



Guidelines for a joint research Deliverable for Activity 5 of the CASITA II project

1. Introduction

The development of guidelines for a joint research program is one of the activities of the CASITA II project. The proposed action is a follow-up of the CASITA I project, which ended in March 2004. The previous phase of CASITA focused on the implementation of disaster management modules within urban planning curricula, the networking of 14 universities in Asia, the introduction of distance education tools, and the development of collaborative arrangements with European institutions.

In the second phase of the CASITA project four universities are selected out of the group of 14 that have plans to develop longer courses on disaster management, mostly at postgraduate level. As indicated in the project proposal, the long-term objective of the project is to support the development of a cadre of young university professionals in Asian countries with competence in applications of modern IT&C tools in hazard, vulnerability and risk assessment and the use of the information for spatial planning and emergency preparedness to facilitate natural disaster vulnerability reduction of populations, infrastructure, and critical facilities in human settlements in Asia.

In order to make the postgraduate courses more sustainable a research programme should accompany the courses. The partners and the universities will set-up a joint research programme in relation to the postgraduate courses. The research will focus on applications of GIS/RS in natural hazards and risk assessment. Eventually it will result in joint publications in selected international peer reviewed journals. The research study will be based on case studies from hazard prone cities and will form the basis for educational case studies to support the learning and to better explain the application aspects of the theory. The postgraduate students from participating universities will be involved in the collection and analysis of data for their research study (such as base maps, contour data, hazard zonation maps so on), aerial photos/satellite imagery and other relevant information. The guidelines developed by ITC will be given to universities as a guide for the collection of data and to have uniformity in information to be gathered. Further discussions will be arranged through Blackboard.

2. Methodology

The research plans within the CASITA II project were discussed initially at the kick-off meeting in January 2005 in ITC. Later, when the representatives of each of the four participating Universities

visited ITC for a three- months stay in the period February-May 2005 the plans were discussed in more detail.

This document contains two different parts:

Overview of research activities in the field of hazard and risk assessment in the CASITA partner institutes:

- International Institute for Geoinformation Science and Earth Observation (ITC)
- Geography Department, University of Bonn
- Asian Disaster Preparedness Center

Overview of planned research activities with the four partner Universities:

- University of Ruhuna (Sri Lanka)
- Chiang Mai University (Thailand)
- Gadjah Mada University (Indonesia)
- Indian Institute of Remote Sensing (India)

Guidelines for research, based upon research materials developed at ITC by David Rossiter.

3. Overview of research activities in the CASITA partner organisations

This section intends to give an overview and provide links to the research activities in the three CASITA II partner organisations related to the theme of the CASITA project, which is hazard and risk assessment.

3.1 Research at ITC

In ITC research is carried out along a number of research themes, or spearhead. Each of the themes may have one or more research projects, which are subdivided in research packages and in which ITC staff carries out research together with partner organisations, PhD researchers and MSc research support. The names of the ITC research themes are:

Geo-Information Science and Earth Observation for

- strengthening civil society
- improving planning and management of multifunctional use of space
- natural disaster management
- a better understanding of global change
- water management, food security, and the environment

Under the theme natural disaster management, a research project has been defined, which is entitled Strengthening Local Authorities in Risk Management (SLARIM). The main objective of this research project is to develop a methodology for spatial risk information collection and management for municipalities, which will allow local authorities to evaluate the risk of natural disasters in their municipality, in order to implement strategies for vulnerability reduction. The project concentrates on medium-sized cities in developing countries, which do not yet utilize Geographic Information Systems in their urban planning, and which are threatened by natural hazards (such as earthquakes, flooding, landslides and volcanoes). The methodology concentrates on the application of methods for hazard assessment, elements at risk mapping, vulnerability assessment, risk assessment, and the development of GIS-based risk scenarios for varying hazard scenarios and vulnerability reduction options, using structural and/or non-structural measures. The methods for risk assessment that are applied depend on the availability of existing data, and range from simple loss estimations based on historic information to more complex methods based on modeling. In the development of elements at risk databases use is made of interpretation of high-resolution satellite imagery, combined with extensive field data collection, using mobile GIS. Also local communities are involved in the collection of vulnerability information, and in the evaluation of social vulnerability and capacity. Although the methodology is primarily designed to assist municipalities in the decision-making regarding vulnerability reduction strategies, the resulting databases are designed in such a way that they can also be utilized for other municipal activities.

Within the project a number of case study cities have been identified. The city of Naga in the Philippines has been selected for flood risk management, and the cities of Lalitpur in Nepal and Dehradun in India for seismic risk management. Other study areas selected are: San Antonio del Sur in Cuba, Tegucigalpa in Honduras, San Salvador in El Salvador, Turrialba in Costa Rica.

The project is carried out by research staff, PhD and MSc researchers of various disciplines at ITC, in collaboration with other partners (such as ADPC) and linked to external research and capacity building projects.

The SLARIM research project is consisting of a number of components, which are divided along a number of work packages. The following components can be distinguished:

- **Users need assessment and organizational setting**, which investigates the requirements of local authorities with respect to information and decisions regarding natural disasters. The research will develop a methodology for the evolutionary design of a spatial decision support system for risk management that is based on a continuous

- monitoring of actor needs, organizational learning processes, and subsequent performance at risk management.
- **Flood hazard and risk assessment** research that focuses on the development of the science, models and techniques to develop a quantitative approach to the analysis and assessment of flood risk. It evaluates the applicability of various hydrological and hydraulic models in developing countries with limited amount of data. The research also intends to compare the result of the modeling approach with a participatory mapping approach using a community-based vulnerability and capacity assessment approach. The research also deals with the comparison of vulnerability curves for different elements at risk and different countries.
 - **Earthquake Hazard and risk assessment** research, which focuses on the development of the science, models and techniques to analyze and assess the risks posed by earthquakes, in developing countries that have limited amounts of data. Existing approaches such as RADIUS or HAZUS are evaluated and adapted to the local conditions regarding data availability and types of elements at risk.
 - **Landslide hazard and risk assessment**, which evaluates the types of GIS-based models for landslide susceptibility and hazard assessment can be used at different scales, and depending on the available input data. The research also concentrates on defining practical methods for landslide vulnerability assessment, and the combination of hazard and vulnerability into landslide risk maps, both using qualitative as well as quantitative methods.
 - **Volcanic hazard and risk assessment**, which evaluates the various approaches for modeling different volcanic processes, such as lava flows, pyroclastic flows, lahars, ashfall etc. both using conventional methods as well as using GIS-based models. Another important element is the quantification of vulnerability of elements at risk in volcanic hazard zones.
 - **Elements at risk mapping** focuses on the use of remote sensing data for the generation of elements at risk maps and the characterization of the elements at risk using mobile GIS. High resolution images play an important role in the generation of building footprint maps, in combination with LiDAR data if available. One other aspect of this component is to define the most appropriate basic unit for risk assessment (e.g. individual building, homogeneous unit, census tract, ward etc.) and techniques for sampling.
 - **Geographic information systems and data bases**, which focuses on the development of techniques and decision support tools using GIS to integrate, manipulate and display a wide range of risk-related information.
 - **Use of Earth Observation data for disaster management**, which focuses on the use of remote sensing for base data collection for hazard and risk assessment, and damage assessment.

More information on the SLARIM research project, and links to published papers and PhD research, can be found at the following website:

<http://www.itc.nl/research/policy/spearhead3/vwesten.asp>

On 4th April 2005 the United Nations University and ITC entered into an agreement, appointing the International Institute for Geoinformation Science and Earth Observation (ITC) as Associated Institution of the UNU. The UNU-ITC agreement has an initial duration of five years and is directed at developing and carrying out a Joint Programme on capacity building in Disaster Management and in Land Administration, and the dissemination of knowledge on these and directly related issues. Within the framework of the ITC-UNU agreement, ITC is in the process of formulating a UNU programme on Capacity Building for Disaster Geo-Information Management, which will contain activities related to research, training, capacity building, and projects dealing with the use of Geoinformation for natural and man-made hazard and risk assessment and management, with specific activities in different regions. One component of the programme is focused specifically on Africa, and intends to establish a network of Universities which have interest in developing courses on disaster risk reduction, and eventually come to joint educational programmes under the umbrella of the UNU programme (for more information: <http://www.itc.nl/unu/dgim/>)

3.2 Research at the Geography Department of Bonn University

The Department of Geography in Bonn is divided in six sections dealing with climatology, geomorphology/hydrology, geographical research of development, research of city and regional development, historic Geography and remote sensing/GIS. In the geomorphology/hydrology section especially the "Geomorphological and Environmental Research Group" is dealing with natural hazards. Currently, the following research activities are carried out with a relation to the themes of the CASITA II project:

- *InterRisk*: Integrative Landslide Risk Analysis and Perception in the Swabian Alb, Germany
- *MultiRISK*: An innovative conceptual approach to model natural risks – application to climate and land use change for BÍldudalur, North West Fjords, Iceland.
- Landslide susceptibility mapping using aerial photography in Fiji

InterRisk aims to achieve a comprehensive view of natural risks out of different perspectives. The focus is put on the German region "Swabian Alb" and on processes related to landslides. It is an integrative approach in which social, historic and physical geographers are participating. Intersections of the involved disciplines are emphasized. The research is carried out in four sub-projects:

- **Analysis:** A risk analysis of gravitativ mass movements is carried out on a local and regional scale. The mass movements are investigated to gain information about the current stability and the factors that drove and controlled the landslides.
- **Assess:** The sub-project Assess is concentrating on an economic risk analysis and evaluation. Potential damage is measured again on a local and regional scale. Among others, one goal is to prepare a monetarized risk map of the area.
- **History:** Historical landslides in the region of the Swabian Alps are mapped and investigated systematically. Beside the inventory of the landslides also the perception and the management of landslides in former times is studied. The investigated period is between the middle age until the beginning of the 20th century.
- **Perception:** The perception and evaluation of the risk due to landslides of the domiciled people is objected by this sub-project. Questions about the spreading of landslide related information and how the people are reacting to those information are followed.

Within the four mentioned sub-projects, a total of 4 PhD students and numerous MA students are involved. The first funding phase of the project ends in September 2005. An application for funding all projects until 2007 is submitted. Herein, a further sub-project on Climate is added. All partners are closely working together in order to develop a sustainable risk management for the affected regions.

The *MultiRISK* project is based on a former extensive research in Icelenad between 2000 and 2004. Currently one PhD-student of the Geomorphological and Environmental Research Group is working in this project. It is expected, that also MA students will be involved soon. Despite the multiple occurrence of different endangering processes in the same region or locality these processes are commonly investigated and modeled individually in different software programs with various data requirements and separate data management. Focus of the project is to perform an integrative and multi-processual modelling of natural risks within one software system. Therefore, a GIS extension is to designed capable of modeling multiple risks by different processes. It will be developed as a stand-alone tool. Tests and validation will be carried out for three different communities in Northwest Iceland. With the designed and created GIS-platform scenarios of global warming and land-use change will be modeled. Within the GIS-platform, respective process models will be integrated as modules. Modeling is based on DEMs and process related parameters. Hazard run-outs will be calculated and hazard zones derived,

depending on the magnitude and frequency of the respective process, so that different scenarios are possible. Consideration of risk elements (e.g. people, houses, infrastructure), their damage potential, and their vulnerabilities to the respective processes and its magnitudes, leads to delineation of natural risk zones.

The last selected project on landslide susceptibility on Fiji aims to use aerial photography to establish an inventory of landslides for a given catchment in Southern Fiji. Landslides are mapped from the aerial photography using an adopted landslide classification scheme. The resulting inventory will then be combined with various parameters (e.g. DEM, geology) in order to delineate landslide susceptibility zones.

3.3 Research at the Asian Disaster Preparedness Center

ADPC conducts research through its four teams, viz. Climate Risk Management, Disaster Management Support Systems, Public Health in Emergencies, Strategic Disaster Risk Management, and Urban Disaster Risk Management. ADPC promotes, supports and facilitates applied research through its regional programs and activities. The research activities of ADPC are undertaken by various stakeholders (national, provincial, local governments, NGOs, academia, and others) engaged in disaster risk reduction at various levels.

Some examples of applied research undertaken by ADPC are:

3.3.1 ProVention Consortium Applied Research Grants for Young Professionals

The ProVention Consortium in collaboration with the World Bank's Hazard Management Unit launched in December 2002 an "Applied Research Grants Program for Disaster Risk Reduction". Young researchers were invited to propose creative projects in three categories: hazard and risk identification, risk reduction and risk sharing/transfer. The aim of the Program was to support innovative disaster risk management projects in developing countries, build up local research capacity and encourage young professionals (under 35 years of age) to become more involved in disaster risk reduction.

Sixty-five individuals and/or teams from 27 countries were awarded grants of up to US \$5,000. Grantees came from a mix of institutional affiliations: universities, government, local and international NGOs and private sector. Each project was carried out under the guidance of a mentor who is a professional in the field of disaster risk management. The young professionals completed their projects in January 2004. After a series of reviews, fifteen projects were selected as representative of the most innovative and sustainable project activities. Team leaders from these projects presented their findings at the Global Symposium for Hazard Risk Reduction, July 26-28, 2004 at the World Bank headquarters in Washington, DC.

The second call for the Applied Research Grants ended on 31 May 2005.

ADPC was responsible for administering the Grant Program for Asian and the Pacific region. ADPC provided widespread dissemination of the announcement of the grant awards scheme and invited applications from young professionals through an announcement in its newsletter, on its website as well as sending the call for applications to over 300 partner organisations in universities, technical institutions, Government departments, Red Cross red crescent Societies, NGOs, research institutions, UN Agency regional and country offices.

Once selected, direct communication was established with each grantee and their mentor/guide. In addition, each grantee was offered a DM information kit based on a selection of reading materials, and offered information support in terms of access to specific documents in the ADPC library, to be identified by the grantee through an online search. Effort was made to link each grantee with disaster management organisations in country in the government and NGO sector, academics and ADPC staff interested in their area of study.

ADPC also encouraged grantees and participated in the web conferences held in May 2004 for grantees to present the results of their research. These proved to be exciting and interesting interactive learning opportunities for grantees to share the results of their work.

3.3.2 Policy Research under Asian Urban Disaster Mitigation Program (AUDMP)

Under the AUDMP implemented by ADPC in Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Philippines, Sri Lanka, Thailand, and Vietnam, some of the national demonstration projects in the project countries undertook policy research to review existing policies for disaster management, land use planning, building construction processes, etc. and proposed changes in the policies. Such policy research was followed by a workshop in the project countries to help the stakeholder groups review the findings and take the recommendations to appropriate levels for initiating policy changes.

The country projects also undertook development of plans (such as Emergency Management and Response Plan) for cities which were almost non-existent for the cities in Asia. Development of such plans required significant research and review of such plans elsewhere in the world and several rounds of consultations with various stakeholders.

3.3.3 Study of the South Asia Regional Initiative on Disaster Insurance and Risk Management

In 2002, Asian Disaster Preparedness Center (ADPC) undertook research on "Disaster Insurance and Risk Management in South Asia" supported by the World Bank's Disaster Management Center (Hazard Management Unit) with the objective to contribute to the disaster risk reduction in the region. The research provided the basis for the subsequent field visit to the eight countries in South Asia, by the Bank, to identify existing capacities, needs and gaps in the different countries in order to introduce disaster insurance and risk management in the South Asian Region.

The research study involved the collection and analysis of data spanning three decades, with specific reference to natural disasters and writing of a report on the disaster history and the economic and social impacts of natural disaster in the South Asia Region. The eight countries included in the research study were Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

The study was carried out by a team of ADPC staff and researchers, backed by in-country disaster management professional from the Center's partner-institutions in these countries. The study team benefited considerably from the institutional memory and the institutional networking linkages of the Center's disaster management professionals with their multi-country insights.

Eight country reports and a report synthesizing the findings, was produced as a result of the study. The study highlighted common geophysical and socio-economic characteristics in the region that influence disaster vulnerability. The compelling need for integrated risk management approaches to be taken up in the context of capacity building in the region was highlighted in the report. Based on country experiences, it argued for an urgent need to create consensus among governments in the region to ensure that damage assessment and needs analysis to be an integral component of all development initiative.

It stressed the need for the governments in the eight countries to earmark a reasonable percentage of development plan expenditure to be deployed towards sectoral mitigation efforts for disaster risk reduction. Recommendations to evolve new financial intermediation instruments for disaster risk reduction and need for strengthening the techno-financial regime in the countries in the region to incorporate enforcement of hazard safe construction was also made.

3.3.4 Climate Forecast Applications

ADPC has been implementing in the Climate Forecast Applications (CFA) program since 2001 with support from USAID/OFDA. The CFA aims to develop locally-appropriate climate information

tools and capacity to apply these in real-time in Indonesia and the Philippines to mitigate the impacts of hydro meteorological hazards. It employs a two level approach: 1) carrying out targeted demonstration projects to explore and refine methods, and 2) identifying and stimulating national capacities to scale up the application of the methods so that they can be applied elsewhere. The experience implementation of CFA in collaboration with International Research Institute for Climate Prediction, New York could be utilized to provide early warning systems in the program countries.

3.3.5 Regional Analysis of the Socio-Economic Impacts of the December 26, 2004 Tsunami/Earthquake disaster in Asia

A regional analysis of the 26 December 2004 earthquake and Indian Ocean tsunami is being undertaken to identify actions that, undertaken jointly by the countries, will result in significant economies of scale when tackling the subject of disaster and risk management. The regional project is to be executed under the umbrella of the ProVention Consortium, by the Asian Disaster Preparedness Center (ADPC), with technical support from individual international consultants and in close cooperation with ECLAC and the World Bank's Hazard Management Unit.

The development objective of the proposed project is to mitigate the socioeconomic and environmental impact of disasters in South East Asia through financial risk management. The immediate objective is to determine the immediate and medium term socioeconomic and environmental impacts of the 26 December 2004 disaster in order to contribute to the nascent body of knowledge related to the socio-economic impacts of disasters.

It also should be noted that since January 2004 ADPC, in collaboration with ECLAC, has been implementing a study for the Gujarat State Disaster Management Agency (GSDMA) in developing a Damage & Loss Assessment Methodology and system in the state of Gujarat, India.

4. Overview of research collaboration with 4 participating Universities.

4.1 Sri Lanka

4.1.1 University of Ruhuna

The contact point was the Department of Geography, which belongs to the Faculty of Humanities and Social Sciences. <http://www.ruh.ac.lk/Uni/Hss/geography/geography.html>

The department has limited resources. The department has 14 permanent staff members and 3 temporary staff. They teach human and physical geography. They have a computer room with about 15 rather old computers, and no computer network or Internet connections. Only one staff member is dedicated to GIS-related training. He recently started with this and has written a basic lecture note on GIS and Remote Sensing. Other facilities are also basic. They have for example only 3 mirror stereoscopes. Unfortunately due to a strike of the supporting staff it was not possible to visit all the facilities. The courses are in Sinhali language at graduate level. Postgraduate courses are planned but not yet implemented.

A two day workshop was held at the Geography Department of the University of Ruhuna, in Matara on the south coast of Sri Lanka on 27 and 28 June 2005 as part of the CASITA II project. The workshop was attended by teaching staff from Ruhuna University and two ITC staff, **Cees van Westen** and **Dinand Alkema**.

The following staff members participated in the meeting:

- Ranjith Senaratne: vcrs@admin.ruh.ac.lk (Vice Chancellor) – only at the opening)
- P. Liyana Arachchi: plarachchi@slt.net.lk (Main contact person in CASITA, head of department)
- Dr. S.K. Mohamed Ali: kadija@geo.ruh.ac.lk (Oriented to social aspects)
- S.L.J. Fernando: jagathfernando@yahoo.com (Coastal Geomorphology)
- S. Wijeratne: samanwijeratne@yahoo.com (Coastal zone management. Has participated in the tsunami course which was given as part of CASITA in AIT, Bangkok)
- P. Amaraweera: pamaraweera@yahoo.com (Working on landslides. Has participated in the tsunami course which was given as part of CASITA in AIT, Bangkok)
- T.G. Shyama Malkanthi: shyama-gamage@yahoo.com
- K.M. Nadeeka: nadee_mudalige@yahoo.com
- Chandana Gunasena: cgunasena@ruh.ac.lk (GIS / RS teacher. Plan is that he comes to ITC for 3 months in the period January- March 2006)
- M.I.D.H. Wijewickrama mihisip@slt.net.lk (NBRO)
- M.M.C.U.B. Moremada mihisip@slt.net.lk; nbro@slt.net.lk(NBRO)
- P.K.S. Mahanama senavi@slt.net.lk (Senior Lecturer, Dept. Town and Country Planning, University of Moratuwa)

As a result of the CASITA-1 project, a course on Natural Disaster Management (3102) is now included in the third year of the undergraduate program as well as course on Natural Hazards in Sri Lanka (4101), and a 45 hours course on GIS/RS is planned for the coming semester.

They also presented some of their ongoing research – that is presently mostly focused on the tsunami disaster, e.g.:

- Evaluation of tsunami disaster response in Matara area
- Evaluation of the tsunami reconstruction programme in Matara area, with focus on buildings, including the effect of the 100 m. buffer zone imposed by the government.
- Evaluation on causes and circumstances of deaths due to tsunami.

After the tsunami disaster RU staff and students have assisted in the socio-economic survey of the Matara district related to tsunami impact, coordinated by Central Environmental Authority. Also at the university a Centre for Relief Rehabilitation and Reconstruction Studies (CRRRS) was established. Website: <http://www.ruh.ac.lk/tsunami/crrrs.html>. We did not have a chance to visit this centre.



Figure: Participants of the research collaboration workshop in the University of Ruhuna.

As possible topics for research collaboration they proposed:

- A study on floods in the lower flood plain of the Kelani river (Colombo –city) with Liyanaarachchi and Chandana Gunasena. This is one of the few places in the country with a lot of data (including detailed altitude data), but it has already been extensively studied. It might be taken up as a kind of “learn research” area, and another area closer to Matara (Gin-Ganga catchment near Galle) could be selected as second study area. Counterpart is Drs Dinand Alkema (ITC- The Netherlands);
- A study on landslide hazard and risk assessment in the Kandy municipal area with Mr. Palitha Amaraweera, Mr. M.I.D.H. Wijewickrama (from NBRO) and possibly also in the Ratnapura area. Counterparts are Dr. Thomas Glade, Mr. Torsten Drey (Bonn University) and Dr. C.J. van Westen (ITC).

Ruhuna University is currently working on a proposal for a Masters degree program with a duration of 2 years of which the 1st year is a diploma course and the second year finishes with an MSc-degree. The total course consists of 2 x 2 semesters of approximately 200 – 250 hours. They also have plans for a 1 year diploma course on Coastal Zone Management.

At the end it was concluded that staff members of the Ruhuna university should apply for the short course of the coming year at ITC, possibly already one person for short course 1, starting in September. Mr. Chandana Gunasera will apply for the short course 2, starting in Januari 2006.

Some other points that were discussed:

- Other staff members were stimulated to apply for NFP-fellowships for the PG / MSc courses starting in 2006.
- In November 2005 a representation of Ruhuna will come to the refresher course in Hanoi, Vietnam.
- In April / May 2006 there could be a training course organised at Ruhuna university by visiting ITC staff, followed by a second training in autumn 2006 – under the CASITA-2 project.

- We copied a number of GIS /RS case studies including data and exercise materials.

4.1.2 University of Moratuwa

A separate meeting was held in Sri Lanka with P.K.S. Mahanama, from the Department of Town and Country Planning of the University of Moratuwa. He was involved in the first phase of the CASITA project and we invited him to register for the Refresher Course in Hanoi. The University of Moratuwa has implemented a GIS and Remote Sensing course, and a course on Disaster Management as a follow-up of the CASITA project. They use ArcView (for GIS) and ILWIS (for Image Processing). They also work with Avenue scripts for modeling. Mr. Mahanama is also the coordinator of a project with UN-HABITAT, and the city of Munchen (Germany) on "Environmental Management Information System (EMIS)". The aim is to work with local authorities in setting up database of environmental aspects within cities. They now have 3 test cities (Kandy, Batticaloa, and another one). <http://www.unhabitat.org/cdrom/governance/html/emistk.htm> Unfortunately a planned visit to Moratuwa University on could not take place due to the strike of the non-scientific University staff in the country.

4.1.3 Peradeniya University, Postgraduate Institute of Science (PGIS)

In June a meeting was held at the Postgraduate Institute of Science (PGIS) of the Peradeniya University. PGIS is a national institution attached to the University of Peradeniya, established in 1996. PGIS is the only of its kind in Sri Lanka, and offers 20 MSc and PhD programs with over 600 students annually. The main objective of PGIS is to promote and provide postgraduate instruction, training and research in various scientific specialities (including Earthscience, Environmental Science, Statistics and computer Science) and various application fields among which natural hazard and disaster management.

After the tsunami disaster PGIS was instructed by the government of Sri Lanka to develop a Postgraduate course on Disaster Management. The course is planned to start in September 2005 already, although the curriculum has not been fully developed. PGIS will receive support from various International organisations in the curriculum development, such as from the US Pacific Disaster Center (PDC, Dr. Jim Buika: <http://www.pdc.org/index.php>), Geoscience Australia (<http://www.ga.gov.au/>), ADPC (<http://www.adpc.net>) and Queensland University, ENSG (France), Humboldt Foundation. Most of these organisations provide some fellowships for MSc students to go study part of the course in other countries and provide some input in the form of resource persons. The course is intended for people involved in Disaster Management, with intake of maximum 30 seats. The course is focussed on the use of GIS and Remote Sensing, and the structure is very much "hazard" oriented, as the modules treat all possible hazards one by one.

We discussed the possibilities of collaboration with PGIS for the Master course on Disaster Management with Mr. M.A.K. Lakshman Dissanayake (director@pgis.lk) Director of the Post Graduate Institute of Science, and Mr. Kapila Dahanayake, Senior Professor, Department of Geology. Former director of the Post Graduate Institute of Science

4.1.4 National Building Research Organisation (NBRO)

In relation to Sri Lanka, ITC has carried out some research activities in 2001 in the field of landslides with NBRO:

- **Wijewickrama, M.I.D.H.** (2001) Designing a methodology for zonation of run - out area of landslides: application of GIS for the landslide hazard zonation
- **Tamire Hailu Uloro** (2001) Integration of GIS and stereo image interpretation to update landslide distribution.
- **Orestes Fonticoba Alea** (2001) Application of GIS for landslide hazard and risk assessment, Kandy area.

We visited the offices of the National Building Research Organisation (NBRO) in Morawaka, Kandy and main office in Colombo, and met a lot of ITC alumni. A presentation was given on

“Geoinformation for landslide hazard and risk assessment”, and plans were discussed for joint research projects:

- A project proposal will be written for the UN-OOSA call for proposals on the use of satellite data for disaster management, dealing with multi-hazard risk assessment in relation with the reconstruction planning of the tsunami affected areas, particularly in the Matara district, with the involvement of NBRO, local government, University of Ruhuna, ADPC and ITC. This proposal was submitted, but later on rejected because UN-OOSA didn't consider Sri Lanka as part of SE Asia.
- One of the staff members of NBRO, Mr. M.I.D.H. Wijewickrama, will spend a three months visiting scientist visit in ITC, from September-December 2005, to work on a joint publication on Landslide Risk Assessment for Kandy, and to work on a proposal for the Asia Pro Eco Post Tsunami call for proposals.
- NBRO is interested in supporting the PhD research work of Torsten Drey from Bonn University on the use of satellite data for the updating of landslide inventory maps, and updating of factor maps for landslide hazards assessment (such as landuse maps).

4.2 Thailand

Research collaboration between the Geography Department of the Chiang Mai University and the other project partners (ADPC, ITC and Bonn University) is still in the initiation phase.

4.2.1 Chiang Mai University

The Department of Geography is one of three departments of the Faculty of Social Sciences, within the Chiang Mai University. It has been established since the start of the University in 1964. Currently, the Department has 17 staff members, which are mostly involved in teaching. It offers program study in both Bachelor and Master degree.

The curriculum of the Bachelor program in the Geography Department is emphasis on spatial analysis particularly in giving knowledge in various concepts, theories, including application of quantitative analysis methods. It also includes application of new technology, and computer techniques in data analysis and cartographic design, and also application of geographic information systems (GIS) in data analysis. The result of the study will help students to be able to use knowledge and understanding to apply in survey, planning, solving problems, and developing of resources utilization in each area in order to create maximum yield. The result from spatial analysis will lead to development of model to use in solving various problems, including natural hazards and risks and will be able to apply them with other academic branches.

The Department of Geography also offers a Master program with thesis (Master by research) and a Master program with independent study (Taught Master). Furthermore, the Department of Geography also cooperates with The Geo – Informatics and Space Technology Development Agency (GISTDA) in the establishment of The Geo – Informatics and Space Technology Center (Northern Region) in order to serve remote sensing data, to consult, to train, and to provide research services in different branches to various institutes from both public and private sectors in the Northern Region and nearby countries.

Cees van Westen visited the Department of Geography of the Chaingmai University on Friday afternoon 23 and Saturday 24 June 2005. The main objective of the visit was to get to know the Department, to discuss their wishes and input in the CASITA project and to evaluate if Chiangmai University would be a suitable partner for a joint education programme in the field of Geoinformation for Disaster Management.

The Department of Geography forms part of the Faculty of Social Sciences, and although it also deals partly with Physical Geography, it is mostly oriented to local aspects mostly in the field of Natural Resource Management. Although they are planning to develop a course (of 3 credits which is approximately 3 weeks) on Disaster Management, they do not have major expertise in this field. This is more available in other Department, especially in the Department of Geological science (Faculty of Sciences) and the Department of Soil Science (Faculty of Agriculture).

The Department of Geography is oriented mainly to education and local support to Government organisations and has limited research focus. They give all teaching in Thai and also the staff has

generally some difficulty with English, so that it is rather difficult to fully grasp what their interests are and to have an open conversation. All documents they have are also in Thai, so it was a bit difficult to get a full understanding of the situation.

They teach the following programme:

- A bachelor programme in Geography, with about 80 participants annually, and which last four years. It has a number of modules dealing with GIS, Remote Sensing and Cartography. In the end of the course the students have an independent research topic of approximately 4 months.
- A Master programme in Geography, with 40 (?) participants annually, with duration of 2 years (?) and which has an important component for thesis research, which normally takes them 1-2 years. They also have some courses in GIS and Remote Sensing.
- A Master Programme in Geoinformatics, which is given in the weekends on Saturday and Sunday, and which is now running for the second time. The first batch of students was 5, and the second batch was 12. All of these are persons that already have a job, e.g. from cadastral organisations, private consulting companies.

Furthermore, the Department of Geography also cooperates with The Geo – Informatics and Space Technology Development Agency (GISTDA) in establishment of The Geo – Informatics and Space Technology Center (Northern Region) in order to serve remote sensing data, to train, and to provide research services in different branches to various institutes from both public and private sectors in the Northern Region and nearby countries.

The Department has good computer facilities.

A further visit was made to Chiangmai University, Department of Geography on 13 September by Dinand Alkema from ITC, and by Dhruva Shrestha on 23 September, also visiting the Departments of Geological Sciences and the Department of Soil Sciences. The interest in joint research activities in the latter two departments proved to be much higher than in the Geography Department and plans are being developed to carry out research in combination with Chiang Mai University, ITC and Land Development Department (LDD)

4.2.2 LDD

Previous collaborative research at ITC in Thailand has been in relation with the Land Development Department (LDD) under the Ministry of Agriculture and Cooperatives. ITC and LDD have had a collaborative agreement from 2003 to 2005, during which extensive research activities have taken place. The following MSc students have carried out their research in Thailand as part of the LDD/ITC collaboration:

- **Sunee Sriboonpong** (2001) Assessment of forest recovery after fire using LANDSAT TM images and GIS techniques : case study Mae Wong national park, Thailand
- **Bamutaze Yazidhi** (2003) A comparative study of soil erosion modelling in Lom Kao - Phetchabun, Thailand. http://www.itc.nl/library/Papers_2003/msc/ereg/bamutaze_yazidi.pdf
- **Endale, M.** (2003) Cropland soil erosion prediction using WEPP model : a case study on hillslope in Lom Kao district, Thailand
http://www.itc.nl/library/Papers_2003/msc/ereg/melkam.pdf
- **Gebre Kirstos Teklehaimanot** (2004) Use of simplified field tests and revised MMF model for assessing soil erosion : case study Lom Kao area, Thailand
http://www.itc.nl/library/Papers_2003/msc/nrm/teklehaimanot.pdf
- **Zerabruk**, 2003. Design of a spatio-temporal database for land degradation assessment and monitoring
- **Kunda, F.** (2004) Study of soil organic matter under different land uses in relation to land degradation : Nam Chun sub-watershed in Lom Sak, Thailand
- **Saengthongpinit, C.**, 2004. Soil erosion assessment using revised MMF equations with special reference to terrain parameters
- **Soliman, A.S.** (2004) Detecting salinity in early stages using electromagnetic survey and multivariate geostatistical techniques : a case study of Nong Suang district, Nakhon Ratchasima, Thailand.
- http://www.itc.nl/library/Papers_2004/msc/nrm/aiman_soliman.pdf

- **Solomon, H.** (2005) GIS based surface runoff modeling and analysis of contributing factors : a case study of Nam Chun watershed, Thailand. Enschede, ITC, 2005. 99 p.
http://www.itc.nl/library/Papers_2005/msc/ereg/harssema.pdf
- **Patterson, D.** (2005) Analysis of land cover and land use practices in relation to soil degradation in Lom Sak, Thailand. Enschede, ITC, 2005. 85 p.
- **Pattaraporn Sojaya** (2005) Sustainable agriculture.

The following research topics have been given emphasis in the first phase of the LDD/ITC collaboration:

- Land degradation studies in Namchun sub watershed, Petchabun province
 - Field survey to collect basic data (soil, land cover, land use)
 - Geopedological mapping of the pilot area I and II
 - Land cover/land use mapping of pilot area I and II based on recently acquired photos
 - Parameterisation and application of a number of models for comparative assessments e.g. erosion models, runoff models, terrain models
- Land degradation studies in Nong Suang, Nakorn Sima Province
 - Field survey to collect basic data (soil, land cover and land use)
 - Electromagnetic survey and data processing for soil salinity study
 - Geo-statistical analysis of soil data to see horizontal and vertical variation of salinity problem
 - Crop yield modelling in saline soil

In the second phase of the project with the LDD and ITC the idea is to involve also Chiang Mai University as a research partner.

In the year 2003 and 2004 project efforts have concentrated more in soil data acquisition, erosion and salinity studies. Data collection and application of various models and techniques to study the landscape - land cover/land use- soil degradation relationships were applied in project pilot areas. Studies related to landslide and flood hazard are clearly missing.

Therefore the objective of the second phase of research collaboration are:

- Landslide hazard study (selection and application of models to predict land slide hazard)
- Flood hazard study
- Environment impact assessment
- Land suitability assessment and land taxation
- Compilation of validated methods in land degradation assessment

In the field of landslide hazard assessment a small joint research activity between ITC and CMU has taken place in the CASITA I project. GMU staff prepared a case study on regional landslide susceptibility assessment in Phayao Province in Thailand.

See http://www.adpc.net/casita/UCS_CMU.html

Planning for 2005:

Two MSc students from ITC will work in Thailand together with CMU and with LDD staff on landslide hazard assessment.

- Mr. **Satira Udomsri** (from LDD itself) will be carrying out a research on the morphometric characterization of the terrain for slope instability assessment
- Ms. **Sheila Namuway** (Uganda) Predictive modelling of landslide hazard assessment using multivariate statistical analysis: a case of Doi Angkhang, Thailand.

Three Msc students from LDD have started their studies at ITC in September 2005:

- Mr. Moonjun Ruanporn (Thailand)
- Ms. Prueksapong, Apuntree (Thailand)
- Ms. Prachansri, Saowanee (Thailand)

Also a PhD student (**Torsten Drey**) from Bonn University will carry out a joint research with ITC, LDD and CMU. The topic of the PhD research of Torsten Drey will be the use of spectral and altitude (DEM) information obtained from low cost satellite data (Aster) to do landslide inventory

mapping. He would like to investigate how good the DEMs are from Aster, and if images are available before and after major rainfall events that have produced many landslides, whether the landslides can be obtained using the combined spectral and altitude differences.

Possible case study area:

Land degradation due to mass movement and soil erosion is crucial in the mountainous areas in Northern Thailand. In Wang Chin area, Prael province deforestation of steep mountain slopes and improper land use practices enhances instability of slopes, which result in land sliding if excessive rain occurs. The Mae Suary sub-watershed area lies between 99° 25' and 99° 38' longitudes and between 17° 41' and 17° 53' latitudes and covers 250 sq.km of surface area. Elevation varies from 105 to 1,222 m asl. The area receives average rainfall of 1,125 mm, most of which falls during rainy season. August is the month with highest rain. Land use is mainly forest and shrub on the sloping area while there are some orchards on low and medium terraces of the Yom river, which passes through the Wang Chin District covering 27 km length. Paddy areas occupy along two sides of the Yom river which was damaged by mass movement in 2001.

4.3 Gadjah Mada University, Yogyakarta, Indonesia.

Contacts between Gadjah Mada University and ITC

Previous MSc research in ITC where staff of UGM was involved:

- **Surmayadi, M. (2002)** GIS modelling for pyroclastic flow hazard and risk assessment : a case study of Merapi volcano, Central Java, Indonesia
- **Sutanta, H. (2002)** Spatial modeling of the impact of land subsidence and sea level rise in a coastal urban setting : case study Semarang, Central Java, Indonesia.
- **Muh Aris Marfai (2003)** GIS modelling of river and tidal flood hazards in a waterfront city : case study, Semarang City, Central Java, Indonesia.
http://www.itc.nl/library/Papers_2003/msc/ereg/marfai.pdf

Compared to the large extent and variety of the disasters in Indonesia, the human resources who are capable and professional in managing such disasters and the capability of using geo-information sciences with emphasis on Remote Sensing and GIS (Geographic Information System) are still very limited. It has been considered important, therefore, to develop a master degree of disaster management program in Indonesia. Gadjah Mada University is an international recognized university which is potential in answering this problem. In 2004, the Faculty of Geography, of the Gadjah Mada University has conducted a refresher course on the Application of Geo-Information in Disaster Management which was supported by ITC, the Netherlands. UGM and ITC have decided to jointly develop a Master program in Geo-Information for Disaster Management which will be starting in the academic year 2005/2006.

In general, the aim of the program is to develop an academic and professional skill in managing disaster with emphasizing in the application of RS/GIS for Disaster Management. The management is a combination of scientific knowledge and technical skill with a multidisciplinary approach. The following are identified organizations in Indonesia that possible support the programme:

- BAPPENAS (National Development Planning Agency)
- Depdiknas (Department of National Education)
- Bakornas PBP (National Agency for Disaster Management)
- LAPAN (National Agency for Aeronautic and Space)
- BAKOSURTANAL (National Coordinating Agency for Survey and Mapping),
- Departments/Non Departments related to all aspects of Disaster Management;
- UN's Organizations, and NGO's.

MSc research ideas (for students from UNSYIAH Banda Aceh University and or Gadjah Mada University) :

- Earthquake damage assessment using community based approach with GIS
- Community-based disaster hazard and risk assessment using GIS
- Geo-information for Tsunamigenic Hazard Risk Assessment and Disaster Management in Banda Aceh, Indonesia

- Using RS/GIS for Resettlement Planning : A Case Study in Meulaboh, Aceh, Indonesia

PhD research ideas:

- Implementation of the Integrated Coastal Zone Management (ICZM) at Provincial and District Levels in the Tsunamis Affected Areas in Banda Aceh, Indonesia
- Tsunami Run-in Modelling and Multi-Temporal Sattelite Image Analysis of the Impact on the Tsunami December 26, 2004 in Banda Aceh, Indonesia

Joint Research Project ideas :

- Developing a strategy for risk disaster (tsunamigenic earthquake) reduction using Geo-Information Technology in Banda Aceh, Indonesia
- Developing Disaster Management Information System (Adopted from SIPBI-UGM Prototype) in Aceh and North Sumatera, Indonesia
- Research on Determining the Coastal Environmental Factors Causing the Different Damage in Banda Aceh, Indonesia
- Research on Environmental and Natural Resources Management with special regards to Land Use Planning/Zoning, Ecological Conservation of Mangrove As Safeguards Against Coastal Disaster.

An MOU between GMU and ITC has been prepared, in which research collaboration is mentioned as one of the main objective, next to the establishment of a joint educational programme. Efforts will be made to provide information about ongoing research activities in order to establish contacts and collaboration between professionals working within the same fields.

In the case where a joint research project has been proposed by either party, efforts will be made to evaluate the need for participating staff, and the location of the research activities. If a decision is made by both parties to approve the proposed project as a possible joint effort, both institutions will agree to actively seek funding for the proposed joint research project through internal funding channels or (when appropriate) through funding by outside agencies.

Every joint research project will have a counterpart supervisor from amongst the qualified staff from both institutions. The project supervisors will be responsible for reporting on the project status at least once in every six months. The mode of ownership of research materials and research findings shall be spelt out clearly at the commencement of a participation of each party and the prevalent regulations of the collaborating institutions

4.4 Indian Institute of Remote Sensing, Dehradun, India.

As part of the joint MSc course between the Indian Institute of Remote Sensing and ITC, a total of 8 students carried out their research on the use of GIS and Remote Sensing in various natural hazard applications. On Friday, 11 February, 2005 the first MSc graduation ceremony of the EREG programme was held at the Indian Institute of Remote Sensing (IIRS), (NRSA), India. Eight students who completed the first joint MSc. course between IIRS and ITC in Environmental Assessment and Disaster Management (EADM) received their MSc. degrees in the presence of Prof (Dr) Freek van der Meer and Dr. Cees van Westen from ITC and Dr. B.R. Arora, Director, Wadia Institute of Himalayan Geology (WIHG), India, who was the chief guest:

- **Agarwadkar Yogesh, Y.Y.** (2005) Salinity mapping in coastal area using GIS and remote sensing. Enschede, ITC, 2005. 56 p.
- **Barua, A.** (2005) Generation of geological database for seismic microzonation of Dehradun. Enschede, ITC, 2005. 105 p.
- **Kumar Singh, S.** (2005) Analysis of uncertainties in digital elevation models in flood hydraulic modelling. Enschede, ITC, 2005. 83 p.
- **Sarma, K.** (2005) Impact of coal mining on vegetation : a case study in Jaintia hills district of Meghalaya, India. Enschede, ITC, 2005. 76 p.
- **Kumar Nayan, N.** (2005) Spatial modelling of Hoplocerambyx spinicornis infestation for hazard prediction, management and control in Sal forests of Thanu Range (Uttaranchal). Enschede, ITC. 55 p.
- **Ranjan, R.** (2005) Seismic response analysis of Dehradun City. Enschede, ITC, 85 p.
- **Khatsü P.,** (2005) Urban Multi-Hazard Risk Analysis Using GIS and Remote Sensing: A Case Study of a Part of Kohima Town. Enschede, ITC, 78 p.
- **Kumar Verma, V.** (2005) Assessment of Land Degradation by integrated Analysis of Spectrally based information and Terrain attributes in Semi-Arid Regions

Supervision was given by both IIRS staff as by ITC staff.

This EREG MSc programme is the first course outside the Netherlands from the Earth Resources and Environmental Geosciences educational programme, which will be renamed to Applied Earth Sciences in October 2005. The joint course was introduced in India at IIRS, as a result of the joint collaborative GEONEDIS Project between IIRS and ITC during 2000 – 2004, the CASITA I project in 2003-2004 and the CASITA II project in 2005-2006. This course started on 7th July, 2003 with a duration of 18 months. The first 9 months (12 modules) were spent at IIRS, out of which 3 modules were supported by ITC faculty in India. Afterwards the students visited ITC for 3 months to follow 4 modules during 29 March to 22 June, 2004 and also to write and defend their proposals. After their return to India, the students spent about 6 months towards M.Sc. research dissertation at IIRS, Dehradun, which was supported by ITC faculty by e-mail. The MSc. dissertation was reviewed in mid-way by Cees van Westen in October, 2004. Finally the defence of the MSc. thesis was held on 10 February, 05 under the chairman ship of Prof. (Dr.) Freek van der Meer, Chairman, EREG Programme Board, ITC.

Apart from the IIRS MSc students also one ITC Msc student has been involved in research with the IIRS:

- **Pratima Singh** (2005) Population vulnerability for earthquake loss estimation using community based approach with GIS. Enschede, ITC, 2005. 120 p. http://www.itc.nl/library/Papers_2005/msc/upla/pratima_singh.pdf

ITC and IIRS staff are now jointly working on the elaboration of scientific papers together based on the MSc research and other joint activities. The following research publications are tentatively planned:

- Singh, L.P., van Westen, C.J., Champati Ray, P.K. , Pasquali, P. Accuracy Assessment of InSAR derived Input maps for Landslide Susceptibility Analysis: A Case study from the Swiss Alps. (Accepted by Landslides)
- Khatsü, P., Lakhera, Van Westen: Urban Multi-Hazard Risk Analysis Using GIS and Remote Sensing: A Case Study of a Part of Kohima Town.

- Ranjan, R. , Mahajan, A.K. Van Westen, C.J. , Sporry, R., Champati Ray, P.K. Seismic response analysis of Dehradun City.
- A.K.Mahajan, R.J.Sporry And S.K.Chabak. A shear wave velocity survey for seismic hazard zonation studies in Dehradun, India
- Singh, P., Brussel, M. and Van Westen, C.J. Building vulnerability assessment using a combination of GIS and community-based methods.
- Singh, P., Brussel, M. and Van Westen, C.J. Population vulnerability assessment using a participative GIS approach.

MSc students of the joint ITC-IIRs course on Hazard and Risk Assessment in the course 2004-2005. They are carrying out MSc research with joint supervision from both ITC as well as IIRS supervisors:

- **Sekhar L.K** . Debris Flow Dynamics in a Forest Ecosystem
- **Brijesh Gulati**. Earthquake Risk Assessment For Urban Transport Infrastructure Using Remote Sensing and GIS
- **Oinam Bakim Chandra**. Multi-resolution/multi-temporal effects on flood inundation mapping.
- **Rahul Srivastava**. Evaluation of environmental parameters related to tsunami impact
- **Ms. Barnali Chatterjee**. Satellite based monitoring of changes in mangroves in South Eastern Coast of India – A Tsunami related study
- **Ms. Parul Chopra**. Drought Risk Evaluation using remote sensing and GIS data
- **Bikash R. Parida**. Drought Monitoring Using MODIS Data
- **Ms. Sindhu Rathaur**. Evaluation of Fire Hazard and Risk Assessment in Chilla Range of Rajaji National Park – A Remote Sensing and GIS Approach

5. Research resources

This part of the document deals with a list of resources, mainly focusing on the Internet from which useful information can be obtained in relation to development of research skills, and the availability of materials for research.

5.1 Research skills resources

A very useful guide for Research methods and skills was compiled by Dr. David Rossiter from ITC.

<http://www.itc.nl/personal/rossiter/teach/lecnotes.html>

The table of contents of this guide is presented below:

1 Introduction to the module: objectives, contents, assessment

- 1.1 Objectives of this module
- 1.2 Assessment of this module
- 1.3 Assessment of the thesis proposal
- 1.4 Whose thesis is it, anyway?
- 1.5 Time management

2 The scientific method

- 2.1 Types of sciences
- 2.2 The deductive-inductive scientific method
- 2.3 Levels of certainty
- 2.4 Logical thinking
- 2.5 The research process
- 2.6 Argumentation

3 The MSc thesis project

- 3.1 Types of research projects
- 3.2 The “research” thesis
- 3.3 The “design” thesis
- 3.4 The “social” thesis

4 Statistical inference for research

- 4.1 Basic concepts
- 4.2 Frequentist and Bayesian interpretations
- 4.3 Bayesian concepts
- 4.4 Frequentist concepts
- 4.5 Frequentist hypothesis testing
- 4.6 Examples of frequentist inference
- 4.7 Building a statistical model
- 4.8 Conceptual issues in correlation and regression

5 Ethics & professionalism in science

- 5.1 Ethics
- 5.2 Fraud
- 5.3 Intellectual property and fair use
- 5.4 Professionalism

6 Literature review

- 6.1 Purpose of a literature review
- 6.2 Purpose of citations
- 6.3 Types of sources
- 6.4 Peer review for quality control
- 6.5 Choosing among sources
- 6.6 Citing material you haven't or can't read
- 6.7 Miscellaneous citation problems
- 6.8 Bibliographic style and the list of references
- 6.9 How to Search
- 6.10 Literature review: Exercise
- 6.11 Literature review exercise: Sample output

7 Technical writing

- 7.1 Structured technical writing
- 7.2 Writing clearly
- 7.3 Verbs: tense and voice
- 7.4 Punctuation
- 7.5 Some matters of style
- 7.6 For non-native speakers
- 8 Assessing the quality of an MSc thesis**
 - 8.1 Examination procedure
 - 8.2 Evaluation criteria
 - 8.3 Exercise
- 9 Abstracting a research paper or thesis**
 - 9.1 Purpose
 - 9.2 Example
 - 9.3 Exercise
- 10 Presenting a research proposal and results**
 - 10.1 Purpose
 - 10.2 Designing and writing the presentation
 - 10.3 Writing the text
 - 10.4 Designing the graphics
 - 10.5 Sequencing
 - 10.6 Using PowerPoint
 - 10.7 Making the presentation
 - 10.8 Internet resources

Other useful resources on the Internet are:

- Rules of thumb for writing research articles
Hengl, T. and Gould, M., 2002. Rules of thumb for writing research articles. International Institute for Geo-information science and Earth Observation (ITC), Enschede, p. 11, Available online by the ITC at http://www.itc.nl/library/Academic_output/
- A Guide to writing research papers
<http://www.people.vcu.edu/%7Ecturner/guide.htm>.

Useful software resources from Internet:

- Cambridge Scientific Abstracts (Internet database service): <http://www.csa.com/>
- Web of science (Most extensive data base for research papers)
- Endnote (Bibliographies management software): <http://www.endnote.com/>
- Ghost view (PDF compiler freeware): <http://www.ghostgum.com.au/>
- Wikipedia (On-line encyclopedia): <http://www.wikipedia.org/>
- Open Office (Linux based Office freeware): <http://www.openoffice.org/>
- Latex (Document compilation freeware): <http://www.latex-project.org/>
- Free GIS software : <http://freegis.org/>

5.2 Remote Sensing and GIS resources

A very good overview of remote sensing is given by Wim Bakker from ITC on his personal homepage:

- Remote Sensing organizations:
<http://www.itc.nl/personal/bakker/satellite.html>
- Remote sensing data directories and archives:
<http://www.itc.nl/personal/bakker/invdir.html>
- One recent very good tool is NASA World wind. World Wind lets you zoom from satellite altitude into any place on Earth. Leveraging Landsat satellite imagery and Shuttle Radar

Topography Mission data, World Wind lets you experience Earth terrain in visually rich 3D.

<http://worldwind.arc.nasa.gov/>

- An extensive list of GIS and Remote sensing sites can be found at:
<http://www.frw.ruu.nl/nicegeo.html>
- GIS case studies on hazard and risk assessment can be found in the following websites:
http://www.itc.nl/ilwis/documentation/version_2/aguide.asp

Use of remote sensing in the study of natural hazards:

- The Website of the Canadian Centre on Geohazards offers a good overview.
http://www.ccrs.nrcan.gc.ca/ccrs/misc/issues/hazards_e.html
- The CEOS disaster Information Server also provides a good overview on the use of Remote Sensing for disaster management:]
<http://www.ceos.org/pages/DMSG/index.html>
- Earth watching
<http://earth1.esrin.esa.it/ew/>
- International Charter on Space and Major Disasters
http://www.disasterscharter.org/main_e.html

Annex 1:

Guidelines for Research thesis work and reporting (example of the agreement made between ITC and IIRS)

5.1 The research thesis work and reporting

5.1.1 The thesis period focuses on individual research. The thesis work requires that the M.Sc. participant:

- (1) Presents a draft research proposal to the Programme Director as required by the course. Proposals (prepared in discussion with members of staff) have to fall within the subject matter of the course and specialisation and must be consistent with the research policy and expertise of the departments that play a major role in the course.
- (2) Prepares a detailed research proposal (approximately 8 pages), in consultation with the supervisor(s), to be submitted to the supervisor(s) before the deadline set by the Programme Director, followed by a presentation and defence of the proposal to the Thesis Admission Committee.
- (3) Carries out the research and reports on progress to the supervisors according to an agreed schedule for the research and preparation of the thesis.
- (4) Makes a mid-term oral presentation to staff and participants on the nature and progress of the research when and as required by the Programme Director.
- (5) Prepares and submits the thesis report and presents and defends the thesis when and as required by the Programme Director.

5.1.2 The thesis work will be assessed three times:

- (1) The detailed research proposal and presentation, leading to admission / no admission to the thesis period,
- (2) The mid-term presentation which, in case of weak performance, may lead to a written warning and
- (3) Finally the thesis and oral examination

In addition to these formal assessments, the participant will receive feedback on his/her performance from the supervisors.

5.1.3 A participant not presenting the (draft) research proposal, not making the midterm presentation, not submitting the thesis report or not making the final oral examination within the specified time, will be considered as having failed. Only in exceptional cases and for reasons being beyond the control of the participant (at the discretion of the Programme Director), the participant can apply in writing for a new opportunity to meet the above requirements.

5.1.4 The thesis, approximately 50 pages of text (approximately 350 words per page and in the standard ITC format for theses), excluding appendices, shall constitute an ordered, logical and critical description of the research and should afford evidence of reasoning power, critical attitude, competence in the scientific discipline (application and/or development of knowledge and skills), and knowledge of relevant literature.

5.1.5 The thesis may describe work done in conjunction with a supervisor or any other person, but the extent of the participant's personal contribution must be certified by the supervisor concerned.

5.1.6 With the explicit approval of the supervisor a participant may be permitted to incorporate in his/her thesis a limited amount of unpublished work undertaken by the participant prior to the start of the research. A participant may not incorporate in

his/her thesis material which has been submitted for achieving the award of a degree from any other educational institution.

5.1.7 The source of any photograph, map, or other illustration shall be indicated, as shall the source, published or unpublished, of any material not resulting from the participant's own work. If material from other work is incorporated verbatim, without proper acknowledgement of the source (plagiarism), the Thesis Assessment Board may decide not to assess the thesis. This will mean that the M.Sc. degree cannot be awarded.

5.2 Admission to the thesis period

5.2.1 For admission to the thesis part of the course, at least all but two of the previous modules (see rule 6.2 to see which modules are to be included) must have been successfully completed and no mark below 50 is allowed. The second requirement for admission to the thesis part, which is as important as the marks obtained in previous modules, is the ability to do research independently. This ability will be developed and assessed during the first 15 modules and finally assessed on the basis of the detailed thesis proposal and the presentation of it.

5.2.2 The Programme Director will nominate, and the Degree Assessment Board will appoint a Thesis Admission Committee. This Committee will assess the proposal and the presentation by the participant. The Thesis Admission Committee is accountable to the Programme Director.

5.2.3 When the Thesis Admission Committee is of the opinion that the research skills have not been mastered to the level required for the start of the thesis work, the participant will not be admitted to the thesis part of the course or will be strongly advised not to pursue a M.Sc. degree.

5.2.4 A participant who is not eligible for admission to the thesis part of the course will receive a Certificate.

5.3 Supervision of the thesis

5.3.1 Based on the draft thesis proposal, and in consultation with members of staff and the M.Sc. participant, the Programme Director shall recommend a primary and secondary supervisor to the supervisor's department(s). The management team of the department of the supervisor might then appoint the supervisor.

5.3.2 The two supervisors shall divide the supervision tasks and make a supervision plan and meeting schedule with the participant.

5.3.3 Supervisor(s) shall:

- (1) Guide the M.Sc. participant in the formulation of a detailed research proposal.
- (2) Establish a schedule of regular supervisory meetings with the M.Sc. participant (on an average once per fortnight). Additional meetings may be arranged by agreement.
- (3) Provide general advice and guidance on the execution of the research and where appropriate on techniques and procedures.
- (4) Provide feedback on draft written work normally within 10 days of receipt.
- (5) Forward where appropriate any comments on the performance of the participant to the Programme Director.
- (6) Advise the Programme Director when the progress of a participant gives cause for concern so that action can be taken in accordance with these regulations.

5.3.4 Where a M.Sc. participant finds that he/she is not receiving the quality of supervision required in the regulations, the participant should report to the Programme Director.

5.3.5 Replacement of a supervisor may be considered if research is found to be outside a supervisor's area of expertise, or at the request of the supervisor and/or the participant.

5.3.4 Supervision during MSc thesis period:

- IIRS and ITC staff will provide MSc thesis research ideas prior to selection, based on research projects and interests, by consultation between ITC and IIRS staff.
- The selection of research topics by IIRS students is restricted by the expertise at IIRS. A topic can only be chosen if supervision at IIRS is available. The PD and PC will discuss the proposed topics and list the appropriate ones.
- Before moving to ITC, MSc course participants will present a 1 to 3 page(s) research pre-proposal to the PD and PC. The purpose of this pre-proposal is to define the research interest and to obtain a broad idea of the topics.
- Participants will be assigned an IIRS and an ITC supervisor who will help them to prepare a detailed research proposal. If the participant is at IIRS, the IIRS supervisor will discuss the topic and coordinate with the ITC supervisor and the opposite will happen if the participant is at ITC. The participant's research proposal will be formally assessed by the Thesis Admission Committee, appointed by the ITC programme Board.
- The IIRS supervisor will coordinate the fieldwork for the MSc participants in cooperation with the ITC supervisor. Both supervisors, who will have equal responsibilities, will do the MSc supervision. However the supervisor of the Partner at whose premises the participant is will be the first contact person for the participant. All main feedback to the student should be done by e-mail, with a copy to the other supervisor.
- During the MSc research period, participants must make a progress report once every three weeks, which will be send by e-mail to the ITC and IIRS supervisors, with a copy to the PD and PC. Progress reports must include minutes of the meetings of the MSc participant with his or her supervisor.
- The MSc participants will make a mid-term presentation of their progress in the middle of their MSc research period, which is in module 19-20. The midterm presentation will be attended by IIRS supervisors, Course Coordinators and at least one ITC representative. The MSc participant will receive a written report with recommendations from the ITC Program Director and IIRS Program Coordinator.
- All editing of draft chapters by supervisors should be done electronically and edited chapters should be sent to the student and the counterpart supervisor.

5.4 Submission of the thesis report

5.4.1 The participant must submit a well-organised copy of all digital files associated with the thesis work on CD-ROM, and a hard-copy of graphic output, at least two weeks before the examination date or as specified by the Programme Director.

5.4.2 No changes may be made in the thesis report after submission for the thesis examination. Only when the Thesis Assessment Board decides that the thesis is satisfactory subject to specific minor corrections in the report being made, these corrections and nothing other than these corrections may be made. In all other cases changes can only be made when the thesis will be re-examined by the Thesis Assessment Board.

5.4.3 ITC will produce sufficient hard copies of the thesis, including two for the participant. The participant must bring one of his/her copies of the thesis to the oral examination.

5.4.4 One copy of the thesis will be sent to each member of the Thesis Assessment Board. The Institute will retain two bound copies if a degree is awarded, one of the copies

being lodged with the Institute Librarian and the second and third copy with the departments of the supervisors.

5.4.5 Where work submitted has been done in cooperation with others, the supervisor must submit a statement to the Thesis Assessment Board indicating the extent of the participant's share of the work.

5.5 Thesis examination

5.5.1 For the thesis examination, the Programme Director nominates and the Degree Assessment Board appoints a separate Thesis Assessment Board for each participant. The Thesis Assessment Board is accountable to the Programme Director. Each Thesis Assessment Board has 3 to 5 members: the supervisor(s) of the participant, a professor or associate professor in a relevant discipline (chair), an external examiner and, if necessary, other staff members of the ITC. In most cases, the external member will come from outside ITC, preferably being an academic staff member of a university. In the remaining cases, the external member will come from an ITC department that does not play a major role in the course.

5.5.2 The thesis examination consists of the assessment of the thesis report and the oral examination that includes a presentation and defence. The oral examination has a maximum duration of 1.5 hour.

5.5.3 The Programme Director assigns a date for an oral examination and informs the participant at least one month in advance of the date fixed.

5.5.4 The members of the Thesis Assessment Board shall read and assess the quality of the thesis report as an ordered, logical and critical exposition of research work in the approved field. At the oral examination the Thesis Assessment Board will assess the participant's reasoning power, critical attitude, competence in the scientific discipline, and knowledge of the relevant literature and will raise questions concerning the thesis.

5.5.5 The oral examination is open and will be announced as such. In exceptional cases the Programme Director can decide for individual participants to have the defence closed to observers other than ITC staff.

5.5.6 MSc Thesis examination: the MSc exam and graduation ceremony will be held at IIRS. The thesis will be assessed jointly with a veto right for the degree-awarding Partner ITC. Each thesis assessment board must consist of at least 4 members including one of the supervisors, an ITC professor or UHD (chair), the Dean of IIRS or a senior staff member of IIRS, and an external expert. Both the ITC Program Board and IIRS must approve the constitution of the thesis assessment boards.

5.5.6 On the basis of the assessment of the participant the Thesis Assessment Board shall take one of the following decisions:

- (1) The thesis is satisfactory. One single mark is given.
- (2) That subject to minor corrections (implementable within three working days and to be implemented before the official end of the course) in the thesis, the thesis is satisfactory. One single mark is given subject to the corrections in the thesis being made.
- (3) That the thesis is not satisfactory. The Thesis Assessment Board advises to give the participant an extension of one to three months to produce an acceptable thesis before a re-examination will take place.
- (4) That the thesis is not satisfactory and is given the FAIL grade.

5.5.7 Extensions for the thesis period can be given before the thesis is submitted and/or as result of the thesis examination on advice of the Thesis Assessment Board.

Extensions will only be given when:

- (1) Funding for the extension is available, and
- (2) The main cause of the unsatisfactory level of the thesis has been beyond the control of the participant (see 5.1.3).

If the Programme Director is of the opinion that the second condition is met he will forward the advice for decision to the Head of Education. The maximum total duration of extensions of the thesis period is three months. Extensions are only allowed when the participant stays at ITC. This does not apply to participants who study part-time. They are allowed to work on the thesis in the home organisation and since the M.Sc. course may be spread over a period of maximum three years (see rule 2.2) they can work on the thesis until about a month before the end of the three-year period.

5.6 Access to the thesis report

5.6.1 The primary function of the Institute is the development and dissemination of knowledge. Theses are lodged with the Institute Librarian and shall be available for consultation, inter-library loan and photocopying. Theses that meet the following criteria will also be made available in digital format at the ITC website:

- (1) Have been awarded a mark of 70 or more
- (2) Contain no material of which the copyright rests with third parties
- (3) Contain no confidential data or information.
- (4) Are found suitable for publication on the ITC website by the Thesis Assessment Board

5.6.2 Any staff member who publishes results from M.Sc. research work or theses should make a proper reference to the M.Sc. participant's work.