REINFORCING THE CAPACITIES

FOR RESEARCH AND TECHNOLOGICAL DEVELOPMENT

IN DEVELOPING COUNTRIES

A Guide for the appraisal,

implementation and monitoring of

RTD projects and programmes

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HOW TO USE THIS GUIDE

This Guide deals with support for Research and Technological Development in the less industrialized countries. The European Commission has just recently designated this area as "strategic in overseas aid and cooperation from the Union towards the developing countries". This is a field hitherto scarcely explored, because it is often judged to be:

- of marginal interest ("the DCs do not need science; they can buy the available technology from the world 'supermarkets' ")
- esoteric ("research is the realm of specialists")
- inflexible ("supply is not adapted to needs; the demand finds expression with great difficulty")
- a domain awkward to manage (owing to absence of diagnostic tools, means of identifying need and case investigation).

The Guide takes all this into account and aims to reach generalists:

- It is intended for agents working for the Commission, desk officers and task managers, who, in the departments and delegations, are responsible for initiating and following up aid programmes (whether based according to sector or geography); but not necessarily in scientific aid and cooperation.

- It is designed as an instrument for dialogue and exchange: it should be of interest to those responsible for forecasting, policies and projects for development in the partner countries.
- It aims to capture the attention of a similar, equivalent public in the European Community's member states. The objective is to help promote conditions for coherent and truly complementary supportive actions for RTD.

The Guide consists of two parts:

- *Part One defines the field* under consideration.

. the distinction is made between RTD and scientific research; the issues at stake are defined (chap. 1)

. the Community's doctrine and instruments for action in this domain are reiterated (chap.2)

. a strategic approach is outlined (chap.3), and the means of putting it into practice are presented (chap.4).

Several RTD case histories are given as illustrations.

- *Part Two suggests instruments* for investigation of RTD projects and programmes (chap.5). This part is largely given over to identifying programmes and their pertinence. This stage is an essential element of the procedure to avoid any serious fundamental problems later on. Some of the instruments are straightforward (we can restrict ourselves to these); others are more intricate (they have been constructed so that, if possible, they are valid beyond the boundaries of RTD). The combination of these tools constitute a set of instruments according with the "logical framework" of analysis of the problems involved and with the follow-up of the "projects cycle", with which European Community officials are already familiar.

The Guide can be modified and added to

- In its present form it constitutes a Memento, in which the examples and instruments presented can be improved upon by interaction with its users.
- Subsequently, the Guide will be augmented by updating and new case studies.
- Finally it is perfectly feasible to envisage a presentation in an electronic, interactive form geared to easy navigation which if desired could take in further complexity.

PART ONE

OVERALL APPROACH

Chapter 1. Research and technological development: the issues at stake

SCIENCE AND DEVELOPMENT

The idea of putting science forward to serve development is nothing new. Many of the advances made are the fruit of applying its discoveries. And for a long time it has been assumed that it was enough to install science establishments so that spontaneously their findings could be transformed into useful, well diffused techniques .

From the 1960s onward (especially in the 1970s) therefore, great effort has been devoted by the newly independent nations (but also by the Foundations, and by bi- or multilateral cooperation schemes, to build up by training scientific skills and knowledge, equip and build laboratories, create governing organizations and scientific and technical institutions, in almost all the developing countries. Universities have multiplied. Both national and international research centres are engaged in seeking solutions to problems, particularly in health and agriculture. Some spectacular successes have been achieved by applying their results both on a wide scale (the "green revolutions"; control of tropical diseases: malaria, onchocercosis in West Africa and so on); and, on a rather more local discrete scale (such as shellfish culture in Tanzania, nitrogen fixation by plants in Senegal, fertilization of tea plantations in India using earthworms).

This mechanism, which operates mainly through the public sector, now appears dilapidated (particularly in the less advanced countries). It is being questioned, accused of being deceptive (results are a long time in coming, or do not reach the potential "customers"); in any case, poorly adapted. The transition from scientific discovery to application has been perceived to be far from spontaneous. It requires the active organization of the relation between research and the sectors of production. This is the fixed goal of the actions "Research and Technological Development" (RTD) ***(Box 1).***

BOX 1.

The RTD (Research and Technological Development) consists of a continued interaction between the research world and the potential users. Any action taken in this area is multidimensional: it involves political, educational, institutional (legislation, status of establishments, status of researchers), and, naturally, scientific and technical dimensions (monitoring the state of technological, advancement problem forecasting, quality of research).

RTD is guided by the concern for developing in a sustainable way the capacity to market products with a growing added value. It is not to be confused with Scientific Action, even if it includes, among other things, support for research programmes ***(Box 2).***

Box 2. RTD versus S&T

- The ambition of the Scientific and technical actions is to further knowledge. The RTD scheme seeks to develop innovation. S&T gives priority to scientific excellence, whereas RTD takes as its criterion the relevance of action, with regard to the objectives of sustainable growth and development.

- RTD rests first and foremost on abilities in political analysis and monitoring of technical-commercial situations. As means and methods it has :technology transfer; the augmentation of practical, technical and scientific knowledge in industries; the creation of institutions that favour technical innovation; and sometimes specific backing for priority research programmes . Insofar as the action of S&T has allowed maintenance of specific high-quality competences to conduct these programmes, it is on these skills that RDT will be founded. Failing that, RDT has charge of anticipating what bodies of specialists to create and to sustain it when it emerges.

NEW NEEDS IN RESEARCH &TECHNOLOGICAL DEVELOPMENT.

RTD has now become a determinant factor for development, whether economic or social.

On the one hand, the developing countries (notably the less well advanced ones) are faced today with previously unknown problems: urban concentration and the management of towns and cities; resurgence and control of epidemics; satisfying of basic needs and environmental conservation; discredit of education systems and their rehabilitation, and so on. These problems are of such amplitude that solutions cannot be imagined without a great leap in technology; and the very novelty of these difficulties means that well-adapted technology and techniques are not usually available in the industrialized world.

On the other hand, the set of problems involved in development has changed, owing to the much-stated globalization, which gives new opportunities to countries on condition that they enter into the world economy. However, there are conditions attached to this. The top prizes go to countries that favour investment in skilled work and in the

innovation brought by the new actors at work in modernization : the private sector, communities from the civil society and foreign capital that has become easily movable over the world. ***(Box 3).***

BOX 3. GLOBALIZATION

As a term "globalization" covers the restructuring of national economies through world trade; and by the rapid transfer over the Earth of financial capital and equipment (Fig. 1 & 2). Characteristic of the past 30 years, this strong tendency continues its progress. It results from processes led by various agencies:

- over a long period ***intergovernmental*** *action is tending to lift all barriers to circulation of goods. This increasingly multilateral nature of the world trade order is expressed by the lowering of customs duty on manufactured products (whose average changed from 40%, in 1947, to 3.5% in 1994). The World Trade Organization, the successor to GATT, extends this movement to other areas (agricultural products, intellectual property, investments); from the year 2000, it is to tackle other, non-tariff based trade protection.*

- a second process driven by the ***private sector.*** *Companies have changed in their behaviour. They keenly develop their* ***direct investments abroad.*** *This results from a new form of competition which mainly the big multinationals indulge in. These firms build world-scale networks of supplies and production, movetheir resources in search of all sorts of comparative advantages. Division of labour on an international scale is altered by this.*

- Several other trends come in to reinforce those already mentioned :

. the almost completely generalized deregulation of ***financial markets,*** *since the mid 1980s.*

. the high profitability of capital in the financial sphere and their "short-termism", which imposes on productive capital a shortening of the product cycle. This is what gives ***innovation*** *a strategic role in competition.*

. the globalization of the media (TV etc.), which favours the globalization of demand, andcompetition

. the dramatic upsurge in ***the science and technology of information***

. the current concepts of ***management and organization sciences,*** *which underpin the "global" control and management of the large companies.*

The figures, opposite, illustrate how globalization has progressed.

Fig. 1. Gross product and world trade (1986-1995)

The world product has grown by 325% since 1960, world trade by double that.. As globalization extended, the differential between these two growth trends widened over ten years. The World Trade Organization predicted that from 1996 on, the world trade in goods should increase by three times more than their production.

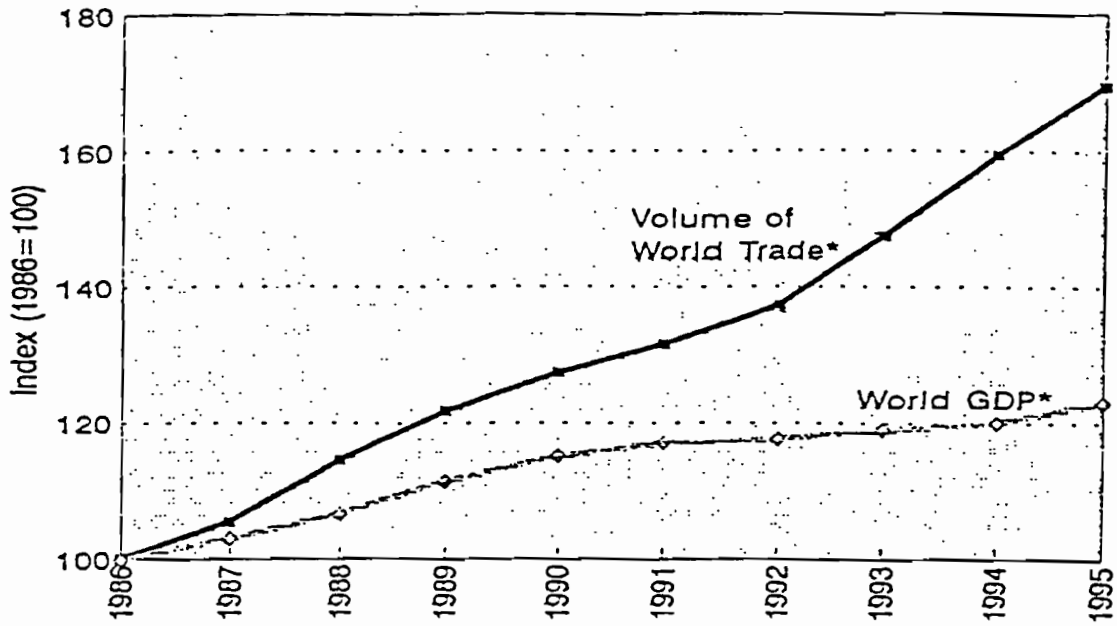
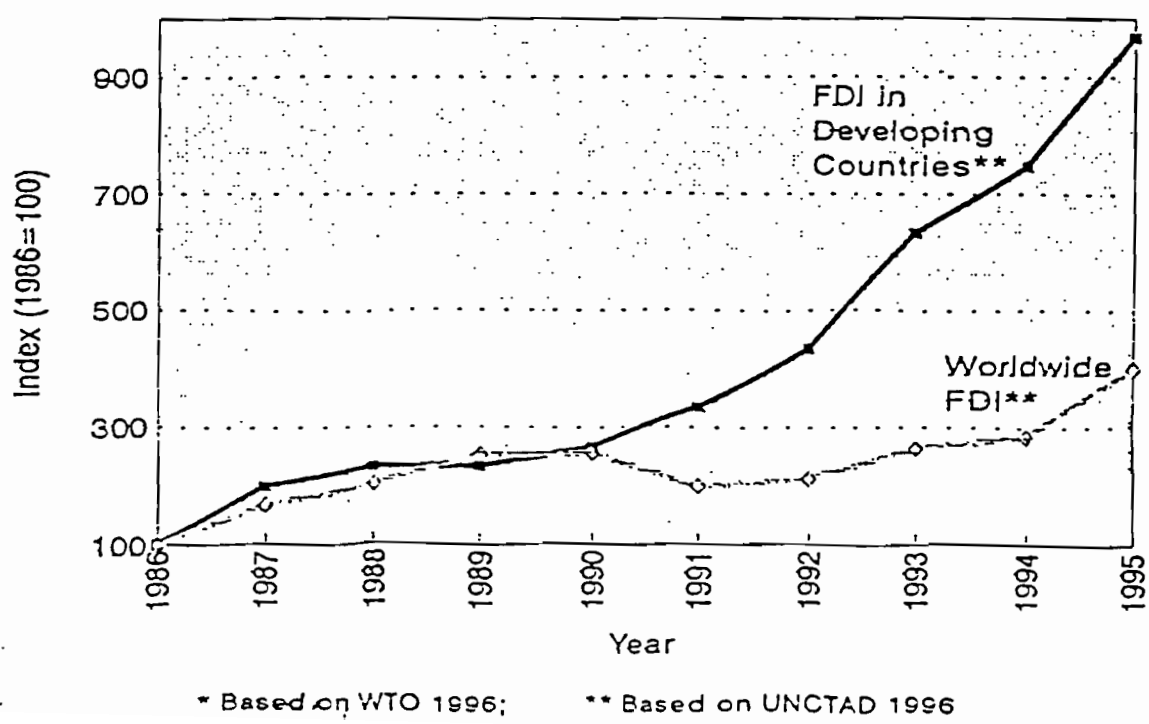


Fig. 2. Direct foreign investments (1986-1995).

There has been a spectacular increase, particularly in investment flow into the developing countries. Which developing countries are targeted for such investments depends on a range of different criteria : the cost of unskilled labour (though this now amounts to no more than 5 to 10% of production costs); localisation; effective institutions and infrastructures. The existence of professional expertise, and a technological cast of mind add up to favourable ground. The presence of locally based RTD capabilities are ever increasingly taken into account.



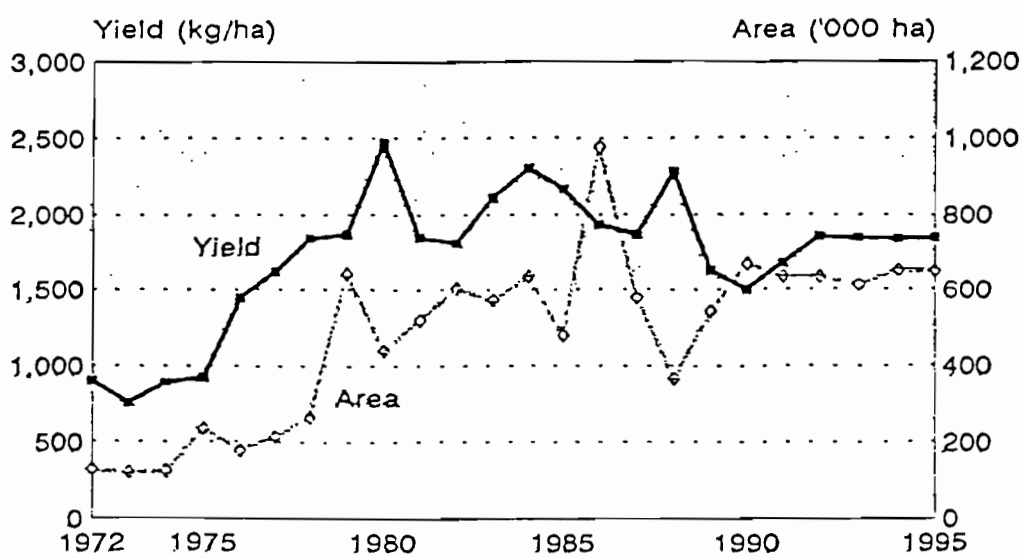
* Based on WTO 1996; ** Based on UNCTAD 1996

BOX 4. Research-development and the diffusion of wheat cultivation in Bangladesh.

The success of the green revolution (the popularization of wheat cultivation) is all the more remarkable in Bangladesh because at the same time productivity of maize and rice increased in that country. Wheat is new as a crop in this country, where it grows only during the short winter season. Almost everywhere in such a brief period it could not reach maturity to the point where semi-dwarf varieties are available which have been elaborated by CIMMYT. The Bangladesh Agriculture Institute has taken over, to conduct painstaking agronomic research and adaptations on these varieties: perfecting of the optimal cultivation practices, adaptation of mechanical tools, and development of local cultivars. It then became possible to introduce and popularize these wheat varieties as crops, with some chances of success.

The diagram (below) indicates that the yields and the areas sown grew very rapidly, until (around 1980) all the potential of the existing varieties was exploited, in the given agrarian and social context. Production went from 37 000 to 1.2 million T between 1960 and 1995, but it was not achieved through bringing fresh land into cultivation (none was available). It stemmed purely from increases in productivity, derived from scientific and technical advances: the expansion of surface areas resulted from intensification of methods, using soils generally left in fallow in winter.

The diagram also illustrates the limitations of the green revolution. After a decade of unsteady results linked to climatic instability (1980s), sown surface areas have attained a plateau. Yields have started to decline, with the old Mexican varieties degenerating and becoming increasingly vulnerable; whereas new, more productive varieties are still awaited.



(Computed from FAO Production Yearbooks, various issues 1974-95)

One major discovery of this past half-century will have been that, on the way to development, investment in knowledge and skills can make up for absence of natural resources. Some decades ago, the highest chances of taking off were given to areas doted with a favourable population / natural resources ratio (Africa was put at the top, Asia on the last level). Quite the reverse has happened. The countries that have made the most striking breakthroughs have rather invested unceasingly in their human resources, especially strongly in RTD. This is what has given the "Tiger" economies the momentum to transform an import-substitution based industry into one vigorously exporting high value-added products. Again, in agriculture, it is the countries which are less well endowed naturally which have made the most progress, by raising the standards of knowledge that are brought to bear. The green revolutions in Southern Asia (21% of the world population live there on 3% of the world's useful land) have to varying degrees called on four kinds of competence: in formulating their policies, in reforming their institutions, in technological innovation and in integrating new knowledge and skills. Brought together as a coherent whole, this constitutes an effective RTD system ***(Box 4).***

BOX 5. A GOOD INVESTMENT IN RTD

Growth of agricultural production and environmental rehabilitation in Sub-Saharan Africa

In the 1930s, the semi-arid district of Machakos in Kenya was a picture of disaster. Soils werein an advanced state of erosion, deforestation was rife and there was galloping deterioration of pastures. From 1930 to 1990, the population and the surface areas under cultivation increased sixfold, which must have causd further degradation. This is what indeed happened up to the beginning of the 1960s: the food deficit was increasing and emergency aid often had to be resorted to in the face of famine. Thirty years later, the process has reversed.

From extensive cattle rearing combined with slash and burn cultivation the agricultural system was converted to one of ploughing on terraces, combined with horticulture, arboriculture and an integrated form of cattle farming. This reversal (productivity and revenues increased; halting of erosion, family-based reforestation, collection of water for domestic and agricultural uses; freeing of children - including girls - to attend school) stems from the adoption of improved techniques, coupled with access to the market. Kenya's highly experienced research and popularization system has played a leading role here: working in conjunction with farmers, adaptation of techniques and varieties to their requirements, taking up their suggestions, enhancing their technical know-how (terrace building and preparation, cultivation of improved varieties). Because of local conditions and at the request of farmers, choice of maize varieties (often difficult to make) favours not the fully resistant kinds but those just less sensitive to drought. The farmers then take on the task of testing them and pushing along the development of cultivation practices by their observations (planting the new varieties upwind, the local varieties downwind, and collection of seeds from the best crossed ears). The women were especially innovative. One major lesson of this operation is that a vital condition for success is to propose to farmers a wide range of techniques with which to experiment; and the more dialogue there is between farmers and researchers, the more chances the gamut of techniques offered has to adapt to existing socio-economic and micro-environmental conditions.

Reference: TIFFEN, 1994. More people, less erosion...John Wiley, Chichester, UK.

In contrast, those nations that have not invested constantly in research, or who have not succeeded in matching research with their sectorial policies, institutions and an innovatory production apparatus, are caught up in a double spiral of increasing poverty and environmental degradation. This is certainly the case for several countries of Sub-Saharan Africa, which not only have not extended or enhanced their industrial base (which on the contrary is regressing), but where agriculture has advanced less quickly than the population - and anyway, not so much by intensification as by taking increasingly land that is fragile. General opinion is that there has been a lack of effective diffusion of improved technologies, suitable for farmers' holdings, might have difused significantly. One of the weakest links has consisted of the incapability of national research systems, poorly financed, to adapt techniques otherwise well focused, and available free of cost (notably through the International Centres of Agricultural Research). The successes of some countries or of certain regionally-targeted operations in Africa are not counter-examples ***(Box 5).*** These rest most often on a scientific or technical advance, and the diffusion of the set of knowledge associated with it.

THE FIELD OF PLAY AND ISSUES AT STAKE

The paths taken by the new industrialized countries are increasingly difficult for others to take. All the more so seeing that changes in international relations promise hitherto unknown problems for late starters. The ending of the cold war deprived many a nation of its strategic importance along with the influence they so enjoyed. The rich countries cut their aid and competition for what is left over is fierce. Globalization leads to relocation of industrial activities, but favouring the hinterland of the three major markets (Europe, USA, Japan). The ACP countries find they are penalized (especially those of Sub-Saharan Africa). The great upsurge in so-called flexible production, taking the place of mass production, puts skilled and technically sound labour at an advantage.

The only advantage for many of the less developed countries, the low cost of an unskilled workforce, falls away as the importance of this factor wanes. Research worldwide, such as in robotization or the various biotechnologies, is geared to economize on or substitute for it, as for other resources found in the poorest countries (energy, primary products). The bill for food will rise, in pace with ending of farming subsidies in the rich countries - and the food aid which their surpluses bacame. Most developing countries will have to open up to competition with producers that are much more efficient than they are. All is not gloom, however. The removal of food aid relieves local provisions producers of the associated competition; and any price rises in the domestic market will urge them to increase production for their internal market and become interested in intensification techniques. The new international trade agreements encourage export of farm produce to the previously highly protected markets of the

OECD; and towards the world markets which not long ago were saturated by products the rich or newly developed countries offered for knock-down dumping prices. Success here will be found, however, only by delivering to tight schedules, finely specified products, passing strict health tests. This implies implementation on the spot of new methods and capacities, not only for production but also in processing, transport, packaging and marketing.

That is not all. Every day worldwide progress in science and technology opens up new paths in a host of directions: new energy sources, environmental conservation, information and communications technologies, distance learning, biotechnologies, food manufacturing and many others in gestation. Even the least advanced countries, as they start to rise, need strong scientific capabilities to enable them to tackle the risks and seize the opportunities that will emerge. ***(Box 6.)***.

BOX 6. New opportunities generated by modern technologies.

One example stems from the benefits that can be drawn from advances in telecommunications, once the necessary infrastructure can be installed and maintained: ease of access and cost reduction can counteract the handicap of an isolated location and put local resources to advantage. India has developed a remarkable industry of long-distance computer maintenance and even contributed to software design. These activities, with a high input of technological engineering skill give advanced value-added products which are highly exportable.

Involvement in telecommunications can feasibly lead to the creation of jobs (and prospects) on many other fronts, including agriculture, and indeed for small countries who back the development of the attendant skills. The Caribbean countries, where several airlines have set up their accountancy and booking services, provide proof; similarly, Zimbabwe, profiting from a telecommunications-based ordering system established near the airport, has entered the business of producing flowers or even fresh fruit salads for delivery at the required time any where in the world. Many other competences (biotechnologies, knowledge of traditional medicines dealt with according to current scientific conventions etc.) can give rise to similar initiatives. Costa Rica has for example made an important agreement (albeit of debatable advantages) with the pharmaceutical firm Mercks. Local ethnobotanists are trained in identification and collection of medicinal plants, chemists in preliminary analyses. A national park is maintained, to conserve biodiversity. Discovery of the active ingredients and elaboration of manufactured molecules require the participation of a world network of working units, some located in Spain and the United States. Costa Rica is therefore no more than a link in a chain of knowledge, skills and realization of the final products; ta rise in the country's competences can nevertheless be envisaged, in the same way that a share of the profits is provided for (Coward, 1996).

Importation of instrumental mechanisms is no longer enough for development to take place. In each sector, the innovatory spirit supposes a combination of opportunities coming from different horizons (notably, possibilities opened up by information and telecommunications technology), an interest in the techniques currently gestating, an ability to anticipate and accompany the forseeable changes (in the markets, organization of work, in the natural or social environment). That is true as much for policy makers as for the entrepreneurs and necessitates the strong backup of a capacity for political, economic and social analysis.

A research and technological development capacity does not stop at a network of engineering consultancies. Its mission is to assist those active in the economy to build continuously the comparative advantages that are *dynamic*, which now outmatch static ones deriving from the climate, geographic location or cheap labour. It is a question of introducing a progressive revolution in attitudes, incorporating scientific rationality with other modernizing factors. The long-term objective is to thus establish a strong well-diffused permanent capacity, to obtain, use, develop, create and spread knowledge or scientific and technical information, capacity which supports the sustainable action and policies for export, ensuring strong growth.

The countries living off "inherited" wealth or resources, or which started late, are the ones that now need the most help in this direction, because they have fallen behind in the march towards a technological society. Either taken by urgency or distrustful of science, they invest less and less in their few existing scientific institutions established in a previous phase. The objective must be reached in stages. But the development path that must be conceived, cut and assiduously followed will involve RTD.

THE PARTIES INVOLVED AND THEIR ROLE

There are countries known for an education system where attendance rate is high which are among the poorest of nations. Others have a reputation for their skilled craftsmanship yet make no headway industrially. Some produce academically highly qualified scientists but who are remote from the aspirations of society at large. Elsewhere educated businessmen, kept up-to-date with new technologies around the world, buy systems from abroad. They might then discover some that were developed by research in their own country, which is poorly known locally.

The precise goal of an RTD system is to organize *links* between scattered centres of competence, which are scarcely aware of each other's existence; especially true between scientific capacities (whose standards have to be maintained by *scientific policies*) and the industrial and productive worlds. This is why RTD intervention acts on several levels, involving the responsibility of different parties.***(Box 7 Parties/Roles).***

Box 7. Parties involved and their roles

The implementation of a succesful policy for aid to RTD involves the participation of several partners :
- on one hand the political decision-makers (donors and receiver countries)
- on the other, the various parties involved directly in Research and Technological development (scientists, diffusion and valorization organizations, organised producers and end-users, notably in the private sector).

a) The Communication to the Council and Parliament of the European Union of May 1997 describes the role of ***the political decision makers*** *as follows :*

Role of the public powers in the DCs :
Their principal role is to define the national policy for RTD and decide institutional measures likely to favour reinforced investment in RTD (regulations on intellectual property rights, on telecommunications etc). The development and adaptation of the regulations should allow the reinforcement of the regional cooperation in this sector. The European Union could attach such conditions to its development aid, as it can for its scientific cooperation.
The state also has an operational rôle in RTD, indeed especially so in the less developed countries, because it is public research that predominates. The priority research areas and the type of action led by the state must be clearly defined. The choices made must be compatible with a sustainable, long term public finance commitment. Public-sector action should concentrate on basic research, training in professional activities linked to research and the national mobilizing programmes, also on setting up of large-scale scientific and technical facilities. The European Union's actions must contribute to the distribution of those costs and responsibilities between governments of the same region.

Role of the European donors.
In the framework of a new strategy, the European Union will define clearly the complementarity of its actions, and ensure they are consistent with bilateral actions conducted by member States.
As a matter of priority, th commossion could support several strands : a reinforcement of the dialogue on RTD at political level; institutional reforms; reinforcement of scientific cooperation on both regionel and international scales; the coordination of European positions on the subject in international circles. The Member States could give greater place to actions aiming to reinforce scientific and technical capacities in the countries with which they maintain bilateral cooperation schemes, notably by means of the guidance as to their orientation and financial support brought to their own scientific community and to their industrial companies.

***Box 7. Parties & Roles** (continued)*
***b)The other partners** are the parties directly involved in RTD, in the North and in the South.*

In the DCs, "it is the leaders in society, the producers or users of knowledge and technologies...It is expected of them that they get organised, to take an active part in establishing priorities and implementing research-based actions. They should also assume increasing responsibility in financing the RTD effort..." The private production sector, especially business, need be made aware of the strong requirement for innovation, especially in technical aspects. Scientists will have to practise several different research-related professional activities : from the creation of knowledge or methods, through training, to the diffusion and valorization of their results, and to the creation of a demand in a spirit turned positively towards the existing clienteles
Non governmental associations and organizations are expected contribute to the popularization of science and technologies, and also to developing an attitude that accepts the importance of the maintenance.

In the North (seeing that the DCs cannot on their own make up lost time), it is a question of mobilizing public and private expertise so that they can become involved in original scientific and technological partnerships, in line with the priorities identified jointly by the countries in the South and the European Union. Private companies especially can contribute greatly to the technological apprenticeship of the South. Research organizations can enter into fruitful cooperation schemes with their counterparts in the developing countries, on the basis of regional high priority programmes that Global forums (similar to the one recently established for agricultural research) will have allowed to designate agreement between certain parties.

→ The first level of action is *political*. It is a question of drawing up a solid long-term policy for technological development, taking account of the world environment. The experience of countries developing strongly is strikingly clear. Their unflagging growth is based on a dynamic policy for technology, in which proposals for cooperation from international companies are actively prospected and selected, choices made by the private sector are steered, workers' training and scientific and technical capacities are developed according to a course set for the long-term (Malaysia's "vision 2020" programme is the most recent example; the cartels in Japan, the interventions on the financial markets and selective tax incentives of South Korea are among the most well-known devices). Nevertheless, even if the programme followed is in tune with a grand "vision", is a guide that needs constant updating. Its monitoring devices are technological and commercial observation; and the sectorial and social diagnostic tools and forecasting scenarios. It is not necessarily the State which takes charge of research or of any reorganization of production in sensitive sectors. The goal is rather to facilitate the interconnection between national and international participants, to bring universities into closer contact with industry and researchers nearer to managers.

→ The second level of action is *institutional*. This entails modernization of the legal and regulatory framework, to create a more favourable environment for innovation (throughoutthe whole productive sector). Many different aspects are concerned: intellectual property law; legislation for international litigation, rules for circulation of "intangibles" (consutancy, computer software, information, technologies); quality certification; development/valorization agencies; professional incentives to innovate, especially for public sector researchers: status of universities (financial independence), researcher status (prizes or bonuses for good results, for mobility, profit-sharing following application of findings).

→ The third sphere of activity concerns technology *infrastructure* needed by the country in question. It comprises the installation of tools now essential for both commercial and scientific activities: computing and telecommunications, with wide access. It includes financing enabling establishments to produce basic and technical application programmes meeting the requirements of the economy.

→ The fourth area is lastly that of *local scientific capacities*. Among the foremost aspects feature support for accomplished scientists (often poorly known locally, whereas they can be easily identified from global bibliographic data bases); backing for specialist circles and for instruments that can bring them together (specialist journals, learned societies for instance); aid for certain leading-edge institutions (which concentrate and keep talents); and if need be, attention to scientists who are scattered abroad, whose countries have wagered not on their return, but on linking them up to a network to connect them with those active in the country.

Also required is a raising of the level of general knowledge in science, first of all among farmers and businessmen, who are often suspicious of technological change. More deeply, it is necessary to promote a culture of innovation, in all the segments of society, as much in the private sector as in the public domain.

A SECTOR OF STRATEGIC COOPERATION

The modernization of production is the weak point of many of the less advanced countries. It can be achieved by elaboration of a sustainable RTD system. Many governments, taken by an urgent situation, in the throes of structural adjustment and sometimes crippled by debts, have had to concentrate on short-term priorities. The donating bodies have contributed in concert to ad hoc operations, to transfer or substitution initiatives, where research was not involved or reduced to a kind of instant engineering. Investment by the developing countries in RTD has been at a standstill for 15 years and indeed this overall indicator marks some deep disparities. The new industrial countries are intensifying their efforts (China and South-East Asia now put in

as much as half the effort of Japan). In contrast, 60 countries (including most in the ACP group) account for no more than 0.5% of world expenses on RTD; they contribute 1.2% of scientific production and 0.2% of technical production. The portion represented by private financing is exceptionally weak here (around 5% of expenditure) and is falling back. Science's productive base is affected (which bibliographic data bases show : since 1990, they have recorded in many countries a distintegration of networks of scientists, the disappearance of leading institutions and a production reduced by 15 to 50% in such sensitive sectors as agricultural science). Many researchers (and not always the most indifferent performers) change profession or go abroad. Those who remain function poorly, are isolated and have little influence as a force, because they are enclosed in their particular fields, rarely strategically important for production purposes. Furthermore, neither the States nor industry and commerce (including the private farming sector) show any signs of wishing to control and exploit the valuable parameter technical progress has become.

For the European Union, this represents a field ripe for collaborative aid action. Firstly, because it is vital for integrating the least advanced countries into the world economy. Secondly, because the Union is well placed in RTD, in which it has had some successful experiences. Besides, the Union has at its disposal a regulatory framework, instruments of intervention, specialist and mobilized scientific and technical expertise, and a reaffirmed political will, which has to be transformed into some original programmes.

Intervention in this area is intended above all to contribute to a historic renewal of initiative, by the countries themselves now in danger of being marginalized. Such an operation will thus serve durably the long-haul cultural and political objectives, those held by the Union in its overseas aid action.

Operations must of course fit into the existing body of regulations. They need to be guided by a strategic vision and should target the weakest links. They call for plenty of imagination, in an area where what is required is the building-up of capacities and institutions, not simply technology transfer. This is what we examine in the chapters that follow.

Chapter 2. The framework and the instruments of European Community policy.

The European Union has long experience in development aid and cooperation towards research and technological development (RTD). One strategy, orientated towards the developing countries, now aims for a coordinated effort to converge different sectorial policies: in particular those concerning scientific cooperation and development aid ***(Box 8)***. A range of means of financing can be made use of for this type of action.

BOX 8.

Scientific and technical cooperation *(S&T) builds partnerships between research teams from the North and the South, in the context of joint research programmes or projects. The essential point here is to support high quality of research in the South, to enhance their value and generate new potentially useful knowledge.*

Aid for development of RTD *is intended to reinforce the scientific capacities of a country or region and the technical competence of their people, by backing for appropriate institutions, training, equipment, and making up-to-date information and technologies accessible.*
Cooperation in RTD *combines these two devices. This approach seeks to establish links between research and its end-users, and to steer the society towards innovation.*

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A. THE STRATEGIC FRAMEWORK.

A1. The basis for sectorial policies: the Treaty of Maastricht

The Treaty of Maastricht provides the bases for several sectorial policies, which need to be made to converge for successful cooperation in RTD.

Title XV sets the objectives of a Community policy in *research and development*. It defines the means for achieving this.

> Article 130 F stipulates that one of the objectives is to "promote actions of research judged necessary under other chapters of the treaty: one of them concerns cooperation for development (Title/Section XVII).

Articles 130 G and 130 M envisage specifically the promotion of "cooperation in technological development with third-party countries". This cooperation is foreseen as contributing to "research, technological development and community demonstration".

The Framework Programme for Resarch, Technological Development and demonstration activities, covering a number of years (FPRTD, allowed for in article 130 I) therefore has included, from the outset, a section on scientific cooperation with developing countries. Administered by DG XII (Research) it has identified its budgetary line (see further on: the instruments, INCO-DC).

Title XVII defines the aims of a *cooperation and development* policy.

Article 130 U states that for the countries concerned, the policy must favour :

- sustainable economic and social development.
- their harmonious, progressive integration into the world economy.
- the combat against poverty.

The measures to be put into operation are decided by the Council (Article 130 W). Several Directorates can contribute.There are various instruments for financing (including the European Investment Bank, and several credit lines managed by various DGs).

The ACP countries (Africa-Caribbean-Pacific group, co-signatories of the Lomé convention with the Union) can benefit from all these actions. Moreover, they have access to a *special form of cooperation* negociated in the framework of the ACP-CEE convention and financed by the EDF (European Development Fund).

Article 130 X emphasizes the importance of coordinating cooperation policies for development of the Community and the member states. It provides for *consultation* on aid programmes, possible joint actions, and the contribution by the Member states to finance Community programmes (EFD). It gives the Commission the brief to take any possible initiative useful to promote coordination.

A2. Strategy: Communications and Resolutions.

These fundamental policies can be combined, to construct in a specific field an effective *strategy of action*. This is the focus of several communications emanating from the Commission and of Council resolutions, in what is now estimated a crucial area of cooperation : operations involving RTD.

Such communications are proposals for legislation, by the Commission to the Council (or to the European Parliament, on subjects for which a joint decision is stipulated). If the Council approves, it replies with a Resolution, fixing the general objectives and the broad outlines of action. Cooperation in Research and Technological Development is governed by the following texts.

- The Communication *Prospects for international cooperation in research and technological development.* (COM 95-489) makes a distinction between emerging economies from other developing countries. It stresses the need to reinforce the S&T potential of developing countries. It also encourages financial support, on EDF funds, of projects that carry an element of Research and Technological Development.

- The Communication *Scientific and technological research - a strategic part of the European Union's development cooperation with developing countries.* (COM97-174) deals specifically with objectives of RTD cooperation with developing countries.

- This document draws lessons from the past, stressing the necessity to make what are two complementary devices *consistent* with each other: international scientific cooperation; and economic an technical cooperation.
- It proposes to leave considerable room for RTD thanks to an array of financial instruments devoted to economic and technical cooperation (such as EDF, ALA and MEDA regulations, EIB).
- The communication sets out the objectives and principles for a *global strategy*, combining the action in three spheres: institutional, investment and scientific and technological cooperation. Public aid to development should notably focus more on the RTD sector, with a long-term viewpoint. Such aid can concern any of the three areas; and even, if need be, support research (other than in the areas covered by INCO-DC, undertaken under other criteria - mainly to do with relevance).
- It draws attention to certain particularly *underprivileged spheres* :

- economic, social and political sciences, necessary for laying down diagnostic procedures, developing foreseeable scenarios and organizing the public debate essential generating a participatory process;
- engineering sciences, without which there is deficit in technological culture;
- incorporation of traditional knowledge, adapted according to modern scientific approaches.

- The Communication finally gives *yardsticks for establishing priorities*. To the spheres already identified (health, natural resources management, agriculture and related industries), it adds demography and population movements (including urbanization) and the interconnected fields of information and communication. Furthermore it emphasizes the pressing need to rehabilitate the universities as the proper centres where knowledge is elaborated and transmitted (in particular through partnership contracts with European universities). ***(Box 9).***

- *The Council of 5 June 1997 confirmed* the "strategic" role attributed to RTD for stimulating development

- It approves the convening of a *steering group* of specialists from the Member-states and the Commission, which co-opts as required experts from countries of the South for exchange of information and views and to consider the overall strategy and its implementation.
- It defined four main guiding principles for action, one of which is *mainstreaming* (whereby the concern for RTD is taken into account during the formulation of any development policy, programme or project, even for a sectorial operation. ***(Box 10).***
- The accent is placed on: institutional construction; creation of an environment favourable for RTD; promotion of regional and South/south initiatives and action; the role of universities; the combination of strategic, "basic" research with short-term, "problem solving" research.

BOX 10. The Resolution of June 1997. Article 6.

Art. 6. "General Principles :

- Partnership at both policy and operational levels, promoting the developing countries' ownership in order to optimize effectiveness

- Differentiation in order to take into account the different needs and circumstances of individual countries and regions

- Mainstreaming development research as an integral part of development programmes and policies, geared towards a better understanding of developmental processes, while not excluding specific esearch activities

- An integrated approach to solving specific problems, which will entail interdisciplinary collaboration, including the social sciences, and will associate the end users of research and technology."

BOX 9. Communication of May 1997. Extracts

..."Apart from a few rare exceptions, it is clear that neither the donors, nor the receiving countries themselves, have clearly perceived the major role RTD can play as support for policy for sustainable development. The level of investments that have been devoted to it has therefore remained quite inadequate.."

..."The development of an RTD policy rests on the coordinated implementation of actions in three spheres at once complementary and distinct. The first relates to institutional-type actions and aims to define the legislative and regulatory frameworks which condition the pertinence and viability of RTD activities. The second concerns the growth of essential research capacities (particularly infrastructure investment and human resources). The third area of activity is that of scientific and technological cooperation which allows what is an essential opening up of research towards the exterior, eases access to the bases of knowledge it needs, and imposes the use of international standards of quality. In the past the institutional aspects have been ignored or neglected, depriving the actions that potentially influence research capacities or scientific and technical cooperation of a coherent framework..."

..."The Community's cooperation with the DC in RTD has at its disposal two types of instrument to implement it: the international programmes of scientific cooperation which meet the objectives of community policy for research and are managed from the core of the framework programme; and the economic and technical cooperation operationswhich fulfil the aimsof policies outside those of the community and (these programmes) are put into effect with the aid of various financial instruments (EDF, and the ALA or MEDA regulations), specific to certain regions. Differentiation of the RTD actions which relate to each particular instrument, and the reinforcement of their coherence around a common general objective constitutes the basis of a global, original strategy"

B. THE INSTRUMENTS

The Commission has two kinds of instrument at its disposal :

- *those geared to international scientific cooperation.* They are included in the Framework Programme for Research and Technological Development, directed by the DG Research: DG XII. The FPRTD comprises a special section for cooperation with the developing countries: *the INCO-DC programme*, registered in action 2. INCO-DC has its own identified credit line, its objectives by region and its own selection procedures for projects (with annual tendering).

- *the tools of economic and technical cooperation.* To fulfil the aims of external policy, or the objectives of cooperation of the different General Directorates, they call on various budget lines. One of the main budget lines is the one governed by DG VIII (Cooperation), in the framework of public aid to development earmarked for ACP countries (*the Lomé Convention*, financed by the European Development Fund). However, other tools must also be mentioned, open to diverse developing countries, like the ALA and MEDA regulations (managed by the DG Ib, oriented toward Latin american and Mediterranean countries, and supporting inter-university cooperation schemes, rather than true research programmes); cooperation schemes open to all the third party countries concerning information technology, telecommunications; etc.

Next we look at two important instruments: INCO-DC (for scientific cooperation) and the aid to development of ACP countries, governed by the DG VIII.

B1. The science and technology cooperation programme: INCO-DC

This Programme and its constituent parts, now with more than ten years' experience behind them, have been evaluated several times, with largely favourable results. The Programme is open to all developing countries. Action undertaken wagers on the forging of lasting links between co-workers and laboratories who get on well.

Activity is initiated every year by a call for proposals, each of which must bring together research teams from at least two EU member-states and one or several DCs. Schemes put forward are evaluated by a body of scientists, then by a DC committee which examines the opportuneness of the project.

Invitations for proposals are made according to a theme plan set for four of years. Currently, the research activities are centred on three main subject areas dealing with development-related problems common to all DCs (agriculture, health, natural resources management). An additional sector of "mutual interest" is provided for (in particular in the information technologies and non-nuclear energy)

Taking into account the disparities in degree of development existing between different DCs, the programme is adjusted according to region. At this scale, it specifies the main themes; it can target one aspect of these themes and set up a regional network of laboratories focused on it (for example: water, in the Mediterranean region); it also takes account of actions taken up by other backers.

B2 Public aid for development: the ACP countries

The Lomé Convention ***(Box 11)*** symbolizes since 1975 continuous cooperation between the European Union and a number of states known as ACP countries (Africa-

Caribbean-Pacific). Its aims are to promote and accelerate the economic, cultural and social development of these states, at the same time making priorities of the respect of human rights and strengthening democracy and the rule of law. The Convention is administered by the Union's DG VIII (Cooperation). Financial backing comes from the European Development Fund, which does not come under the Community budget. The Fund's sources are voluntary contributions from member states.

BOX 11 The Lomé Convention and the RTD "sector".

RTD is not made a priority "sector" by the Lomé Convention, but rather a specified action that cuts across nearly all the fields of intervention, in particular in :

- agriculture cooperation, food safety, combat against drought and desertification (appropriate-technology transfer, agricultural research etc.)

- fisheries development

- industrial development (S&T infrastructure linked to industry, technology transfer and adaptation, South-South technological cooperation schemes, identification and implementation of relevant S&T programmes, access to information, training etc.)

- mining development (training in S&T skills, injection of risk capital etc.)

- energy development (particularly involving new and renewable energy resources)

- development of services and service industries (including the latest technology), in transport, tourism, computing, communications, support for companies etc)

- cultural and social cooperation with its special section for scientific and technical cooperation, and its Foundation for cultural cooperation (taking into account of social aspects of action and the dimension of cultural identity)

- regional cooperation ("which must give special attention to S&T cooperation between the ACP states")

- cooperation for development finance (whose goal is to help ACP states to "innovate, adapt and transform technologies, through backing for education and training programmes for research, innovation and technological adaptation...").

It is therefore perfectly posible to finance support for RTD by using mechanisms inherent in the Lomé Convention. Notably, a research section can be included in any project. It would be all the more advisable if the latter dealt with large sums of money, in order to validate its objectives, its means and impact. This design of course depends on the ACP country which is receiving the aid.

Lomé Convention affairs are implemented by the Union and the ACP countries working together. The Community declares the amount of money for aid that can be put on the programme, by country and by region. On this basis, the ACP countries draw up their indicative national (INP) and regional (IRP) programmes. These programmes stipulate the priority objectives and the timetable for realization and mention projects already well advanced at the design stage. The Lomé Convention allows for the possibility of interventions geared to RTD in nearly all fields

An evaluation of the RTD activities undertaken in this framework has revealed that up to now "investment has remained very limited (less than 0.8% of the EDF's undertakings) and that the actions set in operation appear highly diverse with no clear coherence. The role of the RTD as a strategic element of sustainable development "does not seem to have ben the inspiration behind past action". The Commission and Council concluded for the necessity of a vigorous strategy in this area, taking its inspiration from a long-term vision. They recommend better mobilization to this end of funds for development aid, following the "mainstreaming" principle.

3. The horizon of the next millenium.

Discussions are already under way to consider the measures to take after the Lomé Convention expires in 2000. ***The green paper*** on this gives an appraisal of 25 years of cooperation and outlines future prospective scenarios. It proposes several options, related to:

- policy (economic/social/environmental; trade and investment; institutional)
- geographical coverage
- financial and technological cooperation in practice.

Already, the green paper recommends that cooperation should be "broadened out and reinforced in spheres such as science and technology, education and training". Notably, in its socio-economic dimension, it should "help maintain the advancement of scientific and technical capacities as a strategic element in sustainable development". The green paper otherwise emphasizes the importance of intensifying regional integration in this area, of developing partnerships between the public and private sectors, in particular between research and industry.

Chapter 3. A global approach

Research and Technology Development aims to link up the worlds of research with potential user bodies (those active in the economy or society); in other words: to allow a supply and demand for research to be expressed and met, oriented durably towards development
(***Box 12*** : inapplicable applied research) (***Box 13*** : get the context under control)

The initial situation often sets up several obstacles. Some of the most common are as follows :
- the scientific skills and knowledge at a given place could be non-existent, or could have deteriorated or be cut off from local professional circles.
- demand is only small, and local economic conditions do not lend themselves to innovation (particularly technical).
- Research financing is lacking, not very anticipatory, all taken on by the state.
- collaboration between the public and private sectors is unusual and problematic.
- throughout society at large and in numerous groups suspicion prevails against innovation and technical solutions (often adminsitered from above and inappropriate for the means at hand and the ways of seeing things of the protagonists).
- the instruments used to direct research (technical watch, budget, programmes, careers, incentives) either do not exist or are incoherent.

Coherence is a major consideration. Research and Technological Development is a transversal issue. The crucial requirement is an all-embracing policy. Taking stock of past cooperation schemes, the European Community has notably estimated that, even though they had met with success in terms of scientific objectives, with the lack of an overall vision, the linkage is not made with a true Research and Technological Development system in the countries concerned. The impact on development has proved limited. The European Community has concluded that, concerning RTD, this global approach is a prerequisite *(Green Paper)*

This chapter sets out the governing principles. Senior management staff, generalists and specialists alike in all sectors, should find it useful for understanding the interactions between their various actions in setting up a sustainable RTD. The approach rests on :
- the principles of European cooperation;
- the distinctive character of a sector (i.e. RTD), where the action must be acceptable, anticipatory and realistic.

Emphasis will be placed on precautions to be taken in operations, which will facilitate the sustainability of measures taken.

The following chapter shows how to elaborate a strategy, starting from a situational diagnosis and applying the principles.

BOX 12. Innovations without innovators.

Paradoxically, most often there is an excess of applied research, or rather "inapplicable applied research": in other words proposals for innovation that will never see development, because no liaison was made early on with those involved in production.

Examples abound. One oft-quoted are foul-tasting weaning cereals for newborns, or others for which tthe constraints of industrial production were not thought of earlier. Another case is that of bread made from maize or rice, elaborated by a university research institute with the idea of absorbing the national production surplus. Wheat (which contains gluten) is still the basic ingredient, but the process involves mixing in with the dough various quantities of the other cereal, aiming all the time for successful breadmaking. Satisfactory results were obtained in the laboratory, but no contact had ever been sought with any bakery. It was only by chance (through a request from one of its engineers, who had been to that university) that a bread manufacturer had sent to him the relevant literature. The company quickly put the bread on the market, only to withdraw it just as quickly. The problem was not poor bread, but at the time wheat importation was subsidized and there was no profit to be gained from developing this alternative technique.

S&T thus proposes a variety of anticipatory solutions. However, to bring them into fruition, links must swiftly be made with industry. Besides, RTD depends on institutions and economic policy. Under protectionist conditions, there are few prospects for technical innovation.

Reference : (Arvanitis, 1990)

The principles for intervention

Cooperation conducted by the European Union has the objective of aiding developing countries to tackle problems of poverty, development that is sustainable and integration into the world economy. This is the main aim; and one of the means could lie in building a viable, structured Research and Technological Development system. The European Community offers to assist countries *if they so wish.*

The principle of *partnership* is paramount. It is for the countries of the South to make their choice, to lead the action and to take it over. This is what guarantees the most efficient use of aid, which the European Union must make accountable to its public. The result is that support for RTD schemes will be selective. Some developing countries can assign to it only a low priority. In this type of case, Europe will concentrate its assistance in other spheres. It will only cooperate in countries that demonstrate their interest and committment as far as this field is concerned.

BOX 13. From S&T to RTD : control the context (An agricultural research project).

The story concerns a long-term collaboration (15 years) between a Foundation linked with a private commercial group and the research centre of a university of agriculture. The objective was to increase what were very low yields for maize. The first programme consisted of "hard" science based technical design : using pedology, hydrology and genetics a "technological package" was elaborated, based on a new cultivar and improved drainage methods. However, the farmers (the poorest in particular) clung to rather erratic cultivation practices and the system so packaged, which must be used as a coherent whole, lost its efficiency. The second programme therefore opened up the system to achieve a more flexible technology and concentrated on technical assistance (the farmers having to test the recommendations, even if it meant changing them). The organization and size of the project were modified : the research centre no longer functions in isolation, later to deliver its discovery as a finished product; its responsibilities grew enormously from the piloting of popularization teams; the research agenda is determined after feedback from detailed observations, made on the parcels of land and farms; the disciplines involved and the content are modified, focused on the removal of any factors inhibiting production in situ, more than on the transfer of knowledge. Still the operation made no progress; the major glaring constraint is economic : farming loans are unattainable for the poorest, accredited too late, or misappropriated for non-domestic and family purposes. The 3rd programme brings together a few researchers stubborn in their beliefs, who got themselves detached to head the project. They spent four years to set up a well-adapted credit system before "their" flexible technology, improved upon in the mean time, at last experienced a notable success . Yields doubled and the operation effectively spread. (Arvanitis, 1990).

For RTD to be a success, therefore, judging by this general lesson, first needs to control the context, to create conditions making the results of research acceptable. Who takes on this task and how ? In these cases it is the researchers; the solution is not the most rational one; but often the most practical for operational purposes. But this implies that there must be people prepared to do it, or offered incentives and authorized to do so by their governing organizations.

If there is such an interest, four interlinked fields of action can be distinguished : *political, institutional, investment (in particular : improvement of human resources), scientific and technical*. Construction of a system of RTD is especially sensitive to specific points in each of these aspects.

a). Strengthening Policy Analysis Capacity for RTD

Policy formulation begins with the statement by political decision makers of high level goals such as poverty reduction, improved public health or enhanced educational opportunity. These are desirable ends in themselves, even though there will inevitably be debate about their relative importance and about the many trade-offs that occur at the margin when there are many such ends and the resources for achieving them are very scarce.

At the next level are strategic or intermediate goals. These are means towards the ends of the higher level policy goals, but they are also desirable in themselves. Natural resource conservation is such a goal. The creation and strengthening of in-country RTD capacity is another. It is a goal insofar as it fulfills the aim of developing dynamic comparative advantage in the shape of a technologically-based and technologically-minded society, capable of facing unforeseen challenges and grasping unexpected opportunities. Insofar as it succeeds in generating a stream of useful technologies, it is also a means towards the end of fulfilling high level policy goals such as poverty reduction.

The vital link between policy goals and their implementation is the design and deployment of appropriate *policy instruments*. The most familiar such instruments are probably those associated with macroeconomic policy, such as fiscal measures, exchange controls, credit restrictions, interest rates, monetary policy, etc., but there are many others. Policy instruments appropriate to the development of in-country RTD capacity include laws, regulations, personnel policy, fiscal measures, direct investment, human resource development and the creation of infrastructure and institutions.

The purpose of Policy Analysis is threefold. First, for any given a set of policy goals it identifies the most appropriate "performance indicators" and sets achievable targets for these [1] . This may involve highlighting conflicts between goals and identifying possible ways in which these may be resolved. The second purpose is to design an integrated and mutually consistent set of policy instruments that will most efficiently achieve the targets set for the performance indicators. Finally, Policy Analysis monitors progress, using the performance indicators to provide early warning if corrective action is required, and to indicate necessary adjustments.

[1] A "performance indicator" is an objectively verifiable variable which can be used to measure progress towards a given goal. for example, if increased net foreign exchange earnings were a policy goal, the most apprpriate indicator may be the foreign exchange reserves of the national bank.

Policy analysis capacity is required at many *levels*, but the need is usually greatest within government bodies with multi-sectoral responsibilities, such as the Prime Minister's office, the finance ministry and the planning commission. PA units within such agencies require a highly-trained staff of full-time policy analysts. Their cross-sectoral responsibilities place such units in an ideal position both to develop the means of implementing RTD policy and to place the relevant instruments within the wider policy context with which it must be integrated. General education, utilities and transport infrastructure, for example, not only make vital contributions to economic growth, but they also have a crucial role to play in stimulating the private sector to build its own RTD facilities. Similarly, RTD policy, insofar as it ultimately generates useable technology, has a crucial role to play in furthering government aims in areas like transport, utilities and education. The interactions can be highly synergistic.

Many of the policy instruments designed to promote RTD will have impacts on, and trade-offs with, wider policy issues. For example, tax incentives to promote RTD in the private sector will reduce total tax take, while free or subsidised technical training will increase government resource requirements. Such instruments must therefore be integrated with a wide range of macroeconomic, social and trade policy areas.

Line ministries, such as agriculture, education, forests, health, industry and transport also require some degree of PA capacity in order to set and implement RTD policies at the sectoral level within the general framework of national RTD policy. Within sectors further capacity may also be required, for example at the level of the research institute or the technical university, which have to identify and deploy the instruments needed to achieve the tasks allotted to them by policy makers. However at these levels there is not likely to be a need for a full time staff of policy analysts. There is, however, a need across the board understanding on the part of senior management of the role of PA within the institution and an ability to commission it as and when required, and to evaluate the findings.

There is a potentially very important role for the *private sector* in policy analysis and this must be supported and strengthened. Government and government agencies represent the "demand" side of PA. On the "supply" side there is also a role for government, but there is often an even stronger role for the non-government sector, such as academia, NGOs, private consulting firms and specialised PA institutions (along the lines of the Thailand Development Institute). Often the most efficient way of conducting PA is for staff within a public sector agency to translate policy goals into an analytical agenda and then commission an independent outside body to conduct the analysis.

b). Strengthening Institutions

The creation of RTD institutions is not a new departure for most developing countries, but in the past this has been almost exclusively in the public sector. This tendency was often guided by a sense of suspicion and distrust with which many LDC governments have historically viewed the private sector (both the for-profits and the voluntary sector). This was often reinforced by the predilection of most donor agencies for providing development assistance on a government-to-government basis. Although there have been occasional success stories, the economic return on this investment has been largely disappointing. Public sector research have been saddled with unwieldy bureaucratic structures and poor reward systems that have often stifled scientific initiative, creativity and productivity.

The challenge now is to find the right combination of public and private sector RTD institutions. New and innovative ways will be needed to achieve this blend. These may involve imaginative combination of institutional forms (public sector research institutes, academia, NGOs, the for-profit private sector, regional organisations, European organizations) and contractual relationships (payment-by-results, commissioned research, research contracted by users' groups, etc).

The type of institutional strengthening that is required will vary between sectors of the economy. In manufacturing the technology that will produce economic growth will be delivered primarily by the for-profit private sector through its own R&D laboratories and other facilities. However firms will invest in such facilities only if the environment is conducive. Part of this environment comprises the social and economic infrastructure whose provision is an inseparable part of development. Another part is getting the policies right. Here the need to strengthen policy analysis capabilities and institutional capacity clearly go hand-in-hand.

The policy environment must be such as to encourage firms to switch from the easy option of import substitution behind a wall of protectionist measures, subsidies and distorted prices, to export orientation with its potentially higher rewards but also higher requirements in terms of management standards, product quality and delivery schedules. Since this will require in-house RTD capacity, creating a policy environment that encourages private enterprise will ultimately encourage businesses to create this capacity. However some other more targeted policy instruments will be required that specifically encourage firms to develop an RTD capability sooner rather than later.

Policy areas that have *to be addressed include*: measures to promote competition; the protection of intellectual property rights (especially the granting and enforcement of process and product patents, and protection of trademarks, copyrights and designs);

BOX 14. Intermediate technology

The Delhi Forum Movement is one of India's non-governemental organizations which keep a close watch on the improvement of life for the poorest people, with particular regard towards the resources that might be brought by a technology adapted to their situation and what they have. One of its offshoots is the Centre for Technological Development, where volunteer engineers and researchers work according to problems identified by grassroots workers in the local branches.

For example, in Himshal Pradesh, poor horticulturalists are obliged to sell their fruit crop still on the tree unharvested, as they cannot afford storage facilities. The engineers and the movement's researchers became inspired by a preservation technique that had been practised two centuries earlier by the Moghols in the same region (caves are gouged in the hillsides to form cellars). They rethought the system : the form of the cellars, excavation methods and the way of maintaining the appropriate temperature (initially ice is brought in, then irrigation with running water is put in place). Subsequently, they elaborated straightforward desiccation techniques, which allow the sale of produce (apricots, apples) in dried form, ten times lighter and thus alleviating the high cost of transporting fresh fruit, which is in high demand in the towns. A new marketing circuit has been established, based on cooperatives. The local farmers sell their products at higher added-value and their incomes have increased substantially.

Again in Himshal Pradesh : tanning products have been developed using bark preparations from locally growing trees. The leather craft, which was on the brink of collapse because hides sent away for tanning with chemical agents worked out at a high price has thus been revitalized. This craft industry has itself been modernized by craftsmen who had migrated from the area but then returned, bringing new styles and fabrication techniques learnt in the towns, for products such as shoes, bags and other fashionable objects.

The fact that the technology researched into was inspired by grassroots producer-organizations, which themselves carried out experimentation, and adapted it to their available assets is a large contributing factor in the success that has been achieved.

fiscal policy and investment promotion measures that reward companies that invest in RTD; tariff and non-tariff measures to control or promote technology imports; removal of price distortions that discourage innovation; appropriate laws on contract enforcement; credit and interest rate policies that encourage investment in areas such as RTD that have a long pay-off period; promotion of export market research; granting access to foreign exchange; public investment in RTD infrastructure. There must also be a high level of liaison between private and public sectors. Policy makers must co-ordinate closely and continually with the private sector through institutions like trade associations and chambers of commerce and industry.

Government could also do a good deal to promote quality, to provide relevant skills training and to encourage technology-based joint ventures with overseas partners. This last area is one in which EU assistance could be particularly fruitful in facilitating such interchange with European public and private sector institutions.

A more pro-active set of interventions is needed to strengthen RTD institutions in areas that are not naturally attractive to private profit-oriented firms. ***(Box 14)***. In agricultural research, for example, such firms can normally be expected to concentrate their RTD on industrial crops and export crops, where they can capture enough of the value added to secure an attractive return on investment, but they have no natural interest in research on subsistence crops. Agricultural research on subsistence crops is in fact one area in which developing countries have a relatively long history of investment. Many also have invested in institutions for RTD in such fields as natural resource management and health. If a partner country's policy is to continue to support such institutions and there is a clear commitment to make the reforms that will make them less bureaucratic, more productive and more client-oriented, Europe will provide assistance to help bring about these changes. A potentially very fruitful way of doing this is through promotion of partnerships and *networking activities* involving European institutions and professionals. *(see below : Box 15)*

The EU has an important mandate to assist in the development of *regional RTD institutions*. In many sectors there are strong prospects of obtaining additional value added by operating at this level. First, there can be important scale economies, which are especially important for countries that are either small or very poor. Second, many of the scientific and technological problems in areas such as agriculture, natural resource management and health are best addressed on the basis of agro-ecological or climatic zones, and these seldom coincide with national boundaries. Third, more and more developing countries are forming themselves into regional co-operation and trading blocs, so there is an increasing number of potential regional partners. Finally, at the organisational level, regional institutions offer a means of escape from bureaucratic national rules and norms that so often stifle scientific objectivity and creativity.

c). Human Resource Development for RTD

Past investment in education in developing countries has consumed a large part of their resources and those of donor agencies, but the effectiveness of much of this effort mirrors that of institutional development: it has not been sufficiently focussed on addressing the needs of economic development. Often there has often over-investment in tertiary education, at the expense of more basic education. Within tertiary education,

even within scientific and technological faculties, there has been insufficient emphasis on the creation of marketable skills. *The educational system* of many developing countries seems to have been geared to producing good candidates for public service employment, but since there are never enough public sector jobs to go round, the result too often has been to create a class of educated unemployed young people who see no prospect of a career, and whose frustration carries a constant threat that it will boil over into political and social instability. The opportunity cost of this misdirected investment has been failure to produce the type of skills that are needed in a science- and technology-based economy.

The Human Resource Development needs of such an economy are great and far-reaching. They include widespread (moving towards universal) primary education, S&T education in secondary schools, polytechnics, technical universities and faculties within general universities, professional enrichment activities, in-service and other forms of on-the-job training, apprenticeship schemes, and adult education for basic literacy and numeracy. It is also important at all levels in the educational system to foster the attitudinal changes needed for a technology-based economy. Education also has its own specific technological needs in such areas as distance learning and lowcost production of textbooks and other learning materials and Europe has a considerable role to play in the provision of these.

Continuing professional development of scientists, technicians and engineers should have high priority. There is much potential for creating linkages between the scientific community in the developing world and those of European countries. ***(Box 15 : Networking).*** The new *information technology* has enormous potential to speed up the interchange of scientific information.

Small and poor countries do not have the resources to invest in the full range of educational institutions they need to develop a viable RTD capacity. The EU will support the development of the type of *regional training institutions*, which have been so successful in Asia. Examples include the Asian Institute of Technology in Thailand and the Asian Institute of Management in the Philippines. Certain national universities in Asia's NICs have also developed into regional institutions. Examples include the University of the Philippines, the Universiti Pertanian Malaysia and Thammasat University in Thailand. Education at regional institutions confers the additional advantage of exposing students to other cultures and is therefore a genuinely broadening experience.

BOX 15. The research networks : principles.

Networking is common practice among researchers. All have in the world their group of correspondents, with whom they exchange ideas, experimental material, information on methods, bibliographies, comments (on results), practical support and collaboration projects. The idea has over the past ten years taken shape to make best use of this facility and organize, on the scale of developing regions, around specific issues (cultivation of maize or cassava; combating Aids etc.), consortia of scientists belonging to international centres, aid agencies and national establishments in several different countries. This formula, readily backed by donors and organizations in the North specialized in aid and cooperation with the South, has aroused an enthusiastic response. In Sub-Saharan Africa alone, in 1990 more than 100 networks were listed, sometimes superfluous. This success calls for examination and evaluation. An interesting review (de Lattre-Gasquet and Merlet, 1996) deals with several cases that have been assessed.

Many of the parties involved find advantages in mounting a research network. For the fund providers, it is a means of promoting regional cooperation, and of intervening in a great number of countries, without the need for direct contact with each and every one. The international centres broadcast the products they have elaborated. The aid-providing and collaborating establishments of the industrialized countries expand their influence, endeavour to retain their partners in the South, make their results known and create a demand. The researchers in the South come out of their isolation, gain access to techniques, information or materials their establishments could not generate; they also gain in esteem, reputation and often in remuneration.

The simultaneous aims of the networks are : to forge links; exchange information; and conduct joint research. Their objective is not, unlike commercial firms getting organized in the face of globalization, to create relations to achieve a finished product more efficiently. It is rare that they bring together the final users, their organizations, those in popularization of science, the non-governmental organizations, industry. They are scientific and technical networks rather than RTD.

d). Scientific Co-operation

For a long time now the European Union has been running schemes in scientific cooperation. Integrated into the Framework Programme for Research (DG XII), they are now all grouped together under a single programme : INCO-DC.

By getting laboratories in both North and South to work on the same projects, selected on the basis of tendering, this instrument brings out scientific added-values, very widely recognized to day. It is worthwhile to know its functions, in order to call upon its

BOX 15. The research networks : appraisal.

In concrete terms, they are functional for tackling the sensitive and delicate problems which do not respect borders of nations and their ecological and economic circles - in spite of the lack of critical mass that afflicts many small countries. The Networks succeed in maintaining research activities in many crisis-hit national establishments. They have contributed to the creation of region-wide bodies of specialists. To them are owed some original technical and scientific advances (among numerous examples, the work on Canavalia ensiformis, a tropical root crop, to transform it for use as animal feed, has been well covered; cf. Arvanitis 1990). They have enhanced the researchers' skills and developed in them "problem solving" mentality.

The effects on the institutional capacities are more debatable. The Network sometimes changes into a superstructure, dominated by a influential piloting body (often from the North). It is handicapped by failings of national establishments (of their managerial practices, their ability to negotiate in a scientific context) which counteract any remedial effect. Profit sharing (let alone that of intellectual property) is by and large unthought of. "The Network option" does not resolve the problem of quality of laboratories taken on, nor, in the medium term, that of maintaining them as indispensable places where competences can be renewed and knowledge accumulated. The transaction costs (in particular the time put in by full-time researchers paid by their establishments) have not been properly assessed. Some wonder if the research priorities of national institutions are still respected; or if researchers are nor diverted from their main tasks. The initiative is adapted to crisis situations, but it has its problems. The inadequacy of communication systems is a major handicap. Individual or national interests sometimes override considerations for the good of the region. Certain networks appear to be "premature" (inspite of the ecological, economic and technical justifications for them), because of the human and institutional context in which they have to find their place. There is still no sure method for assessing results, far from the case of the "projects" where there are many well-defined criteria for putting them into practice. From the sponsors' point of view, it would be advisable to consider these operations as an investment : that of a preliminary phase where first liaisons are forged, whose benefits will come along sooner or later according to the quality of the parties involved.

services advisedly (see Chapter 2). The European Union's strategy for RTD aid insists on the concept that in future aid for research be organized in closer coordination with scientific cooperation. This can involve the private sector. At the same time maintaining the prime imperative of scientific excellence, the strategy adjusts its research themes according to each region. From now on it could favour the countries and regions that demonstrate firm evidence of a real interest for developing their scientific and technical abilities and their support for RTD.

B. The eligibility criteria.

Beyond the criteria of a solid commitment to supporting RTD, of a rational approach in actions taken and scientific excellence, the general direction of European Union policy insists that proposed cooperation programmes, with EU financing envisaged, should comply with a certain number of criteria consistent with its options ***(Box 16)***. The second part of this Guide (see Chapter 5 . instruments) shows how to implement this.

BOX 16. Seven eligibility criteria

The choices made by the European Union, as regards aid for RTD in the developing countries, require that any envisaged action possess th following positive features :

- *a strong contribution to strengthening local capacities*
- *answer a demand or anticipate one, always with "customers" in view.*
- *ability to be an integral part of a global policy, even for sectorial actions*
- *it should consider a regional approach and put it to good account, even for actions which are essentially local*
- *envisage a participatory process*
- *take into account the knowledge and skills existing locally*
- *it must be complementary to actions undertaken by EU Member States*

Chapter 4. Situation diagnosis and formulation of strategies.

This chapter translates the principles already presented into operational form. It demonstrates how an overall coherent strategy can be elaborated from a diagnosis of the given situation.

A. Situation diagnosis

Before any operations integrated into a strategy can get under way, stock must be taken of prevailing conditions. Local resources must be known, the forces at work understood and the risks and opportunities assessed.
There is a possible source for each type of information required.
Since the action envisaged has to be anticipatory, a diagnosis must bring to light some key questions and pave the way for alternative solutions, allowing several scenarios to be investigated.
Senior "generalist" staff have no need to conduct a detailed diagnosis themselves, from start to finish. What is important is that they know how to oversee the evaluation and that they monitor certain sensitive *situation indicators*. The specialists of sectors concerned, other than in science and technology, need to be able to grasp rapidly an accurate picture of the existing system, in order to orient their action. Some characteristics will hold their attention more than others (local scientific capacities in their sector, predominant technical systems, available alternatives etc.) : the associated studies and the indicators can be incorporated into their set of observational tools.
This section sets out the elements of the diagnosis and stresses those that can form the subject of situation indicators needing to be followed up regularly.

A 1. Assessing the political context

The assessment will supply information on the context, Government policies and more exactly on their sectorial RTD policy.

The context indicators are quite standard ones. They concern the economic situation (national wealth, distribution, breakdown into sectors and products, debts, trends - indicators used by the World Bank); and the social situation (UNPD human-development indicators). Steps involved in any possible structural adjustment must be known (notably concerning the civil service if research is effected largely by the State). More qualitative information is useful, bearing on political and cultural stability, and on the existing education system. On the whole, these data are often already known to senior people working in or for this country.

The *State policies* appear in national plans (if these exist). They are reflected in national annual budgets, but also in both regional and national Provisional/Indicative Programmes negotiated with the European Community. Therein lies a source of information. Special attention will be given to declarations and applications for aid in Science and Technology matters. One useful indicator is the total public spending on research, another even better is the *RTD effort* (expressed as % of GDP). These parameters facilitate meaningful comparisons between regions or countries. Attempts will then be made to break down these data to reveal the respective contributions to the financing and the execution of work, on the part of external and domestic sources from the public or the private sector. International agreements concerning Science and Technology are another important factor. Especially influential are the bi- or multilateral cooperation arrangements (including grants for training abroad, allocated to the various subject areas); and the cofinancing agreements for regional S&T institutions, stipulating the ways in which the results are to be transferred.

Information on the *sectorial policy* can be gleaned from the national plan for research, if there is one. There are other, scattered sources that can replace them. Research institute and university *budgets* can be examined (is there money apportioned to research in universities for example?). One can look at the numbers of specialists, researchers and lecturing-research staff, by subject field; or their status, salaries, careers. Does the policy anticipate special priority areas for intervention? (*"Mobilising programmes"*) ? Is it shown up explicitly in special incentives (funds, staff, formation of institutions) ? The apportionment of funds in budgets gives evidence for it. It might be asked if funding from outside is working in the same direction. The information is to be sought in the national budgets and in those of the various donors; also, in annual reports of ministries and specialist institutions (complemented by interviewing). Other points should be considered :

- the form of the *system of scientific education*, its reputation; what are its resources and value (staff, programmes, educational methods, efficiency and return, with particular stress on apprenticeship and on technical and higher education).
- are *technological cooperation* schemes between companies (especially with firms from abroad) encouraged and, if so, by what measures; are there examples; what role has the State played in setting them up (case studies) ?
- how are the right balance and coordination achieved, sector by sector, between *basic, strategic and development research* ? Indices of scientific production on the one hand and of technical contribution, on the other (see the section "Scientific and technical capacities", further on), should give some idea.

- last, and by no means least, is there an *overseeing organization responsible* for national and international watch in the technological, scientific and commercial spheres are the necessary competences present and people who do in fact fulfil this function (this is often the case among "academic" scientists, not called on often enough regarding technological development).

It is possible to put forward this diagnosis for each country. However, if a study of this has to be commissioned, it is better to do it at the *regional level* : this is an economy of scale. Senior sectorial managers will benefit from having at their disposal a detailed study on these points (as well as a list of researchers in their field, their standards of ability, and their preferred subjects: see the section "scientific and technical capacities"). The generalist or the specialist of the Science and Technology sector will require a full diagnostic study. Every body will then update their information, from keeping informed of significant policy changes.

A 2. Scientific and Technical capacities

We first turn our attention to the *active potential* : eminent scientists, specialist circles and institutions that are in good working order. An excellent source, which is not well enough known, consists of *bibliographic data bases*. Several of these exist, which go through a wide spectrum of scientific and technical journals published throughout the world.[2] Generally highly accurate, by searching them over a period of a few years the scientists who regularly produce work can be identified (as well as their research themes); as can the specialist circles (generating publications followed up in a particular subject area), and the prominent institutions (that manage to keep talented groups together and accumulate valuable results). The search can be specially restricted to one sector (for example, agriculture, health, social sciences, urban issues); or extend it to a whole set of activities, in order to spot the strengths and weaknesses of a country or a region. A breakdown of the publications can lead to a quantified evaluation of the potential. The *personalities who represent a resource* can also be identified, those at the hub of activity (because they co-publish with a rich network of different colleagues) and the institutions, whether active or inactive. This information is all the more valuable in that the most productive prominent scientists frequently remain unknown to managers and political leaders, and are kept out of development operations.

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[2] Some data bases are generalist (among the most well-known are ISI-ISIS from the USA, and PASCAL-FRANCIS produced in France); others are specialized (such as AGRIS in agriculture, MEDLINE in medicine and health). For a small fee, specialists (*see Appendix : Resources - people and institutions*) can conduct interrogations focusing on a country, a region, or a subject area.

In any initiative for action, it can be important to call on those high-calibre people, to keep a watch from the scientific angle, help to plan *mobilizing programmes* and to draw their entourage into combined efforts. Of course, this list is only indicative. However, it is a reliable entry point in the scientific world (especially for "basic" and "strategic" research, but also more than one might think among researchers into adaptation or in development *per se* who are obliged by their career, their profession and their reputation, to write at least in the form of reports that are picked out and searched by certain specialist data bases).

It is more difficult to gain an idea of the *people and establishments able to contribute technical findings*. The data bases that record filed patents, which normally serve to measure this, are disappointing for many cases of the least advanced countries. On the other hand it is useful to make an inventory of *technological cooperation* between firms, and the new products local companies have developed. Another source are the files of local experts and research units with whom companies, development project offices, ministries or public authorities, non-governmental organizations and various donors work. Visits can be made to established institutes of research and development, their activity reports will be examined to identify their technical results and how they contribute to popularization. An integral part of the process is to identify the research teams that have taken part in Scientific and Technical Cooperation programmes of the European Community, and to gain an awareness of their results that can be applied (documentation available from the DG XII INCO-DC). Like the preceding investigations, these should result in an inventory of the people and establishments that constitute the potential, in certain indicators of the state of this potential and in a measurement of the services it fulfils (applications, popularization, scope, efficiency).

The sectorial managers or generalists can conduct part of this research; or they can commission, for quite small cost, these inventories at the same time as the task of centring in the political framework.

We have stressed a great deal the need to obtain awareness of the capacities already established : this is a major prerequisite.
Another dimension of the diagnosis consists in recognizing the restrictions governing the attitude of people in scientific and technical professions. Many of them relate to the institutional framework (they will be taken up more fully under this heading) : in particular the status of personnel, career plans, salary differentials with other professions, the status and management of constituent institutions, incentives to publish or for entering the various professional activities in any way linked to research

(including training, development of applications, popularization). Account must also be taken of the ethos of scientific circles (which is a socio-cultural parameter) : what are their values, the signals they adopt as markers of accomplishment and success (such as reputation, in the confines of given disciplines ?), their appreciation of the private sector and commercial interests. It may be that different schools diverge on these points among the locally based scientists (for instance an exclusively academic culture opposing a development-oriented one). It is important to identify the foci of such cultures and see if there are any signs of conceptual change regarding the nature of the profession.

One serious problem is the *brain drain*. Many studies have been devoted to it recently, concerning the developing countries (for example, *Journal STS,* vol. 2, no. 2,1997). The phenomenon can be measured (a survey is to be done), and covers two aspects : departures abroad (or non-return of students); and the "internal brain drain". The latter includes change of profession, a mass migration to the private sector or consultancy; abandonment of scientific posts for managerial jobs; and desertion of technical training in favour of more prestigious subjects.

The problem is cause for concern, notably regarding a continued regeneration of the breeding grounds where competences are acquired and knowledge is updated. Local possibilities for technical and scientific jobs will be considered, in the public sector (where they are often limited by the "structural adjustment programmes") and private sphere (where they can be rare in key areas, in surplus in others : some specialist circles are taken up but not regenerated, particularly by donors and development projects, which are high consumers of experts.). An attempt will be made to gain an idea of the scientific and technical diaspora, which can constitute an external resource, if the people involved are willing and their areas of competence are appropriate ***(Box 17)***

A 3. The institutions.

The diagnosis will cover the institutional aspects which are particularly influential on the upsurge in research and development.

The *technological cooperation* schemes between firms (notably with foreign companies) are today considered as one of the favoured routes towards obtaining the appropriate know-how (appropriation not only of the processes, but also managerial abilities and broad technical knowledge). If the country's political context lends itself to such schemes, it is important to adapt certain institutional instruments. The diagnosis will build up a state-of-the-art picture of provisions in the code for investments, the legislation for international litigation, labour regulations, the judicial system, regulation of transfer of technology or intangibles such as licences or intellectual property rights. The latter is a hugely important consideration.

Box 17. Mobilization of expatriate knowledge and skills : a Colombian experience.

The "Colombian network of researchers and engineers abroad" consists at present of 24 associations established in different countries and bringing together people working in a great variety of sectors, in universities, laboratories and private companies. From these different centres, or nodes, collective research activities are organized in liaison with national teams and programmes. The general coordination of the network is ensured by the Colombian research agency. A network of electronic communication through Internet provides the capacity to exchange information in the framework of common projects, evaluation of scientific and technical programmes, training sessions or data search.

Right from the start, the development of this network has been under continuous observation and assessment (Meyer et al., 1997). After three years, 1000 were taking part, exchanging messages for professional purposes, and such use was growing geometrically. The "nodes" that have formed outside the country have facilitated North-South cooperation. Science workshops, summer schools, and short exchanges for researchers have been organized. Finally, the network has generated joint projects (more often scientific than technological : a convenient method of protein separation in the laboratory, nuclear medicine etc.). The investigation shows not only the difficulties that spring up at this stage, but also the unexpected effects (the formation of small circles of specialists in fields hitherto unrepresented: for example, manufacture of industrial robots).

Can this method of "brain retrieval", based on a kind of "diaspora option" (rather than repatriation), be emulated by other countries ? The case study of the Colombian initiative throws light on certain conditions. There is one main problem. How can such a widely dispersed population be pulled together and its many abilities and fund of potential be directed towards the country's strategic fields ? To do this, indicators and methods are needed that allow detection of the desired competences present in the diaspora and stimulate appropriate research to move in the right direction. The pilot study conducted on Colombia has served as a laboratory to design such instruments. The outcome is a set of science maps, which can be read and followed in order to find suitable partners and identify the leading subjects that can best bring them to work together.

Reference : Meyer et al.

A quick diagnosis (of presence and quality of facilities) must also take in the infrastructures important for successful implantation of modern industries and companies. The vital ones are communication networks (notably for telecommunications, especially links abroad), capacity and service at ports and transport facilities (including airlinks), and the arrangement of attractive installation sites.

The measures envisaged to entice the private sector to invest in RTD are just as important. The diagnosis will prepare the list of these and an assessment. Anticipated here are tax incentives, the setting-up of commercial and technical watch, government mediation to find foreign partner firms, encouragement for research and industry clubs, and so on.

One crucial point concerns how responsibilities are shared between the *public and private sectors*. A good indicator is the proportion that each side has in terms of expenditure and implementation of Science and Technology operations. These indices are worthy of further qualification, through the identification of private establishments that contribute to RTD effort.

The *public sector* is often both producer and almost exclusive financier of scientific and technical research : all the more important then to discern the nature of its institutions and any malfunctions. On the financial side, the policy towards public subsidies will be clarified (are they bound with particular programme orientations, or with acceptable results, for instance ?). Any regulatory provisions regarding receipts from user-bodies or beneficiaries will be examined. If there are any, including a sales or export tax on products (funds earmarked for research), what is the compensation (association of organized payers in defining programmes and participation in the results ?) How strongly are public research activities commercialized (institutions' own resources ?). What kinds of device encourage this ?

Here we touch on the question of the *status* of research institutions (including university centres : do they enjoy financial autonomy ?); and also the diagnosis of their management : what incentives exist for exercising professional activities linked to research other than teaching or producing publications ? what premium is given to contracts or to links with the exterior ? what is the assessment system of these activities and personnel ? have valorization services been created (capable of prospecting clients for work in hand, competent for signing commercial contracts, industry experts sufficiently well versed to assist with negotiations between firms).? Are the directors well versed in science and technology; are they just passing through or well settled in this profession; on which criteria are they judged ?
The *status of researchers* is also covered : recruitment procedures, salary scales, criteria for promotion (in theory and in practice : promotion by merit, seniority, for services rendered; consideration taken for responsibilities of teaching, publications, other activities, weighting).

The diagnosis will be based on the statutory texts, but also on case studies. It will attempt to quantify the degree of opening up to the outside world, and the extent to which this public sector is commercialized (the total value of contracts, the functions fulfilled outside the institutions, the calls for expert advice, are some of the indicators). ***(Box 18)***

4. The socio-cultural environment.

The rate and way in which Research and Technological Development progresses depend as much on the end-users' as on the researchers. And as much on the way innovation is received and appropriated as on the fine-tuning of new products or systems. Attitudes among the production sectors towards technical innovation are a determinant factor. More generally, cultural predispositions regarding science and technology play an influential role. Training has an impact, whether diffused through the official education system, at work or by apprenticeships, or by programmes for "technical and scientific literacy" undertaken by non-governmental organizations (such as exists in India).

Let us look for a description of the predominant *technical systems*. Linked to a branch of industry, sometimes to a product (in agriculture for instance) these systems combine different bodies of knowledge--practical, technical (codified in manuals) and scientific- which are stable unless perturbed by external events (natural threats or disasters, disappearance of markets and so on). They embrace all the connections involved in production : a chain of interests interlinked, from producers to manufacturers and merchants, within which all innovation has to be negotiated. Otherwise, technologies (especially in agriculture, but also health care and transformation of the environment) are associated with a *system of representations* of the world and its human and natural order. Introduction of new practices necessitates compromise, which is much easier if the innovation is developed by people in the cultural milieu concerned. Analyses of these factors are familiar to technological anthropologists, who can review or conduct surveys. In order to match the diagnosis of the ethos prevalent among researchers, a similar exercise will be performed on the producers. Particular attention will be paid to the entrepreneurs and local communities who engage in *technological apprenticeship*. It is a question of identifying them, to pick out the most dynamic sectors and gain an appreciation of the processes leading most rapidly to assimilation (the type of popularization, in farming; in industry : production under licence, brand representation and maintenance, adaptation or development of products or processes etc.). For a detailed analysis, survey methods have been elaborated by socio-economists, who have proved their worth notably in Latin America ***(Box 19).***

Box 18. Venezuela : a successful innovation, a research centre in ruins.

The story is one of a small university-associated research institute, created and sustained with great energy by a handful of teaching staff with the desire to conduct research " with and for industry". The many chemical procedures elaborated range widely from food preparation techniques to metallurgical and petrochemical processes. The project which had the most far-reaching scope led unwittingly to the centre's downfall. the work concerned industrial clays. The idea was to use the properties of a locally found, fine-grained clay to manufacture a solid yet light construction material. Breezeblocks made from this would be cheap to transport and easy to handle, and would find a ready market. The product was perfected experimentally, then presented at a trade conference in the USA. By chance, some Venezuelan industrialists were attending. They had come abroad seeking a licence agreement for a similar product. They found it worthwhile to help their fellow countrymen to refine the process in a pilot-plant which they co-financed, in the university grounds. As the results were convincing, the industry eventually engaged all the engineers and researchers who were working on the project to adjust and control factory manufacturing methods and run production. So in this way the institute lost its vital core. It has now shrunk to a small monitoring centre for industrial quality. The university did not receive any compensation and had to pay for demolition of the pilot-factory. But is proud to tell how through this operation it has contributed to national development This tale holds several lessons : the transfer of researchers to industry (whose needs and ethos they know better than might be believed) does favour technical innovation, but it is only beneficial overall if a new generation is ready to step in and take over. The universities are crippled in these situations, through absence among their management of an awareness of business and because of their solely academic culture and tradition of not working for profit. This culture has harmful effects, like a low regard for all applied research, or can lead to the design of many processes which are "applicable but not applied" , because they were conceived and developed without consulting any potential clients (other stories from Venezuela and elsewhere give abundant illustrations of this phenomenon).(Arvanitis, 1990).

Finally, it must not be forgotten that "wealth flows into places where competence, efficiency and quality of life exist, and flees those which are deprived of them". The diagnosis has to be completed therefore with a quick overview regarding the political stability, level of education, degree of public security, environmental problems and conservation policies.

Box 19. An apprenticeship in technology.

A factor restricting RTD is the attitude of companies. In protectionist times, few take the risk of technical innovation. Now with protectionism removed, not many have the necessary culture to change this attitude. A Latin-American survey (Pirela et al., 1993) on the fine chemistry industry estimates that just one quarter of firms were "technologically active", with the highest chance of reacting effectively to the challenges of competition on global markets. It is those who have begun their "apprenticeship" who maintain links abroad and who have built up internally a technical culture. This culture results from an accumulation of practices and small innovations : information search on alternative technologies, negotiation of technology, adaptation of components and machines, manufacture of these components and of equipment , trademark representation (with the responsibility for maintenance), manufacture under licence, development of new products, links with research and sometimes creation of an internal department devoted to it. Beyond the obstacles to innovation and factors that determine it, which it brings out, the study shows that firms' technological apprenticeship is a considerable lever for development; that the technological culture prevalent among their directors has a great influence on this; that in developing countries, the accumulation of small innovations (rather than the quest for major techno-scientific breakthroughs) offer the best trump cards, as they allow flexible responses to the demands of small, diversified markets; that new-product development is one of the best ways of acquiring R&D capacities, and for learning to identify the exploitable "niches" *on international markets. Further, the survey indicates that innovation-support policies (which are an important part of aid towards RTD), benefit from being selective, taking into account the deficiencies and attitudes of several types of enterprise in each sector : assistance with external technological liaison for some, strengthening of managerial abilities and information technology research methods for others. Participation in mobilizing programmes, which will back vigorously link-ups with universities and research centres, will be reserved for companies who are themselves running research-development teams or centres within their organization.*

An in-depth socio-cultural diagnosis becomes even more necessary as the RTD action develops. A close follow-up by specialists is required. Provisionally, a broad perception of the situation is acceptable, backed up by case studies (analyses of previous successes and failures). As the action progresses, a proper *observatory of technological change* can develop. This would be supported by studies by social scientists and could form part of the general *watchbody* which will be the nerve centre for strategic planning.

A5. Linking up circles of activity.

A link-up between different circles of activity is the objective of RTD action. The starting diagnosis will identify and assess the instruments already existing (systems for popularization in farming, schemes for health information distribution, for instance : are they tied in with research ?), and the most favourable places for these to operate (do research-industry clubs exist; are chambers of commerce and industry attuned to the technological issues at stake ?).

Similarly, connections possibly already present at *regional level* can be examined, this time between research centres (what is the nature of the link and the division of labour between international research centres and the national research system, in agriculture or health ? are there any regionally-oriented university-level or technical training centres ?). Knowledge of the diasporas of scientists and of their disciplines and competences can also be useful from the start.

It is furthermore important to know the action plans of the various *different donors*. That will be useful notably for putting into practice a core principle for European Union action, namely the complementarity and subsidiarity of EU interventions in relation to those conducted by member states.

A6. Financing.

The financing of RTD has been examined in preceding sections. A recap in a special chapter is worthwhile. This will be augmented by information on RTD-aid supplied by different donors, its total amount, its objective (assistance for running costs, equipment, grants, salaries, and so on), the way it evolves, and its favoured fields. The financial effort of the national private sector will be described (and quantified if possible), as will the direct foreign investments.

A7. Commercial and technical watch

Action geared to RTD must be anticipatory. The diagnosis will identify the people and institutions that can alert those in power, industry and producers' organizations to new scientific findings or recent technical innovations which either threaten their interests or create opportunities. This function is rarely organized in the less advanced countries. Nevertheless, there are present technically well-informed entrepreneurs, scientists well acquainted with the world's publications, engineers who work on the international network, who can fulfil this role informally. They evidently cannot be called on to help unless they have been identified.

A8. Key problems and alternative solutions.

In conclusion, the diagnosis must be able to expose the key problems at a given time and devise a range of alternative solutions. That is where the strategy-building phase begins.

B. Building a strategy .

The headings and items set out in the description of the *diagnosis* have a direct bearing on the steps to be taken. The indicators used to describe the current situation can therefore be taken up and adapted as *result indicators*, once the strategy has been decided.

There are three stages in the formulation of this strategy :

a) identify the key problems, devise overall solutions, *compare their appropriateness.*

b) divide the selected scenario into subjects areas (themes) for action. These themes bear upon different functional levels: one concerns the institutional framework that should be built; another the measures required to go with this (continued commercial and technical watch, education and training, information and communication). Finally, several themes at the heart of the strategy, will consist of ***mobilizing programmes*** concentrating means and the work involved in connecting up research with end-users, so as to construct a space that permanently generates dynamic advantages.

The choice of these *mobilizing programmes* is not easy. No predetermined list is given here, since such programmes depend on the local situations. However, we can define their character. A mobilizing programme is built around a scientific and technical field (probably multidisciplinary), which will have applications in several spheres (for example knowledge of urbanization and its control: such a programme will bring in human sciences and engineering; it bears on habitat, transport, health, the materials industry etc.; another example: water; this programme will bring in the natural, industrial and human sciences, from an exploratory angle - discovery of resources, modelling of changes and trends - and in the context of development - collection, transport and distribution methods; the programme is also relevant for health, and such sectors as agriculture, urban problems and industry, all competing for its use).

Mobilizing programmes are not sliced up according to the divisions set by traditinal sectors of activity. However, as these programmes are intended to include producers, end-users and beneficiaries, they will profit from being defined as closely as possible following a technical system, an industrial chain or an area of activity; or at the crossroads between a very restricted number of them, giving special emphasis to just one of them, as leader activity (for example: development of biotechnologies, with the accent on applications to farming; or enhancing the value and market impact of local knowledge, especially that of people's traditional acquaintance with plants with potential interest for pharmacy or value as part of the biodiversity). Therefore, in the choice of programmes, a balance should be found between the technical and scientific areas and the sectors of activity.

c) Each theme brings with it a certain number of measures that have to be taken. The themes chosen are put to a series of tests. At this stage their mutual *coherence* will be checked, as will the feasibility and *viability* of each theme.

It then remains to divide up the themes into sub-programmes. At this level, the measures to take become highly specific. A new test is needed, one that compares the envisaged sub-programmes, and which can perceive the compatibility and viability of each. A similar procedure is required when projects are to be selected and later for their follow-up and assessment (which takes as reference the whole set of conditions that govern the strategy).

The choice of scenario therefore first implies some imagination, then the sifting of conceivable solutions using four kinds of device: *comparison of solutions; feasibility and viability; matching against the European Union's cooperation principles; verification of the overall reasoning behind it ("logical framework").*

The tools required for this are presented in chapter 5. Beforehand, however, we will examine the important problems that can crop up at each stage, and the steps that can be taken to get round them.

B1. Key circles. Key problems.

The choice of all-embracing solutions, in order to induce the key-circles to build themselves dynamic advantages over others, is made under three constraints. First, it is subordinate to the country's development policy, and to its policy in the RTD sector. Secondly, it is guided by the scientific, technical and commercial watch; thirdly, it must comply with the European community's principles for action (and be intended particularly for underprivileged human groups). Many problems can arise that make examination for pertinence delicate to handle.

B2 - What can be done if the national RTD policy is out-of-date or obscure ?

The first priority in such a situation comes down to convincing the authorities of the issues at stake involving RTD, of the possible positive pragmatic aspect of initiating action in this area, and of the range of aid from outside that it can attract.

The second priority is to reinforce the capacities of analysis in RTD fields, among governmental services and the private sector.

In the mean time, it is possible to sustain actions set up for demonstration purposes, by drawing on the leading establishments able to shoulder them (e.g. a college of agriculture, biotechnology laboratory, public health institute, chamber of commerce). Support for these establishments is, besides, one of the elements of action under the category of reinforcement of local scientific and technical capacities.

B3 - What can be done if there is no system of technical and commercial watch ?
There are three aspects to the function of observation and surveillance. The first is a watch on the markets (which the industrialists or producer organizations are supposed to look after); then, a technological dimension looking at the impact the world science agenda might have on crucial areas of activity for the country concerned (for example, is an important export product on the way to being substituted or synthesized ? would a new construction method provide opportunities to exploit locally-found materials ?); thirdly, local technical systems are observed for any changes or developments. If such a surveillance function and attendant instruments are not yet well catered for, the priority is to convince the powers that be and the producers of its value as a nerve centre, then assist with necessary training and with the setting-up of such a device, financed preferably by the end-users and placed under their control (centre to detect and record technical changes). Meanwhile, it is possible to aid towards a formal, politically backed, consultation of experts.

B4 - What can be done if the demand is low, or if needs are not clearly expressed ?
Here the priority is training of specialists, whose task will be to increase awareness in circles of end-users or organized producers, by employing examples that concern them directly and running activities as demonstration exercises.
- *In all these cases,* the most suitable approach is work at *regional level,* to bring forward the most successful experiences of certain countries, to design institutions at this scale, and devise joint programmes. It is also opportune to approach different donors and to take coordination initiatives as and when needed.

B5 - What if the required budget is difficult to find ?
The first priority is to identify the beneficiaries or the end-users; and convince them to contribute financially, if they wish to be included at the defining stages of programmes and projects. Special mechanisms must be found for programmes intended for users who are not likely to be solvent (for example, construction of social housing or facilities for the poor, sanitation for the poorer urban areas); the principle of getting the "clients" organized and inclusion of their associations are essential. If the clients were still not to be found, the idea of Mobilizing programme would have to be abandoned. A given Programme could have a variable geometry, depending on the budgets available, but it must be able to bring together a budget with enough critical mass to make a significant impact. Nevertheless, it must be remembered that a sound Programme skillfully designed, which has identified and started to mobilize clients, is a real attraction for foreign donors and investors. All should be done to make them interested, keep them informed, consult them and to canvass them as need be.

B6 - What if the status and the academic culture, or bureaucratic management of scientific establishments hamper any dynamic advancement of research ?

Support for improvement of managerial abilities is the priority in such a case. Such assistance must include fostering of a spirit oriented towards the customer, among a new category of managers who are scientific and technical specialists.

In the longer term, measures to back other reforms regarding status, working regulations (on careers, assessment and so on) are undoubtedly to be envisaged.

In the meantime, help can be given to certain exemplary experiments, involving Research foundations, Valorization agencies (perhaps associated with a university), Prizes for discoveries or original results etc. For an effective demonstration, it is important that at least one place, with original operational rules, be doted with the necessary means (up-to-date documentation, guaranteed maintenance, premiums for oriented research etc.). The principle is the same as that already mentioned: support a leading establishment, linked with one or more "Mobilizing programmes".

B7 - What if the scientific capacities are insufficient in a key field ?

This sort of situation is often seen in the engineering sciences (which are under-developed, both in terms of training and research); or in the social sciences, divided between academism (with no further outlets) and consultancy (with no longer any link with the universities and their standards of quality and innovation).

Associated with the choice of an RTD strategy (even Mobilizing programmes) there must be an assessment of medium-term needs and required skills and knowledge. Liaison will be formed gradually with the education system, by reorientation of resources (but it also implies new educational methods).

Meanwhile, several different solutions deserve to be tested. As many countries have done, negotiations can be held with interested multinational companies to persuade them to help finance a specialist technological institute for their area of activity. Singapore has obtained such an agreement, for computing; Costa-Rica also, for the biology of pharmaceutically interesting plants.

Along the same lines, an organized profession can be canvassed (e.g. those in sugar manufacturing, or building) to associate themselves with a similar initiative, if they expect to gain from the spin-offs of the Mobilizing programme which is calling on them to participate. The donors, who are big consumers of experts in the development projects that they support, should be capable of being mobilized to sustain the regeneration of the capacities they say are useful. The corresponding institutes can in any case be created on the *regional scale*. Finally, the missing competences could be sought among the many emigré scientists drawn away with the diaspora, who might be persuaded to contribute. Several countries (e.g. Colombia, Uruguay, South Africa) are now conducting trials of this kind of campaign.

PART TWO

INSTRUMENTS

Chapter 5 : Tools for the appraisal, implementation and monitoring of research-aid projects and programmes

in the context of development policies

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1. Organization of the chapter : proposed procedure and structuring.

1.0. The objective of this chapter (Tools) is to give a proposal for a general procedure which, at every stage in the management of the project cycle[1], will ease the task of taking account of the general principles governing RTD cooperation described in previous chapters. The guide is intended equally for the investigator of a delegation, the agent of the commission, or the promoter of an intervention. It will be used in the different phases of preliminary analyses and in monitoring scientific and technical aid actions, or more generally, for setting up and follow-up of RTD actions that form part of public-sector development aid programmes. Considerations exposed in this guide will help to **reinforce the position of RTD** in the Union's economic and social cooperation input. Greater awareness can then be generated of the importance of strengthening support for RTD, a crucial factor for sustainable development and the integration of the DCs into the world economy.

1.1. The procedure elaborated in this guide is a structured one. It is built around **three complementary sets of analyses** or modules ***(Box 1, and 11)*** to be carried out when new actions are being assembled or ongoing ones need to be assessed. One of the objectives most sought after is the promotion of **high quality of interventions** in the RTD sector; another important one is the **emergence of local teams** and local capitalization in terms of research capacities.

1.2. The analyses put forward will therefore aim to detect projects of a high standard, and to help locally-based teams to devise them. Progressively these teams will become fully capable of handling the tools and methods that will make their actions more **"competitive"**, in other words resistant to comparison and the competition with other actions.

The investigator of a delegation, who evaluates proposals and projects, has to use a process of sorting and selection. A choice must be made between several possibly competing proposals which he might be persuaded to uphold. This guide therefore offers some benchmarks, applicable to many RTD sectors, as bases for a **preliminary comparative analysis of competitiveness** of interventions before deciding between them. The guidelines will facilitate comparison of the **scientific quality** of the proposed projects and also of their originality, the **real innovations they bring** compared with other competing proposals or substitute actions *(Boxes 21 to 25)*.

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[1]The term "project " is used in its widest sense. It could mean a theme-based research project or any programmed intervention that has to be realized conventionally but that aims to bring institutional suport to a research team or structure.

The desired quality is defined in scientific terms for conventional research projects. The quality objective remains, for actions of the institutional support type. It will then be a question of checking the high standard of methods, tools and initiatives mobilized.

1.3. A second set of analyses tests **the internal coherence of the proposed intervention** and its pertinence in relation to the fixed objectives ***(Box 3)***. The series of tests will assist in identifying the strengths and weaknesses of the proposal and the opportunities to grasp and the strategy to adopt for its implementation.
A full example covering priorities, the strategy, the pertinence and overall coherence of an intervention is given *(Boxes 31 to 35)*. It illustrates in detail the procedure for defining development-research priorities, in this case applied to agriculture. In a general way, this example touches on the list of strongly limiting factors, variables and processes that could play a determining role in the way the research action proceeds. Special tools (hierarchization grids) next allow the degree of influence of a factor compared with others to be determined. Applied to the whole of the factors, these matrices provide a hierarchy of factors (from the most to least influential) lying behind the constraints identified. The same process is adopted to assess the degree of difficulty of lifting the identified constraints or to implement the different solutions proposed, and gradually build up a selection of strategies for resolving the problems and making decisions. In this example, a series of questions is suggested, to guide the evaluation and choice of interventions applied to the farming sector.

1.4. A third set of analyses provides a check as to whether or not the action under appraisal complies with the **accepted priority criteria for interventions upheld by the Union *(Box 4)***. Seven main criteria have been fixed, and are derived from the considerations on strategy dealt with in previous chapters. They take account also of the first evaluation elements available on 6th and 7th EDF actions *(Box 40)*.
Several case studies illustrate the proposed procedure, more specifically in terms of **reinforcement of local capacities**, participative process and response to local demand. These examples *(Boxes 41 to 44)* tie in with preceding analyses of competitiveness.

1.5. These three series of analyses are essentially part of the project and intervention identification phases, in turn the early phases of the **project cycle *(Box 5)***. These investigative stages identify the relevant variables and indicators that characterize the project and which will be useful in the monitoring and assessment phases of the project. The project-cycle phases as a whole are recalled briefly with illustrations and examples. The last group of boxes *(51 to 55)* bring out some good questions to raise at different stages of the project, related to the priority criteria already set out.

1.6. The proposed procedure is therefore structured around these three 'packets' of analyses *(Box 1)*, all the elements of which cannot be gone into exhaustively at this stage of elaboration of the guide. These three blocks are resituated into the general flow of the project-cycle phases. The important thing here is to present the general structural frame of the procedure, its **important key-elements matched with specific instruments and tools** which can be developed in more detail later. This guide will therefore be open to modifications and additions and compiled with an accumulation of elements of analyses, examples and references relating to a wide range of contexts.

1.7. The guide demonstrates the interest of recommending, for each element of analysis, general **standards and criteria** which will ease appraisal in many sectors of activity. The distinguishing criteria proposed should also help the investigators to effect choices in the face of a huge number of candidates (for example, after a call-for-tender).
The instruments and procedures appearing in the guide will facilitate measurement and comparison of the quality of research programmes or operations that accompany wider development projects, as it uses as far as possible **quantitative criteria** to complete qualitative evaluations. As work progresses to apply the elements of this guide, a great deal of information is gathered, sorted and analysed. An **information system** can therefore be established that will be useful later when running projects and programmes are monitored.
The managers involved in **monitoring, assessment and reorientation of interventions** will be able to use this information system to steer the course of their action. The system will be a permanent source of **tools to help decision-making and action-taking,** drawing on the data base built up in the course of the different sets of analyses and, more particularly, on the criteria, the norms and the indicators formulated at each stage of the procedure.

1.8. The present version of the guide : general procedure, tools, illustrated by a few examples, is presented in printed paper form. Several possible modifications and developments are conceivable, once it can be transformed (figures, bibliography, success story, demonstration of how to use the tools, or the set of instruments, follow-up) into computerized form, on **diskette or CD-ROM**. Transfer into computerized form, as a first step, would allow on-line aid to be arranged, usable by intervention investigators at different stages in their procedure.
In a subsequent stage, a **data base could be envisaged that could be used on a network** starting from the different elements accumulated when interventions were being investigated. An **interactive information system** could be constituted with analysis charts for each different sector of activity (health, agriculture, food industry, etc.).

Several participating bodies (commissions, delegations, institutions, partners) could contribute and feed this data base in real time. The guide's present structural design leaves scope for later assessments and enhancement as work progresses.

1.9). With the interactive information system in operation, this data base could also form part of a **learning platform** that would be steadily developed in the delegations and offices of the commission's departments. The guide and its many developments would then become the starting materials for **training sessions** in order to "gear down" the action of participants and thus increase awareness among the various bodies of the importance of RTD action.

Finally, the data base thus constituted could be **partitioned according to the competences or responsibilities of the different users**. Access to information would be arranged depending on the sectors of intervention and areas of activity of each participant : scientific evaluation, finance, project products and the nature of the partners. The whole of this data base and its conceivable applications will facilitate enormously the appraisal of RTD actions, their programming, follow-up and assessments, notably by improving the effectiveness of investments in RTD.

2. Analysis of the competitiveness of the proposed intervention.

The methods available to evaluate and choose actions in RTD are often empirical and depend on the sector. They often cannot lead to any structured approach to the **competitiveness of the new proposal to be evaluated**. Insofar as the elements of this guide are to be applied to highly diverse sectors of RTD, we propose to return to the factors of competitiveness put forward by M. E. PORTER[2] for the industrial sector in the 1980s. We apply these very broadly to RTD, insofar as :

* the set of methods used and currently available is generally considered unsuitable and not usable for all RTD sectors;

* methods bearing on the **competitive character of research projects** in the industrial sector should allow evaluation of RTD interventions in other sectors (agriculture, health, education etc.) also marked by an increasingly open and competitive environment owing to the internationalization of aid networks, new communication and information technologies, etc.

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[2] Michael E. Porter. *Competitive strategy: techniques for analysing industries*, and *Competitive advantage: creating and sustaining superior performance*. The Free Press. N.Y. 1980 & 1985.

* the notion of **quality of research projects or of aid for research** in the context of development policy is ever-more sought-after and declared in international tendering and in bids widely open to competition. For example, the development of new relationships between the public and private research sectors is a strong incitement to promote high-standard, competitive research projects and teams. Competition can also make its presence felt indirectly (calls for tender apart) when it is a question of choosing a limited number of interventions that can be financed within a given budget.

* the complexity of the operations involved in **decision-making** for research-project selection implies the organization of a process of evaluation, qualitative description and quantification, starting from quite simple generic criteria. This system, which entails marking by points, will culminate eventually in the replacement of empirical procedures by series of structured interlinked analyses that produce measurable, objectively verifiable indicators.

* the preparation of highly specialized guides tailored for each subject area could lead to very different results depending on the areas concerned; they would be difficult to use for non-specialists of the given sector who had nevertheless to work in several of such areas. The option taken for the guide's implementation should make it applicable to a wide range of different actions.

* **Analysis of the intervention's competitiveness** is organized around five points, which, taken in order, should assist in selection of proposals. It entails testing and evaluating :

  > the quality of the starting references (scientific for a research project, methodological for a supporting action) and of the methods used;
  > the degree of originality of the proposed intervention;
  > the possible use of a substitute action, or another project;
  > attractiveness of the project for potential end-users;
  > the project's potential as stimulus for synergic effects.

These five elements are now going to be explained, some of them in detail in specific boxes *(Boxes 21 to 25)*.

2.1. Quality of scientific references and of methods used

This analysis must lead to a "state of the art" picyure for the area considered and the subject dealt with. The intervention submitted for evaluation should be accompanied by full details of authors, works, bibliographic sources, and the approaches and tools utilized. These **references** must be **well established and recognized**. Through this analysis of the origin of the sources used as the foundation for the intervention, the investigator will check (or the project promotor will demonstrate) that the proposed action will duly mobilize the existing chain of knowledge and steadily **incorporate into it new knowledge and skills** which both the new situation and the problem to be solved demand.

Also related to the quality of references is the **competence of individuals**, of teams, networks, institutions and both public and private structures mobilized by the action.

This stage provides a better prior evaluation of the quality of the intended receivers of aid and of the services and products expected. A determination will also be made of the **level of quality** to be achieved on completion of the intervention, a useful parameter to have for future assessments.

Box 21 presents elements for establishment of this "state of the art" along with pertinent questions that should be raised in this first phase of analysis of competitiveness.

2.2. Originality of the research project or research-aid intervention : creativity, invention, innovation

An original project can be distinguished from other proposals on several fronts. Its approach, its subject and organization are out of the ordinary, making it shine out from a mass of proposals. Its originality can also stem from a special **creativity level** that guarantees a strong **capacity for innovation**. Examination of a project for its originality will help to highlight its special character and aid in later monitoring and assessment on suitably adapted criteria and indicators. It is therefore worthwhile to assess the originality of a project, not as an a priori advantage but rather to show up more effectively its strong points and shortcomings.

Box 22 defines some of the pertinent questions to ask in order to reveal the innovative aspects of the studied proposal, which are the factors making it competitive alongside other interventions. The questions will aim to discover the extent of any innovation and its foreseeable impact. Projects that are not faced with competition and besides have a high "chance of success" must bring a strong contribution to the advancement of methods and knowledge in their sector.

2.3. The degree of distinction of the proposed project from any other alternative solution

At this stage, the ability of "existing products" to supply a similar solution for an equivalent or lower cost will be estimated *(Box 23)*.
It is useful to gain a better appreciation of the size and importance of the **anticipated benefits** in relation to the existing situation. If the proposal under appraisal does not differ significantly from actions in hand or already achieved, or if it does not offer any real advance in knowledge or know-how, it is poorly competitive, hence not very attractive, and its novelty is marginal.

2.4. The action's degree of attraction for potential customers

If the results of a research-oriented intervention, or research and development action can be considered as the products, it is then possible to include in the RTD approach notions of "customers" as end-users of results, of a research-product market, even of marketing. *Boxes 23 and 24* suggest questions on the possible use of a substitute and the **degree of attraction** of the proposal for potential customers. There is a process of decentralization of initiative regarding the allocation of research funds for setting up regional (within-country) consultations involving those seeking and those producing research results. This should favour the generation of a research-products market. In this framework, implementation of a real marketing initiative for research takes on its full significance, and analysis of proposals for competitiveness then becomes essential.

2.5. The capacity for progressive reinforcement of strong points

The analyses already outlined indicate, in the first instance, the strengths and weaknesses of proposals, according to several criteria. Consequently, a list of complementary questions and points to clarify can be drawn up.

An overall look at these analyses should put a value on the intervention's capacities to reinforce the strong points and reduce the weaknesses and, thus, improve its competitiveness and promote among those who run the action the will to valorize their research.

Box 25, which concerns valorization of the research, suggests broad outlines for methods of **prospective forecast of the scientific sector**. Included are : value analysis, applied to RTD; marketing of research; professionalization in research valorization.

3. Priorities of research for development. Internal consistency of the intervention. Strengths and weaknesses. Pertinence in relation to objectives.

3.1. Identification of a project's limiting factors

This group of analyses (2nd module) is used to confirm the procedure that validates the choice of priorities and check the internal consistency of the intervention put forward. It also pinpoints its strengths, weaknesss and pertinence in relation to the fixed objectives.
Box 3 gives the overall approach to the analysis. *Boxes 31 to 35* apply this approach to farming.
(Box 31) displays limiting factors or variables and *Box 32* details them for a specific objective. The types of factor or process that could have a crucial role are identified like a pack of cards each of which would be given a characteristic value. A series of questions is then suggested, which guides the evaluation and characterization of these constraints.
In the illustration given, we have selected 12 limiting situations which we grade using a **classification matrix** *(Box 33)*. Each constraint is compared in turn with all the others to determine if it is "scarcely more influential" (denoted 1), "more influential" (2), "much more influential" (3). The result of this comparison is written in each box of the grid. It is thus possible to quantify, as the procedure progresses, the expected or observed significance of the constraints and to put them in a hierarchy. The same exercise is performed to assess difficulties of overcoming a constraint and implementing a solution.

3.2. Setting in place of an intervention strategy

An overall classification table *(Box 34)* can be obtained after this hierarchization of limiting variables and processes in order of **degree of influence** and **difficulty of removing the problems** they create.
This table, in graphic form, highlights the factors having the most influence and the constraints that are most difficult to clear away. The situation diagnosis, for the example proposed, would show that the constraints on the water resources would be quite difficult to remove, and of small influence. The problems of market access, of controlling the risk of parasites and of acquiring essential materials are, conversely, much more influential and less difficult to resolve.
Progressively, it becomes possible to propose intervention strategies, RTD projects negotiated with the different participating bodies, where priority sectors for action and antagonistic or synergistic variables would be identified.

3.3. Analysis of the strengths and weaknesses of the intervention, opportunities for implementation, threats and risks

This analysis is organized in the form of a grid. It displays in a table the intervention's strong points, its weaknesses, and summarizes previous analyses (histograms at the bottom of *Box 34*). The strengths will be exploited to the maximum while minimizing the impact of the weak points. The grid is complemented by a list of opportunities and threats or risks linked to the project's environment.
The different scenarios corresponding to the four divisions of the grid combine, on the one hand, maximization of strong points and minimizing of weak points and,on the other, opportunities and risk reduction that are taken into account. This approach can also verify the pertinence of options taken in relation to the intervention's objectives.
Box 35 illustrates the process using an example of a current cotton-production improvement scheme in Mozambique, for which the TOWS method is applied. [3]

The various tools appearing in the second module refine the salient points concerning a project appraisal. These points, taken after analysis for competitiveness against other proposals, provide a test of its internal coherence and subsequently allow specific implementation scenarios for the project to be envisaged.
When the actions under study are categorized positively after the two sets of anayses, they can be validated by reference to the priority criteria fixed by the European Union.

4. General principles and criteria for a European intervention.

General guiding principles for project appraisal are derived from the strategic analyses conducted by the European Union in defining a cooperation policy to reinforce the **RTD capacity in developing countries**. These principles supply the key elements that will guide the investigator and promoter and guarantee that the proposed project will meet the criteria for obtaining financial support of the European Commission.
These principles stem, in particular, from a rapid examination of past experience of industrialized countries, of countries in the EU and developing countries in RTD, an analysis whose main features figure in Part One of this manual.

Seven priority principles have been retained,[4] as follows (4.1-4.7).

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[3] Threats, Opportunities, Weaknesses, Strengths (TOWS). Adapted from R.G. Dyson: "Strategical planning". Models and analytical techniques", J. Wiley and Sons Ltd, Chichester 1990.

4.1. Reinforcement of local capacities

Local RTD capabilities, whether individual or collective, will be strengthened as a matter of priority. The projects picked will be those with interventions showing special effort made towards creation and reinforcement of **local research capacity**, both basic and applied. On this basis, the actions involving training, scientific exchanges, data acquisition, capitalization of knowledge will be promoted actively to encourage the formation of **local knowledge networks**.

The projects selected will therefore be ones that strengthen the research capacities of a place, to foster technologiacl innovation locally. The desire is to reverse previous tendencies to favour technology transfer to the detriment of aid for all kinds of "home grown" innovations.

The projects will therefore include numerous activities in the training, and acquisition of skills by a continuing process of learning and apprenticeship.

For the same reason, the institutional reinforcement of research organizations will be favoured, to give them the ability permanently to take proper charge of the RTD initiatives. Such reinforcement measures will be organized so as to make a lasting impact rapidly. Special support will be directed to institutions whose teams can steadily acquire marked comparative advantages and constitute recognized centres of competence, even of excellence in RTD.

Box 41 sets out a scheme to reinforce local capacities in terms of research management. This example has been chosen with account taken of the need to reinforce local capacities in this sector. Whatever the RTD themes chosen, strengthening of local skills in managing the research funds allocated is becoming a high priority to guarantee good use of resources from external sources (including money from aid).

4. 2. Response to demand without precluding anticipation

The aim of the project put forward will be to answer a development need, an overall demand and not just a programme of theoretical research. The demand could not only tie in with an urgent local problem but also lead to work that could answer questions arising later in the face of future development challenges. The projects upheld will aim both to respond operationally to a pressing demand and to develop **local anticipatory and prospection abilities .**

Reinforcement of local capacities might be a priority for an institutional support project; the participatory approach is definitely so for a research project in a real environment.

Box 42 shows an example of a response to a local demand in a sector which up to now has not been much considered in standard RTD programming (see also *Box 40*).

Anticipate future demands : this means favouring certain projects in sectors of research that are not currently "conventional", in terms of theme or partnership. In the example case described here, it is a question of taking into account research on the transformation and not merely on the production sector in agriculture. To be alert to overall research demand, the demands of private-sector partner-users for results of public research must be considered and analysed

4. 3. Global approach, sectorial approach

The project under appraisal must slot into *an overall research policy* or a set of well-coordinated actions.
Examination of NIPs and RIPs [5] should already have tackled these aspects of research programming. However, seeing that this area of activities (RTD) is rarely taken into account in these outline programmes, a recap appears (in *Boxes 51 and 52)* of the programming and identification procedure in applying the logical framework and management of project-cycle phases.

From the results of these analyses should emerge the main thrust of priorities for future programming in the research sector, or needs to reorient priorities already defined.
In this respect, the project appraisal, right from the programming stage, will be the chance to check the existence of an overall research policy, national coherence and if the bodies concerned are part of a system whose cohesion could be improved by the project's actions.
Verification of the coherence of the approach also concerns the themes dealt with by the research projects or by research sections of wider development projects. Particular attention will be paid to multidisciplinary initiatives relevant to different aspects of commodity chains, from production through transformation to release on the market. In this framework, some importance will be accorded **to the human and social sciences** as part of actions for research selected. *Box 43* gives a global approach of the problem of research for the development of agricultural production. The overall framework proposed enables one to locate the objectives of the action described and better to take into account the relation between the sectorial thematic approaches and a global approach to development.

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[5] National and Regional Indicative Programmes.

Reinforcement of "socio-economic" research should facilitate the evaluation of conditions in which users take up the results of research by offering sets of "instructions" on how to use innovations. Such research could improve people's understanding of research supply and demand and make it easier to draw best value from the work done (cf. *Box 44)*.

4. 4. A participatory process

The way the project's results are diffused and how long it will exert its effects strongly depend on the processes it will set in operation. A major principle influencing whether or not an intervention is chosen will be its intention to formulate and implement participatory processes. Right from the design and programming stages the participation of the different parties concerned by the project (those who carry out the operation, beneficiaries, donors) will be built into its actions.

The project's actions will therefore aim to reinforce national and international scientific discussion and consultations between partners in research projects.

Box 44 sets out some indicators for use in monitoring and evaluation of a partnership between research and development.

4.5. Regional and /or local approach

A research project often means a continuing investment whose impact can be detected in the medium and long term. In order to achieve this, teams must be brought together that have enough critical mass, recognized abilities and who are working in continuity and stability. A developing country alone can scarcely have at its disposal all these conditions in several disciplines and different sectors. The actions selected will therefore fit in a regional context of establishing national centres of ability linked up to one another. If research priorities are well defined at different scales, and the various tasks distributed effectively, unnecessary overlap and competition will be avoided.

A study of the respective roles of international research centres, national institutions and international organizations will bring valuable information on the kind of complementary and synergic features to look for and reinforce.

4. 6. Taking into account local know-how

The actions of projects upheld will focus on identifying, characterizing and valorizing local, often traditional, know-how. They must be taken into account, whether they relate to farming or medical practices. Research on improvement of knowledge about these practices will be encouraged with a concern to validate them in a rapidly changing socio-economic context, as described in the first part of this guide.
Consideration of local knowledge and skills implies more effective identification of the role of the parties concerned by the proposed actions. A strengthened social and human sciences research base in developing countries will be able to detect such knowledge. It could then be formalized and collected with a view to exchanges and adoption for other situations.

4. 7. Complementarity and subsidiarity of intervention, comparative advantages

The project proposed will be examined for its complementarity alongside interventions of other research organizations, other financial backers (bi- or multi-lateral) and to see how it fits in with international schemes. Network approaches are highly recommended.
Complementarity in terms of the relative proportions the public and private sectors undertake to pay for RTD actions will also be studied.
Information highly relevant for this criterion will be obtained by analysing the competitiveness of interventions *(Boxes 21 to 24* of the first module*)* .
The complementarity of functions between research, popularization of knowledge and development will also be defined in order to ensure an effective diffusion of the research results obtained.

5. The phases in the project cycle.

These general principles and key elements will be taken into account throughout all six phases of the project cycle. Here we have dwelt essentially on the first phases of programming and identification, because this is an *appraisal* guide. The elements gathered during this appraisal phase will be taken up again at the implementation and then in the monitoring-evaluation phases. Therefore it is important, in these first phases of the project cycle, to identify the *objectively verifiable indicators* (OVIs)[6] by

[6] *Box 44* presents an illustration of this.

The "project cycle management manual" [7]

This manual describes the main parts of the integrated approach and gives details of the 6 phases of the cycle. The parts most important for each phase are examined. Moreover, the coherence and viability criteria to be applied during the cycle are presented. These are the elements used in the appraisal guide; they will therefore not be dealt with again here. Only the 6 phases of the cycle are briefly recapped.

1 - Indicative/provisional programming

This takes up the general directions and principles behind cooperation schemes set up by sectorial and theme-based consultations on regional and national scales. Project programme proposals will already have been established at this stage.

2 - Identification

Project ideas already selected as new proposals are formalized globally in terms of fixed objectives, desired results and activities to be undertaken. The degree of formalization obtained at this stage will show if supplementary feasibility studies are necessary.

3 - Appraisal

The detailed operation of the project is defined in this phase, using results from a feasibility study. These results are compared against previously established priority and coherence criteria. A decision on a proposal for financing the project can then be made.

4 - Financing

"Ad hoc" committees look at the proposal for financing and modify the attendant documents where necessary for definitive co-signing of the Financing Convention by the appropriate parties involved (ACP-EEC)

5 - Implementation

The resources and processes provided for in the financing Convention are mobilized. The plans for implementation of the actions are produced. Monitiring reports are produced regularly.

6 - Evaluation

While the project is running, and at the end of each phase, its results and effects are evaluated. The project can be reoriented if necessary, on the basis of the picture obtained, or extended by adding a new phase. Evaluations take for reference several different criteria (pertinence, effectiveness, impact).

Box 5 is a table showing correlations between the different phases of the cycle and the European priority criteria with which interventions have to comply to be selected.

[7] European Communities Commission - Series: Methods and instruments for project cycle management - No. 1, February 1993.

An example is then given for the programming and identification phases of the project. The example chosen concerns the agro-industrial sector, for which little work has been done on programming.
Box 53 displays terms of reference for putting into practice a strategic plan for research in the agriculture and food sector. The example focussed on opens up a clearer view of the research strategy to be put into place as a function of its commercial, economic and social context.
Box 54 sets out an analysis of participatory methods for natural resources planning and management aiming to reconcile, on the one hand, conservation with exploitation and, on the other, consultation with planning.
A further illustration of the programming procedure, taking into account the priority criteria as a whole, is found in *Box 55*. An operational procedure for research programming is featured which aims to build annual operational intervention plans. This procedure incorporates all the necessary parts to mount a research project and prepare the later phases of monitoring and evaluation.

6. Tools proposed : Tables and Boxes.

Boxes and Tables are provided below.

a) Boxes

These Boxes are intended to illustrate the different parts of the procedures put forward in this chapter. In this printed paper version they outline some examples. Computerized versions (diskettes, CD-ROM) could later be made available that present these elements in more depth, along with references or specific case studies.

Box 1. Guide for the appraisal, implementation and monitoring of S&T and RTD projects and programmes. Organization of the guide.
Box 11. The three main parts of the analysis, and their interlinkage (Diagram)

2. Competitiveness of the project
Box 21 : Quality of the scientific references and methods used : state of the art.
Box 22 : Originality of RTD projects and projects focussing on innovation.
Box 23 : Degree of distinction from other proposals that could be substituted.
Box 24 : RTD customers' preferences.
Box 25 : Competitiveness and valorization of the research.

Box 3 Definition of priorities for development research. The intervention's strategy and coherence, the global approach.

Illustration : an application to the agricultural sector :
Box 31. Definition of priorities, the various parts of the appraisal.
Box 32. Improvement of cultivation systems, identification of limiting parameters often encountered.
Box 33. Placing factors in a hierarchy, classification matrix.
Box 34. Setting up an intervention strategy.
Box 35. Strengths and weaknesses, opportunities and threats - risks.

Box 4 The basic principles of a European intervention; priority criteria: relevant questions to ask.
Box 40. RTD interventions from the 6th and 7th EDF : areas of interest and character of the interventions. Some observations
Box 41. Reinforcement of local capacities : training in research management.
Box 42. Research in support of rural farming-related industries : evaluating firms to improve their competitiveness.
Box 43. Sectorial approach/global approach : where the proposed intervention is placed.
Box 44. Research and development partnership. Some indicators and means of monitoring and assessment.

Box 5 The phases of the management cycle and the European priority criteria.

An example : Appraising the project of an RTD Centre for food industry technology.
Box 51. Programming.phase
Box 52. Identification phase

Box 53. Terms of reference for updating a strategic plan for research in the agriculture-food sector.

Box 54. Management of natural resources: elements for participatory methods of planning.

Box 55. A pragmatic approach to research programming. Building operational intervention plans. The steps to take.

b) Tables

These outline some operative tools.

* *Table 6-0* gives a check-list for taking rapid stock of the situation when a delegation's assessor makes the first contact with the intervention promoter. An inventory of the items required for the analyses described in this guide can thus be drawn up.

* *Table 6-1* sets out the general form project documents should take.

* *Table 6-2* is an appraisal matrix to follow when drawing up the project file.

* *Table 6-3* is another appraisal matrix, to be used with the one in *Table 6-2*. It sets out some of the questions that should be asked.

* *Table 6-4* is a form for drafting a calendar for actions to be implemented and setting out costing details.

* *Table 6-5* is a summary sheet concerning the intervention submitted for appraisal.

Box 1 : Guide for the appraisal, implementation and monitoring of S&T and RTD projects and programmes.
Organization of the guide. The main parts of the analysis.

There are three main sets of complementary analyses which link up with one another :

1 - Competitiveness of proposed projects.

2 - Internal coherence, pertinence and priorities :
strengths / weaknesses
opportunities - risks

3 - Criteria and general principles for RTD interventions

N.B. Throughout the *different phases of a project*, these analyses give an input of information that can be incorporated in a set of sensitive control instruments to aid in management of the project.

Box 11. Guide for the selection, implementation & monitoring of S&T and RTD projects and programmes Organization of the guide. The three main parts of the analysis

THREE ANALYSES :

1. Analysis of the competitiveness of programmes and projects.

2. Analysis of the overall coherence of programmes and projects.

3. Analysis of the orientation of programmes and projects in relation to priority criteria.

*Note. These analyses fit into a general procedure of selection, implementation, monitoring and evaluation of programmes and projects (logical framework).*See Boxes 51 to 55

CHARACTERISTICS :

1. It is structured.
2. It is a basic framework that will be modified and developed.
3. It puts forward standards and criteria that facilitate the selection of RDT projects and programmes.
4. It helps in measuring and comparing programme quality (high standards, references...)
5. It uses both qualitative and quantitative criteria.
6. It aids in setting up an information system linked with the functioning of programmes.
7. It steers the action of managers concerned through a process of monitoring and assessment.

1. Competitiveness :

Analysis of five strengths

- Scientific quality / Originality — *see : Box 21*
- Originality — *Box 22*
- Attractiveness for clients — *see : Box 24*
- Comparison with alternative strategies — *Box 23*
- Strengths in terms of "leadership" — *Box 25*

Questions to ask ?
Weak points ?
Strong points ?

2. Overall coherence (TOWS matrix) :

Boxes 31 to 35	Strengths ?	Weaknesses ?	Strategy definition
Opportunities ?	What to do ? How ?	What to do ? How ?	Maxi - Maxi / Mini - Maxi / Maxi - Mini / Mini - Mini
Threats ?	What to do ? How ?	What to do ? How ?	

Questions to ask ?
Weak points ?
Strong points ?

3. Priority criteria :

Boxes 40 to 44	Questions to ask?	Weak points ?	Strong points ?
1. Reinforcement of local capacities			
2. Response to a demand / anticipation			
3. Global approach / sectorial approach			
4. A participatory process			
5. Regional / local approach			
6 Taking local knowledge into account			
7. Complementarity / subsidiarity			

Box 21 : Competitiveness of the project : quality of the scientific references and methods used; state of the art

A. Analysis of the core references and the sources used

A particular operation (for research, or institutional support for example) can be justified according to the foundation of knowledge and skills available in the proposed operation's subject area. The state of the art and standards attainable can be assessed by considering the following points :

1 - study of the literature and documentation (lists, accurate references, recent and older literature) to formulate the basis for working hypotheses in the proposed research.

2 - the general research method, experimental methods. Methods that will be used for data acquisition, surveys, information processing and analysis.

3 - association with networks for exchange of scientific and technical information, links with reference institutions, the quality of the partnership and of the partners in the North and in the South.

4 - the curriculum vitae of the research manager, experience in leading research teams or research-for-development schemes; CVs of others to be involved in the project.

5 - results of research work already published and available as guarantee of scientific credentials; products emanating from research already diffused; other indicators of the quality of the team that will be engaged in the intervention.

B. Some useful questions

1. Is the revised bibliography representative ? Does it : take into account the most prominent authors, allow an overview of the subject, give an up-to-date summary of the available findings on the subject ? Can it be used to build up a new set of hypotheses ? Do certain references stand out as indispensable ?

2. Are the hypotheses formulated for a new research intervention or to be used alongside a development operation backed up by a coherent expression of knowledge acquired and the questions still not satisfactorily resolved ?

3. Will the new knowledge expected to be acquired help advance significantly the state-of-the art on the subject ?

4. Have the research methods and tools employed, the instruments it is proposed to use and set in place, seen successful use in other, equivalent situations ?

5. If the method suggested is partly or completely original, is it based on an adequate assessment of the chances of succeeding (see chapter 3, overall coherence) ?

6. Has the team mobilized at different phases of the intervention sufficiently justified its selection ? Has enough thought been given to the abilities required and the appropriate profiles for staff ?

7. Is the scientific environment apt for the project team to work in, has it at its disposal the equipment suited for the working conditions and the necessary back-up ?

8. Have the end-users' and beneficiaries' expectations regarding results been adequately taken into account in drawing up the project intervention phases (see chapters 4 and 5) ?

9. Are the assessors of the projects submitted sufficiently informed of the evaluation on similar research when it was in progress - and are they aware of comments and criticisms made at the time ?

Box 22 : Originality of RTD projects. Projects focussing on innovation

A competitive advantage of a proposal submitted for appraisal may lie in its innovatory nature, in its inherent creativity. A few questions raised can pinpoint this character and thus steer the later processes of monitoring and further modification of the proposal selected.

* Can the **innovatory character** of the research proposal be ascribed to :

= interpretation of the initial situation, formulation of the objectives to be achieved and of the desired results ?

= **are certain features markedly original** in : research methods, instrum -ents called upon, tools put to work (e.g. rapid surveys, participatory methods, pogress reports, gradual reorientations, role negotiation) ?

* Does the research proposal **challenge hypotheses** currently put forward on the subject ? If so, are the core references (*Box 11*) recognized as respectable ?

= will the expected results significantly enhance benefits or satisfaction of end-users ? Is there any innovation to be found here ?

* Do these characteristically original features of the project have **a positive effect on the research costs** ?

If the answers to this set of questions are "Yes", the proposal under scrutiny will be more or less a **solid proposition**.

For example, some innovative projects [8] for farming or food-processing units encourage new combinations of production factors. In practice they materialize as :

1 - The elaboration of a **product, of a new item or material unfamiliar** to intended "customers" of this novelty (e.g. a new variety).

2 - Introduction of a **new production method**, practically unknown in the area of activity in question (cultivation technique).

3 - Penetration of a **new market**, winning over of a **new clientele**, the creation of new outlets (new industrial valorization of a food product for instance).

4 - Control of a **new source of raw or basic materials** as yet unexploited, or of an inhabitual ("alternative") energy source.

5 - A **new way of organizing production** (e. g. grouping together producers, inter-company agreements, consortiums).

These types of innovation help define the scope of the innovation lying in other proposals with which it is to be compared.

[8] Source: Schumpeter and Perroux, cited in Défis, Recherche et Innovations au Sahel - J. M. Yung - P. M. Bosc, Vol. IV, Documents Systèmes Agraires No. 17, CIRAD, 1992.

Box 23 : Degree of distinction from other proposals that could be substituted, RTD customers' preferences

or:

Can the proposal under analysis be substituted by other projects ? Some pertinent questions :

1 - Compared with other solutions, already available, does the project submitted offer any distinct advantages in terms of :

* yields - productivity - intensificaton;

* permanence of results' impact - sustainability (economic, ecological, social) ;

* reduction of risks, depending on what they are - diversification;

* self-reliance of the end-users of the results if faced with new problems of the same type;

* organization of the work.

2 - Will end-users of results and products really benefit by abandoning their traditional practices in favour of any proposed innovations ?
In which areas is such a choice still possible ?

3 - Are those involved in the innovation identified and can they assume responsibility for the risks associated with putting them into practice ?
What reasons motivate and determine their decision to adopt this proposal rather than any other substitute ?

4 - Must the innovations be adopted entirely "en bloc", or can they be taken on partially or selectively ?

Box 24. A complementary approach on the attractiveness for potential customers will be able to define RTD - customers' preferences. Some questions will help in this approach :

1 - Have the supposed customers and end-users of a given type of RTD result at their disposal information concerning the available alternatives ?

2 - Does this information come from reliable data acquired by way of RTD project evaluations ?

3 - In the sector of activity considered, is it possible to analyse cases of RTD schemes already completed, on which the "customers" and beneficiaries have expressed their opinion on the results obtained ?

4 - Can effects of fashion or prevailing "wisdom" be detected which strongly influence the RTD-project selection (e.g. research project for sustainable development and natural resources management, or projects run by women) ?

Box 25 : Competitiveness and valorization of the research

A - Value analysis [9] applied to RTD projects.[10]

This is arranged on the basis of :

* compiling and distribution of economic information on costs of the research;
* involvement of all parties concerned in devising and developing products from research, comparisons and discussions to draw up a common strategy;
* critical analysis of design methods for traditional products (by surveys, monitoring procedures, experiments in controlled conditions, in real working environments, diffusion of results, evaluation).

B. Elements for the valorization and marketing of the research

The valorization exercise aims to reach a better match between the demand for the research and the supply in terms of results, i. e. to bring research closer to the relevant "market". That will imply :

* conducting studies on market demands and assessment of needs;
* developing a prospective picture of the way research demand might develop and on the adaptation of research products;
* spotting of potential customers and analysing their decision-making;
* identifying competition in the sector and following up how their advantages change;
* identification of the supplementary skills and knowledge that should be mobilized and the partnerships to set up;
* promotion of communication and the spreading of information on the products resulting from the research, on the knowledge and skills involved, on the associated expertise and areas of excellence;
* efforts to professionalize personnel in research institutions in value enhancement of research.

---

[9] AFAV. L'analyse de la valeur.(Value analysis) (in French), Ministère de la Coopération, Paris, 1994.
[10] P. Maitre and J-D. Miquel De l'idée au produit; (From idea to product)(in French), Edns Eyrolles, Paris, 1992.

Box 3 : Definition of priorities for development research. The intervention's strategy and coherence, the global approach

The procedure suggested (here applied to farming) will define research priorities, grade them in a hierarchy of importance and devise an intervention strategy.

Box 31

Definition of priorities, the limiting factors that could have a determining influence :

* the functioning of production systems,
* agronomic research,
* the way the commercialization system of production units operates,

=> questions guiding project assessment and selection.

Box 32

From identification of variables to constraints.

Box 33

Hierarchization of factors at the root of the constraints:

* degree of influence of one factor compared with another,
* degree of difficulty of implementing a solution, or of getting round a constraint.

=> classification matrix.

Box 34

Setting up an intervention strategy

⇒ Synthetic diagram

Box 35

Strengths and weaknesses, opportunities and threats - risks.

⇒ TOWS matrix

Box 31. DEFINITION OF PRIORITIES FOR DEVELOPMENT-RESEARCH (applied to farming)

ypes of factors that uld be determinant in functioning of *gricultural systems*

...among which...

Types of limiting factors commonly encountered in *agricultural research*

...among which...

Limiting elements representing constraints in relation to *three types of decision*...

...which determine the functioning of the production units (P.U.)

Outflow from the farming system

Human | Socio-economic | Decision processes | Physical | Biological | Agronomic processes | Diagnosis processes

F. Risk of parasites
E. Water resources
D. Inorganic elements
C. Organic matter
B. Climatic risk
A. Ecological risk
G. Workforce
H. Producers' knowledge
Availability of materials
Access to markets
K. Access to finance
L. Access to technology

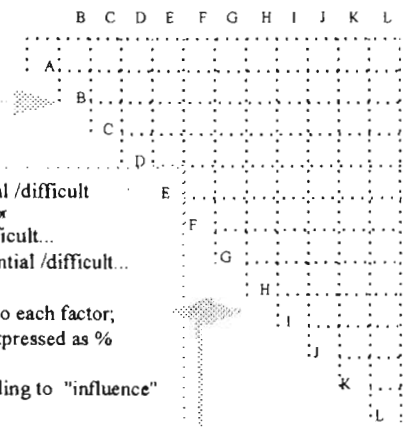
Draw up a global diagnosis of the production unit | Choice of technical paths | Decide on a management plan

Farming System

Functioning in terms of management on cycles of one or several years | Functioning in terms of production and work | Functioning in terms of the reproduction of the P.U.

Outflow

Hierarchization of factors and processesses contributing to constraints



3 = *much more* influential /difficult when compared to the other factor
2 = *more* influential /difficult...
1 = *scarcely more* influential /difficult...

---

* add up marks allotted to each factor;
* order in hierarchy is expressed as %

---

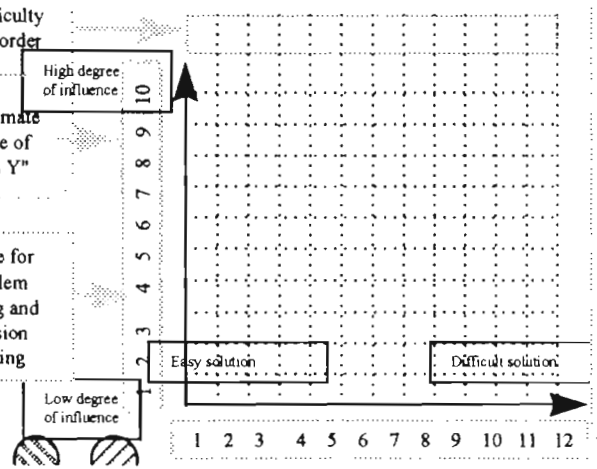
* Classification is according to "influence" and "difficulty"
(The same matrix to be used twice)

X
Y

Mark the difficulty in "X" in the order found

Mark the estimate of the degree of influence in "Y"

Guide for problem soving and decision making



Guiding questions for assessment and selection of projects.

1. Have the factors, items or variables possibly at the root of constraints been identified ?

2. Have the foreseeable constraints been pinpointed and characterized ?

3. Have the constraints pinpointed and characterized been hierachized (degree of influence and difficulty) ?

4. Has the impact of these constraints been defined in the global diagnosis of the production units ?

5. Has the effect of these constraints on the choice of technical paths been evaluated ?

6. Have strategies been identified to deal with these constraints in P.U. management ?

7. Have the technically based choices and management decisions been put in the form of hypotheses for operation of cycles of one or several years ?

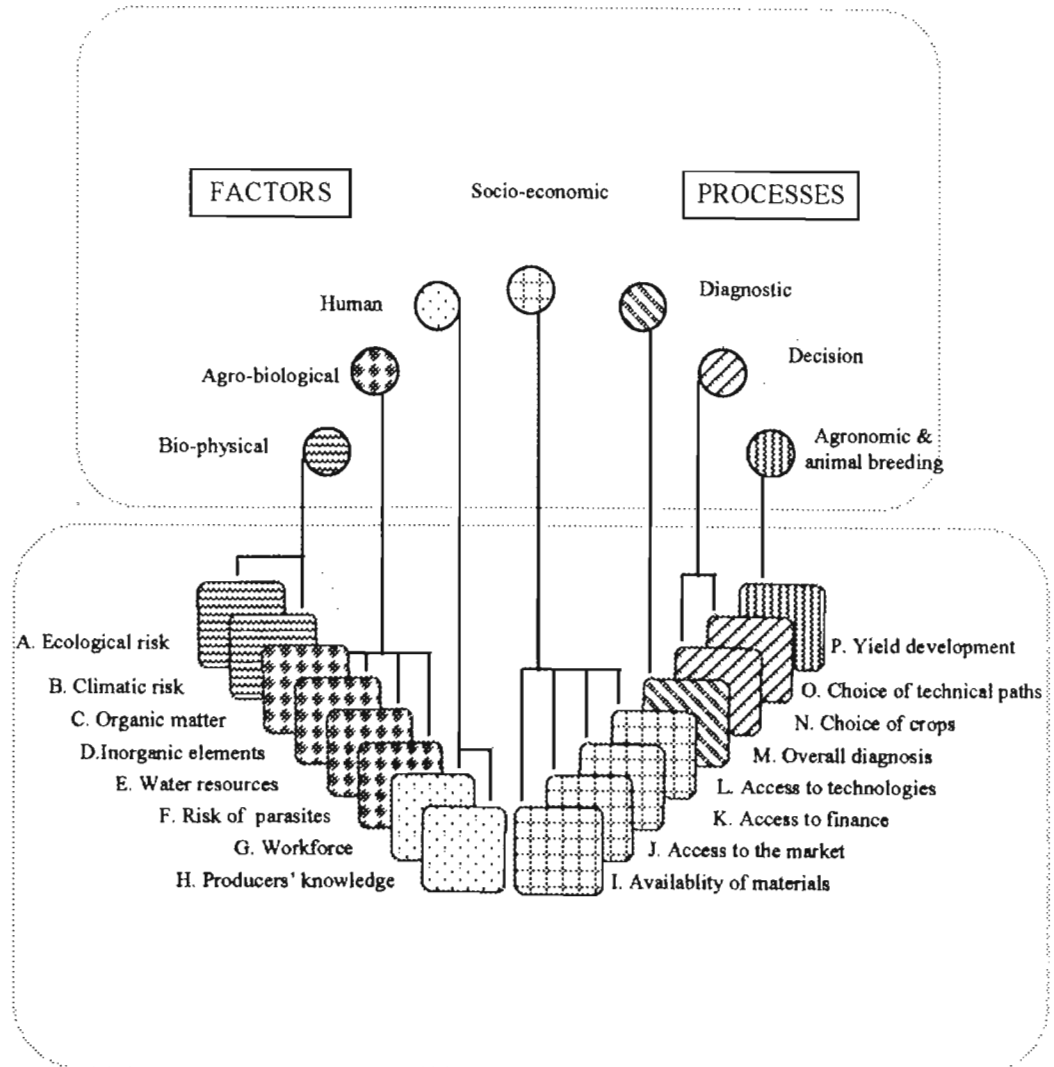
8. Have these hypotheses been expressed in terms of yields, gross profit margin, work force balance, etc. ?

9. Are these hypotheses expressed in relation to growth objectives, aims for investment, diversification and autonomy, flexibility of the P.U. (medium and long term) ?

From the identification of variables to constraints

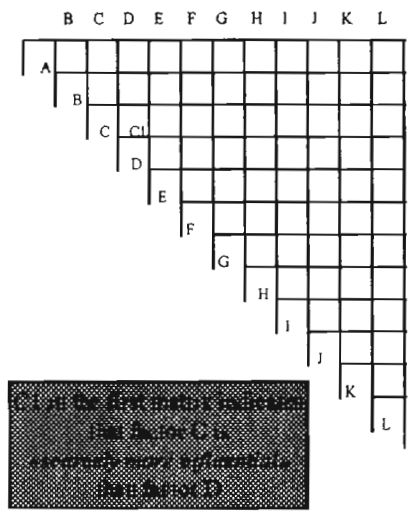
Types of factor or variable leading to constraints

Types of constraints fréquently encountered



Degree of «influence» ⟷ Hierarchization of factors and processes that lead to constraints ⟷ Degree of «difficulty to remove»

Box 33



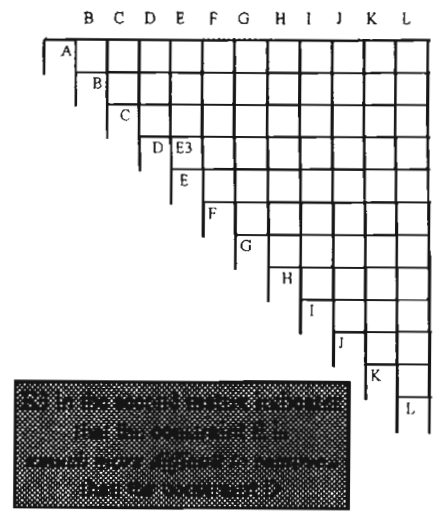
3 = much more influential /difficult
2 = more influential/difficult
1 = scarcely more influential/difficult

---

* add up marks attributed to each factor;
* order in hierarchy is expressed as a percentage

---

* Classification is according to "influence" or "difficulty" (The same matrix to be used twice)



Note : By using this classification matrix, a series of key elements (factors, variables) identified as determinant in a given agricultural situation, can be arranged in order of importance

Box 34. ESTABLISHMENT OF AN INTERVENTION STRATEGY

Factors, variables and processes leading to constraints

- **A. Ecological risk**
- **B. Climatic risk**
- **C. Organic matter**
- **D. Inorganic elements**
- **E. Water resources**
- **F. Risk of parasites**
- **G. Workforce**
- **H. Producers' knowledge**
- **I. Availability of materials**
- **J. Access to markets**
- **K. Rural loan availability**
- **L. Access to up-to-date technologies**

Choix de stratégie de résolution des problèmes et prise de décisions

Hierarchization of factors and processes that lead to constraints

Degree of influence

Degree of difficulty

3 = much more influential/difficult to remove
2 = more influential /difficult
1 = scarcely more influential/difficult

---

* add up marks attributed to each factor;
* order in hierarchy is expressed as a percentage

---

* Classification is according to «influence» and «difficulty»
(The same matrix to be used twice)

Mark in boxes "Y" the degree of influence estimated. Then plot on left side of Diagram n° 1.

	A	B	C	D	E	F	G	H	I	J	K	L
X	8.4	8.4	6.8	9.9	10.7	9.1	8.4	9.9	4.5	9.1	4.5	9.9
Y	7.0	8.8	8.8	7.9	4.4	10.6	7.0	5.3	9.7	13.2	8.8	7.9

Mark in boxes "X" the degree of difficulty estimated. Then plot on the right side of Diagram n° 1

Diagram 1 : influence / difficulty to remove

Guiding questions for assessment and selection of projects.

1. Have the factors, items or variables possibly at the root of constraints been identified ?

2. Have the foreseeable constraints been pinpointed and characterized ?

3. Have the constraints pinpointed and characterized been hierarchized (degree of influence and difficulty) ?

4. Has the impact of these constraints been defined in the global diagnosis of the production units ?

5. Has the effect of these constraints on the choice of technical paths been evaluated ?

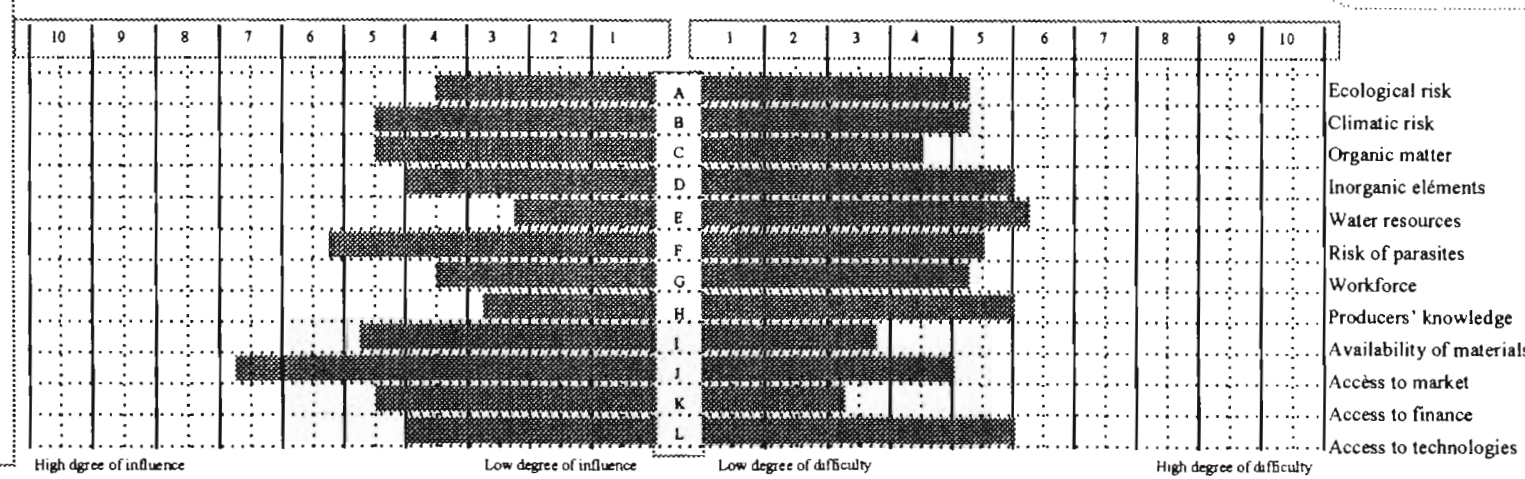
6. Have strategies been identified to deal with these constraints in P.U. management.

7. Have the technically based choices and management decisions been put in the form of hypotheses for operation of cycles of one or several years ?

8. Have these hypotheses been expressed in terms of yields, gross profit margin, workforce balance etc. ?

9. Are these hypotheses expressed in relation to growth objectives, aims for investment, diversification, autonomy, flexibility of the P.U. in the medium and long term ?

This diagram helps identify the most influential factors (J and F); those for which solutions are more difficult to carry out (E, D, H et L) ; and the reciprocal relations between these two criteria (influence and difficulty to remove the constraint).



Box 35. **TOWS matrix** (analysis of strengths, weaknesses, opportunities and threats or risks)

An example of a TOWS matrix: cotton production in Northern Mozambique

Fill in the appropriate parts of this matrix in order, from 1 to 5 :

1 : Description of the organisation (activity, function, purpose, location, competitiveness, objectives).

2 : Identification and evaluation of external determining factors (economic, social, political, technological, market, etc) positive (opportunities) or negative (threats).

3: Evaluation of strengths and weaknesses (internal factors) lying in management, finances, marketing, operational aspects, etc.

4 : On the basis of the preceding factors, attempt to define the characteristics of probable scenarios which might affect the organisation.

5 : Analyse and choose between the alternative strategies that best fit the probable scenarios.

Strong points to be exploited to the maximun. Weak points, to be reduced to the minumum	A - List the strong points : A1) Farmers receptive to ideas and motivated because it is (currently) the only cash crop. A2) Soils are fertile and plentiful.	B - List the weak points : B1) Low technical level (of producers, research and training system). B2) Managerial methods poorly adapted for the issues and potential developments atr stake.
Opportunities, aim to make the most of them. Threats or risks : aim to minimize them	**Strengths**	**Weaknesses**
C - List the opportunities C1) An organised cotton production chain. C2) Real possibilities for diversifying the farming activities. C3) Growth market for both cotton and food crops.	Type of strategy possible : maxi - maxi In this part of the matrix, strong points are examined alongside opportunities, aiming to draw maximun benefits from any combination of these. A1-(C1- C2 - C3) Make the cotton commodity chain capable of supporting diversification of products and revenue sources A1 - C3 : Support emergence of professional bodies able to organize markets effectively. A2 - (C1 - C2 - C3) Improve research and technical back-up that will lead to a planned expansion of surface area and gurantee cotton yields of about 1,4 T/ha, introduce and reinforce food crops progressively	Type of strategy possible : mini - maxi In this part of the matrix, weak points are examined alongside opportunities, aiming to minimize weaknesses and draw maximun benefits from opportunities:
Opportunities		
D - List threats or risks : D1) Possible fall in cotton price in some years. D2) Cotton growing could become a poor business prospect for farmers if the commodity chain contented itself with increasing just the surface areas and not the yields. D3) The cotton company might not be able to take on the role of regional leader.	Type of strategy possible : maxi - mini In this part of the matrix, strong points are examined alongside threats and risks, aiming to maximize the effects of the strengths and reduce as much as possible the influence of threats or risks :	Type of strategy possible : mini - mini In this part of the matrix, weak points are examined alongside threats and risks, aiming to reduce to the minimum any combined effects :
Threats		

Source : adapted from Robert G. Dyson - "Strategic Planning : Models and Analytical Techniques" - John Wiley & Sons Ltd - 1990

Box 4 : The basic principles. Priority criteria for a European intervention.

The basic principles, some illustrations:

Box 41 - Reinforcement of local capacities

Are the research structures in place able to properly manage the resources allocated to them, efficiently and with transparency ?

=> *Box 41* : Reinforcement of local capacities in research management - A training initiative.

Box 42 - Answer a local demand, without precluding anticipation

Classically, demands bear on the agricultural production sector. Several pieces of research will in the future focus on the food industry and the processing of farm produce for better preservation and value enhancement.

=> *Box 42* : Role of research in support of rural agriculture-related industries. Elements for evaluating firms.

Box 43 - Global approach, sectorial approach

The project studied concentrates on a specific theme-based initiative. How can this intervention be incorporated in a more global approach ?

=> *Box 43* : sectorial approach or global approach: where is the proposed intervention situated ?

Box 44 - Participatory process

Truly participatory procedures imply that institutional changes should be made and that partnerships should be modified in character.

=> *Box 44* : The partnerships between research and popularization and producers; mechanisms, indicators and monitoring-assessment.

Box 40 : From the 6th and 7th European Development Fund : areas of interest and character of RTD interventions. Some observations.

These provisional data result from an assessment which is under way. They will be updated at the end of the assessment. This first batch of information has been taken into account in the choice of examples to illustrate the procedures this guide recommends.

1 - **Inventory of projects and location**

Out of 206 projects implemented, 166 include at least one RTD component. A third of these are set up in a regional context and cover several countries. Half of them have been run (or are running) in West and Central Africa.

2 - **Areas of intervention, sectors of activity**

Most of these projects concern farming in general and, more specifically, improvement of production. Their approximate distribution by sector is :

Agriculture	50 %
Environment	10 %
Forestry	10 %
Stock breeding	10 %
Fisheries	10 %
Institutional support	5 %
Mining, health	5 %

There is a marked predominance of projects financed for the agriculture sector in West and Central Africa. This can be explained by the high proportion of farmers in ACP countries and by the high priority attributed to development strategies founded on agriculture.
In the future, the low scores for stock breeding and the agriculture-food industry should be compensated for.
Regionally-oriented projects concern mainly food crops.

3 - **Type of research**

The research lines these projects are engaged on :
* are more applied than fundamental research,
* concern adaptation rather than acquisition of new knowledge and concepts,

* focus on particular themes rather than study wider aspects of systems,
* are conducted in real working situations on farmers' holdings rather than under a controlled environment (e.g. at experimental field stations).

4 - **Research subjects**

These research projects bear largely on annual crops such as millet, niebe, or sorghum which have been the object of great hopes inspired by "green revolution" concepts.

5 - **Scientific disciplines**

In these actions the scientific disciplines involved concern two main areas : genetic improvement and animal pathology. The assessment confirms the paucity of interventions in sectors related to production economics, food consumption, food processing, natural resources management by the producers. These are highly important aspects for farming and rural development in the developing countries.

6 - **Terms of administration**

The terms laid down for administration and financial management have hindered the progress of RTD procedures and schemes. It would be useful to identify and analyse the functioning of projects that had developed original management methods.

7 - **Impact**

Strong limits have been placed on the expected impact of results of research undertaken because linkage between research and popularization has been inadequate. Furthermore, producers and their organization have contributed little to validation of research results, which reduces the significance of the results obtained.

The importance of regional projects must be noted. Their integration into the institutional framework, as complements or substitutes for actions of National Agricultural Research Systems (NARS), deserves to be well thought out as does the relation of these regionel projects with regional research authorities (CORAF, ASARECA, SADEC) and international research centres and agencies.

Box 41 : Reinforcement of local capacities. Training in research organization and management[11]

Background

1. - Consequences of Sectorial Adjustment Plans applied to agriculture: research structures and, more particularly, agronomic research, are faced with new problems following a general reduction in government subsidies to research establishments. In this context, a renewal of the research effort essentially involves reorganization of existing structures and the implementation of **Research Management** practices that are "healthy, efficient, transparent and durable".

2 - **Training of researchers**, at universities and in specialist schools, does not consider the different areas of management involved in research projects and organizations.

3 - Increasing trend of disinvolvement of the State prompts the NARS to prospect for external financial sources. **Management flaws** instill fear which must be removed if **the range of sources is to be enlarged and providers reassured**. Financial backers will be particularly sensitive to improvements that can be made in this sphere.

4 - **Decentralization of research activities**, aiming to bring them closer to real conditions encountered in the field, leads also to the setting up of devolved systems of management, with the relevant staff and tools working near at hand.

5 - Against a background of ever-increasing competition and the imperative to promote high quality, allocation of financial means will more likely be seen concentrated on structures that can earn the confidence of financial backers, whether national, regional or international.

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[11] CORAF meeting. N'Djamena - March 1997. E. Viricelle, A. Moreno.

Training-based actions with the goal of reinforcing local capacities in organization and management of research could include modules on:

1 - A participatory process for determining to what extent management needs are generalized over the whole research operation

* Report of the current situation drawn up under the responsibility of the management team and the middle managers in charge of particular **managerial tasks**.
* Accurate identification and description of the different management functions, assessment of deficiencies, priorities for intervention and their nature. **Active participation** of senior management, and other staff concerned, in the diagnosis.
* Preparation of a schedule for the whole set of actions needed: intervention, tools, training. **Engaging of the participants to be involved.**

2 - Improvement of the management functions

* Analysis of the ability of the functions to contribute to worthwhile creation and the overall efficiency of the structure.
* Introduction of new technologies supporting management and instilling a mastery of these: management tools adapted and used for research, instruments for steering projects and programmes in real time.
* Development of indicators and a range of instruments sensitive to parameters useful for management.

3 - Professionalization of the various management occupations involved in agronomic research

* Improvement of career structures in activities that in any way support research.
* Setting up a system of training schemes to increase qualifications and enhance the potential of manpower resources.
* Promotion of individual self-improvement and self-reliance.

Box 42 : Role of research in support of rural farming-related industries. Elements for evaluating firms to improve their competitiveness

Conventionally research in the farming sector has the objective of improving agricultural production (*Box 10*). Anticipation of future developments means that light should in particular be shed on the needs for research in food processing and rural farming-related industries.

Background (an example from Latin America)[12]

The concept of rural farming-related industry brings together production units that have the following characteristics :

* Employment of a local workforce and use of local materials.

* Added value generated by processing and marketing of farm produce is either totally or partially ensured in the production unit itself.

* These firms either belong to the producers themselves, or are conferred to them as managers.

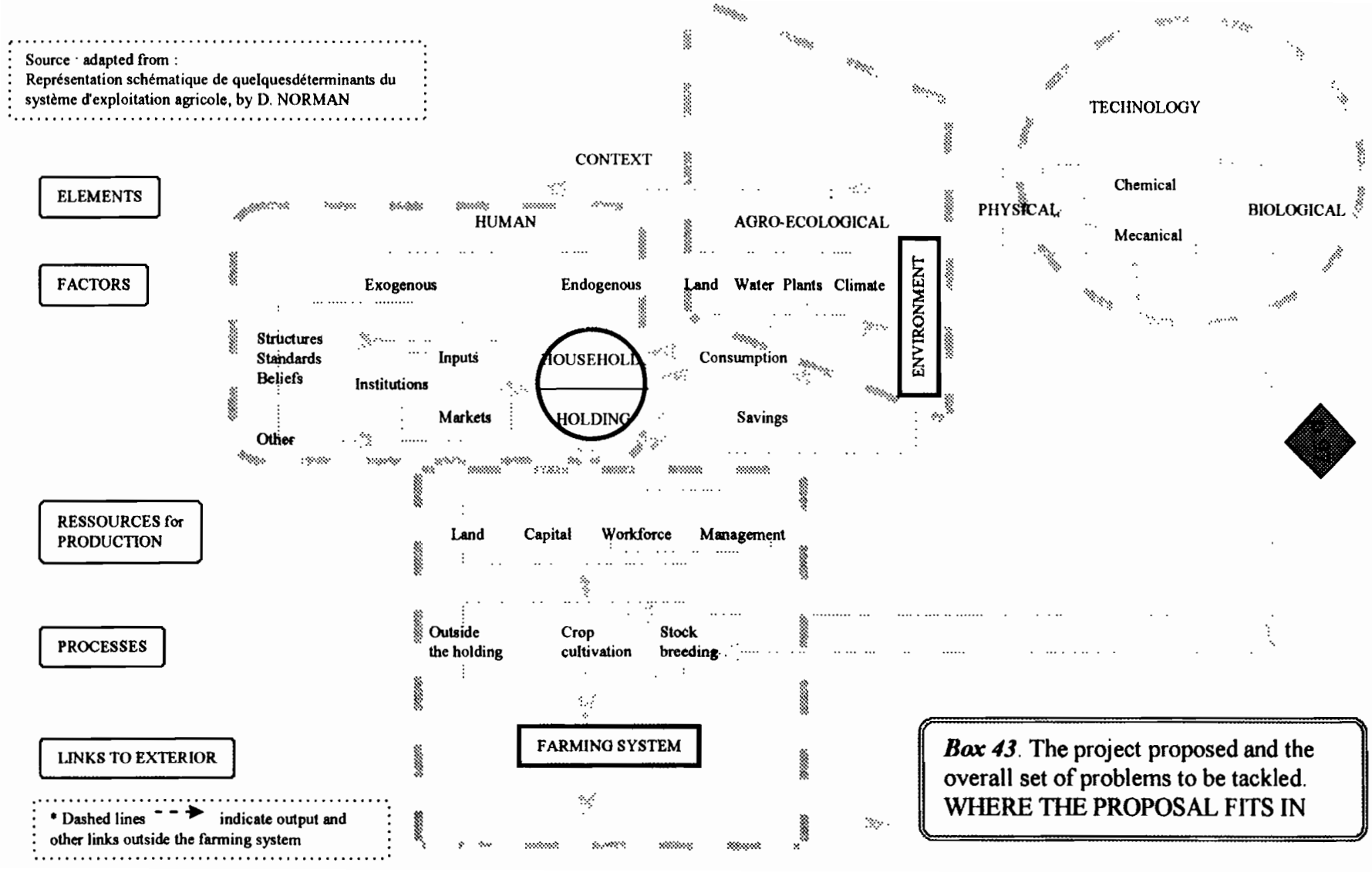
* There is a degree of integration between primary agricultural production, the processing procedures and marketing of the product.

* Production units are small and product volumes treated are limited. Technologies used, the production systems and structure of the firm are quite simple.

* The new environment of globalization of markets and the opening up of national economies to free tade put these concerns in a precarious situation.

* To reinforce these companies, which sustain employment and incomes in rural areas, better assessment of their current competitiveness is needed so that it can be improved.

[12] Improving the competitiveness of rural farming-based industries. Methodological guide for evaluations (in Spanish). Pamela Guiraud, PRODAR-IICA / CIRAD, 1996.



Box 43. The project proposed and the overall set of problems to be tackled. WHERE THE PROPOSAL FITS IN

Box 44 : Research and development partnership. Some indicators and means of monitoring and assessment

Indicators are identified in order to describe and follow up changes in partnership mechanisms; certain means and tools for verification are proposed. The information and items come out of ongoing work being conducted with institutions and organizations of several West African countries.[13] They refer to institutional changes and the evaluation of the partnership.

1 - Institutional changes

1 - 1. Culture of the enterprise involved in the partnership (mechanism = M)

* Objectively Verifiable Indicator (OVI) :
  declaration in the constitutional texts and management documents of institutions.
* Means/Tools for verification (M/T) :
  company project
  establishment regulations

1 - 2. Decentralized management of research and agricultural advice (M)

* OVI . Regional priorities (provinces marked out for development)
* M/T . Regional development plan
* OVI . Regional programmes in research and popularization
* M/T . Strategic plan for regionalized research, adjusted periodically
  . Annual programme of research and popularization
* OVI . Management of the resources for performing research and conducting popularization schemes at the regional level
* M/T . Regional budget, local and regional personnel management
* OVI . Recruitment and appraisal of farming advisers in rural communities
* M/T . Assessment report.

[13] P. Rondot - Projet Ministère de la Coopération. (in French). World Bank/CIRAD, 1996. Senegal, Mali, Burkina Faso, Guinea.

1 - 3. Participation of producers in decision-making processes and management of research institutions (M)

* OVI . Producers represented in research programming committees and management boards.
* M/T . Producers take part in meetings.
. Minutes of meetings.
. Records kept of decisions.
* OVI . support for representatives in their functions when participating in the management of institutions.
* M/T . Number of training schemes.
. Educational content.

1 - 4. Reinforcement of producers' abilities (M)

* OVI . General meetings, elections.
* M/T . Minutes of sessions and meetings.
* OVI . Organization of exchange days, open days.
* M/T . List of participants.

2 - Assessment of the partnership

2 - 1. Increase in rural incomes

* OVI . Increase in production.
. Increase in yields.
. Reduction of production costs.
. Income development.
. Diversification among producers.
* M/T . Rate of adoption of technologies.
. Follow-up of production units.
. Technical and economic yardsticks.
. Changes in surface areas cultivated, by crop.

2 - 2. Institution durability and effectiveness

* OVI . Financing of research and farming advice service:
by the producers
by the public services
* M/T . Number of agreements and contracts.
. Proportion of GNAP devoted to research, changes.
* OVI . Changes and development in the way popularizers work.
* M/T . Surveys among popularizers, work schedule.
. Reports, technical sheets produced.

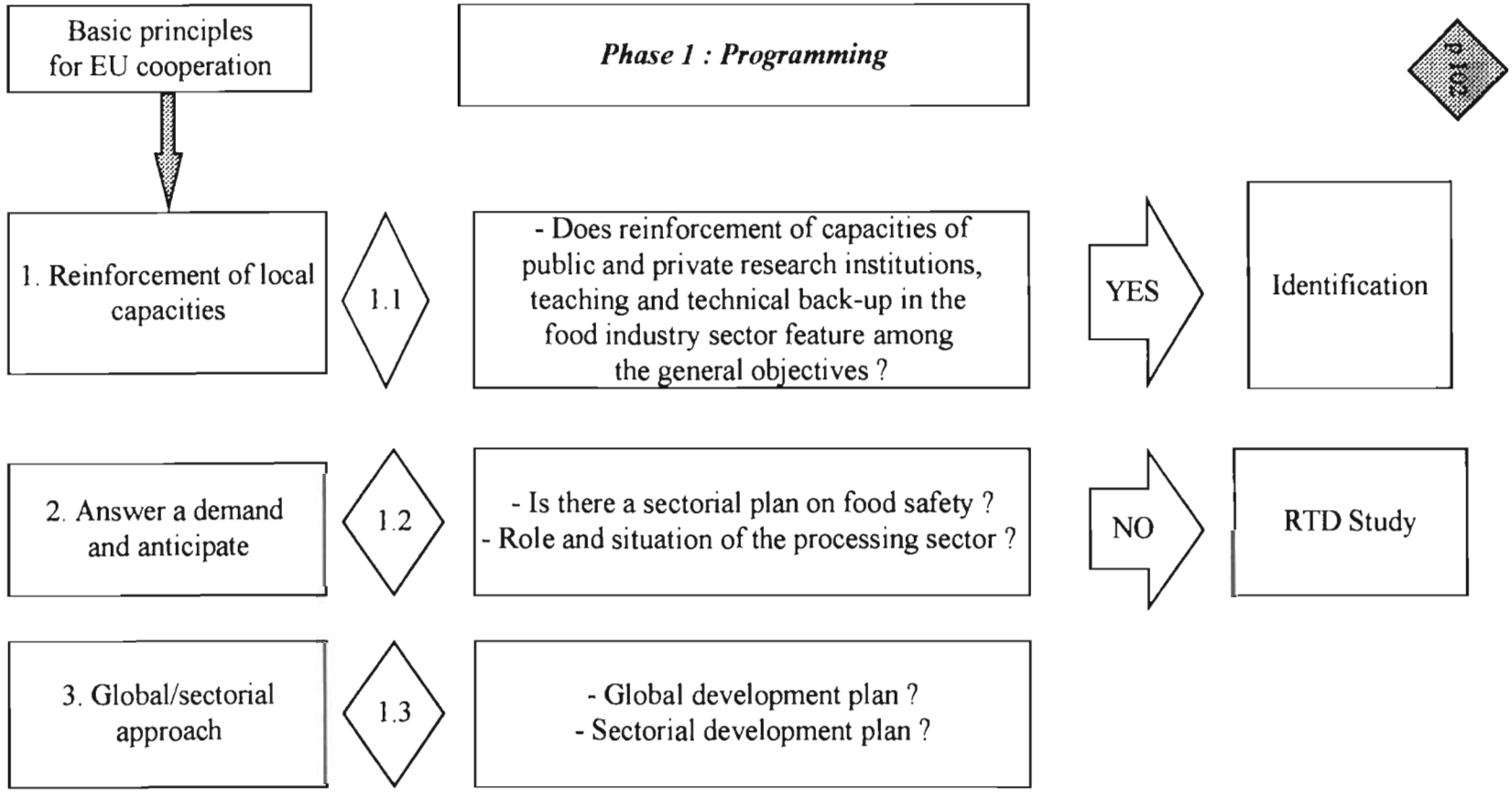
Box 5. GENERAL ORGANIZATION OF THE PROCEDURE.
Taking into account of basic principles at each different phase of the project cycle. (THE PERTINENT QUESTIONS)

Basic principles \ Phases of the project cycle	1 Programming	2 Identification	3 Investigation	4 Financing	5 Implementation	6 Assessment
1. Reinforcement of localcapacities	Box 51	Box 52				
2. Answer a demand and anticipate						
3. Global approach / sectorial approach						
4. Participatory process	Box 54					
5. Regional approach / local approach						
6. Taking into account of local knowledge						
7. Complementarity / subsidiarity						

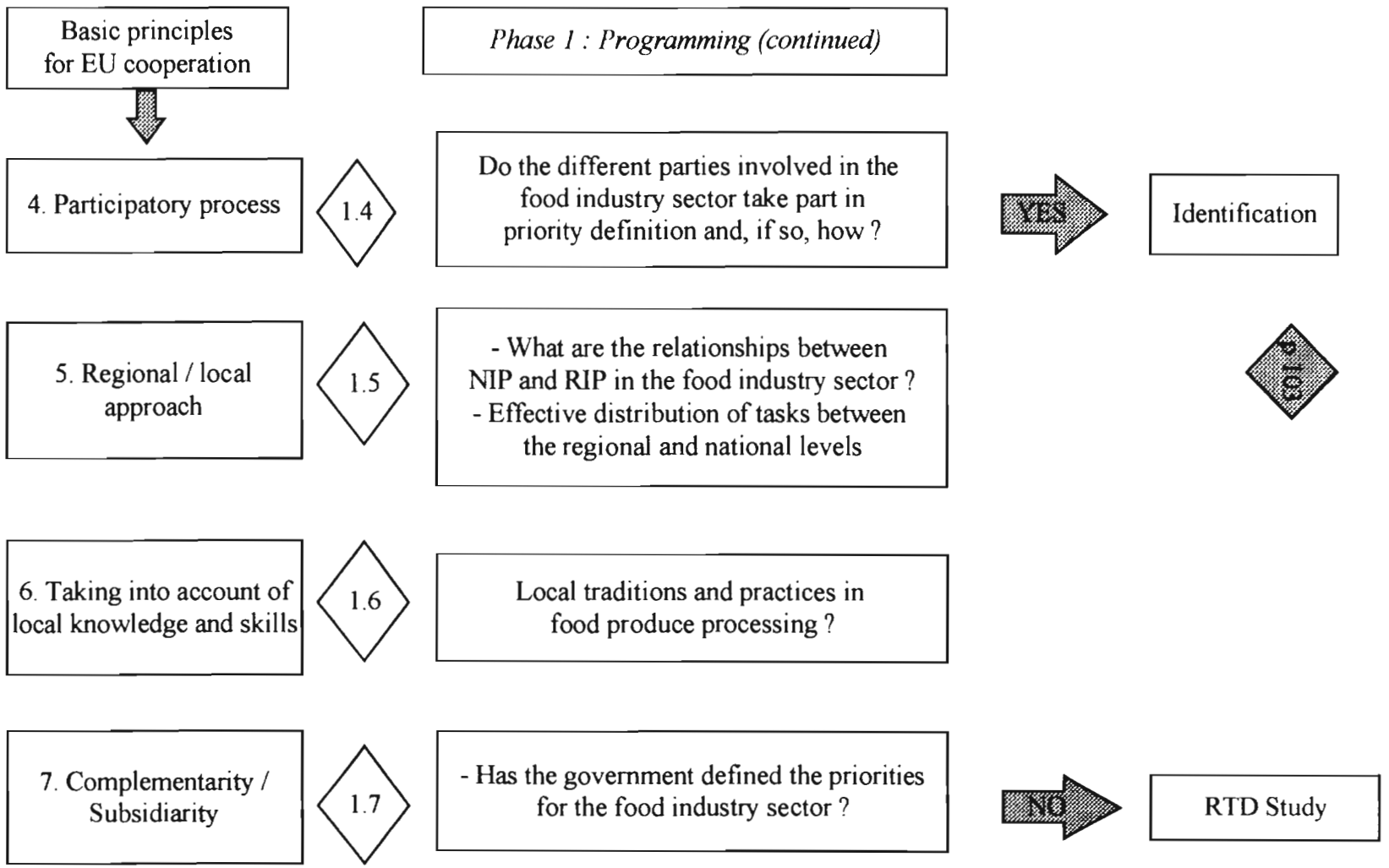
Ex : see Box 54 when Programming : which questions are pertinent at this phase, if you want it to be participatory, and negotiated with the actors concerned by the project

Box 51. *Logical framework* of the project & Principles and priority criteria for a European cooperation

An example : ***Programming*** the proposal of an RTD Centre for food industry technology *(1st part)*



Box 51 *(continued). Logical framework* of the project & Principles and priority criteria for a European cooperation. An example : ***Programming*** the proposal of an RTD Centre for food industry technology (*2nd part*)



Box 52. *Logical framework* of the project & Principles and priority criteria for a European cooperation. An example : *Identifying* the proposal of an RTD Centre for food industry technology (*1st part*)

Basic principles for EU cooperation

Phase 2 : Identification

1. Reinforcement of local capacities

2.1

- Are local capacities for RTD (academic and technological; education and technical support) strong enough to face challenges implied by economic development ?
- How are means and ressources distributed between the different aspects :
  - . technology, facilities, processes, quality
  - . socio-economic factors
  - . general nutrition context
  - . organization of marketing of food industry products
  - . geographical considerations, distribution of the main markets
- What means are available to spread information and enhance the value of the results ?

2. Answer a demand and anticipate

2.2

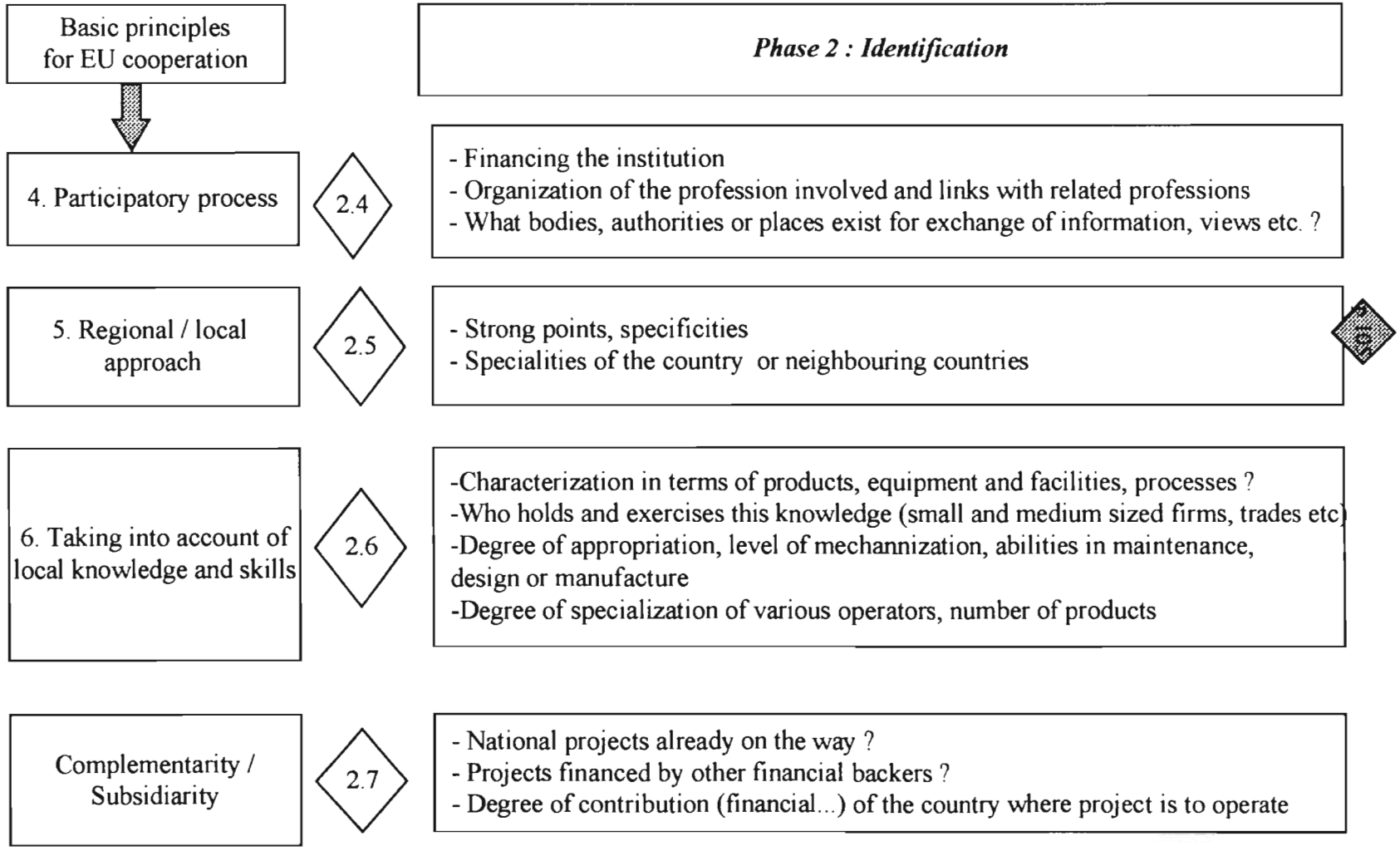
- Local urban demand ?Changes ?
- Proportion of demand satisfied by the local production ?
- Main local markets ?

3. Global/sectorial approach

2.3

- Problems of this sector that are common to several industries or commodity chains (supply system, marketing, technologies, infrastructure, logistics) ?

Box 52 (continued) *Logical framework* of the project & Principles and priority criteria for a European cooperation.
An example : ***Identifying*** the proposal of an RTD Centre for food industry technology (*2nd part*)



Box 53 : Terms of reference for updating a strategic plan for research in the food-industry

These elements arise from actions in research programming in this sector, in different countries of West Africa (Burkina Faso, Senegal).

1 - Background : Need for a strategic plan in technological research for the food industry.

* States' disengagement from production activities in favour of the private sector.
* Implementation of sectorial plans for agriculture and the environment.
* Importance of crop diversification for national consumption and exploitation.
* Importance of developing innovatory processes for storage, preservation and processing of food produce.

2 - Sectorial study to initiate

* Technical and economic diagnosis of firms.
* Diagnosis of chains of production, national markets and expatriation.
* State of partnership between firms and research and development institutions or food industry technological centres.
* Review of the processes and technologies used and to be promoted :
  . food processing methods and equipment,
  . effects on product quality.
* Review of facilities and equipment that can be used and set into operation :
  . management and maintenance of laboratories; experimental food markets or preparation centres,
  . equipment - priorities for acquisition.
* Examine the research work in the sector:
  . existing knowledge and skills, their mobilization as a function of intervention priorities.
  . results obtained, innovations, local know-how,
  . valorization of research results.

Box 54 : Participatory procedure. An Example: *participatory methods in planning and management of natural resources*

The example given is based on the results of a project [14] in resources management in an Amazonian forest environment. The project's main objective is to make viable the conservation process, to consolidate it by introducing innovations and productive alternatives to the local populations.

The project's participatory process rests on four types of action, as follows:

1 - Self-conducted diagnosis and monitoring-assessment workshops

The method used takes up the procedures devised by research-action, based on experiments in informal education developed in Brazil and other Latin American countries.[15] The aim is to reconcile socio-economic interests of local people and the authorities' declared imperatives for conservation of the forest heritage.

The first stage in the self-conducted diagnosis, run by the community itself, gives the public the opportunity to speak in balanced debates with all the parties concerned. A general discussion is organized, which leads to the establishment of a set of conditions to comply with and a programme of actions to undertake (reciprocal committments, division of "labour" and so on).

2 - Democratic and mutually supportive initiatives

Development of a regional plan for conservation of the environment and of Indian territories: zones that must be protected, zones that can be used and exploited, and infrastructures are defined at workshop meetings organized for each specific problem.

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[14] Projet Aires Protégées Amazoniennes (Protected Areas in the Amazon Project), TCA-EU DG1, 1993-1997 - R. Pasquis/CIRAD, C. Castano/MINAMBIENTE, Colombia.

[15] M. Garcia, Areas Protegidas y autogestion comunitaria, (Protected areas and community self-management), 1994, Bolivia.

3 - Participatory approach to mapmaking

This approach to mapping consists in organizing the collection of points of view from the whole of the parties involved, the location of conflicts, preparation of cartographic documents for future negotiations and to draft agreements. All this work also allows potential disagreements to be pinpointed and evaluated.

The results obtained contribute to the drafting of the management plan for future activities of the groups concerned.

4 - Methods for resolving conflicts of interest

Conflicts, which result from complex and ever-moving social relations, are described and characterized; the strategies of the various parties involved are identified; a meticulous investigation is undertaken. This work is used to formalize and legitimate the customary rules of natural resources management and prepare the framework for negotiations. Concrete proposals for reconciliation are drawn up. The negotiators are chosen. Elements towards a solution are built up progressively; they must give rise to definite proposals for action.[16]

[16] C. Villareal, FAO, FTPP. Resolucion de conflictos en comunidades forestales,(resolving conflicts in forest communities), 1993, Equador.

Box 55 : A pragmatic approach to research programming. Building operational intervention plans. The seven steps to take.

In order to tie together research programming, the choice of priorities, programme building and budgeting by objectives, an operational procedure is proposed. This procedure has been elaborated in different research institutions, in North Africa [17](Algeria, Morocco, Tunisia) practising research programming and budgeting by objectives.

1 - Develop a set of economic arguments for each project

This economics-based argumentation can lead to the evaluation of the economic effects of the problem to be dealt with and the economic benefits expected from the results of the research it is proposed to undertake (such as savings stemming from a decrease in potato seed imports, area (hectares) of soil eroded per year, shortfall to win back following loss of export markets for dates in aftermath of worm infestation, improvement of producers' income by increasing their cereal yield through using a particular cultivation technique).

2 - Draw up a recapitulatory list of positive results and experiences

By quoting useful findings already popularized on given subjects, credibility can be given to the team involved or to the institute to which it belongs (size at which olive trees regenerate, practice of cultivating fallow in an arid region, method of seed multiplication, semi-weaning in lambs, a method for preserving potatoes, and so on). List the research results to be confirmed (adaptive research) or implying new work which justifies the implementation of this research project.

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[17] V. Dollé - Programmation et budgétisation par objectifs. Travaux de suivi et d'évaluation pour la Banque Mondiale. (Programming and budgeting by objectives. Monitoring and assessment). Algeria, 1990-1993; Tunisia, 1992-1995; Morocco, 1993-1996. (World Bank).

3 - Show the expected results and products

Identify the research products desired and the time schedules expected for them to be developed. Distinguish between the intermediate products and the finished products, whatever their nature (map, typology, cultivation technique, variety with resistance to particular attack, stockbreeding methods, and so on). Organize fedback announcements of the results from the start of the intervention.

4 - Describe the component research operations (RO) of the project with a detailed calendar for engagement on each part (showing start and finish) and the way series of operations link up (e. g. the beginning of RO 4 depends on the results of RO 2 and so on).

5 - Draw up summary tables on equipment acquired and to be acquired, the resources to be mobilized indicating the priorities for purchasing or expenditure commitments. Show the different elements of the whole experimental set-up to be put into operation (e.g. parcels of land for field trials, survey instruments and so on).

6 - List personnel required, the training needed, consultations to hold in order to acquire the competences necessary to achieve the project's objectives. These means correspond to scientific capabilities that must be built up (by recruitment or training) or to mobilize on a short-term basis (consultation) to bring together scientific teams that will have the mandate to carry out the projects.

7 - Establish annual budgets for equipment and facilities and for running the project. Make distinction of the means to be acquired through the intermediary of the governing Ministry, the farming profession, international cooperation schemes, or the large financial backing organizations.

Points 1 and 3 give rise essentially to the elements (i.e. indicators) which can be used to monitor and assess the actions of the project.

Box 6.0 Check-list for a preleminary characterization of a research project.

Project identification. *POLITICAL & LOCAL CONTEXTS.*

Summary of the project	*Title or Denomination*	*Code number*	*Countries,Regions & areas concerned*	*Background to the project* — *General* — Government policy Sectorial policy	*Specific* — Characteristics of the sector	*Project history* Presentation of previous phase or preparation phase

PARTIES INVOLVED								BENEFICIARIES		SCALE OF INTERVENTION		
Main or leading organization	Partners	Nature of intervention: Research	R-D	Experimentation in real working situation	Training	Size in %, m/m, or cost	Type of contractual relations	Main targets	Partners of negociated experiments	Regional Theme-based	Country	Uniform area

SITUATIONS & PROBLEMS TO BE SOLVED						PREVIOUS POSITIVE RESULTS			BIBLIOGRAPHIC ACQUISITIONS	
Population density	Existing resources Environment	Organization of holdings	Predominant production systems	Economic context Markets	Capitalization	in research	in development	for training	context-based	theme-based

IMPLEMENTATION OF THE PROJECT									OPERATING SCHEDULE
Research themes	Human ressources					Financial means			
	Nationals			From abroad					
	Research	Development	Training	Permanently in the country	Support (months)	Total	Source	Type	

BOX 6.1 SET of the project documents

Summary

Objectives of the project

General objectives of the research
Measurable specific objectives
Match of objectives with National or Regional Indicative Plans

State of knowledge

Innovative aspects of this research
Methodology

Content of the work

Method tools
Detailed description
Tasks of each partner
Project management

Schedule

Expected gains

Project costs

Plan for operation and valorization of results

Box 6.2 : Investigation grid

	Objectives of the project	*Content*	*Schedule*	*Expected gains*	*Costs*	*Operation plan*
Principles Orientation Context	see Box 6.3 ⇔			⇔		⇔
Integration framework	⇔			⇔		
Criteria to be fulfilled	⇔		⇔		⇔	⇔
Research methods		⇔	⇔		⇔	

Box 6.3 Investigation grid

Principles,Orientation, Context	*Objectives*
Answer a demand	How have the objectives been defined ? Objectives of NIP and RIP taken into account ? Market research done ?
Global approach / sectorial approach	
Participatory procedure	Who first defined the nature of the project research ?
Reinforcement of local capacities	
Consideration of local knowledge and skills	
Complementarity / Subsidiarity	

Box 6.4 :SCHEDULE and COSTS

1.1 Schedule

Programme phases	Year 1	Year 2	Year 3

1.2 Costs of the project

ITEM	TOTAL COST	Part 1	Part 2	Part 3	Part 4	Part 5
TOTAL						

BOX 6.5 : SUMMARY SHEET

TITLE : .....
.....

DURATION : .....

BUDGET REQUIRED : .....

FINANCING : .....
.....

BENEFICIARIES :
* .....
* .....
* .....
* .....

PARTNERS :
* .....
* .....
* .....
* .....

GENERAL OBJECTIVE : .....
.....

DETAILED AIMS
and OBJECTIVES :
* .....
* .....
* .....
* .....
* .....
* .....

MAIN TASKS :
* .....
* .....
* .....
* .....
* .....
* .....

EXPECTED GAINS :
* .....
* .....
* .....
* .....
* .....

ANNEXES

Appendix A . Appraisal of a RTD project in sustainable natural resource management.

Appendix B. for further information.

Appendix C. Glossary.

Appendix A.

CASE STUDY. APPRAISAL OF A RTD PROJECT IN SUSTAINABLE NATURAL RESOURCE MANAGEMENT

(This example is hypothetical).

1. ***Objectives.***

To conserve biodiversity in non-timber forest products (NTFPs), while increasing both export earnings and the incomes of disadvantaged groups.

2. ***Statement of the problem.***

In parts of the country the collection of NTFPs is a traditional activity of ethnic minorities, particularly their women and children. These products were traditionally used as raw material for a range of handicrafts, medicines, etc. but some of them are now increasingly valued in the modern pharmaceutical and cosmetics industries. An important export market has now emerged as a result. This has pushed up demand and therefore prices, which in turn has caused collection to grow to the point that this natural ressource is now being exploited unsustainably. As local stocks become exhausted, foragers are now travelling increasingly long distances into remote forest areas to obtain supplies. This both reduces the returns to labour and threatens the more economically valuable species with extinction. The risk of reduced biodiversity is heightened by the threatened loss of an important source of income for some of the country's poorest people. At the national level a valuable source of export earnings is at stake.

3. ***The challenge.***

The present situation carries opportunities as well as dangers. Thes arise from the prospect of bringing the more valuable species into cultivation. This would bring the following advantages :

Steadily falling pressure on the forets ressource, thus rendering the activity sustainable while conserving biodiversity

Additional labour inputs required for cultivation would be moer than offset by reduced labour requirements for collection and transport of the product from the wild.

Cultivation would permit scientific research to be done on both the agronomy of the plants, so as to increase yield, and on plant genetics aimed at increasing the concentration of useful materials the plants contain.

The amount of economically useful material each plant yields is only a tiny fraction of its weight and volume, so that local processing would both increase value added and very greatly reduce transport costs. This in turn would both increase local-level employment and incomes, and reduce costs, so that the produce could be made more competitive on the world market, thus boosting export earnings.

Ther development of a model that balances the needs of ressource management, promotion of the interests of the disadvantaged and export promotion will make a major contribution towards strenghtening indigenous RTD capacity. It will achieve this through its provision of formal training, through a marked emphasis on learning by doing, through its demonstration effect and through attitudinal change, much more than through its (minimal) provision of research equipment and infrastructure. It will contribute to the growth of an interdisciplinary R&D culture as it requires collaborative work in the fields of sociology, anthropology, ecanomics, agronomy, extension, plant genetics, low cost technology development, marketing and management.

The proposed project has two components, which will commence at the same time, but can be expected to yield their benefits within differnt time frames. The first requires adaptive work in terms of RTD, covering germplasm collection from the wild, agronomic research to establish optimum farming practices, and extension to popularise cultivation. The second component is more strategic and will yield benefits in the long term. It requires genetic research to develop improved cultivar, and engineering research to develop suitable low cost technologies for local processing.

4. ***The project cycle management.***

In terms of the project cycle management, the following key questions must be addressed while considerinf project funding :

A. *Indicative programing*

A1. What is national policy on RTD ?
A2. What level of resources has the government devoted to RTD, as an indication of its intent to pursue this development track ?
A3. What priority does government give to sustainable natural resource management (NRM) in general and biodiversity of NTFPs in particular ?
A4 What is the legal situation concerning ownership of forest resources, including genetic resources, and their exploitation ?
A5. What is national policy on income generation for disadvantaged groups ?
A6. What is the policy on export promotion ?
A7. What linkages, networking, collaboration is there to regional organisations ?
A8. What policies are other donors, particularly EU member states, following in this area ?

B. *Identification*

B1. What potential conflicts are there in the trilateral relationship between national policy on (a) natural resource management, (b) export promotion and (c) concern for the welfare of disadvantaged peoples dependent on the forest resource ?
B2. What local capacity presently exists to accomplish the project in terms of institutions, human resources, infrastructure and equipment ?
B3. What requirements on the part of the EU, the natioanl government and regional bodies are implied by this assessment ?
B4. What attitudinal changes are required within the national or regional RTD establishment in order to : implement a participatory approach, instil a concern that the disadvantaged should share in the benefits of development and to develop a sense of balance between the requirements of resource conservation and those of human welfare ?
B5. What are the training and related needs implied by this assessment ?
B6. What will the proposed project contribute towards strenghtening indigenous RTD capacity and making it sustainable ?

C. *Formulation.*

C1. What are the trends in depletion of economically important NTF species and how have thes been measured ?
C2. How large an area, and how many species, are affected or could potentially be affected by the identified problem ?
C3. What are the trends in labour requirements for collecting the crop from the wild ?
C4. How much do the products in question presently contribute to export earnings, and what have trends been ?
C5. Taking into account both alternative sources of supply and possible competition from synthetics, what is the world market situation and outlook for the pro ducts in question in
(a) the raw state and (b) the semi-finished (i.e. locally processed) state ?
C6. What are the economics of cultivation and processing vis-a-vis continued collection and transport of materials in their raw state ?
C7. To what extent has the local population been consulted in identifying and quantifying the various aspects of the problem, and how seriously are they concerned about it ?
C8. What social, cultural or religious problems can be anticipated in converting a wild species into a cultivated one, or in starting to transforming the society in question from gatherers to farmers ?
C9. What changes in market infrastructure for both inputs and outputs are iplied by a shift from gathering to cultivation and local processing ?

D. *Financing.*

D1. What are the economic indicators of the project ?
D2. Is the breakdown of project costs sufficiently detailed ?
D3. Is the costing for the various components and the time allocation budget realistic ?
D4. Is provision for counterpart funding by the national government / regional institution adequate and realistic ?
D5. Is there adequate provision for safeguarding operational funding commitments by national government / regional institution ?
D6. Is the project financially sustainable in terms of eventual public sector disengagement and increasing private sector takeover ?

E. *Implementation / Monitoring.*

E1. What is the project implementation schedule ?
E2. What provision is made to ensure that this schedule is adhered to ?
E3. What are the requirements in terms of progress reports and monitoring of outcomes ?
E4. What objectively measurable criteria have been identified that will monitor whether the capacity strenghtening objectives of the project are being adequately met ?
E5. What provision is made for ensuring early identification of any implementation problems?
E6. What measures are in place to ensure that the research team functions, and continues to function, as an interdisciplinary team ?

F. *Evaluation.*

F1. How will success in terms of RTD capacity strenghtening be measured in terms of
(a) individual researchers (training, professional development);
(b) scientific institutions to be strenghtened and supported;
(c) national RTD policies to be strenghtened and supported;
(d) networks and regional linkages to be established as capacity-strenghtening mechanisms ?
F2. How, and to what extent, will the expected project beneficiaries be involved in the evaluation process ?
F3. How will environmental regeneration in the shape of resurgence of endangered species be measured ?
F4. What criteria are in place for evaluating success in terms of adoption of recommended practices ?
F5. What criteria will be used to assess success in terms of income generation ?
F6. What methodology will be used to estimate the project's impact on export earnings and market penetration ?

Basic principles	*Phases of the Project Cycle*					
	Programming / Identification / Formulation / Financing / Implementation / Evaluation					
Reinforcing local capacities	A1, A2, A6	B2, B4, B5, B6		D1, D4, D5	E1, E2, E3, E4, E5, E6	F1, F3, F6
Targeting disadvantaged groups	A1, A5	B4	C3, C7, C8		E4	F2, F4, F5
Response to/ Anticipation of Demand	A1	B4	C1, C7, C8		E4	F2, F4, F5
Global / Sectoral approach	A1, A3, A4	B4, B5	C1, C2, C4, C5, C6, C8, C9	D6		
Participatory approach		B4, B5	C3, C7, C8		E4	F2, F3, F4, F5
Regional and / or Local approach	A1, A3, A7	B5	C2	D4		
Taking Local knowledge into account		B4	C1, C7, C8			F2, F4, F5
Complementarity / Subsidiarity of intervention	A8	B1, B3				

	Intervention Logic	Objectively verifiable Indicators	Sources of verification	Assumptions
Overall objectives	1. Genetic Ressource conservation 2. Sustainable Incomes 3. Higher Export quantity/quality	* Sustainable use of NTF ressource * Reduced labour / increased incomes of target group * Increased export revenue	* Base line survey by Forest Research Institute * Base line PRA by University * Department of Customs Stats	
Project purpose	Bring valuable NTFPs under cultivation			Technological and biological viability of the project
Results	1. Reduced pressure on NTFPs 2. Higher labour productivity 3. Higher land productivity 4. Increased local value added 5. Increased export earnings	* Increased plant density in wild * w hectares cultivated; plant density up by x %; y local processing plants; average income up z %; * Export earnings from crop up p %	* 2000 survey, Forest Res Inst * Follow-up of PRA by University * department of Customs Statistics	* Local population sufficiently motivated * World market price maintained * Private sector interest in processing and marketing
Activities	1.PRA 2. Germplasm collection 3. Processing technology devt 4. Agronomic experimentation & extension 5. Genetic Research/improvement	EU : Human resources, training component, equipment, market survey. GOVERNMENT: Staff, extension, operational funding, legislative changes	EU : (Agreed level of expenditure met) GOVERNMENT: (Agreed level of expenditure met)	Local / EC staff are able to develop the necessary technology Extension service able to promote technology

Appendix B

FOR FURTHER INFORMATION.

A series of 7 books deals with: *20th century Science, beyond the metropolis* **(ORSTOM-UNESCO, 1996)** *See : vol. 1: The Conferences* (especially: G. Balandier, L. Busch, G. Oldham, S. Schwartzman).

vol. 5 Etat des lieux (M. Callon; R. Coward: Technological cooperation by US companies)

vol. 7 International cooperations (De Lattre, Gaillard, Meyer...)

and also, vol 3 *Nature and environment*, vol. 4 *Medecine and Health*...

£

£ £

Some journals are worth a cursory reading, especially :

Research Policy

Science, Technology and Society: An International Journal devoted to the Developing world. (SAGE publisher). *See :*

vol. 1 n° 1 (S. Hill on South-East Asia, , D.E. Kaplan on South Africa, V.V. Krishna on India, V.P. Kharbanda on China...)

vol.2 n° 2 about Brain-drain

vol. 3 n° 1 about Technological apprenticeship...

£

£ £

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Appendix C.

GLOSSARY

CGIAR	Consultative Group on International Agricultural Research
FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GDAP	Gross Domestic Agricultural Product
GGDP	Global Gross Domestic Product
IITA	International Institute for Tropical Agriculture
LDC	Least Developed Countries
NAFTA	North American Free Trade Agreement
NIC	Newly Industrialising Country
PA	Policy Analysis
R&D	Research and Development
RTD	Research and Technological Development
S&T	Science and Technology
SSA	Subsaharan Africa
TNC	Transnational Corporation
WTO	World Trade Organisation