INTERNATIONAL TECHNICAL COOPERATION IN THE GEOINFORMATICS FIELD

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1. INTRODUCTION

EARSeL, as the European Association of Remote Sensing Laboratories, is concerned about research and application of Remote Sensing. It was founded as a result of the strong interest in satellite Remote Sensing in the 1970's expressed by the European Space Agency and the Council of Europe by a great number of dedicated Remote Sensing scientists.
Now, more than 20 years after its foundation EARSeL members, after international satellite programs have become operational, are still concerned about applications of Remote Sensing. EARSeL, like other organisations of the Remote Sensing Community realise, that satellite Remote Sensing offers global, regional and local observation possibilities, which are difficult to attain by other methods. It further realises that the most potential applications are in areas, where data are greatly lacking, which is in the developing countries.

It is therefore no surprise, that within EARSeL a Special Interest Group on Remote Sensing in the Developing Countries has been established under Prof. Dr. Rudi Goossens. The workshop in Gent is the first concentrated event in treating problems associated with the use of Remote Sensing in the Developing Countries.

The purpose of my paper on "International Technical Cooperation in the Geoinformatics Field" intends to focus on the needs of Remote Sensing in these areas, and to describe the overall framework under which the application of Remote Sensing can be executed for the benefit of a global sustainable development.

2. ECONOMIC DEVELOPMENT AND TECHNICAL CO-OPERATION

It is first appropriate to reflect on the different levels of economic development distributed over the globe

2.1 Economic development

There are 4 types of economic development to existing in history and in geographic distribution in the world:
- nomadic
- agricultural
- industrial and

- service oriented

The reasons for these differences can be found in different conditions existing throughout the regions of the globe:

- climate
- soil conditions
- mineral resources
- labour
- education
- technological innovation and
- motivation

The United Nations has developed a list of indicators characterising the different levels of development in the countries of the world:
- percentages of nomadic life and the number of employees in agriculture, industry and services
- the gross national or domestic product per inhabitant
- the percentage of food supply
- the number of inhabitants per medical doctors
- the child mortality

These are contained in statistical yearbooks lagging a few years behind and they can be subjected to a detailed analysis.

While the gross world product has risen from 4 trillion dollars in 1950 to more than 20 trillion dollars today the economic disparities between low level and high level income countries per inhabitant have remained almost constant.

Low level income countries still have a GNP per inhabitant per year of under 600 $, with a shadow economy of more than 50 % and a tendency of a declining of the GNP. There are mainly agricultural countries.

The medium income countries have a GNP between 600 and 3000 $ per year per inhabitant. They are mainly industrial countries with a shadow economy of less than 20 %.

To this group belong the former socialistic reform countries with a stagnating GNP/yr/inhabitant, the so-called tiger countries of Asia with the highest GNP growth rates and the Latin American Countries in debt with a stagnating GNP.

The high level income countries have a GNP of over 3000$/person/year with a low shadow economy. They have become services oriented economies with more than 50 % of the population employed in services. Their agricultural and industrial production has been automated, for which they possess the financial and technological means. In this group also belong the oil exporting countries.

Even though the GNP growth rates between these countries are greatly fluctuating due to the global market, these countries have realised, that it is a moral obligation that the

low level and medium level income countries be assisted financially and technically by the high level income countries to diminish the economic and technical discrepancy.

2.2. Technical Cooperation

Currently the total governmental economic co-operation amounts to about 60 B$, of which the USA, Japan, France and Germany contribute more than 50 %.

One third of this amount goes to Subsaharan Africa, the poorhouse of the world, one third goes to South East Asia, about 10% to the Middle East, and the rest of about 30% for the rest of the world.

These governmental funds are supplemented by private investments of the same order of magnitude, which in the age of globalisation are difficult to trace.

3. THE STATE OF WORLD DEVELOPMENT

Technical and economic co-operation, must however, also be seen with respect to the trends of world development, which is characterised by a population increase.

3.1. Population Increase

Presently the world population is 6 billion. It is expected to double within the next generation.

So far 78 % of the global population lives in developing countries, where the problems are to be intensified by this growth, which takes place mostly in these developing countries.

While during the last generation these has been an increase of the population by about 40 %, the increase of the agricultural area was only 10 %, while the food production by irrigation, the use of pesticides and fertilisation has risen by 100 % pushing the agricultural growth capability to a limit.

But there is a need to double the agricultural production in the next generation without jeopardising the sustainability.

Another problem is the scarcity of water in many developing countries. The United Nations at the UNCED-Rio de Janeiro Conference of 1992 has clearly recognised the need for sustainable development and in its Agenda 21, chapter 40 has called for the monitoring of

- degraded forests
- crop yields
- wastelands
- wetlands
- drought areas
- floods
- sedimentation
- soil erosion leading to desertification

In connection with this many international conventions have been agreed upon to monitor the state of the atmosphere, the forest cover, the marine pollution, the conservation of water, biodiversity and soil.

3.2. Urbanisation

The Habitat II Conference in Istanbul in 1996 has drawn attention to the fact, that the expected population increase will principally be in the urban sector of the developing countries. Urban growth there is at the rate of over 5%. This will considerably increase the urban population. If no attention is paid to create infrastructure for the urban areas (water supply, sewerage, electricity, transport facilities) unorganised slum conditions and the growth of criminality may be the consequence.

4. INFORMATION NEEDS AND INFORMATION MANAGEMENT

Geoinformatics offers two technical tools to administer and to monitor environmental information: GIS and Remote Sensing

4.1. GIS

Geographic Information Systems have been developed since the 1960's as computer systems capable to input, store, manipulate, analyse and output geographic data in digital form.

In the modern sense they are data systems to manage the environment for sustainable development with its components of

- analysis
- planning
- decision making
- progress monitoring

80 % of the effort of GIS development lies in the acquisition of data, since data are not only vector map data, but also raster-based remote sensing data, which are faster and less expensive to acquire.

A GIS ideally consists of a vector based base map, onto which raster based thematic layers are added from remote sensing. To both links to non-graphic data are established.

All vector, raster- and non-graphic information should serve the aims of integrated sustainable development and the protection of the environment.

The statistical figures of the U.N. secretariat for 1993 show that the global availability of vector information from maps is a scale problem. While a 1:200.000 global average is nearly complete, the regional coverage at 1:50.000 only exists for two thirds of the land mass, and at 1:25.000 only for one third.

What is more alarming is, that the update rates for 1:200.000 are 3,3 %, for 1:50.000 2,2 % and for 1:25.000 5 %. This means, that the average age of vector information at the 1:200.000 scale is 30 years, at the 1:50.000 scale 45 years, and at the 1:25.000 scale 20 years.

It is no surprise that projects for a specific problem area in agriculture, forestry, geology, desertification, planning etc…, embark on their own costly data acquisition with the result that these data are produced in duplication and are not being maintained.

Here the integration of vector information with remote sensing data can lead to a more cost effective solution as this is done in the countries of Europe.

4.2. Remote Sensing

It has been shown that remote sensing can be successfully applied on an operational basis in meteorology, climatology, for the monitoring of disasters (storms, volcanoes, fires, floods), and the monitoring of non renewable and renewable resources (geology, soils, hydrology, agriculture, forests, land cover).

Satellite remote sensing systems now offer a wide range of global, regional and local sensors depending on the repeatability versus resolution requirements, ranging from daily coverage at km-resolution to local coverage at m-resolution. While NOAA can monitor global information, Landsat is capable to monitor regional information at the 1:200.000 scale, and Ikonos-2 can do so at the local level at restitution speeds unachievable by other means and at affordable costs. What is not possible to be acquired by optical systems due to cloud cover, can be acquired by radar systems. Remote sensing has thus become an effective and accepted technology.

The problem does not lie in its usefulness but in its integration into a whole-programme for sustainable development.

5. IMPLEMENTATION OF TECHNICAL COOPERATION PROJECTS

Technical co-operation is not offered in form of a technology, but in project achieving specific aims.

5.1. Stages of project implementation

Economic co-operation by the donor countries is usually offered in the following forms:

- financial co-operation in terms of grants (usually under 10 M$)
  or loans (usually over 10 M$)
- project co-operation (usually up to 10 M$)
  in form of technical projects, educational partnership and institutional partnership
- scholarship and exchange fellowship
- conference support, network operation

The strategies, in which these supports are applied usually differ from donor to donor.
Some donor countries (France, Japan, Canada prefer top-down measures protecting their industry and technology interests, securing return of funds to the donor countries.
Opposed to this is the bottom-up approach, in which a country quota system is used. Within the quota system, originating in the North-South-Report which emphasises priorities to provide food, education and employment, the country selects projects on account of its own priorities (U.S.AID, German GTZ).

About half of the economic co-operation is distributed or negotiated bilaterally by donor/recipient agreements. Another half is channelled multilaterally via the United Nations System, in which the World Bank arranges for loans, UNDP for country related projects and the theme oriented organisations (FAO, UNITAR, UNSO, UNESCO) for regional projects.

The exception is regional programmes supported by several donors (e.g. OSS by France and Germany) or by the European Commission (DG VIII).

The main difficulties in technical co-operation are institutional (political empire building), or financial (wrong priority assessment, lack of sustainable funding). But difficulties of a technical nature may also occur due to use of unsuitable technology (lack of maintenance and training). Educational measures may also not lead to the anticipated result in case of a missing infrastructure (sur-education).

5.2 Project planning by logical framework

So that the anticipated results are obtained for a project, technical co-operation agencies such as the German GTZ, The World Bank, but also the Japanese JICA use the "Logical Framework" – methodology developed for the U.S. Defence Department as an evaluation strategy.

The evaluation begins with a participant analysis, to make sure all important partners are involved. Next is the problem analysis, in which the problems to be cured are collected. The subsequent target analysis converts all problems into goals. Then the constraints are assessed. This finally leads to a project plan which contains the main targets, the additional targets, the funding, personal and equipment requirements.

After a project proposal passes this review, first inside the donor agency, second together with the country representatives, then the project is started with reviews of the project plan every 3 years.

6. EXAMPLES FOR PROJECTS

To illustrate the nature of technical co-operation projects, 3 examples are presented, which have all been granted and evaluated by the "Logical Framework"-methodology.

6.1 Geoinformation curriculum in India

India has been traditionally known as a country, in which a high mapping standard was developed through the Survey of India, a military institution founded as early as 1760. Since it remained a military institution maps and aerial photos have been secret. The Department of Space, with its satellite programme, including remote sensing satellites of the IRS-series pointed the need out to obtain regional and local information for the state user departments in the various Indian States.

The Department of Space established federally funded state remote sensing centres in which Indian satellite data were used to acquire data from these Indian satellite images for the local purposes of sustainable development. In the state of Tamil Nadhu one such centre was established at Anna University in Chennai (Madras), the "Institute of Remote Sensing" IRS. The Department of Space constructed a building for 100 workspaces, provided simple equipment and imagery. The university supplied 12 staff members of the local government departments to work on their projects by remote sensing.

What has been missing, has been additional technology to enhance the activities. GTZ provided additional equipment (GPS, digital photogrammetry and GIS). After an initial 3 year period the university applied for support to create a whole academic geoinformation

programme curriculum on the basis of an existing program of the University of Hannover.

For an 8 year period the 4 geoinformatics-technology oriented Institutes of the University of Hannover (survey, geodesy, photogrammetry, cartography) conducted crash courses in India, Indian staff members went for research to Germany in exchange. Even German students conducted thesis project work at Anna University

The institution now graduates 30 students per year in the programme, which is well accepted by local employers. Remote sensing has thus been integrated as a component of geoinformation technology.

6.2. Environmental Information Systems in Subsaharan Africa

An advisory committee for Environmental Information Systems consisting of a few motivated African individuals, supplemented by others from the donor countries or agencies has been created in 1990 on an initiative by the World Bank.

Environmental Information Systems need remote sensing data as one of its principal inputs, however it had been very difficult to introduce remote sensing as an effective tool in the African countries. Is was observed that one donor created a small programme within one ministry, another donor with another agency, and the net result for the country was less than satisfactory.

The objective of this multidonor supported effort was to prepare guidelines, by which environmental information systems should be established in the countries.

The UNCED-Rio Conference favoured a country approach and not a regional African approach, since only governments had their own budgets, but not regional bodies.

The suggestion was the establishment of "National Environmental Action Plans" (NEAP'S). The advisory committee came up with the following strategy to implement EIS in steps:

- establishment of a national coordination committee, in which all concerned ministries were participating
- identification of a lead agency by their own election or by assignment of the national government.
- establishment of national priorities assisted by donor funded studies. The donors would not compete but agree on countries they would principally support.
- definition of a pilot project with equipment supply and training as a consequence of the priority study.
- establishment of E.I.S. as a complement to the NEAP.

A number of countries in Africa have followed this procedure, for example: Madagascar, Benin, Ivory Coast, Senegal, Uganda, Burkina Faso, Ghana; others have partially adopted it, such as Zimbabwe.

The Advisory Committee has now been transformed into a non-governmental organisation (NGO) as a non-profit company, by the name of EIS-Africa. It serves as an African network.

It sends newsletters to 3000 African individuals, is present on the web, organises biennial technical conferences in form of "Africa-GIS" and collaborates with the UN Economic Commission for Africa in Addis Ababa, which coordinates multilateral governmental programmes (e.g. Africover by FAO and Italy), as well as the regional training centres in Nairobi and Ile-Ife.
To the donor countries this is confirmation enough, that technology has been transferred effectively into African hands.

6.3. Land registration systems in Southeast Asia, in Eastern Europe and in Latin America

The topic of land management and land administration is one of the most significant unresolved issues. Land is an important commodity. Land management is a political or public measure for the just distribution of land resources.
Land registration is the means to document and make available rights to land, be it ownership or the use of land.

Land registration is introduced by means of a cadastral system, which has two functions: to geometrically describe the land and to specify the holder of land rights.

In Europe the cadastre has a long tradition. After 1803 Napoleon and his officers introduced the tax cadastre in continental Europe. It generated large scale mapping and the creation of a property register for the purposes of taxation.
Around 1900 private interests for a better definition of parcel boundaries originated the "Ownership Protection Cadastre". It has been realised already in the 1930's that the large scale mapping system with the continuously updated property register is an excellent planning tool in form of a "multipurpose cadastre".

The costs of large scale mapping were prohibitive to introduce the same developments outside of Europe. Many problems in developing countries, and even in developed countries outside Europe still exist by the insecurity of titles and the lack of boundary definition for agricultural land, for pastures and for land to be developed for economic activities.

Fast, inexpensive methods are needed by which the insecurities may be abolished by the creation of a cadastre. Nowadays GPS technology is available to register boundary points, but remote sensing offers a cost-effective alternative.
Digital ortho-photo-technology (using digitised aerial photos or high resolution satellite images) is now available to identify boundaries and owners in a photo-adjudication process.
For example Albania has a 5 year programme financed by the European Commission at 10 M$ in which a full cadastre can be created at a cost of 5$ per parcel, which is well in relation to the value of the land.
Germany supports similar programmes in Georgia, Cambodia, in Ethiopia and in Guatemala. The World Bank conducts cadastral projects in Argentina, Peru and Honduras and it had concluded a huge land titling project in Thailand.

In many areas of the world, such as Subsaharan Africa, where land rights are not allocated the owners but to tribal communities even such low cost methods are too time consuming or cost prohibitive.

Thus, under the initiative of UNECA a simple method allocating information on land rights to imagery by a "pointer" has been advocated without the need to identify and resolve the boundaries.

Here again it is important to integrate remote sensing technology into the information technology requirements.

7. CONCLUSIONS

It has been shown, that remote sensing is a most useful technology if it is integrated into the many-facetted requirements faced by the developing countries.
In general, we should review the changing aims dealing with the nations of the world in the developing countries.

In the 19th century European attitudes were dominated by colonialism, control and interference.

In the20th century there was conflict solution, competition and the search for independence.

What should it be in the 21th century? Cooperation or chaos?

I think, that we all realise our interdependence.