

Gordon Brent Ingram, Ph.D.
Associate Professor
Forest Sciences Division
ITC
P. O. Box 6
7500 AA Enschede The Netherlands
telephone: +31(0)53 487 45 77
facsimile: +31(0)53 487 43 79
email: ingram@itc.nl

Mr. He Bin
Division Director
Yunnan Environmental Information Center
Yunnan Institute of Environmental Science
P.O.Box 650032
No.23 Wang Jiaba, Kunming P.R.China
telephone:+86(0871)4158253
facsimile:+86(0871)4145717
email: hebin@yies.org.cn

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**A strategy for training in
development, management & use of
geographic information systems for
forest biodiversity conservation
as part of the Forest Conservation and Community
Development project, Yunnan Province**

FINAL REPORT
to the
FOREST CONSERVATION AND
COMMUNITY DEVELOPMENT PROJECT,
Yunnan Department of Forestry
State Forestry Administration
People's Republic of China
&
The Ministry of Foreign Affairs
Government of The Netherlands

Introduction & terms of reference

This is the proposed policy and programme document for an ambitious set of geographic information systems for forest biodiversity conservation. The goals for facilitation of decision-making, for reserve managers, land use planners and scholars in natural and environmental sciences is one of the more far-reaching to ever be initiated – within China and elsewhere.

This programme document is supported by a more detailed document from ITC entitled, “Needs assessment for training in design, data format development, management & use of forest biodiversity conservation geographic information systems with an emphasis on the Caiyanghe Nature Reserve pilot project.” Both reports have developed collaboratively and after considerable discussion. Where differences are perceived between the two reports, this the He & Ingram strategy, clarifies policy and proposals for service delivery. In contrast, the ITC report provides key background to questions of conservation biology, field and data organization methodologies and technical aspects of development of geographic information systems for conservation of forest biodiversity.

This strategy is only for this coming year, 2000. Based on the experiences of this year, the authors propose the development of a longer-term training strategy for 2001 to 2003 in December of 2000 and January 2001.

The goal of this strategy:

To facilitate the forest inventory & conservation planning operations

The core of the intended functions of the geographic information systems for the six nature reserves in this project centre on a set of inventory, monitoring and decision-support. These are called subsystems 1 through 5 (FCCDP Project Management Office 2000a) and consist of

- subsystem 1: fragile biological resources and ecosystems of immediate attention for habitat protection and management;
- subsystem 2: protection and management of fragile ecosystems in the cores of the nature reserves;
- subsystem 3: monitoring of “key and indicator ecosystems and species” in the buffers of the nature reserves;
- subsystem 4: inventorying production capacities in areas adjacent to nature reserves; and
- subsystem 5: planning and management of land uses in adjacent zones.

But in terms of training for GIS to make such data bases and decision-support tools support these functions, a number of crucial methodological and technical decisions have yet to be made. GIS training, at the levels of systems design, development, management, and use, must, therefore, go on while decisions are being made. And, in order to develop and implement these systems, a significant portion of this GIS training must be at the management level in order to link scientific principles with policy and a range of technical functions.

Identifying the end-users

The data bases and decision-support systems envisioned in this project have been intended for a number of end-user groups, each of which may require tailored applications software. In initial list of end-users has centred on the following groups with at least two sub-groups each for technicians and actual decision-makers:

State Forestry Administration (Kunming & Beijing);
Nature reserve managers; and
County and prefecture offices.

Linking IMA with the geographic information systems

This project has an extensive framework for eventually integrating data on inventory, monitoring & analysis data (IMA). The IMA exchange networks link an exceptional group of researchers in tropical and subtropical forest ecology and biogeography. However, most of the information formats for IMA have yet to be formalized (or standardized). It will take another half year to a year to begin to develop digital formats for in-field data entry. Before this time, much of the field data will be recorded manually and then transferred to computer systems. This is unfortunate for the year 2000 but formats take time to be designed and integrated into instrumentation. In this context, there are a plethora of unresolved technical questions of how best to develop the geographic information systems and to train for their use and maintenance – in terms of the intended functions of subsystems 1 to 5.

Over the next year, the Caiyanghe Nature Reserve GIS pilot project was prudently established to illustrate and provide a focus for resolving these scientific, methodological, policy, and technical questions. But in this context, the design and development of this first GIS must be anticipatory of the need for extensive evaluation and redesign. The link between IMA and the first GIS, in particular, must be as transparent as possible. Workshops and training courses in the nature reserve and in Kunming are necessary, particularly by and during the autumn of 2000. The term workshop refers to a day or days where information is presented and exchanged between colleagues with decisions and recommendations of an advisory nature made. A training course is developed by experts as a more structured form of education of individuals (particularly staff members). These

learning experiences would enable the pilot project, and the subsequent 9 months of much of the FCCDP work in general, to function as a learning experience for personnel of a number of Chinese agencies. And the group learning process that leads to redesigns and reworking, for applications of the lessons of the pilot project to the other geographic information systems (and nature reserve management contexts), becomes a fulcrum for much of the intended transfer of expertise and technology to Yunnan-based counterparts.

Within this context of the pilot-GIS-as-institutional-learning-project, the Beijing-based Academy of Forest Inventory and Planning of the State Forestry Administration, and its Environment and Wildlife Monitoring Centre's GEF – China Nature Reserve Management Project, has offered (as of mid-March 2000) significant support around data formats. That office in Beijing, with its own software group that has been working together for over five years, has agreed to supply collaborative technical support. The focus is on adaptations of the digital data formats, C-BIMS (China Biodiversity Information Management System) to Yunnan as one of the most biodiversity-rich regions in the country. The word 'collaborative' is important here. While the Beijing group mentioned above is developing C-BIMS as a national standard, this Sino-Dutch project is being encouraged to adopting the core of C-BIMS while adapting it to the higher levels of monitoring and conservation decision-support necessary for forests with a high degree of species which are approaching extinction. These adaptations could well be used to enhance the national system of C-BIMS in the years to come. Rarely in China has a project based in a distant province such as Yunnan, involving bilateral assistance, been in a position to influence natural resource management and land use planning policy.

But C-BIMS has been adopted by the project rather late in what should have been the design phases of the development of the first geographic information system. And C-BIMS only provides a partial core for subsystems 1, 2 and 3. The pressure to find an cross-institutional basis to build on C-BIMS while responding to the needs of various producers and potential users of this data and subsequent analysis will structure both the nature of the training needs, in 2000 and early 2001, particularly for management levels. Questions of funding for integrating C-BIMS into this project, in Yunnan Province, are outside the terms of reference of this strategy document.

Possible GIS architectures

We can think of GIS architecture as that similar to the design of a houses (in this project, 6 houses) with gardens that partially touch on each other. 'Architecture' is needed to fit everything needed into the houses and the gardens; to build some fences where necessary and to have some common space. And a stream may flow between or through some of the gardens.

If the GIS architecture is faulty, the 'houses' can collapse on people in the rainy season causing misery. how to satisfy the intended functions of the five subsystems for very different nature reserves in terms of size, shape, socio-economic and cultural contexts? And if a house is designed to be too small, or the rooms are partitioned

awkwardly, there may not be room out of the rain for all of the records, books, heirlooms, scrolls, and other signifiers of (group) memory. What does this metaphor of a small neighbourhood or village infer about principles for design of the geographic information systems?

The design of the data bases, their inter-relationships and applications must be flexible to be useable for managers for more than a few years. Each nature reserve is different and involves a slightly different set of social and conservation projects. Thus **the** six geographic information systems should not be identical though it is necessary to employ the same data formats, applications and standards. Secondly, a number of decisions need to be made early on in the design process. For this pilot GIS, a number of decisions are necessary by May 1, 2000:

1. the software and the types and inter-relationships of the applications intended to implement each subsystem;
2. the partitioning and layering of the data particularly in terms of implementation of each subsystem;
3. the outer boundary of the territory represented by each geographic information system (that includes the nature reserve cores, buffers and important adjacent areas in rational natural and cultural units);
4. the relationship of the processed remote sensing data to the forest cover map(s);
5. the minimum levels of field data to be collected **before** initial processing of remote sensing data;
6. the relationship between the landscape attributes and categories on the forest cover maps, as derived from IMA formats, to already-established categories of forest types, landscapes, ecosystems; and
7. the role of successional phases and cultural factors in the attributes and categories described on the forest cover maps (as based on the fieldwork combined with fieldwork).

Goals for operationalization of the pilot GIS in 2000

The operational goals for this pilot GIS are remarkably simple, deceptively so. For 2000, they are the following:

- A. the setting of territorial boundaries to be represented by the GIS that include all of the nature reserve core, all its buffer zones and key adjacent areas within a rational spatial unit as defined by natural and cultural factors;

- B. creation of a base map through digitizing and scanning in Kunming;
- C. creation of an integrated set of forest cover, ecosystems and land use maps as based on 1998 and 1999 (spectral) remote sensing data in conjunction with ground truth techniques and other field data collection involving global positioning systems;
- D. some entry of species and habitat data as based on IMA formats (that have yet to be formalized) (this will not be all of the IMA data necessary for effective development of the pilot) including that on:
 - biophysical parameters including on topography, soil and climate;
 - protected species;
 - disturbed ecosystems and habitats;
 - distribution and density of some target species;
 - distribution and statues of rare, endangered and endemic species; and
 - land use factors particularly relevant to corridor establishment and extension (and the creation of at least one thematic map as related to current land use or related resources);
- E. determination of decision-support applications to support subsystems 1 to 5;
- F. training five or more people to be able to successfully achieve each of the operations listed above (in six to nine months); and
- G. scientific and managerial upgrading in forest biodiversity conservation (that is part of the evaluation process after the first field research period in April and May, 2000).

It will be difficult to attain these goals within 2000 but this strategy attempt to show how such highly coordinated efforts would be possible.

Steps in operationalization of the pilot GIS in 2000

A plan for operationalizing the pilot GIS is outside of the terms of reference for this contract. However, the following activities and sets of decisions will be necessary in order to have the skeleton of a system on which to train. The progression of steps is important though in some cases there may be alternative sequences.

March 2000 concept for training & system development

The schedule, below, is already out of date (as of April 2000) and therefore some of the steps described below can not be carried out, now, until months after originally envisioned below.

1. end of March: request and contracting for systems design and training services for the remainder of the year from Yunnan Environmental Information Centre and the Forest Sciences Division of ITC;
2. first week of April: beginning of one month+ course in digitizing and creation of the base map for the GIS;
3. first week of April: first course in systems management
4. second week of April: beginning of field work on species and habitats;
5. third week of April: training workshop to set the outer territorial boundaries represented in the first GIS;
6. third week in April: first workshop on GIS architectures, functions and applications for pilot project
7. third week of April: training course for beginning of field work for initial processing of remote sensing data with the use of the more spatially precise, global positioning systems (gps);
8. fourth week in April: first training course in management of digital data quality;
9. first week in May: second training course in systems management;
10. mid-May: completion of first base map;
11. third week in May: first week course in English studies for successfully using software manuals
12. third week in May: completion of the field reconnaissance with gps for initial processing of remote sensing data;
13. fourth week in May: initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS;
14. second week in June: creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use;
15. third week in June: beginning preparations for ITC training in 'Forest biodiversity assessment and monitoring'
16. fourth week in June: compilation of hardcopy data from the first field season
17. first week in July: workshop on structure of the biogeographical and habitat data
18. second week in July: workshop on protocol for hardcopy field data entry into GIS
19. third week in July: beginning at 3 week course at ITC, Forest biodiversity assessment and management with participation of up to three Yunnan-based researchers and managers
20. first week in August: second week course in English for using software manuals
21. third week in August: second workshop on data quality management with an emphasis on protocols

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22. last week in September: completion of entry of all data from the mid-2000 field season
23. first week in October: second workshop on GIS architectures, functions and applications for pilot project + decisions on the architecture of at least two more of the geographic information systems
24. second week in October: first workshop on prioritizing decision support tools to be designed
25. third week in October: first workshop on digital formats for field data collection
26. fourth week in October: second field workshop on use of remote sensing and field data in conjunction with gps and beginning of the field work to make the forest cover maps for the second and third nature reserves (and respective geographic information systems)
27. first week in November: second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer
28. first week in November: workshop in in-field digital entry of data on species and ecosystem – in conjunction with remote sensing and gps
29. first week in December: completion of field work for pilot nature reserve
30. first week in December: second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer
31. second week in December: second workshop on importation of processing of remote sensing and digital field data
32. second week in December: first training workshop on designing decision-support applications
33. second and third week in December: evaluation of data and status of data bases for the pilot nature reserve

Training steps for specific operationalization goals for 2000

The training steps listed above function to contribute to the satisfaction of the specific operational goals in the following progressions.

operational goal A

setting of territorial boundaries of GIS

first week of April: beginning of one month+ course in digitizing and creation of the base map for the GIS (prepares technicians to execute the boundaries);

third week of April: training workshop to set the outer territorial boundaries represented in the first GIS (provides the theoretical background and opportunity to make space decisions in an interdisciplinary, team context);

operational goal B

creation of a base map through in-house digitizing & scanning

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first week of April: beginning of one month+ course in digitizing and creation of the base map for the GIS (provides introduction and basic training);

fourth week in April: first training course in management of digital data quality (assures accuracy and sufficient information quality);

first week in May: first training course in systems management (assures that system and staff can maintain the digital data);

mid-May: completion of first base map (initial test of training preparedness and levels);

third week in May: first week course in English studies for successfully using software manuals (allows technicians and managers to better solve systems problems that could threaten data integrity and viability)

first week in August: second week course in English for using software manuals (see above)

third week in August: second workshop on data quality management with an emphasis on protocols (enhances quality of data over time)

operational goal C

creation of a forest cover, ecosystems and land use map;

third week in April: first workshop on GIS architectures, functions and applications for pilot project (lays the basis for the processing and analytical work involved in tracking aspects of vegetation, habitat and ecosystems)

third week of April: training course for beginning of field work for initial processing of remote sensing data with the use of global positioning systems (gps); (lays the basis for collecting key field data)

third week in May: completion of the field reconnaissance with gps for initial processing of remote sensing data; (lays the basis for collecting key field data)

fourth week in May: initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS; (lays the basis for the processing and analytical work involved in tracking aspects of vegetation, habitat and ecosystems)

second week in June: creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use (tests level of analytical capabilities and synthesis);

third week in June: beginning preparations for ITC training in 'Forest biodiversity assessment and monitoring' (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

first week in July: workshop on structure of the biogeographical and habitat data (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

second week in July: workshop on protocol for hardcopy field data entry into GIS

third week in July: beginning at 3 week course at ITC, Forest biodiversity assessment and management with participation of up to three Yunnan-based researchers and managers (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

third week in October: second workshop on GIS architectures, functions and applications for pilot project + decisions on the architecture of at least two more

of the geographic information systems (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

third week in October: first workshop on prioritizing decision support tools to be designed (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

fourth week in October: second workshop on use of remote sensing and field data in conjunction with gps and beginning of the field work to make the forest cover maps for the second and third nature reserves (and respective geographic information systems) (the technical basis for collecting and synthesizing field data)

first week in November: first bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

first week in November: workshop in in-field digital entry of data on species and ecosystem – in conjunction with remote sensing and gps (the technical basis for collecting and synthesizing field data)

first week in December: completion of field work for the second and third nature reserves (lays the basis for more forest cover maps)

first week in December: second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (lays the intellectual basis for use of such maps in habitat protection and ecosystem management)

second week in December: second workshop on importation of processing of remote sensing and digital field data (lays a technical basis for making these maps)

operational goal D

entry of species and habitat data

third week in April: first workshop on GIS architectures, functions and applications for pilot project (data formats often involve applications to make entry easier)

third week of April: training course for beginning of field work for initial processing of remote sensing data with the use of global positioning systems (gps); (these field operations are often a major way to obtain and organize species and habitat data)

mid-May: completion of first base map; (base maps are a major way that species and habitat data are organized)

third week in May: completion of the field reconnaissance with gps for initial processing of remote sensing data; (gps is another major way that field data is organized)

fourth week in May: initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS; (this lays the basis for organizing species and habitat data)

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second week in June: creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use; (this lays the basis for organizing species and habitat data)

third week in June: beginning preparations for ITC training in 'Forest biodiversity assessment and monitoring' (this training lays the intellectual basis for obtaining, organizing and using this data)

fourth week in June: compilation of hardcopy data from the first field season (another crucial way that this information is organized)

first week in July: workshop on structure of the biogeographical and habitat data (crucial to how this information is organized)

second week in July: workshop on protocol for hardcopy field data entry into GIS (crucial to how this information is entered into the GIS)

third week in July: beginning at 3 week course at ITC, Forest biodiversity assessment and management with participation of up to three Yunnan-based researchers and managers (this training lays the intellectual basis for obtaining, organizing and using this data)

third week in October: second workshop on GIS architectures, functions and applications for pilot project + decisions on the architecture of at least two more of the geographic information systems (central to functions of how this information is entered, organized and applied)

third week in October: first workshop on prioritizing decision support tools to be designed (central to functions of how this information is entered, organized and applied)

third week in October: first workshop on digital formats for field data collection (central to functions of how this information is entered, organized and applied)

fourth week in October: second workshop on use of remote sensing and field data in conjunction with gps and beginning of the field work to make the forest cover maps for the second and third nature reserves (and respective geographic information systems) (central to functions of how this information is entered, organized and applied)

first week in November: first bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (this training lays the intellectual basis for obtaining, organizing and using this data)

first week in November: workshop in in-field digital entry of data on species and ecosystem – in conjunction with remote sensing and gps (central to how this information is entered and applied)

first week in December: completion of field work for the second and third nature reserves (central to how this information organized)

first week in December: second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (this training lays the intellectual basis for obtaining, organizing and using this data)

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second week in December: second workshop on importation of processing of remote sensing and digital field data (crucial for use and organization of the data)

operational goal E

creation of one thematic map on current land use

first week of April: beginning of one month+ course in digitizing and creation of the base map for the GIS (lays the basis for the thematic maps);

third week of April: training course for beginning of field work for initial processing of remote sensing data with the use of global positioning systems (gps) (some of this information can be used in thematic maps);

mid-May: completion of first base map (crucial to developing the thematic maps);

third week in May: completion of the field reconnaissance with gps for initial processing of remote sensing data (this data can be selectively imported to make thematic maps);

fourth week in May: initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS; (this data can be selectively imported to make thematic maps);

second week in June: creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use; (this data can be selectively imported to make thematic maps);

third week in June: beginning preparations for ITC training in 'Forest biodiversity assessment and monitoring' (lays the basis for selective use of thematic maps)

first week in July: workshop on structure of the biogeographical and habitat data (lays the basis for selective use of thematic maps)

third week in July: beginning at 3 week course at ITC, Forest biodiversity assessment and management with participation of up to three Yunnan-based researchers and managers (lays the basis for selective use of thematic maps)

third week in October: second workshop on GIS architectures, functions and applications for pilot project + decisions on the architecture of at least two more of the geographic information systems (key functions for making thematic maps)

third week in October: first workshop on prioritizing decision support tools to be designed (key functions for making thematic maps)

third week in October: first workshop on digital formats for field data collection

fourth week in October: second workshop on use of remote sensing and field data in conjunction with gps and beginning of the field work to make the forest cover maps for the second and third nature reserves (and respective geographic information systems) (key functions for making thematic maps)

first week in November: first bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (provides the intellectual basis for the development and use of thematic maps)

first week in November: workshop in in-field digital entry of data on species and ecosystem – in conjunction with remote sensing and gps (provides another level of data for making these maps)

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first week in December: completion of field work for the second and third nature reserves

first week in December: second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer (provides the intellectual basis for the making and use of these maps)

second week in December: second workshop on importation of processing of remote sensing and digital field data (provides the basis for the making of these maps).

Existing capacities for GIS & related training

The following offices have either central supporting roles in the development of this geographic information system.

Yunnan Department of Forestry forest biodiversity conservation GIS

This is the recently established and heavily Dutch funded facility. All of the staff have a substantial introductory knowledge of GIS but, as with staff in any GIS facility, they need ongoing training (if only for new versions of software). At this point, few of the staff have had substantial academic or professional familiarity with geographical information systems for forest biodiversity conservation.

Academy of Forest Inventory and Planning, Beijing

The State Forestry Administration's Environment and Wildlife Monitoring Centre has a software development group associated with the GEF-funded China Nature Reserve Management Project. The group has tentatively committed itself to providing support to transferring specific software, protocols and expertise to the Yunnan Department of Forestry forest biodiversity conservation GIS

Nature reserve manager offices, County Forest Bureaux

These offices currently have little digital technologies at all (and little training to use it to date) but are expected to be major beneficiaries of this FCCDP project. They are envisioned as major 'end users' for decision-support in the last years of the project.

State Forestry Administration (Beijing)

There is a working group on software development that has been focused on development of C-BIMS.

Yunnan Institute of Environmental Science (Kunming) & the He Bin Consulting Group

This institute's Information Centre has been in existence for over ten years. This Centre has developed and provided services to over twelve different environmental management projects that have had significant GIS components. The Centre has a solid record in environmental management decision support systems and applications; perhaps more than any other group in this part of China. Presently, there is 14 staff with 6 focused, full-time, on GIS and 3 on data base applications development. There is no other comparable group with GIS expertise in Yunnan Province. In addition, this GIS group is

the only in Yunnan Province to have experience using global positioning technology with remote sensing and databases.

This group has provided extensive training programmes to forest institutes, county forest bureaux, county-level environmental management staff, watershed management personnel, and various groups of university students. The training staff of this Centre provides basic training in the development of GIS – especially for environmental management. The centre has provided extensive training in use of the following hardware and software: digitizing technology, WindowsNT, OS, SGI Unix, Sybase, Arc/Info, Arcview, ERDAS, Ermapper, Trimble gps pathfinder office, and web site development. In all of these topics, the Centre can provide basic and some intermediate training.

Forest Sciences Division, ITC

Within the world of remote sensing and GIS, the ITC (and its Forest Sciences Division) has moderate capacities in delivery of training in remote sensing, geographic information system, and digital decision support technologies. The approaches of the ITC have tended to be problem-based and today are increasingly interdisciplinary. The groups that ITC best serves are mid-career professionals with first and often also post-graduate degrees who are often already in managerial and scientific positions. Unfortunately, all instruction is in English, which makes offerings of limited use to people with very limited training in English, as is the case in Yunnan. English instruction makes the typical ITC offerings available to only ten to twenty people associated with the six nature reserves and associated agencies. Fortunately, ITC also has a tradition of training trainers who then instruct in local languages such as Mandarin and the minority languages spoken by reserve managers. And ITC could instruct, via translators, especially in 'hands on' field conditions.

The Forest Sciences Division of ITC can offer 2 ongoing professionals, one senior and one junior, based in the Netherlands, for several periods a year in China, for the life of the project. These individuals provide training and advising services in English. Since few personnel available for this project speak English, the ITC personnel would be oriented to transfer of technical, scientific and instructional expertise; effectively to train the Chinese-language trainers. In order to transfer the necessary range and combination of expertise, 60 % to 70% of this training, to English-language speaking professionals, would best be in or in the vicinity of the nature reserves and adjacent areas (and would be intended to bring together professionals from different levels and sectors). Another 30 % to 40% of the training and advising would best be at the Kunming facility bringing together that staff with those from the scientific institutes and the provincial land use planning offices.

ITC-affiliate - Wuhan Technical University of Surveying and Mapping

The ITC-affiliate in China is envisioned as possibly providing supplemental training of a purely technical nature when the Yunnan Environmental Information Centre and ITC cannot provide sufficient depth of time on a particular topic. There are questions, however, about the Mandarin in which WTU trainers would teach and the possible difficulties that some lower-level trainees might have who were more familiar with local

language. This might be more of a problem in the latter years of the project when nature reserve managers and county and prefecture-level officials are expecting training. Consequently, we propose that any WTU involvement in this project be under the direction of the Yunnan Environmental Information Centre.

Topics & activities for training for 2000

The following represent the key areas of expertise, skills and problem-solving capabilities that will be necessary to begin the six geographic information systems in the Kunming facility of the State Forestry Administration in 2000. Nearly all of this training can be focused on the pilot project nature reserve. However, given the pressures to begin work in the other five nature reserves, a good deal of training for those efforts in 2001 should take place in 2000. The skills below are the minimum necessary to make the minimum level of progress for 2000 as described under the progress documents. A range of other skills will be necessary in the final year to two years of the project to insure delivery and use of copies of these systems to particular offices of nature reserve managers and land use planning offices at the country and prefecture-levels.

i. technical training

- A. digital entry of data
- B. assessment and management of quality of digital data
- C. creation of base maps
- D. digital entry from global positioning systems
- E. techniques for field entry of digital data
- F. use of software for processing remote sensing data (ERDAS)
- G. field techniques for creation of forest cover maps with remotely sensed data
- H. processing remote sensing & field data in geographic information systems
- I. creation of forest cover / land use map
- J. English language training for use of manuals and software

ii. GIS facility management (Kunming)

- A. system design
- B. transfer of C-BIMS formats and entry into those formats
- C. Sybase systems administration
- D. web-based communication and data transfers; web-site development skills

iii. expertise for developing conservation facilities

- A. principles of forest biodiversity conservation survey of forest biodiversity conservation geographic information systems (to build on the experience of the first year of field work)
- B. development and management of digital formats for IMA
- A. GIS boundary definition: for each nature reserve determination of territory covered including reserve cores, buffers and important adjacent areas
- B. introduction to development of decision-support applications
- C. introduction to end-user applications development

Priority groups for training

There are a number of rather different groups in need of training. These individuals vary greatly in education levels, professions, localities of residence, the periods when their training is needed, the importance of their training to their organizations, their organizational incentives for training, and terms of reference for decision-making (if any).

Technicians

- A. Kunming forests conservation GIS facility
- B. field workers involved in global positioning technologies and transfers to GIS
- C. field workers involved in entry into digital formats

Management level 1: Kunming forests conservation GIS facility

- A. system designers
- B. experts giving input into system design
- C. system managers
- D. data quality managers
- E. data entry technicians

management level 2: IMA implementation

- A. scientists producing and compiling field data on particular species and ecosystems
- B. field assistants working with digital and spatial data on particular species and ecosystems
- C. cartographers of landscape ecology and forest cover ('vegetation') using remote sensing and GIS software
- D. landscape ecologists, geographers and planners assessing land use history and current status
- E. personnel at Forest Institutes and Forest Academies in Yunnan
- F. land use planners at the county and prefecture levels

management level 3: nature reserve managers

- A. forest guards and other field personnel
- B. land managers
- C. Directors of nature reserves

Training needs assessment overview for 2000

Of these groups, the following have been identified as priorities for training in 2000:

1. the technical staff in the new Dutch-funded forest conservation GIS facility in Kunming;
2. the managers of the new Dutch-funded forest conservation GIS facility in Kunming; and
3. the managers of the Kunming GIS facility along with scientists and managers in need of timely forest cover maps based on remotely sensed data and landscape ecology analysis

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Group I = the technical staff in the new Dutch-funded forest conservation GIS facility in Kunming;

Group II = the managers of the new Dutch-funded forest conservation GIS facility in Kunming;

Group III = the managers of the Kunming GIS facility along with scientists and managers in need of timely forest cover maps based on remotely sensed data and landscape ecology analysis

THE NUMBERS REFER TO THE TRAINING STEPS FOR 2000 LISTED EARLIER

Group I	Group II	Group III
2. digitizing	2. digitizing	3. field work
4. set boundaries	3. field work	4. set boundaries
5. workshop	4. set boundaries	13. creation maps
6. training course	5. workshop	16. workshop
7. training course	6. training course	17. workshop
8. training course	7. training course	22. workshop
9. base map	8. training course	23. workshop
10. course	9. base map	24. workshop
11. field reconnaissance	16. workshop	25. workshop
12. course	17. workshop	26. workshop
13. creation maps	19. training course	27. workshop
15. compilation data	20. workshop	29. workshop
16. workshop	22. workshop	31. workshop
17. workshop	23. workshop	
18. workshop		
18. workshop		
20. workshop	24. workshop	
21. entry data	25. workshop	
22. workshop	26. workshop	
25. workshop	27. workshop	
26. workshop	29. workshop	
27. workshop	28. workshop	
	30. workshop	
29. workshop	31. workshop	

Training delivery concept

The technology transfer strategy is to support the local group most experience in development of geographic information systems for environmental management: the Yunnan Institute of Environmental Science. The group can provide many of the training for key aspects of development and operation of geographic information systems. The Forest Sciences Division of ITC would provide advising and training in design of forest biodiversity geographic information systems, remote sensing, field techniques, and development of decision support applications.

1. Yunnan Institute of Environmental Science (& the He Bin Consulting Group)

This group, and Mr. He Bin the Division Director in particular, are proposed for coordination, basic training, and hand-on supervision within the geographic information system facilities (in the Kunming Forestry Department and elsewhere as these systems are developed).

The current staff of the Centre (and / or the consulting group) can provide at least 15 contact hours of formal training, in small courses, per week (requiring another 30 hours per week in preparation time) and can arrange for consultant trainers for up to another 15 contact hours per week. For shorter periods, the Centre can also provide training on a more 'hands-on' basis where 2 full-time trainers can also demonstrate and supervise GIS operations to smaller groups. The Centre / consulting group can provide three to four individuals, with several years each in training in GIS, at any one time though, like any group of highly-skilled professionals, needs weeks and months of notice for scheduling and preparation.

This group has a modest GIS laboratory – one which is one of the most advanced in the province. At any one time, at least two individuals are available to direct and supervise training. These individuals have over ten years of experience, each, with relevant aspects of GIS and are established trainers. Each trainer has a pool of training assistants that could usually have available two individuals for each training period. The aspects of training that this group are particular capable of including:

- digitizing;
- base map development;
- introduction to system management; and
- development of digital information formats for IMA; and
- support and collaboration on a range of workshop organizing and decision-making around system architecture and the development of individual systems for each nature reserve.

2. Forest Sciences Division, ITC

At the present time, ITC could make available up to two individuals, to work in a team with Chinese counterparts over the next three years.

1.

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An associate professor, *universitair hoofddocent*, is available for training and advising on scientific and technical activities particularly:

1. conception, development of training materials, workshops, and courses;
2. forest biodiversity conservation;
3. field data methods and formats particularly related to landscape ecology and GIS;
4. GIS design for conservation planning; and
5. implementation of the intended decision-making support.

The next availability for Brent Ingram in China in 2000 is October, November and December with significant portions of winter and autumn of 2001 still possible for scheduling.

2.

Scientific assistant, for technical aspects of equipment and software in field work and the processing of remote sensing imagery.

- a. Within the current ITC work schedule, Edwin Keizer is only available for the month of May 2000 and early June, the last week in September and part of October.
- b. Because of the limited availability of Edwin Keizer, Arend de Haas (haas@itc.nl) another staff member at ITC, has been identified and proposed to the ITC Bureau Project Office. He has a comparable level of training in the relevant technologies and highly relevant education (M.Sc. in ecology) for forest biodiversity conservation. He is available for October through December 2000 and into 2001.

The services of these individuals as staff of FSD-ITC could be made available to this project over the coming three years at the following levels:

2000: a total of up to nine months of personnel time in China;
 2001: a total of up to ten months of personnel time China;
 2002 &
 2003: could be at similar levels depending on the needs of FCCDP at the time

+

up to 1 month of training for two trainers from the Yunnan Institute of Environmental Science (Kunming) at ITC for the three-week intensive course Forest biodiversity assessment and monitoring (Module 15), from mid-July to mid-August in 2000 or 2001

3. ITC-affiliate - Wuhan Technical University of Surveying and Mapping

The China ITC-affiliate, Wuhan Technical University, could be contacted for short-term training and materials development services when both the Environmental Information Centre and FSD-ITC were functioning at maximum capacities. The following are the areas that would be in most demand and that might not be fully covered in the Yunnan Environmental Information Centre training:

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- introductory presentations on principles and applications of GIS, base maps, and data base management made in Chinese;
- data quality management;
- translation of English language manuals and other documentation into Chinese; and
- Chinese language training in applications development.

Conclusions:

Proposed workplan for GIS design, operationalization & delivery for the pilot nature reserve

This workplan for 2000 is the first proposal for any sort of coordinated training effort in geographic information systems, remote sensing, and related field methods and links to decision support.

training from Yunnan Environmental Information Centre

(with possible backup support from Wuhan Technical University when necessary)

Where 'cooperation with ITC' is indicated, the ITC strategy of English training for bilingual trainers will be employed. Thus, the Yunnan Environmental Information Centre group will be participating as trainees, in English, but then will be simultaneously translating to a small number of bilingual trainees.

April 2000

Week 1 digitizing & base map development; system administration

week 2 digitizing & base map development; system administration

week 3 digitizing & base map development; system administration;

training workshop to set the outer territorial boundaries

represented in the first GIS;

first workshop on GIS architectures, functions and applications for pilot project;

training course for beginning of field work for initial processing of remote sensing data with the use of global positioning systems (gps);

week 4 digitizing & base map development; system administration;

first training course in management of digital data quality;

training and field work in pilot nature reserve (gps, field methods for remote sensing, vegetation mapping)

May 2000

week 1 second training course in systems management;

training workshop and field work in pilot nature reserve

(gps, field methods for remote sensing , vegetation mapping)

week 2 training workshop and field work in pilot nature reserve

(gps, field methods for remote sensing , vegetation mapping)

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week 3 training workshop and field work in pilot nature reserve (gps, field methods for remote sensing , vegetation mapping); first week course in English studies for successfully using software manuals

week 4 initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS(in collaboration with ITC);

June 2000

week 1 initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS

week 2 close of workshop on creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use

week 3

week 4

July 2000

week 1 workshop on structure of the biogeographical and habitat data (in cooperation with C-BIMS group of the GEF Project / State Forestry Administration in Beijing)

week 2 workshop on protocol for hardcopy field data entry into GIS (in cooperation with C-BIMS group of the GEF Project / State Forestry Administration in Beijing)

week 3

week 4

August 2000

week 1 second week course in English for using software manuals

week 2

week 3 second workshop on data quality management with an emphasis on protocols

week 4

September 2000

October 2000

week 1 initial training course on importation and processing of remote sensing and gps information into forest biodiversity conservation GIS

week 2 close of workshop on creation of first map(s) of forest cover, forest landscapes and ecosystems, and land use

week 3 second workshop on GIS architectures

functions and applications for pilot project + decisions on the architecture of at least two more of the geographic information systems;

first workshop on prioritizing decision support tools to be designed

week 4 first workshop on digital formats for field data collection

second field workshop on use of remote sensing and field data in conjunction with
gps and beginning of the field work to make the forest cover maps for the second
and third nature reserves

November 2000

- week 1: second bilingual training workshop on an aspect of forest biodiversity
assessment and conservation to be held in a nature reserve buffer
- week 2 workshop in in-field digital entry of data on species and ecosystem – in
conjunction with remote sensing and gps
- week 3 second bilingual training workshop on an aspect of forest biodiversity assessment
and conservation to be held in a nature reserve buffer
- week 4 second bilingual training workshop on an aspect of forest biodiversity assessment
and conservation to be held in a nature reserve buffer

December 2000

- week 1 second bilingual training workshop on an aspect of forest biodiversity assessment
and conservation to be held in a nature reserve buffer
- week 2 first training workshop on designing decision-support applications

training from FSD-ITC

May 2000

- week 1 training and assisting field work in pilot nature reserve (see above)
- week 2 training and assisting field work in pilot nature reserve (see above)
- week 3 return to Kunming and training course in forest vegetation and landscape ecology
mapping and demonstrations and supervision to import data to
GIS and make forest cover map
- week 4 demonstrations and supervision to import data to GIS and make
forest cover map

June 2000

July 2000

- week 1
- week 2 ITC: preparation for teaching Forest Biodiversity Assessment and
Monitoring, FSD Module 15 (in preparation for further applications of the IMA);
possible training of up to three Chinese counterparts with excellent command of
English including from the Yunnan Environmental Information Centre. The
Chinese students who complete this course could then become the assistant
trainers when the same course was redeveloped and given in Yunnan in parts of
October, November and December. (NOTE: This training at ITC is preferable for
2000 but would still be worthwhile in 2001.)
- week 3 Netherlands teaching of Forest Biodiversity Assessment and Monitoring, FSD
Module 15 with possible attendance of up to three Chinese counterparts with
excellent command of English

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week 4 Netherlands teaching of Forest Biodiversity Assessment and Monitoring, FSD Module 15 with possible attendance of up to three Chinese counterparts with excellent command of English

August 2000

week 1 Netherlands teaching of Forest Biodiversity Assessment and Monitoring, FSD Module 15 with possible attendance of up to three Chinese counterparts with excellent command of English

September 2000

October 2000

week 1 training in importation of remote sensing field data to GIS and make forest cover map

week 2 close of workshop on creation of first map(s) of forest cover, forest landscapes and ecosystems

week 3 Kunming:

training and advising on GIS design and data formats ;

further training on image enhancement in remote sensing for forest cover maps ;

second workshop on GIS architectures, functions and applications for pilot project + decisions on the architecture of at least two more of the geographic information systems ;

first workshop on prioritizing decision support tools to be designed

week 4 a week of follow up field training in pilot nature reserve with participants from April – May training session with focus on subsequent field work with use of forest cover map ;

refined techniques for field data collection with gps ;

second field workshop on use of remote sensing and field data in conjunction with gps and beginning of the field work to make the forest cover maps for the second and third nature reserves ;

first workshop on prioritizing decision support tools to be designed

November 2000

week 1 second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer in conjunction with vegetation / land use / landscape ecology / habitat viability characterizations to support the IMA subsystems;

workshop in in-field digital entry of data on species and ecosystem – in conjunction with remote sensing and gps ; first bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer

week 2 field training for developing forest cover map in second nature reserve with emphasis on use of remote sensing data in conjunction with vegetation / land use / landscape ecology / habitat viability characterizations to support the IMA subsystems

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week 3 field training for developing forest cover map in second nature reserve with emphasis on use of remote sensing data in conjunction with vegetation / land use / landscape ecology / habitat viability characterizations to support the IMA subsystems

week 4 field training for developing forest cover map in third nature reserve with emphasis on use of remote sensing data in conjunction with vegetation / land use / landscape ecology / habitat viability characterizations to support the IMA subsystems

December 2000

week 1 completion of field training for developing forest cover map in third nature reserve with emphasis on use of remote sensing data in conjunction with vegetation / land use / landscape ecology / habitat viability characterizations to support the IMA subsystems ; second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer

second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer

week 2 second bilingual training workshop on an aspect of forest biodiversity assessment and conservation to be held in a nature reserve buffer ; first training workshop on designing decision-support applications ; second workshop on importation of processing of remote sensing and digital field data;

evaluation meeting of the status, achievements and quality of the output of the first pilot project

Appendix I