DOCUMENT RESUME

ED 358 244 CE 061 979

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TITLE Italy: Environmental Training and Monitoring in Lombardy and Umbria. Training Discussion Paper No. 98.
INSTITUTION International Labour Office, Geneva (Switzerland).
REPORT NO ISBN-92-2-108448-5
PUB DATE 92
NOTE 35p.; For a related paper, see ED 340 580.
PUB TYPE Reports - General (140)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Conservation (Environment); Educational Planning; *Environmental Education; *Environmental Research; Environmental Standards; Foreign Countries; Job Training; Labor Education; *Natural Resources; Paraprofessional Personnel; *Physical Environment; Pollution; Science and Society; Unions
IDENTIFIERS *Environmental Protection; *Italy

ABSTRACT

This paper discusses innovative schemes for environmental protection training in Italy. Section I lists elements contained in well-organized environment protection activity. Section II provides an example of environmental training for Italian trade union leaders that helps them understand the complexity of environmental systems and negotiate the necessary measures to protect the environment. An analysis of a seminar for the trade union leaders discusses training strategy, content, and the seminar's organization around the concept of "territory." Section III contains materials on training for environmental monitoring, including information on monitoring environmental variables and monitoring the mountain environment. Sections IV, V, and VI analyze three examples of training for monitoring the environment in Italy: two in the Valtellina Region, a mountain area where there was a major flood in 1987, and another in the Lake Trasimeno Region in Umbria. Section IV describes International Geophysical Center training designed to complement a university degree. Section V addresses training activities of the organization Cooperativa Rilancio Valtellina in Sondrio for mountain territory technicians. Section VI describes a training course for environmental control technicians offered by the National Center for Professional Training about New Technology for Integrated Projection and Environment. Appendixes include information on content of the training activities. (YLB)

TRAINING discussion PAPERS

244

Italy: Environmental training and monitoring in Lombardy and Umbria

by Raul Gagliardi, Torkel Alfthan and Pamela Zachar

Training Policies Branch
International Labour Office Geneva

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ISBN 92-2-108448-5

First published 1992

Printed by the International Labour Office, Geneva, Switzerland

Introduction

This paper is a follow-up to our first paper[1] which gave an overview of training for environmental protection in the regions of Lombardy and Umbria, in Italy. The present paper will discuss in detail some innovative training schemes that have given good results.

Effective environmental protection requires that people can negotiate about and make decisions on necessary protection measures. We give an example of environmental training for Italian trade union leaders. This training helps them understand the complexity of environmental systems and negotiate the necessary measures to protect the environment.

Monitoring environmental variables is another important aspect of environmental protection. It permits avoiding environmental disasters, and helps us to know how the environment is changing and the reasons behind the changes. Below, we analyse three examples of training for monitoring the environment in Italy. Two of them were in the Valtellina Region, a mountain area where there was a major flood in 1987. The other example is training for environmental monitoring in the Lake Trasimeno Region in Umbria.

Our objective was to identify the main issues in training for environmental protection and the possible solutions by discussing with organisers, teachers and students of the training courses.

Contents

Introduction iii

I. Characteristics of environmental protection 1

II. An example of environmental training for trade union leaders 3

A. Collaboration of trade unions in environmental protection 3

B. The role of the trade unions 4

C. The training activities for trade union leaders organised by the GAIA Association 4

1. *GAIA Association* 4

2. *GAIA's environmental training activities* 4

3. *The seminar's training strategy* 5

D. The content of the seminar 5

E. Organisation of the seminar 5

F. The concept of territory 5

III. Training for environmental monitoring 7

A. Monitoring environmental variables 7

B. Monitoring the mountain environment 8

IV. Employment creation and skill development in the Grosio Commune 9

A. The International Geophysical Centre 9

B. Characteristics of the training courses by the IGC 10

C. Evaluation of the IGC training activities 10

V. **The training activities of CO.RI.VAL Co-operative in Sondrio** 13

A. Characteristics of CO.RI.VAL 13

B. Explaining the complexity of territory: Elaborating territorial maps 13

C. Monitoring and safety management 14

D. The training activities organised by CO.RI.VAL 15

VI. **Environmental training activities in Umbria** 17

A. PROTECNO 17

B. Training course for environmental control technicians 17

VII. **Conclusions** 19

Notes 21

Annex I. Activities for monitoring environmental variables and avoiding environmental disasters 23

Annex II. CO.RI.VAL training activities 25

Annex III. PROTECNO's training activities 31

Annex IV. Course for Technicians for Environmental Control organised by PROTECNO 33

I. Characteristics of environmental protection

Environmental protection is linked to all human activities and these are linked to environmental systems, e.g., ecosystems, meteorological systems, geological systems, hydrographic systems, oceanographic systems, etc. It is therefore difficult to define the limits of environmental systems related to one specific human activity and measure its impact on the environment.

Well organised environment protection activity is always complex and must contain the following elements:

a. An adequate description of the environmental systems and the relations between them.

b. An adequate description and forecast of the impact of human activities. The description and forecast must be non-linear, because environmental impact depends also on other activities, the conditions of the environmental systems, etc., in a complex synergy system of interactions.

c. A system that monitors selected environmental variables and that can signal possible negative changes in environmental systems.

d. A system that monitors human activities.

e. An "alarm system" for alerting authorities and the population when environmental variables reach dangerous values.

f. A "decision-making system" for making decisions on necessary measures for environmental protection. These measures can be more or less urgent and involve many enterprises and individuals. They are not necessarily limited to the national territory. Often, international measures are needed for controlling the environment, e.g., oceanographic pollution, acid rain, etc.

g. A "negotiation system". Environmental protection measures can have negative impacts on some social and economic groups. Implementing them is therefore a political process.

h. Criteria for defining a "positive environment" and a "negative environment". These criteria are based on definitions of the quality of life and human values of ethical, religious, cultural, social and economic nature. Protecting the environment means protecting a particular kind of environment that is considered best for some groups of people. This often implies a situation of conflict because the definition of "positive environment" determines new activities that can cause economic and social changes.

II. An example of environmental training for trade union leaders

A. Collaboration of trade unions in environmental protection

Many human activities need to be changed in order to prevent environmental disasters or to reduce the negative impact of environmental change. These changes are not easily managed. This, in turn, requires knowledge about social, cultural and economic systems and their links with the environment.

Implementing changes calls for negotiations between different social partners and sectors in order to obtain financial and political support for the necessary activities. It may also be necessary to negotiate with the social sectors that will suffer, for example through changes in the quality of life or in the cultural, economical or social aspects. One important aspect is the possible loss of jobs caused by the proposed changes in economic activities.

People can improve the quality of life if correct measures for environmental protection are taken. However, the necessary measures for environmental protection are not easily implemented. There are many reasons:

a. They have a cost (economical, etc.). The resources used for environmental protection cannot be used for other purposes.

b. They generate changes in the system of production, sometimes raising production costs.

c. They may cause the closure of polluting industries.

d. They may change consumer habits and so reduce the sale of some products (for example, non-recyclable goods) and change economic activities.

e. Their implementation calls for skilled manpower that may require changes in traditional training activities and a redistribution of training resources.

Therefore, when undertaking environmental protection measures, the participation of all concerned population groups is necessary. It is particularly important to engage trade unions in the process, if their members are affected.

The changes in human activities necessary to solve environmental problems put out a challenge to trade unions. Their collaboration in implementing environmental protection measures demands considerable change in the traditional conceptions trade unionists have about their role in society. They must adapt their activities and conceptual thinking in order to be able to collaborate in solving environmental problems. Some of these conceptual changes are discussed below.

There is a need for change in the traditional notion of "nature" as an entity where men can develop their activities practically without other limits than themselves. It is necessary to introduce ecology as a limiting factor, an element that regulates human activities. The growth of any human activity is often interrupted by one or several limiting factors, e.g. by the non-availability of resources, energy, disposal capacity for rubbish, changes in environmental variables, etc.

Another conceptual change has to do with the complexity of environmental systems, which make it difficult to foresee the environmental impact of human activities. This complexity can only be understood by moving from "linear thinking" to "circular thinking", or to "networks of causality processes". People have to accept that men are part of environmental systems and

that environmental change can cause problems for human societies. Environmental systems transcend political borders. Environmental problems are "exported" from a country to another and solutions can only be obtained through co-ordination of all the countries concerned. The notion of "responsibility" is also undergoing change. Increasingly, we consider it our responsibility to guarantee future generations a safe environment.

B. The role of the trade unions

Trade unions have traditionally been concerned with the immediate working environment inside the work place. Today, they are tackling environmental problems on a broad front increasingly, realising that the firm's external and internal environment are closely related. Their aim is to raise awareness about the environment at large and the hazards threatening it, while at the same time developing specific programmes to improve health and safety at the workplace.

On the employment issue, trade union leaders used to take a strong defensive stance, trying to maintain job levels, irrespective of the possible detrimental effects that industrial activity had on the environment. Today their attitude to environmental protection and job preservation is more balanced. They consider, for example, that indiscriminate defense of employment in industries that use (and pollute) water also has a negative trade-off. For example, defending employment (and therefore production) may reduce employment in activities elsewhere, such as in fishing and tourism. Trade unions now explore how employment can be maintained by finding alternative, compensating solutions when an industry is forced to close down or reduce its polluting activity.

A seminar in the Italian region of Emilio Romagna, organised by CGIL, one of the biggest Italian Trade Union Confederations, is analysed below.

C. The training activities for trade union leaders organised by the GAIA Association

1. GAIA Association

In the Italian Region of Emilio Romagna, concern has been growing about the environment. The Work Chamber of Bologna (Camera del Lavora di Bologna) supports the "GAIA Association" (Centre for Research and Environmental Initiative) which provides services to the region's CGIL trade union organisations[2] about environmental matters. GAIA engages in activities related to the environment and working conditions, and provides trade unions with documentation, research and training services. GAIA is also a focal point for contacts with environmental organisations.

The objective of GAIA is to raise the general awareness of trade union leaders in the Emilio Romagna region about environmental problems and issues confronting the regional, local and enterprise environment. The GAIA people had come to understand that, in order to be able to influence decision-making at these levels, it is essential that trade union leaders, in addition to being aware about the environment, also possess certain specific environmental and other, e.g. negotiation, skills.

2. GAIA's environmental training activities

GAIA organises training activities for trade union leaders of the region. The seminar "Environment and territory: the territorial contract" is an example. The organisers of the course understood that knowledge about environmental matters should not be limited to knowledge of ecosystems or other environmental systems. A good understanding of environmental systems demands not only environmental information but also a global understanding of human society and its relationships with ecosystems. Trade union leaders should understand the link between human activities in specific social and

economic contexts and the environmental impacts they cause.

The seminar also develops trade union leaders' skills to put forward and defend their viewpoint on environmental issues when they negotiate with firm management and environmental agencies.

3. *The seminar's training strategy*

The seminar's organisers understood that training in environmental matters should not provide information that will be juxtaposed on the student's existing knowledge. Instead, it should give elements for reflection that can interact with the student's knowledge and stimulate a "reorganisation of his/her mind". Ability to understand the real situation and propose adequate solutions is not obtained by "accumulating" new information, but by developing a "new way of analysing environmental problems".[3] For these reasons the aim of the seminar was principally to stimulate participants' reflection about cultural, scientific and technological changes that are necessary to reduce negative environmental impacts.

D. The content of the seminar

The seminar included subjects such as:

a. the relationships between environmental problems and the society that causes them;

b. the characteristics of the production that determine environmental problems;

c. environmental protection norms;

d. the cultural, social and economic context of environment-related problems;

e. the politics of intervention that can change positively the environmental situation.

E. Organisation of the seminar

The seminar used an "inductive approach". First, the participants discuss a given problem, and reach conclusions that are used as a basis for the intervention of experts. The experts do not analyse the subject "neutrally" but organise their intervention around the participants' ideas about environmental problems and how they relate to their daily activities.

F. The concept of territory

The seminar was organised around the concept of "territory", in this case the river basin. The main reasons were:

a. A correct environmental policy requires a territorial policy. The territory is a "convergent point" for different environmental phenomena. The analysis of territory makes it easier to understand how environmental variables influence each other.

b. In May 1989 a law (No. 183) was promulgated that established the River Basin Authorities. The authority for each river basin area and its surrounding region must develop an overall programme of environmental standards and protection for all the industries in the area under its authority. This legislative division was chosen because the basins provide a good overall illustration of the environmental health of a particular region, since the pollutants and emissions tend to accumulate in the water environment, and their consequences can be measured by monitoring aquatic life and the water. Hence, the principal parameter for environmental protection is the "environmental carrying capacity" of the local and surrounding river basin area. It is against this yardstick that environmental pollution and prevention activities will be measured. The Law is expected to generate economic change which will affect trade unions' traditional activities, and trade union leaders must be prepared for these changes.

c. Active participation of trade unions in solving territorial problems is essential, but not easy to achieve. Trade union activities are still usually focused on workers' problems (safety and health at work, employment, salaries, etc.) while solutions to territorial problems demand a global approach.

d. Trade unions' environmental activities are best organised using a global approach. Workers' representatives not only discuss their specific problems but also analyse general environmental problems, linking their activities with other social sectors. The territorial approach is well suited to develop this global approach.

The seminar discussed the tools and the methods necessary for defining trade unions' environmental policy. Much effort was put into diffusing knowledge about the environment in the Reno hydrographic basin, as considered necessary for planning and carrying out trade union leaders' activities.

The seminar was organised as follows. The environmental discussion was linked to the trade union leaders' daily activities, looking there for instruments and knowledge that could be used for understanding environmental problems. The seminar was focused on a specific subject. The first part of the seminar analysed how environmental problems are related to the participants' own life and work and to trade union activities. The second part identified the necessary information that would help to improve participants' working conditions and promote trade unions' environmental activities.

The discussion at the beginning of the seminar of environmental problems and their links with trade union leaders' work, was then used as the basis for the second part of the seminar, which analysed environmental and territoral policies, and the content of Law 183 and its effects on environmental policies and trade unions' activities.

In the second part, information about the Reno hydrographical basin and its main environmental problems were introduced. The participants used these elements to analyse the environmental priorities of the Reno hydrographical basin and to formulate solutions to major problems. The answers can provide a basis for trade unions' proposals about territorial environmental problems.

III. Training for environmental monitoring

A. Monitoring environmental variables

Natural phenomena, like volcanic activity, earthquakes and floods, may cause serious environmental damage, and force huge numbers of people to leave the affected regions. However, this may become less necessary if preventive measures are implemented at regional, national and international levels.

Human activities also cause negative environmental change, such as desertification, green house gases, air and water pollution, acid rain, extinction of species, etc. Human activities often reinforce natural causes of negative environmental change. Environmental protection implies changing these activities.

The prevention of environmental disasters and degradation demands an adequate knowledge base about environmental systems and their links with human activity. Models are needed that explain the links between human activities, environmental change and possible environmental disasters. These models are essential for collecting, analysing and drawing conclusions from environmental data.

Training for environmental protection should therefore develop skills for elaborating and using environmental stability models. These are necessary to determine the direction of environmental change. The models are not necessarily a linear function of changes in environmental variables. The same cause can have different effects depending on how environmental variables interact with each other.

Gradual environmental change that had minor effects in the past may in the future have a large impact on the environment. The structure and the dynamics of environmental systems are not easily understood and we have not yet developed the capacity to prevent all the possible consequences of a given activity.

Training for environmental protection should therefore be linked to the development of new models about the structure and dynamics of environmental systems and using new environmental monitoring and management techniques. Environmental protection staff should be able to integrate new knowledge and develop new skills in order to adapt to rapid changes in jobs. They need skills for using new tools such as information systems, data banks, satellite data and new measuring systems.

Monitoring the environment without preparing proposals and decisions properly means that implementing the proposed changes is of little use. We have as yet no examples of training for environmental protection that provide a complete background in all these tasks.

These activities should ideally be organised by experts in different disciplines (geology, engineering, ecology, information sciences, etc.). Their activities should be co-ordinated and there should be a decision-making system that would act in urgent situations. Well-trained professionals and technicians are needed to undertake these activities. These people should have an understanding of environmental systems and their relations with human activities.

Risk scenarios provide patterns of possible risks to people and property. A risk scenario describes the possible development of an emergency situation and its possible impact on the environment. It is a tool for developing interpretive models. These models consist of a system of correlations between instrumental measurements, which may represent forthcoming events, and risk situations which may result from the events. They also provide

necessary information to identify locations and areas under risk. Different interpretive models are developed for each risk situation and are then incorporated into the computer software of a given district's alerting units.

The instrumental measurements undertaken and interpreted in real time make it possible to forecast future events and develop risk scenarios. When an emergency has been declared, the risk scenarios are employed to support decision-making.

The data provided by the monitoring network and interpreted according to the risk scenarios determine whether a regional area is safe or not. The alerting thresholds are established on an experimental basis by correlating the hydrological, geological and geotechnical events with the short- and long-term evolution of the environmental parameters. When the values of these parameters exceed certain pre-established thresholds, the situation is automatically identified by the computing system of the district alerting unit, which also immediately warns the responsible engineer. The engineer verifies the detected anomaly and, if called for, informs the public authorities about the developing situation.

Remedial action is also an integral part of the safety management system. The monitoring network not only provides valuable information for rational emergency management but also for planning environmental rehabilitation and reconstruction.

Detailed knowledge of the site characteristics allows better understanding of the causes of risk, provides a guide for evaluating various options for action, and makes it easier to plan measures to rehabilitate or reconstruct the environment. The monitoring network is also a safety guarantee for the personnel working in the reconstruction area.

The necessary capacities and knowledge needed for the above-mentioned activities are given in Annex I.

B. Monitoring the mountain environment

In the Valtellina region of Italy we had the opportunity to visit two environmental training centres, both responding to the same regional problem: monitoring the mountain territory in order to prevent the recurrence of a landslide on the scale of the 1987 disaster that would jeopardise the livelihood of the valley's population.

Monitoring the stability of the mountain slopes is vital to the safety and well-being of the people, farms and towns of the valley. But environmental monitoring is also a crucial element in safeguarding the environmental health and sustainability of downstream river basins (in this case the Po river basin, which stretches from Alpine meadows close to the Swiss border in the North, through major cities like Milan, Verona and Venice, to the Mediterranean Sea). The reader may recollect the disastrous floods in Florence in 1966, for which Alpine landslides were partly responsible and which caused serious damage in the city and to its art treasures.

A major environmental disaster on the scale of the Valtellina landslide in 1987 was needed to provide the momentum for developing a full-scale monitoring programme in the region. Because of the landslide, the level of environmental awareness has been raised sufficiently for putting into effect policies and programmes that effectively meet the environmental challenge. The description that follows will illustrate how the Valtellina landslide triggered environmental action and, in its wake, purposeful environmental training.

IV. Employment creation and skill development in the Grosio Commune

A. The International Geophysical Centre

In Grosio, a mountain commune in the Alpine valley of Valtellina, the International Geophysical Centre (IGC) was created in 1991, upon the initiative of the Director of the IGC and the Mayor of the commune, in conjunction with the Academy of Sciences of the USSR. Already in 1986, the Director of IGC had proposed that the centre be established with the task of monitoring the mountain environment of the area around Grosio. However, the project's momentum increased greatly after the 1987 Valtellina landslide disaster. As an important element for the project, the Region of Lombardy and the European Social Fund financed training activities with the objective of establishing and running a co-operative that will monitor the Grosio mountain environment.

The idea for such a co-operative was immediately attractive to the Soviet Academy of Sciences because of the compatibility of Soviet technology for the monitoring devices. Due to improving U.S./Soviet relations, some Soviet equipment (such as devices to monitor US nuclear explosions) has become redundant. The monitoring in the region of Grosio was a market for this equipment. IGC's reasons for opting for Soviet sensor technology rather than, say, American technology, was its low price. Soviet technology, although less advanced than American, costs only a fraction of the latter and meets the needs of the IGC adequately.

The co-operative also responds to a labour market need in the Grosio commune. There are few jobs and many young people must commute to nearby Switzerland to find employment. As a result, a programme that would provide business and technical training to young people of the community and provide employment in the region was immediately appealing to the mayor of Grosio and the community as a whole.

The IGC will undertake three major activities:

a. use of seismic sensors placed in the slopes around Grosio to monitor seismic phenomena and changes in environmental parameters;

b. use of laser technology for monitoring air and water pollution (especially hydrocarbons);

c. cartography activities to document the environmental characteristics of the mountains, digitalise this information into computers, and use it for environmental monitoring.

The centre is currently attempting to create a data bank, based in Grosio, which will collect information using the Soviet monitoring devices stationed throughout the area. The devices have been collecting data for a year and the computerised monitoring systems are now ready to start detecting environmental hazards. The centre is also exploiting cartographic and other data transmitted from Soviet satellites for preparing various types of maps of the region.

B. Characteristics of the training courses by the IGC

For the training programme the Director of the centre was looking for young people who would become partners in the co-operative. He designed a training course to develop the necessary environmental monitoring skills and also "business skills" necessary to organise and operate the co-operative. Such skills could not be found in the local labour market, or, for that matter, elsewhere in Italy. The centre, after advertising in the local media, therefore recruited a group of students to undergo a specially tailored training course.

The selection of the students was important. From a pool of about fifty applicants, nineteen were selected for the course. The selection was based on an assessment of the students' business acumen and ability to work independently. From the outset it was emphasised to the students that the centre was not training them to enter salaried jobs, but rather to create their own employment. However, this had not been mentioned when advertising the courses, and many students were initially discouraged that the training did not guarantee them a job.

The training programme was designed as a substitute for, not a complement to, a university degree. The programme did not train for specialisation in the sciences, nor for strictly technical skills, but rather for general problem solving and managerial skills. Much emphasis in the course was put on developing the ability to market the co-operative's expertise and services. The course programme included training in (seismic and hydrological) data bank management and analysis, and the application, maintenance and use of new, alternative energy (primarily photo-voltaic energy) technology. This energy is used for the data acquisition in areas that have no electricity. Training in alternative energy technology can also prove a new possible activity for local enterprises.

During the course, the students were integrated into community activities and environmental monitoring work. For example, one project that was undertaken during the course was to monitor the environmental parameters of the local agriculture system. The training was tailored to the students' aptitudes in order to overcome their weaknesses and build upon their strengths. One student might specialise in data base management, while another might focus on cartography. However, the curriculum was multi-disciplinary, and each student was capable of moving from one task to another.

The course was mostly conducted by the programme administrators, by local specialists in data base management, and by invited experts. For example, Russian experts provided training for the students in the use of the monitoring equipment. During the course, the students also undertook a study tour to the Soviet Union to familiarise themselves with Soviet sensor technology.

C. Evaluation of the IGC training activities

We met with a group of ten ex-students who were now members of the co-operative. None of the students applying to the course had any background or experience in environmental monitoring work or theory. In fact, the students were initally unaware of the environmental aspects of the course, although they knew that it would deal with "informatics management". Their response to the media advertisements was simply a desire for employment. As the Lombardy Regional authorities were paying for the course, students felt assured that they would find some type of employment after completing the programme. The students said that at first they were a little bit overwhelmed by the nature of the course. Many of the original students dropped out, having difficulties in adjusting to the non-traditional training mode and schedule, which, in contrast to their experience at school, demanded considerable independence and initiative. However, the students now agree that the course was more "adult" in nature than traditional courses and that it developed skills, such as decision-making and self-initiative, which will be essen-

tial to their work in the co-operative. Twelve of the students are now members of the co-operative, two went independent and five are engaged in activities not directly related to the environment.

The Grosio project is an interesting example of environmental work and training that was triggered by a major environmental disaster. Regional and international bodies (European Social Fund) provided money for investment in environmental protection activities in order to forestall future disaster. Grosio's mayor was a catalyst for the project, looking for a solution to the serious unemployment problem.

The opportunity for business and local employment creation was seized by establishing a co-operative that would, as a first step, undertake environmental monitoring and risk assessment activities; secondly, sell its services and products elsewhere in Italy; and thirdly, engage in local area development through investment in environmental and energy-saving technologies. In this undertaking it is interesting to note the complete absence of central government authorities. Also, the formal education and training system was completely sidestepped, a testimony to the lack of confidence among the participants in its ability to innovate and meet the new training and educational needs triggered by these environmental activities.

A more critical question is whether the Grosio initiative duplicates similar, but larger and more structured activities by CO.RI.VAL, another co-operative also engaged in environmental monitoring activities in the Valtellina valley.

V. The training activities of CO.RI.VAL Co-operative in Sondrio

A. Characteristics of CO.RI.VAL.

CO.RI.VAL (Cooperativa Rilancio Valtellina) was established in 1984 with the objective of reviving and stimulating economic development activities in Valtellina. In 1986, the co-operative started a training course for environmental monitoring and protection. However, like the Grosio centre, CO.RI.VAL did not actually begin its environmental monitoring activities until after the 1987 landslide disaster.

The training programme was developed in collaboration with several established information technology companies, including Dough Watson, Digital Equipment, and, in particular, ISMES, an Italian company specialising in environmental engineering and monitoring projects in Italy and overseas. ISMES is owned by the National Electricity Company and has extensive experience in installing and running seismic monitoring systems.

After the landslide in 1987, the Ministry of Civil Protection assigned ISMES the task of improving the safety and livelihood of the Valtellina population. Today, ISMES is the recognised regional authority in monitoring the mountain environment and firms and local authorities in the Lombardy region continuously make requests for ISMES services. ISMES owns and equips a number of regional monitoring centres which are today run largely by staff trained at the CO.RI.VAL centre in Sondrio, which maintains an elaborate geophysical information system about environmental variables in Valtellina.

The division of labour in Valtellina is the following: ISMES owns the equipment of the three monitoring centres (in Sondrio and the nearby villages of Cepina and Mossini), but it has sub-contracted the management, maintenance and operation of the centres to CO.RI.VAL. ISMES also owns and operates a number of monitoring centres elsewhere in Italy. Most of the staff who run the centres in Valtellina are graduates of the CO.RI.VAL training programme. However, ISMES provides some scientific staff. It is the local authorities in the Valtellina area which undertake any rehabilitation and remedial work or infrastructure development that have been suggested by the analysis of the data collected by ISMES and CO.RI.VAL.

B. Explaining the complexity of territory: Elaborating territorial maps

One of the activities developed by CO.RI.VAL staff is elaborating "mapping programmes". The map of a region is "digitalised" (introduced to the computer using a computer programme called "ARCHINFO"). This system makes it possible to have 32 maps of the same territory, each one with different kind of data (maps for depicting human activities, temperature maps, maps depicting mountain slope gradients, maps for rainfall, etc.). These 32 maps can be combined. New information can be introduced in the programme and in the maps.

This system can be very useful for environmental training because it permits seeing how environmental variables are distributed over the territory and how human activity affects them.

The need for environmental protection and remedial work is determined by the elaboration and analysis of specialised maps, which illustrate in minute detail slope gradients, soil quality and stability, rainfall and other environmental variables. The environmental data are

continuously updated and catalogued into CO.RI.VAL's computer files. This information allows ISMES and CO.RI.VAL to work out risk scenarios based on the variables and their changes as documented in the data bank. Information for these maps is provided in part by the monitoring devices located throughout the mountainous region, and also by external information centres. ISMES also undertakes modelling activities and develops its own software to this end. For example, hydrological models determine the correlation between rainfall and soil movements.

Environmental monitoring is a complex activity. Below, we will describe in some detail the objectives of the monitoring system, the methodology applied in collecting and interpreting the data and the activities of ISMES and its sub-contractor, CO.RI.VAL.

C. Monitoring and safety management

Subsequent to the natural disaster which occurred in Valtellina in 1987-1988, a technical methodology was tested on-site and is at present used to overcome the inherent problem of hydrogeological safety in the area. It was the first time a regional land monitoring system was applied for civil protection. The methodology used can also be applied for other, similar types of environmental monitoring.

The methodology uses logistic and organisational resources available at the potential disaster site. This allows for rapid and efficient intervention. Salient to the methodology is the link between data measurement, interpretation and system management. Data are collected automatically, which increases the reliability of the measured values, as the monitoring covers a large number of parameters (both geotechnical and hydrological, e.g. seismic and soil movements, ice and snow cover, rainfall, temperature, etc.).

Automatic data collection makes it possible to process and evaluate the data in real time. The parameters are monitored continuously which guarantees a high degree of accuracy and timeliness for activating predetermined emergency procedures.

All measured data are systematically stored into a data base that is used for developing interpretation models. This system is particularly useful for the long-term management of regional land safety. The interpretation models are used for designing risk scenarios, which are tools for objectively establishing alerting and mobilising thresholds. The risk scenarios make it possible to determine possible emergency situations and to identify the areas under risk.

In the Valtellina region, a network of instruments (sensors, data acquisition units) keep under surveillance all the hydrological and climatic aspects of the region (land slope instability, surface and subsoil hydrology, etc.). The approx. 100 measuring sensors are located at possible risk-developing sites and are connected to the remote data acquisition system, located at Cepina (for the hydrogeological monitoring of Val Pola and Presure) and Mossini (for the hydrogeological monitoring of Val Torregio and Franscia, and for the hydrometeorological monitoring of Val Malenco and Alta Valtellina).

All data are processed using a safety check programme which, through alerting video monitors, permits continuous control of site conditions. The computer at the Regional Unit of Cepina is connected - via radio and surface line - to the computer at the Regional Unit of Mossini. This is in turn connected to the Remote Technical Support Unit, at ISMES headquarters in Bergamo.

D. The training activities organised by CO.RI.VAL

In 1986 the CO.RI.VAL co-operative organised the first "training for mountain territory technicians" in order to develop skills for monitoring and prevention activities in Valtellina. A second course was offered in 1990. Twenty students participated in this latter course, out of which ten went to join the CO.RI.VAL co-operative. Eighty per cent of the students who completed the courses found work in the region without difficulty.

The students who started the course were required to have high school diplomas. Some had university qualifications. The creation of employment opportunities was one of the first objectives in creating the co-operative. Most of the students lived in the Valtellina valley, although some came from as far away as Milan. Tuition and transportation to and from the training centre were paid by the regional authorities and by companies which approached CO.RI.VAL with offers to sponsor the training of some students.

CO.RI.VAL maintains a comprehensive relational data base system, which receives, by radio or cable, data at the rate of 400 data per half hour from its approximately 100 data collection units distributed in the area. Managing this continuous flow of environmental data demands highly developed computer skills in data collection, processing and management. Development of information technology skills is therefore an important aspect of the course's curriculum and nearly half of the course time was devoted to computer studies and data base management. The students were also required to develop an in-depth knowledge of the area's geography and economy.

After finishing the basic "territorial technician" course, some students went on to receive specialised training in the use of the data base software. This training was provided in the form of a short "internal" course. Because the information that is entered into the data base must be carefully screened for accuracy, students must learn to develop and use specific forms, which require very specific input data. The students were trained to use both larger network computers, and smaller independent personal computers, in order to meet the needs of all clients.

The training was mostly provided by ISMES staff and other professionals from the region. Exhaustive training could not be accomplished in a short training period, since understanding complex concepts requires prolonged exposure to both the theoretical and the practical aspects of monitoring work. Practical learning on-the-job therefore complements the training course.

Thus, at the Mossini Centre (an ISMES monitoring centre) trainees must be able to analyse critically the data that the equipment and instruments provide, rather than to accept them indiscriminately. CO.RI.VAL's technician training is evaluated and reinforced by means of a two-way feed-back system at the monitoring centre. After analysing the data, the technicians produce daily monitoring reports about the environment, which are reviewed by the geologists at the centre and also sent to ISMES' main office in Bergamo for review and assessment. This feed-back system acts as a mechanism for learning on-the-job, which is necessary for putting into practice the theory taught at the training course.

CO.RI.VAL training is an organised and well-established programme to develop the skills and knowledge necessary for monitoring the area's environment. The co-operative has the backing of several large companies which provide equipment, financial support, and often employment for CO.RI.VAL's trainees. These are the beginnings of close collaboration between private enterprises and public institutions to effectively manage the local environment. In the three years since the environmental disaster which fueled support for the programme, CO.RI.VAL's administrators have progressed rapidly in their aims to provide qualified monitoring services for the region.

VI. Environmental training activities in Umbria

As an example of the training activities for environmental protection that have been developed in Umbria, we will describe the activities of PROTECNO.

A. PROTECNO

PROTECNO - "Centro Nazionale per la Formazione Professionale sulle Nuove Tecnologie de Progettazione Integrata e dell'Ambiente" (National Centre for Professional Training about New Technology for Integrated Projection and Environment) - is an enterprise for professional training for civil engineering and environmental protection. It uses the services of four enterprises:

RPA - Ricerca e Progetti: a civil engineering company; RPA - Risorsi ambientali: a company specialised in environmental resources; STAER - a company specialised in topography and cartography; and Gesim - Monitoraggio Ambientale, specialised in environmental monitoring. These companies work in the same industrial complex, share instruments and staff, but have independent budgets and administration.

The enterprises use sophisticated information systems, e.g. for architectural design, tridimensional description of territories, elaboration of maps using aerial photography, measuring of environmental chemical variables with high accuracy (1 part in a billion), etc. Some of the staff of these companies were trained in PROTECNO courses. Most of them had no background in information systems nor in the use of the sophisticated instruments that they are using now. The courses (of approx. 1000 hours duration) develop new skills and knowledge, and in-service training allows for continuous adaptation of staff to new monitoring technology.

PROTECNO has the capacity to adapt its training to changing labour market demands. In 1990, PROTECNO started with the organisation of a course for "Technicians in saving energy systems". In January 1991 the Italian Parliament promulgated Law number 10/91 on energy saving that required each industry and each public building to have an expert in energy saving activities. With the above mentioned course, PROTECNO can train this new kind of technicians. Training is part of the services that the enterprises of the group offer, giving an advantage in the competition against other enterprises for the contracts.

Since its inception in 1988, PROTECNO has provided employment-related training for young graduates from specialised high schools and universities. These 1000-hour-long courses, financed by the Umbria Region and the EC, included theoretical and practical laboratory training in companies and specialised institutions. Annex IV describes the training activities organised by PROTECNO.

PROTECNO changes the courses it offers, adapting them to jobs available, meeting its own needs in particular. PROTECNO's training has also been offered to students from other countries, e.g. countries in Africa.

B. Training course for environmental control technicians

The objectives of this course were to give a general background in environmental management and develop skills for dealing with:

a. Environmental pollution by liquids from different sources (civilian, animal technical, industrial) and the related techniques for intervention.

b. Water supply for human use and technology for drinkable water.

c. Atmospheric pollution.

d. Treatment and recycling of solid urban waste.

e. Techniques of monitoring and controlling the environment and emissions of enterprises.

The course develops skills for environmental management, covering sewage treatment, control of drinkable water, legislation (norms for treatment of liquid, solid or gaseous discharges and criteria for drinkable water). The technicians end up in jobs in public enterprises responsible for waste treatment and in private industrial enterprises, zoo technical establishments that require skills in waste disposal management.

The course consisted of theoretical lectures and practical activities, complemented by visits to water treatment establishments and plants for treatment of zoo and agricultural effluent, and for recycling solid urban waste, etc. The programme provided training in information systems, ecology, biology, microbiology, general and inorganic chemistry, agricultural-botany. The course also gave specific information about environmental legislation, instrumental chemical analysis, subterranean water, techniques for reducing pollution (decontamination techniques), techniques for recovering and transforming biomass, drinkable water treatment techniques, solid urban waste treatment, management of discharges (sewage treatment), atmospheric pollution, environmental monitoring and hydraulics.

The programme's broad range of subjects suggest that environmental control technicians need to know the specific techniques for managing water, sewage and waste treatment processes, but also need theoretical knowledge about ecology and biology. The programme also includes training for information systems.

This programme has taken heed of the need, already observed in our first paper[4] about environmental protection training, for trainees to have sufficient knowledge and the necessary analytical ability to understand environmental systems. The programme introduces ecology, biology and botany to ensure knowledge of these subjects. The programme of the course is given in Annex IV.

VII. Conclusions

The courses we analysed offered training for environmental monitoring, an important element of environmental protection. However, the knowledge and skills needed for environmental monitoring are similar to the knowledge and skills used in other human activities. For example, organising data banks, fundamental for environmental monitoring, is also an essential element in many other economic activities. The skills developed in the courses can therefore be useful for other activities. Paradoxically, the "tailored courses" permitted working in other jobs, not related with environmental protection.

The experiences we analysed show that training for monitoring the environment is highly specialised, and that Italian schools do not provide the necessary background to students for absorbing this training. The solution was to provide intensive specialised training outside schools and universities. The training rapidly develops the capacities and knowledge of students by involving them in a specific environmental protection project. Motivation was an important factor in the training as the students were offered the possibility to work as members of a service co-operative when they finished their studies. The students were conscious that the subjects they studied were directly relevant to their future work.

This approach to training is conducive to helping the participants solve environmental problems. The training can be intensive and short (6 months to two years) and the trainees are adapted to a particular enterprise. A major problem is the limited number of people who can be trained in this way. However, in Umbria, there are projects for the training of 75 students. The rapid development of the capacities of the students is among the best features of this type of training. In one of the enterprises studied, PROTECNO students having had no experience with computer systems in the beginning are now working with highly sophisticated information systems. The CO.RI.VAL experience shows that it is possible to develop co-operatives to undertake environmental monitoring and provide environmental services, e.g. in information processing and cartography.

In the courses we examined, the training strategy was to stimulate students' autonomy and active participation. Practical activities were related with theory, in order to develop skills and knowledge in an integrated manner. Instead of transmitting information, the course focussed on developing an understanding of the problems and developing the capacity to deal with them.

The students who followed the courses are now working in enterprises exhibiting great maturity and motivation. They were aware of the difficulties but also of their capacity to cope. We had the opportunity to observe the CO.RI.VAL and RPA's current activities during a day including lunch, and we observed a good team spirit, with a high degree of conviviality that had been developed during the courses.

One characteristic of the courses was their "flexible organisation", in both content and training methodology. The courses were not repeated year after year, but were adapted to specific job needs. However, the students developed general knowledge and skills which helped them gain access to jobs also in economic activities other than environmental protection.

The experiences show that it is possible - even necessary - to substitute traditional university training by more flexible and adapted training

organised by technically highly developed enterprises.

The model can be recommended for developing new environmental monitoring activities. A team is selected during a short but intensive training programme. The model assures rapid advance on the training course. Team members can be selected so that they complement each other. The team can also be given in-service training in order to adapt it to the changes in technology and new activities. The system develops skills and knowledge rapidly when students are directly involved in enterprise activities. It can be a model for developing small firms that are able to solve specific environmental problems using advanced technology.

People at CO.RI.VAL and PROTECNO were interested in extending their training activities to foreigners, including students from developing countries. They thought that the training model may be of use in developing countries, some of which do not yet possess the skills needed for engaging in environmental monitoring activities.

The analysis of training activities for trade union leaders showed that territory can be a useful concept for developing an understanding of environmental issues and for promoting the participation of trade unions in environmental protection activities.

Notes

[1] Raul Gagliardi. *Training for environmental protection in Lombardy and Umbria regions*, Training Discussion Paper No. 74, Training Policies Branch, ILO Geneva, 1991.

[2] The CGIL (Confederazione Generale Italiana del Lavoro - Italian General Confederation of Work) is one of the three major trade union confederations in Italy.

[3] This approach is similar to the didactic model developed recently by the Laboratory of Didactic and Epistemology of Sciences of the University of Geneva and other research centres. This model is centred on the "reorganisation of the student's cognitive system". According to the model, knowledge is built up by successive reorganisation of the student's mind that also permits him/her to assimilate new information.

[4] Raul Gagliardi: Ibid.

Annex I

Activities for monitoring environmental variables and avoiding environmental disasters

Definition and upgrading of risk scenarios

- Identify risk areas;
- Propose risk scenarios and analyse their probability using existing data;
- Propose interpretive models for each risk situation, including the mathematical modelling of environmental variables behaviour;
- Organise the elaboration of new risk scenarios using obtained data.

Data acquisition

- Decide what are the pertinent environmental variables to collect;
- Organise the collecting system, deciding where the environmental variables will be collected, what will be the frequency of collection and the accuracy of the measures;
- Choose the measuring instruments;
- Organise maintenance of instruments (maintenance of instruments can be a very difficult task in some environmental conditions, such as mountain regions).

Data validation

- Organise the validation system of each instrument in order to ensure the data's accuracy (this task can be difficult when the instruments are located in regions not easily accessible).

Data processing

- Organise analytical systems, deciding what computer programmes will be used, how data will be introduced into the computer and how data will be analysed (knowing the mathematical equations which give more information about environmental processes that can be dangerous for human activities).

Data base management

- Organise the data base and interaction between new and old data.

Alarm

- Define warning procedures;
- Establish an "alarm system" that distributes the necessary information about possible environmental disaster to pertinent persons (authorities, etc.);
- Organise decision-making systems.

Improvement of environmental situation

- Propose necessary changes in human activities in order to improve the environmental situation (environmental degradation, quality of life degradation, etc.);
- Negotiate with the social sectors concerned by the changes.

Personnel training

- Organise training for necessary staff. It is advisable to train local people in maintenance and operation of the system and to avoid conflicts between local inhabitants and external organisations operating in the region. The participation of local people in these activities can help to solve unemployment problems.

Annex II

CO.RI.VAL Training Activities

1. CO.RI.VAL, with the support of the Lombardy Region and European Social Fund, developed training activities related to the following sectors:

a. Information systems:

- General
- Individual information systems
- Territorial information systems
- Programming
- Data bank.

b. Environment and territory:

- Ecology
- Pedology
- Cartography
- Topography
- Environmental impact assessment
- Environmental legislation
- Hydro-geological dynamics
- Air-water-soil monitoring
- Measurement systems
- Photo-interpretation
- Zootechnics
- Agricultural techniques
- Hydrical purification.

c. Tourism:

- Territorial analysis
- Market analysis
- Communication.

2. CO.RI.VAL Training Activities in 1988-1989

In 1988-1989, CO.RI.VAL organised the following training activity:

Integrated project of professional training: Technician in information sciences for environment and territory (Tecnici Informatici Ambiente e Territorio)

43 of the 50 initial participants have ended the courses and obtained the necessary qualifications for professional work. They are now working in different enterprises such as: Lombardia Informatica, CO.RI.VAL, Dough Watson, Parco Nazionale dello Stelvio and local and regional enterprises.

Training modules:

- Introductive module
- Module on territorial competence
- Module on information sciences
- Module on application
- Module on execution.

Professional figures:

Expert in obtaining and introducing territorial data:

- 25 participants.
- Requirements: Younger than 25 years, with university diploma.
- Duration: 820 hours.

Course objectives:

- Be able to use instruments for obtaining territorial data, including field operations.
- Be able to use the systems for the introduction of graphic and alphanumeric data in information systems.

Manager/responsible for the information system (Gestore/Responsabile del sistema Informativo):

- 10 participants.
- Requirements: Younger than 25, with university diploma (diplomati o laureati).
- Duration: 1296 hours.

Course objectives:

- To know how to manage the information systems.
- To ensure the efficacy of the information system and the data.

Technician for Territory (Tecnico del territorio):

- 15 participants.
- Requirements: Younger than 25, with university diploma (diplomati o laureati).
- Duration: 1172 hours.

Course objectives:

- To represent the characteristics of the mountain territory using the information system's data.

3. CO.RI.VAL Training Activities in 1989-1990

In 1989-1990, CO.RI.VAL organised the following training activity:

Training course for technician for mountain territory

- 20 participants.
- Requirements: Younger than 25, with university diploma (diplomati o laureati).
- Duration: 1005 hours.

Course objectives:

- To know how to deal with the activities related to institutions and administrations.
- To be a technician in the urban-type planning of non-urban territories in mountain areas and rural regions.
- To apply new environmental technology.

Training modules:

- Ecology - Natural environments - Data collection
- General information sciences
- Soil and environment: pedology, water resources, climate, agrometeorology
- Cartography - Pedology - Evaluation of mountain territories
- Environmental planning: hydrological and forest organisation - Evaluation of environmental impact in mountain environment
- Problems of the forest
- Territorial information sciences
- Vegetal physiology
- Environment - Energy
- Historical and social characteristics of the territory
- Environmental legislation
- Communication and environment.

The 20 participants have terminated the course and obtained the necessary qualifications for professional work.

4. CO.RI.VAL Training Activities in 1991

In 1991 CO.RI.VAL organised the following training activities:

a. **Integrated project for professional training: Training for experts in personal and departmental use of information sciences (Esperti di Informatica Individuale e Dipartamentale)**

- 20 participants.
- Requirements: Younger than 25, with university diploma (diplomati o laureati).
- Duration: 985 hours.

Course objectives:

- To manage the installation of personal information systems.
- To programme personal computers or central information systems.
- To know the methodology for problem diagnosis in information systems.

Training modules:

- Introduction to informatics and programming
- Technical English
- Operative systems Ultrix32 and MS/DOS
- Programming language C
- Individual productivity instruments
- Collaborators' network
- Criteria for installation trouble-shooting.

b. **Integrated project for professional training: Training for experts in programming languages in different information systems' environments**

- 15 participants.
- Requirements: Younger than 25, with university diploma (diplomati o laureati).
- Duration: 1040 hours.

Course objectives:

- To operate and programme in different information systems.
- To programme in Fortran and C.
- To plan and programme with relational systems.
- To be autonomous.

Training modules:

- Operative systems
- Languages
- Data bank
- Planning.

c. **Integrated project for professional training: Training for experts in management of sewage installations (Addetti per la manutenzione di impianti di depurazione di acque luride)**

- 15 participants.
- Requirements: Younger than 25, having completed compulsory schooling.
- Duration: 480 hours.

Course obectives:

- To do the necessary operations for the management of sewage installations.

Training modules:

- Introduction
- Technical competence
- Sanitary norms
- Applications

d. **Integrated project for professional training: Training for technicians for planning and commercialisation of tourist services**

- 20 participants.
- Requirements: Younger than 25 with university diploma (diplomati o laureati).
- Duration: 900 hours.

Course objectives:

- To promote and sell tourist activities.

Training modules:

- The territory
- Technical management
- Marketing
- Communication
- Stages.

e. **Course for re-qualification: Agricultural operator in mountain environment**

- 15 participants.
- Requirements: Older than 25, workers in small or medium-sized enterprises.
- Duration: 750 hours.

Course objectives:

- To develop skills in agricultural techniques adapted to the characteristics of the region.

Training modules:

- Introduction
- Theoretical-professional
- Practical.

f. **Course for re-qualification: Zoo-technician in mountain environment**

- (Project's management: Provincial Federation of Agriculture of Sondrio)
- 15 participants.
- Requirements: Older than 25, workers in small or medium-sized enterprises.
- Duration: 200 hours.

Course objectives:

- To develop specialisation in zoo techniques for mountain regions.

Training modules:

- Introduction
- Theory and propedeutic
- Practical.

Annex III

PROTECNO's Training Activities

1. PROTECNO's training activities in 1989

In 1989 the following courses were organised:

a. "Operators for environmental monitoring".

b. "Technicians for environmental control".

c. "Technicians specialised in photographic interpretation".

d. "Technicians specialised in architecture photogrammetry and stereo photogrammetry, as well as topographic survey of historical monuments and buildings".

2. PROTECNO's training activities in 1990

In 1990 the following courses were organised:

a. "Technicians for data bank processing".

b. "C.A.D. experts for architectural and urban design".

c. "Technicians for energy resources".

d. "Ecological - environmental technicians".

3. PROTECNO's training activities in 1991

For the development of training courses in 1991, PROTECNO asked the Umbria Region for the inclusion of five courses in the Regional Planning programme oriented towards young unemployed professionals or high school leavers. The European Social Fund was to be asked to finance the courses. They were:

a. "Corso per Tecnici Esperti in Banche dati Territoriali e Ambientali" (Course for Experts in Data Banks for Territory and Environment). Maximum 18 participants; duration 1000 hours; maximum age 29 years. The course was to be oriented towards the building and management of information systems for the environment.

b. "Corso per Tecnici Esperti in Risorse Idriche" (Course for Technicians, Experts in Hydric Resources). Maximum 18 participants; duration 1000 hours; maximal age 29 years. The course was to be oriented to the evaluation and management of regional hydric resources.

c. "Corso per Tecnici Esperti in Disinquinamento Aria-Acqua-Suolo" (Course for Technicians Expert in Decontamination (Solve pollution problems) in Air, Water and Soil). Maximum 12 participants; duration 1000 hours; maximum age 25 years. The course was to be oriented to knowledge about all new technology for environmental decontamination (for solving environmental pollution problems).

d. "Corso per Consulenti di Recupero e Marketing di Centri Storici e Immobili Rurali" (Course for Consultants in Recuperating and Marketing of Historical Centres and Rural Buildings). Maxi-

mum 12 participants; duration 1000 hours; maximum age 25 years. The course was to be oriented to the recuperation, restructuring and selling of rural buildings and historical centres.

e. "Corso per Tecnici Esperti in Fotogrammetria Numerica" (Course for Technicians Expert in Digital Photogrammetry). Maximum 15 participants; duration 1000 hours; maximum age 29 years with almost one year of inscription on lists for employment. The course was to be oriented towards working in cartography using advanced technology.

Annex IV

Course for Technicians for Environmental Control organised by PROTECNO

The organisation of the course was:

Subject	Number of hours
Environmental legislation	20
Information systems	50
Ecology	35
Biology and Microbiology	45
Chemical and instrumental analysis	40
Elements of agrarian sciences	35
Studies on subterranean water	30
Techniques for reducing pollution	65
Techniques for making water drinkable	40
Techniques for recuperation and transformation of biomass	150
Treatment of solid urban waste	20
Exercises in chemical laboratory	200
Management of discharges and atmospheric pollution	20
Environmental monitoring	10
Elements of hydraulics	20