect by farmers over the research goals. Information obtained from these discussions was subsequently completed with data gathered in a more quantitative investigation carried out through business questionnaires.

Study area

The study area for the project is the region of Tuscany and in particular four localities known for the importance of the nursery gardening sector:

1. The coastal area of Viareggio, well known seaside town with a tradition of flower cultivation and serious problems of saline infiltration into the aquifer;
2. The Pistoia area, the most important district in Italy for nursery gardening and well-known internationally, where cultivation of mainly outdoor ornamental plants takes place, relying therefore principally on sprinkler irrigation; there are numerous farms in this area, some of large size;
3. The area of Valdinievole (Pescia), adjacent to the Pistoia area but traditionally concerned with floriculture and only in more recent times changing direction towards ornamental nursery gardening on commission from big farms of the Pistoia area;
4. The area of Arezzo, Montevarchi to be precise, with its more recent tradition of nursery gardening, producer mainly of seasonal flowering plants with brief cycles.

Map of Tuscany showing the areas mentioned above



Methodology: the focus groups and the questionnaires

The project was carried out by three steps:

- Four focus groups (one in each investigation area) which included 28 nursery gardeners, carried out in the period October to November 2002;
- An in-farm survey with quantitative questionnaires, carried out in a first part of farms in Pistoia, Pescia and Viareggio during the course of 2003, that involved about thirty nursery gardeners;
- An in-farm survey with quantitative questionnaires that will be carry out during 2004 in the second part of farms: some in Montevarchi and others in Pistoia, up to about sixty farms.

The focus group is a discussion on a special theme in a little group with stakeholders, managed by a facilitator. This is a technique used by researchers to facilitate communication among presents and to look at still unexplored aspects of a problem. In each of the four localities investigated, a discussion took place between a group of nursery gardeners. There were different typologies of farmers: young men and

elderly, workers and owners, delegates of little farms or very big farms, representatives of the nursery gardeners typology in the area.

The guideline used by the facilitators to manage the discussion is shown in the chart below. The strategy followed in the focus was to introduce the theme in general terms, without anticipate any answer and to come out with the personal thought of the stakeholders. Other external “listeners” recorded and noted what was said.

Guideline for focus groups

1. Do you consider water to be a problem for your company?
2. In what position would you place water amongst the problems of management in the business?
3. Have you recently changed any aspects of organization in the business related to water? (Plant/Equipment/Organization of work....)
4. Do you consider that water consumption in your farm has increased or decreased in the last few years?
5. Does it seem to you that there has been a decrease with time in quality/quantity of water in the area where you operate? If yes, has this decrease brought about/could it bring about any damage to production?
6. What do you understand by efficient irrigation plant? Do you know any types and what do you think about them? What are the limitations that you have heard in adopting these systems?
7. Do you consider water a problem for the community? Are you aware of any changes in the availability of water for domestic use, in the quality of water for drinking....
8. In the area that you come from, how much do you think agriculture and nursery gardening influence total consumption of water? And how much pollution of water sources?
9. Do you consider the level of fertilizer used is sufficient/excessive/too little?
10. Do you believe in the introduction of innovations which could save the environment, do you think that in your area they have/would have positive effects on water quality and saving?

The quantitative questionnaire for in-farm survey, asked nursery gardeners a series of information on company procedures, on types of irrigation plant and on fertilizing techniques. Further, farmers were asked to quantify the average annual consumption of water and fertilizers. To help the farmers with their answers, the questionnaire of the quantitative survey was also “tested” during the focus meetings. Questions was simplified from time to time on the basis of observations made by the producers. Therefore, most of the producers interviewees had also participated in the focus groups for two reasons: firstly, this was optimal to compare the two outcomes and to complete the view of the problem, then, it was simpler to obtain information from farmers that already knew the research project. Like in the focus group, the interviewees were selected for the readiness to cooperate with the research. The farmers interviewees were the most representative of the farm typology and of the area practice.

Some of the questions on the questionnaire

In your farm, what are the main sources of water supply?
In your farm, to which of the following treatments are irrigation waters usually subjected?
In your farm, with what frequency (number of times a year, for example) are complete chemical analyses of the water carried out and, if needed, nutrient solutions used for the culture on substrate or hydroponics?
With what frequency does the farmer see to the registration of water consumption and maintenance of the various tools used for irrigation and fertirrigation (cleaning/filter substitution, calibration of the various instruments such as meters, pH/EC probes, etc.)?
What cultural techniques relating to irrigation are normally or most used in your farm?
In your farm, how much water is consumed annually?
What materials are used for the preparation of the substrates employed in your farm for cultivation in pots and/or hydroponically?
In your farm, what procedures and tools are normally used for the management of manuring (estimate of mineral requirements of the crops)?
In your farm, how much nitrogen is consumed annually? (for the reply use one of the two options)

Results of the investigation

1. The water problem in local relations

The work carried out in the focus groups in the four localities has highlighted, first of all, the overall picture of relations that connect the various actors involved and the dynamics existing around the problem of water in nursery gardening.

Viareggio

At Viareggio there is great difficulty in finding good quality water due to saline infiltration of the groundwater. For some time this condition has been the cause of a series of problems especially for the nursery gardeners who irrigate with well water. This notwithstanding, private wells for irrigation of gardens are, in spite of everything, continually increasing. The general public, on the other hand, does not perceive the problem because most water they consume consists of quality near-surface water from the surrounding hills.

Nursery gardeners have tried for some time to overcome or to control these difficulties: they have fought to find alternative solutions to the use of these wells (for example, an agri-industrial mains supply) and they asked the local administration to act to limit civil consumption during summer. The flower growers do not feel they can be accused by the general public, which appears indifferent to the water problem:

“...It is a problem not acknowledged at all by the population of the town. In fact the bathing establishments have their own showers using water that is almost drinkable, so.....it doesn't interest anybody. The problem is in fact the inverse, because we have to declare every well, [...] while if a private person digs his own well to water the garden, no one says anything....”

They do not feel they can even be accused by the environmentalists, because they consider themselves to be one of the categories most careful about limiting consumption, as against the indifference of the other economic sectors. In this sense it is interesting to note how at Viareggio the nursery gardeners say that they have seen their relations with the environmentalists change and they feel themselves “legitimized” in a certain sense in their activities:

“...often at the flower market we were insulted, “kicked” by the environmentalists. Then with time they realised that we were very angry about these matters and already they like us better [...] often they thank us because we are the ones who are a bit more careful about the water problem. They also are of the same opinion, they say to us: <<for better or worse you are the lesser of the evils: if there were more agricultural businesses and less inhabitants or fewer swimming pools, perhaps the problem of water would be almost inexistent>>...”

The relationship between Viareggian flower growers and the institutions who are in charge to manage water resources is rather conflictual: the producers complain about the existence of excessively restrictive constraints, also for the construction of water recuperation plants and about a great diversity of specific regulations by different council administrations. The Viareggian flower growers also express their unease of feeling badly “defended” from the competition of alternative uses of the land and resources and threatened by pressures from other sectors with which they cannot compete, and which often oblige them to forgo their own expansion or, in extreme cases, their own activity.

Pistoia

The situation is different at Pistoia, an area concerned with ornamental nursery gardening. This industry usually uses sprinkler irrigation, resulting in greater consumption compared to microirrigation. All the same the nurserymen do not feel themselves to be in conflict with alternative uses of water and say they

have never been accused by the public, which has good quality water available from underground aquifers.

In fact, in this case the statements by the nurserymen seemed “falsified” by a defensive attitude, seeing as the enormous quantities of water necessary for the large farms in this area make drawing up of water from their wells insufficient and the problem of compatibility with alternative water uses often emerges. In this case, contrary to the situation at Viareggio, the water problem arises not so much because of geological characteristics and the difficulty of finding water but because the very high number of farms in continued expansion requires enormous quantities of water, which are too great even for a territory geologically rich in water like the Pistoia area. The preoccupation and tensions between farmers and public opinion are thus in this case due to a problem of excessive growth in the sector that is putting the carrying capacity of the area into danger. The nurserymen however tend to minimize the effects of their industry and deny the existence of conflictual relations regarding water.

Pescia and Montevarchi

Finally, at Pescia and Montevarchi, the areas concerned respectively with flower growing and potted flower cultivation, the nursery gardeners do not perceive the existence of a water problem because the underground water is good quality and sufficient for agricultural and domestic uses. The nurseries are not as numerous and widespread as in the Pistoia area. Given the abundance of water present there is no conflict between domestic and agricultural use and the nursery gardeners feel “authorised” in their behaviour.

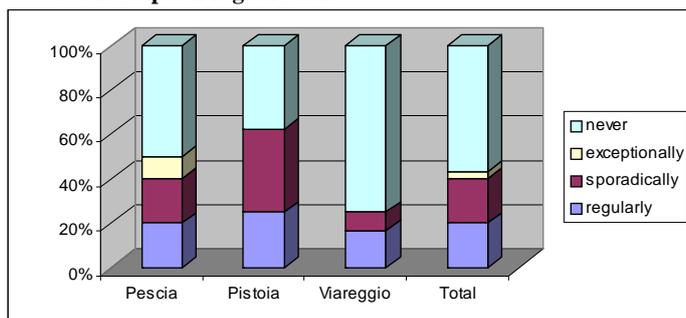
“...From the point of view of water I believe that no one here has problems, also because there is no shortage.”

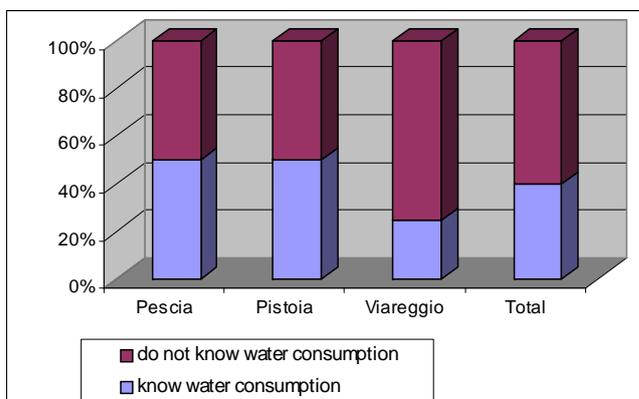
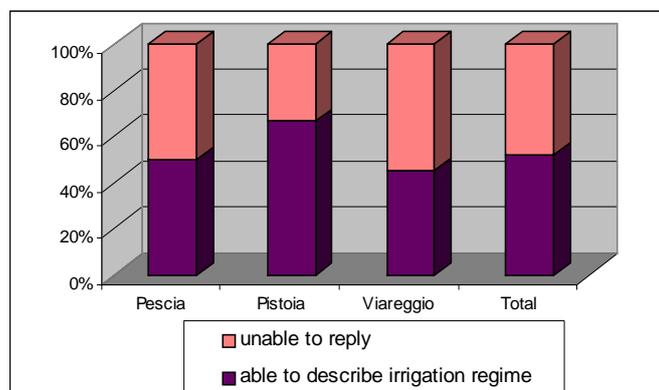
“...being an area that is very rich in it....there have never been problems....”

2. The “water” problem seen by the farmers: their understanding and perception

From the answers to the questionnaire it has clearly emerged that, while qualitative aspects of water provide a strategic importance for the quality of the product obtained and are monitored systematically, one cannot say as much for quantitative aspects. Even though water availability worries nursery gardeners, consumption is not controlled with the same precision and constancy. This means that producers do not actually know their own water consumption. In the quantitative survey carried out through questionnaires, it was asked, in fact, what average annual water consumption by the farm was. Almost everybody had difficulty in replying: only twelve firms of the thirty interviewed in the first part of the survey (2003) knew the amount of water consumed and only after having had the time to find the information. In some cases the producers had difficulty even in describing one of the water regimes used in the company (irrigation period, minutes of functioning of the irrigation plant per day, nozzle capacity).

Water consumption registration



Farms that know their water consumption**Farms able to describe their irrigation regime**

Recording consumption rates seems to be a very rare practice even in the areas where problems of finding irrigation water exist: no significant differences were encountered in the frequency of recording consumption in the various districts.

In spite of the very small number of producers who were able to state precisely the annual consumption of water and nutrients, most of them were sure of having a high level of efficiency and a low dispersion of water draining into the environment. A nursery gardener producing potted plants using *microirrigation* equipment said, for example, during the focus group meeting:

“...the percentage lost is low, we give more or less the amount of water that we see is used...”

And another nursery gardener from Pistoia:

“...with drip irrigation [...] we already save 70% of the water, even 80%...With fertirrigation with drip equipment there are water losses of one in a thousand, there isn't any dispersion. Someone also has shower equipment, but most have drip. Drip plant about ten years old....slowly, one piece at a time, not all the firms have it yet....however...it is a saving of both water and time....the plants grow better, one can target-manure, fertirrigate....”

Some producers of small diameter pots, who practise shower irrigation, realise that they use much more water than the plants require, but clarify how sprinkling is for them the only type of irrigation possible:

“...we try to recuperate the water because we're making a product....small pots, and all watered by sprinkling, not drop by drop, so there is an enormous waste of water...”

In many cases the producer's own consumption is seen as a minimum of respect compared to domestic consumption:

“...it's true that we extract underground water but we return it to the earth...I have seen how much water you need to wash four plates or two peppers or wash a car [...], with that water we are making a product and work...”

In general we can state that often, where there are no reliable instruments to measure water consumption, the impression that the nursery gardeners give is of a high level of efficiency and of consuming “right amounts” of water, demonstrating an incoherence between the real performance and the producers' feelings.

3. The relation between technological innovations and perceived constraints.

One of the most cited technologies during the focus group meetings was the recuperation of drainage water through the so-called *closed cycle*¹. This technology seems to scare the nursery gardeners because of the greater need for monitoring and the possible pathological problems, but above all for the effort due to high initial investment and the difficulty of conversion of farms structurally tied to old plans.

One agriculturist remembered during a focus meeting the numerous structural difficulties:

“...our establishments aren’t to size....there are some who have a piece in one place, another piece further away....it would be impossible...”

Moreover many flower growers have economic ties: the price of the final product does not justify the investments, which according to them would increase only the costs, also because of the greater need for specialized manpower.

“...Our constraint is having these large quantities of plants...So for us this solution is impossible, above all for a plant that at the end doesn’t cost enough to justify such a refined technique....it is not a plant that goes onto the market at who knows what price, for which you need to make a selection also from an economic point of view....usually the species that produce the largest quantities do not sell at high prices...”

From the focus groups carried out in localities where no real water problem exists, it emerges that many investments for the reduction of consumption and nutrient dispersion into the environment are seen as “dead money”, without any economic return and since the farmers never make investments without the certainty of gaining an advantage from them, such solutions seem unproposable.

To conclude, from statements made by the nursery gardeners in the focus groups we can isolate certain phrases that satisfactorily represent the diverse conceptions of efficient irrigation systems.

At Pistoia the nursery gardeners refer to aspects of management and business organization, at Viareggio on the other hand they think of ebb and flow systems, at Montevarchi to recuperation systems of high technological level and finally at Pescia they talk of something very much resembling the present situation (the flower growers of Pescia are already thinking of adopting the best solutions for their productive type). The different positions are summarized in the following table:

Concept of efficient irrigation system/technological innovation

Question	Pistoia	Pescia	Viareggio	Montevarchi
What do you intend by the terms <i>efficient irrigation systems</i> ?	Having a business with homogeneous distribution of plants and more ordered management (concept of innovation to improve firm management, to increase efficiency and productivity)	Dripsystems are already the best technique (they do not need to introduce different solutions)	Ebb and flow solutions, systems which <u>limit salinity</u>	Recuperation systems that they do not consider suitable for their productive type. Technology in general, technical assistance

¹ “Closed cycle” systems mean that irrigation water or nutritive solution is recycled continuously, reintegrating it periodically to compensate for water and nutrient consumption, but without letting it out into the environment, except for very small quantities at the end of the cultural cycle.

4. Nursery gardeners and the perception of their own level of impact on the environment

From the focus group it emerged that nursery gardeners generally think they make a much smaller impact than that made by the agriculture practised by their own fathers and that by other productive activities. Some producers said during the focus meetings:

“Compared to twenty years ago we pollute much less....and there are lots of businesses that have given up....”

“....We don’t cause any pollution, because of the type of activity and because numerically there are now very few of us, even if we polluted it wouldn’t cause any damage to the environment [...]. It would be like putting three drops of acid in ten litres of water...it wouldn’t make any difference...”

On the contrary, carrying out daily activities of maintenance and protection of the surrounding land and needing to maintain the natural resources (water and earth first of all) for the sustainability of their own future activity, farmers have a picture of themselves as responsible producers and real “guardians” of rural areas, subject to numerous external pressures from industrial activities or domestic settlements. As a nurseryman from Pistoia underlined during a focus meeting, in order to justify the intensiveness of nursery gardening:

“...but there’s also a greater control of the land because....I mean....those who grow sown crops don’t make a sufficient return to be able to maintain the ditches. For us it’s a necessity to maintain the ditches, because if they don’t flow the plants stand in the damp and suffer...”

On the other hand, the nursery gardeners know that certain agricultural procedures are induced by the market requirement itself, through demand for products of excellent quality at low cost, for which they attribute the blame for agricultural pollution on the whole society, who with their choices of consumption dictate to the agriculturists the ways in which they are to produce:

“...It’s not speculative inspiration to be a pot grower, it’s that the market demands plants in pots....”

For the producers the environmental problem exists as external pressure on agricultural activity, from which agriculture has to defend itself to a large part. To protect themselves from the accusations of environmental pollution, the nursery gardeners often present their activity as subjected to the forces of nature, which are only partially controllable. This also “absolves” them from certain responsibilities regarding environmental resources.

Conclusions

From the surveys carried out in the four main nursery gardening areas of Tuscany, it is seen that, although the deficit or the water quality are measurable with indicators of a general value, the reply from the farms to pressures on the environment can be very different. The reply depends very much on the perception of the problem that each particular farmer has and on its social definition.

By expressing their own conception of efficient systems, the nursery gardeners also gave an indication of what they expect from technological innovations or simply from the increase in efficiency of irrigation and fertilizing systems, and what they would like to improve within their own business:

Result expected from innovations

	Pistoia	Pescia	Viareggio	Montevarchi
The result expected from innovations	The nursery gardeners expect an increase in business efficiency, the possibility of expanding further	No result is expected, because they consider that they already have the best solutions as regards irrigation	The nursery gardeners await the resolution of the salinity problem, the possibility of continuing their activity	Some await a general improvement, an increased quality in the work

The surveys give us also a clear indication of the intervention strategies most suitable for the different conditions.

For example, in the case where there is no perception of the environmental problem concerning water, it would probably be a good idea to act on the technical understanding of the agriculturists, putting in instruments for objective evaluation of their consumption level, such as a meter, and identifying indicators relating to the impact on water resources.

The environmental indicators are very useful in preventing producers from assuming defensive attitudes or hiding their environmental performances, as often occurs in the absence of reliable evaluation instruments. Moreover objective indicators of the impact made by the business can be useful also in reconstructing the faith of the public where this has been threatened by some episode of water scarcity or pollution of water supplies.

In the case in which there is also little faith in technological innovations, as was seen in the Pescia area, it becomes important to encourage a “constructionist” approach. With this approach the agriculturists are able to understand that the change in their business behaviour and in the management of the water resources really can influence the impact on the environment.

In the case, on the other hand, where perception of the water problem exists and there are high expectations as regards technological innovations (such as the possibility of limiting the problem of salinity), it would be more useful to try to remove the constraints that the nursery gardeners see, and so help them implement the technical solutions effectively.

The possible intervention strategies

Perception regarding water problem	Expectations regarding technological innovations	Possible solutions
Absent	High expectations	Act on technical understanding (eg. putting in meter)
Absent	Little confidence	Help to reconquer confidence and have a more “constructionist” approach
Important problem	High expectations	Help to resolve problems connected with water by removing constraints

In a scenario such as this, so differentiated and complex, the role assumed by communication becomes of fundamental importance. Only through a correct communicative process is it possible to change first of all the perception of the agriculturists regarding the environmental emergency and “construct” with them the possible answer – technological or relating to management of the business – to pressures exerted by agriculture on water resources, involving them in the decision process and making them responsible for their different requirements and for their different expectations in the matter.

Bibliography

- Brunori G, Galli M., Rossi A., (2002) *Politiche “forti” e politiche “deboli”: il ruolo dei fattori istituzionali nell’analisi dell’implementazione delle politiche agro-ambientali*, Rivista di Economia Agraria n. 3/2001.
- Casabianca F., Albaladejo C (2002), *Des multiples légitimités de la recherche – action*. In Albaladejo C., Casabianca F., *La recherche – action; ambitions, pratiques, débats*. Etudes et recherches sur les systèmes agraires et le développement N. 30. INRA-SAD., 11,25.
- Dorward Peter, Galpin Mark, Shepherd Derek, (2003) *Participatory farm management methods for assessing the suitability of potential innovations. A case study on green manuring options for tomato producers in Ghana*, University of Reading, U.K., in *Agricultural Systems* 75, 97-117.

- Dreyfus F., Mouret J.C., *The emergence of environmental concerns in the Camargue; re-thinking a reference network in a learning tool for stakeholders*, INRA-SAD/UMR Innovation, Montpellier, France, in: Atti del V Simposio Europeo IFSA, *Farming and Rural Systems Research and Extension, local identities and globalisation*, Firenze, Italy, 8-11 Aprile 2002.
- Funtowicz S.O., Ravetz J.R. (1994), *The worth of a songbird; ecological economics as a post-normal science*, *Ecological economics*, 10, 197-207.
- Garber M.P., Ruter J.M., Midcap, J.T., Bondari K. (2002) *Extension Education Methods*, in *Hort Technology*, October-December 2002, 12 (4).
- Ison Ray, *Some reflections on a knowledge transfer strategy*, Open University, Milton Keynes, U.K, in: Atti del V Simposio Europeo IFSA, *Farming and Rural Systems Research and Extension, local identities and globalisation*, Firenze, Italy, 8-11 Aprile 2002.
- Lowe P. Clark J., Seymour S., Ward N. (1997), *Moralizing the environment*, UCL Press – London.
- Maturana H.R., Varela F.J. (1992) *The Tree of Knowledge, the biological roots of human understanding*, Boston, Shambala Publications.
- Nuvoli S, Matina P., (2002) *Agricoltura sostenibile e consumi idrici*, in *VII Conferenza Regionale sull'Ambiente*, Regione Toscana, Dicembre 2002.
- Percy Rachel B., *The contribution of experiential learning theories to the practice of participatory technology development*, University of Reading, UK, in Atti del V Simposio Europeo IFSA, *Farming and Rural Systems Research and Extension, local identities and globalisation*, Firenze, Italy, 8-11 Aprile 2002.
- Retter C., Boland H., (2003) *Cognitive mapping strategy as way to explore farmers' social environment*, paper presented at the International Annual Conference 2003 RGS – IBG, London.
- Röling N., (2002) *From multiple to distributive cognition: the case of the Drentsche AA*, in Atti del V Simposio Europeo IFSA, *Farming and Rural Systems Research and Extension, local identities and globalisation*, Firenze, Italy, 8-11 Aprile 2002.
- Röling N., Wagemakers M.A.E. (1998), *Facilitating Sustainable Agriculture – Participatory learning and adaptive management in times of environmental uncertainty*, Cambridge University Press.
- Wilson G, (1996), *Factors Influencing Farmer Participation in the Environmentally Sensitive Areas Scheme*, *Journal of Environmental Management* (1997) 50, 67-93.

