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VILLAGE FORESTRY
CURSO DE TREINAMENTO

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RELATÓRIO DE PARTICIPAÇÃO NO CURSO INTERNACIONAL DE SENSORIAMENTO REMOTO APLICADO A "VILLAGE FORESTRY"

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14. Resumo/Notas

São apresentados um relato e uma avaliação da participação de pesquisadores da área de Sensoriamento Remoto do INPE no Curso Internacional de Sensoriamento Remoto aplicado a "Village Forestry" oferecido no período de 07/05 a 03/06 de 1987 na República Federal da Alemanha pela Deutsche Stiftung für international Entwichlung (DSE) em cooperação com a FAO e o Bavarian State Forest Service. São apresentadas em detalhes as atividades destes pesquisadores e ao final são confrontados seus interesses de aprendizado com as reais informações fornecidas durante o evento.

15. Observações

ABSTRACT

A report and an evaluation of INPE's remote sensing researchers participation in the "International Training Course: Remote Sensing in Village Forestry" are presented. This course accurred from May 7th to June 3rd in the Federal Republic of Germany and was conducted by the Deutsche Stiftung für International Entwicklung (DSE) in cooperation with the FAO of the United Nations and the Bavarian State Forest Service. INPE's researchers activities and others course aspects are presented in detail and their apprenticeship interests are confronted with the real information given during the course.

SUMÁRIO

1. INTRODUÇÃO

A Fundação Alemã para o Desenvolvimento Internacional (DSE) e a Organização das Nações Unidas para a Alimentação e Agricultura, bem como demais entidades regionais, oferecem anualmente a profissionais atuantes em países do Terceiro Mundo cursos de treinamento em diferentes áreas do conhecimento humano. Portanto, no período compreendido entre os dias 7/05 a 3/06 de 1987 foi oferecido um Curso de Treinamento em Sensoriamento Remoto aplicado ao manejo de "Village Foresty", aberto a profissionais do setor florestal que se candidataram e, uma vez selecionados, foram convidados pelo governo alemão a participarem do evento.

Representando o Brasil foram convidados dois pesquisadores do Instituto de Pesquisas Espaciais (INPE) e outro do Instituto Brasileiro de Desenvolvimento Florestal (IBDF).

O curso foi ministrado nas dependências da DSE na cidade de Feldafing, na República Federal da Alemanha, e contou com a participação de técnicos de 8 países.

Os objetivos gerais propostos foram os seguintes:

- o aperfeiçoamento do uso de técnicas de sensoriamento remoto para análises em imagens e mapeamento temático em países de terceiro mundo;
- transferência de tecnologia em aplicações de sensoriamento remoto na área de recursos da terra.

Ao final do curso cada participante deveria estar apto a identificar as aplicações de sensoriamento remoto no seus campos de responsabilidade, elaborar projetos usando técnicas de sensoriamento remoto no estudo de recursos naturais renováveis, estimar a relação custo-benefício de projetos, analisar os dados de sensoriamento remoto e preparar as informações extraídas para uso em processos de planejamento e decisão e reconhecer as tendências de desenvolvimento da área de sensoriamento remoto em países do terceiro mundo. Para tanto, o conteúdo do curso foi composto dos seguintes tópicos:

- técnicas de sensoriamento remoto e processamento de dados com especial ênfase em novos sensores (Câmara métrica, MOMS, TM, SPOT, SLAR, SAR);
- análise analógica de dados aerotransportáveis;
- análise digital e analógica de dados de satélite em recursos terrestres;
- áreas de aplicação no campo de "Village Forestry", isto é, levantamento e degradação de solos, proteção de florestas, previsão de safra, etc.;
- cooperação de usuários no planejamento e conclusão de projetos visando o desenvolvimento rural;
- desenvolvimentos futuros no campo das aplicações de sensoriamento remoto.

O objetivo deste trabalho é relatar e avaliar a participação dos pesquisadores do INPE, confrontando seus interesses de aprendizado ao que foi efetivamente oferecido.

2. DESENVOLVIMENTO

O curso foi ministrado principalmente através de palestras proferidas por pessoas convidadas pela organização do evento segundo a programação apresentada no Apêndice A.

A seguir, serão apresentados alguns comentários sobre o conteúdo de algumas dessas palestras, sobre a participação real dos alunos e professores e sobre a participação específica dos participantes brasileiros.

DIA 08/05 - ABERTURA

Após a abertura formal do curso houve a apresentação de alguns professores e de administradores do serviço florestal da região (Bavária). Na oportunidade foi dada uma visão geral da administração florestal alemã como um todo, seus problemas e características. Em seguida o Dr. Paul Reichert (FAO) apresentou uma interessante palestra sobre o sensoriamento remoto aplicado ao setor florestal europeu, que pareceu bastante diferente do brasileiro, não só no que se refere aos aspectos florísticos e estruturais, mas principalmente nos aspectos administrativos (manejo). O Dr. W. Tzschupke apresentou alguns comentários sobre o sensoriamento remoto aplicado ao setor florestal da Alemanha e, por motivos óbvios (tamanho do país e as características de sua cobertura florestal), foi dada ênfase à utilização de fotografias aéreas.

Um participante do Brasil levantou uma questão durante a seção de discussão sobre o estágio de desenvolvimento das metodologias visando a atenuação ou eliminação dos problemas advindos do relevo em áreas movimentadas. O Dr. Paul Reichert esclareceu que se tem tentado utilizar Modelos Digitais do Terreno com esta finalidade, mas não forneceu maiores detalhes.

DIA 11/05

Deveriam ser abordados os princípios físicos de sensoriamento remoto e algumas informações sobre fotografias aéreas e características de filmes fotográficos para este fim. Tudo foi mostrado de forma bastante superficial e, aos poucos, sentiu-se que o objetivo principal, senão a verdadeira ênfase do curso, seria dedicada às tais chamadas "Village Forestry", seu manejo e monitoramento realizado através do sensoriamento remoto. Surgiu então a principal e unâmime dúvida dos participantes: o que é " Village Forestry"? Iniciava-se nesse momento uma série de contradições sobre o termo, que mesmo para os técnicos alemães possui conceitos diferentes. Na oportunidade "Village Forestry" foi definida como uma floresta administrada por uma pequena comunidade interessada na extração de madeira. Não ficou claro a extensão dessas florestas e seu padrão de distribuição espacial pelo país. Tal fato suscitou dúvidas sobre a validade do uso de técnicas de sensoriamento remoto no manejo de tais florestas.

DIA 12/05

Neste dia foram apresentados novos conceitos sobre "Village Forestry", agora mais abrangentes, considerando que o produto final de tais florestas não seria somente a madeira, mas também animais, recreação, proteção de bacias, produção de água, etc. O sensoriamento remoto seria então aplicado para auxiliar o manejo das "Village Forestry" que, por sua vez, seria feito no sentido de perpetuar a extração dos produtos citados. Alguns comentários foram feitos com relação à parte econômica da obtenção das fotos aéreas. Nessa ocasião estes foram apresentados apenas superficialmente. Sabe-se que a decisão econômica sobre o uso de fotografias aéreas não pode ser analisada pura e simplesmente do ponto de vista da área em relação ao número de fotos. Devem ser consideradas a importância e a relevância das informações obtidas dentro do objetivo do estudo. O nível de detalhamento exigido também influi na quantidade de fotos e, portanto, nos custos de aerolevantamento, mas existem inúmeros casos em que sua diminuição, na tentativa de minimizar custos, pode diminuir a qualidade ou até inviabilizar a execução de projetos.

DIA 13/05

Este dia foi dividido em duas partes: na parte da manhã foram apresentadas algumas noções sobre a aquisição de dados através de radiômetros imageadores (para radiações refletidas e emitidas) aerotransportados e através de radar também aerotransportados. Em seguida foram mostradas, através de slides, algumas imagens orbitais MSS e TM/LANDSAT, classificadas e realçadas, sem contudo serem explicados os princípios de tais processamentos. A parte da tarde foi dedicada à visita às instalações da DFVLR, onde os pesquisadores brasileiros dedicaram atenção especial à Divisão de Sensoriamento Remoto daquele Instituto, especialmente ao Sistema DIBIAS, destinado ao processamento digital de imagens. Foram mostrados os passos a recuperação de imagens gravadas em fitas CCT, para a memória virtual do equipamento e algumas de suas possibilidades visando as correções geométrica e radiométrica, registro, etc.

DIA 15/05

A parte da manhã deste dia foi praticamente uma continuação dos assuntos discutidos nos dias 13 e 14. Na parte da tarde foi apresentado um "workshop" sobre interpretação ao nível de "village". Foi um dos pontos altos do curso onde se pode ter uma idéia mais concreta sobre a utilização das fotografias aéreas no manejo das "Village Forestry". Através de material fotográfico e imagens de satélite de uma mesma área da superfície terrestre, mas em diversas porções do espectro eletromagnético, pôde-se observar o nível de informação sobre tais florestas, adquirido em cada material. Tal tarefa foi realizada em grupos e, ao final, um representante de cada grupo apresentou seus resultados para os demais participantes. O Engº Florestal José Simeão de Medeiros foi o representante de um dos grupos.

Nesta etapa do curso, com o que havia sido visto na tarde deste dia, parecia clara a pouca utilidade de imagens orbitais no auxílio ao manejo das "Village Forestry", dadas as suas dimensões e pela própria filosofia do manejo que não envolve a alteração brusca do ambiente como cortes rasos, queimadas, etc. As "Village Forestries" são manejadas no sentido de alcançar a produção sustentada, ou seja, são extraídos produtos da floresta de tal forma a garantir seus estoques indefinidamente. São realizados inventários periódicos, nos quais as fotografias aéreas são usadas amplamente na atualização de mapas, da situação fitossanitária das florestas, etc. Vale salientar que a maioria das florestas da Bavária, onde foram concentrados os estudos, são naturais e estão sendo utilizadas já há muitos anos.

DIAS 18 E 19/05

O objetivo destes dias de atividades foi orientar os participantes no levantamento de informações sobre as "Village Forestries" através de técnicas de sensoriamento remoto. A orientação coube ao Dr. K.D. Singh (FAO) que, por não trabalhar na Alemanha, trouxe um novo conceito sobre o termo "Village Forestry", agora considerando empresas particulares como possíveis proprietárias de tais florestas, bem como demais comunidades. O Engº Florestal Flávio Jorge Ponzoni concluiu, perante os demais participantes, que no setor florestal brasileiro não existem "Village Forestry", estando tal setor fundamentado em grandes extensões de florestas plantadas com essências dos gêneros Pinus spp e Eucalyptus spp e na exploração de florestas naturais. Acrescentou, ainda, que o aspecto sócio-cultural constitui um dos fortes sustentáculos das "Village Forestry".

Foi apresentado também um interessante método para determinação da biomassa de árvores individuais. Tal método utiliza um delineamento estatístico múltiplo-estágio com probabilidade proporcional ao tamanho na seleção dos ramos a serem medidos em termos de seus diâmetros e comprimento. Por falta de tempo, essa metodologia foi apresentada muito rapidamente sem que se pudesse compreender profundamente seus fundamentos teóricos. Ao final da exposição foi garantido aos participantes o envio de uma publicação que descreve tal metodologia em todos os seus detalhes. Vê-se a possibilidade de sua adaptação e aplicação em projetos brasileiros na área de vegetação.

Às 20:00 horas deste mesmo dia 19 houve a apresentação das atividades dos pesquisadores do grupo de florestas do Departamento de Pesquisa e Aplicações do INPE. Nesta apresentação procurou-se mostrar, com um certo grau de detalhes, os principais trabalhos desenvolvidos na área de vegetação, com um cuidado especial de situar os espectadores no contexto geográfico brasileiro. Foram mostrados estudos em áreas de reflorestamento (mapeamento e inventário), avaliação de áreas queimadas, efeitos da poluição ambiental e outros. Slides e transparências, como também um texto previamente elaborado, foram utilizados na apresentação. Além da presença maciça de todos os alunos do curso, contou-se com a presença de alguns de seus organizadores e professores.

DIA 20/05

Retornou-se às instalações da DFVLR para o acompanhamento de alguns processamentos aplicados a imagens orbitais TM/LANDSAT através do sistema DIBIAS. Acompanhou-se a aplicação do algoritmo de classificação MAXVER, alguns algoritmos implementados no SIG (Sistema de Informações Geográficas), IHS e outros. Foi apresentada ainda uma ótima explanação sobre os estudos de radiometria conduzidos por aquele instituto, os quais são fundamentados basicamente no uso de radiômetros imageadores colocados a bordo de aeronaves. O Dr. Kritikos mostrou o esquema de um de seus projetos, cujo objetivo era determinar o comportamento espectral de espécies vegetais de uma dada área. A metodologia aplicada compreendia o emprego de uma aeronave, na qual havia sido instalado um Scanner da Daedalus. A mesma área foi imageada em quatro altitudes diferentes e para cada uma dessas altitudes foram obtidas concomitantemente imagens da superfície terrestre e as curvas espectrais dos principais alvos distinguíveis em cada nível de coleta de dados.

Na parte da tarde foi feita uma visita ao (GSF), uma fundação destinada à realização de pesquisas em diversas áreas do conhecimento humano, dentre elas o sensoriamento remoto. Antes da ida à divisão de interesse dos participantes brasileiros, entrou-se em contato com uma série de experimentos que envolvem elementos da cobertura vegetal européia conduzidos em ambientes climatizados artificialmente. Nestes locais são simuladas as condições ambientais, incluindo chuva, neve, vento, avalanches, etc. Alguns desses experimentos têm uma duração prevista de mais de 20 anos. Em seguida, foi feita visita à divisão de sensoriamento remoto, onde, dentre outros experimentos, estão desenvolvendo um sistema para análise digital de fotografias aéreas.

DIA 21/05

Pela manhã houve uma exposição, realizada por um pesquisador do ITC da Holanda, sobre o manejo das "Village Forestry" conduzido em uma das ilhas do Cabo Verde.

Um pesquisador da Suíça (provavelmente convidado, pois não constava na programação proposta) apresentou uma interessante palestra sobre o uso de filmes 35 e 70mm na obtenção de fotografia aéreas a bordo de helicópteros e aviões de pequeno porte.

A parte da tarde foi dedicada a uma discussão sobre o inventário nas "Village Forestry". Algumas questões foram propostas (Apêndice B) pelo Dr. Singh a três grupos constituídos pelos participantes do curso. Ao final, as conclusões de cada grupo foram apresentadas e discutidas. Vale salientar que em virtude da até então imprecisa conceituação do termo "Village Forestry", as conclusões foram bastante diversas. Mesmo considerando as opiniões individuais dos integrantes de um mesmo grupo, foi difícil atingir um consenso de forma a apresentar conclusões bem fundamentadas. A opinião dos três participantes brasileiros com relação às questões propostas é que estas são dificilmente respondidas sem um conhecimento do real objetivo do inventário e obviamente da natureza e dos anseios de quem vai executá-lo. Acredita-se que a intensão do Dr. Singh foi exatamente estimular os participantes de forma a compreender melhor a filosofia da existência das "Village Forestry".

DIA 22/05

Um dos diretores da ESRI (Environmental Research Institute) da República da Alemanha fez uma exposição sobre um de seus sistemas destinados ao armazenamento e à superposição de informações regionais. Na parte da tarde os participantes do curso tiveram a chance de manusear o equipamento através de um exemplo prático.

DIA 25/05

Este dia foi inteiramente dedicado à visita à indústria de equipamentos ótico-eletrônicos Karl Zeiss. Foram visitados alguns setores de produção dos mais variados tipos de lentes e prismas de montagem de equipamentos como teodolitos e microscópicos eletrônicos e, ainda foram dados alguns esclarecimentos sobre as características dos novos equipamentos produzidos pela empresa, destinados à fotogrametria e fotointerpretação, bem como à manipulação, interpretação e armazenamento de dados orbitais. Ao final da programação de visita, foi apresentado um filme sobre a história da empresa e suas pretenções futuras.

DIA 26 E 28/05

Nestes três dias o grupo esteve sob orientação Dr. H. Tränkner que propôs um trabalho prático em sensoriamento remoto aplicado à "Village Forestry". Talvez esta tenha sido a fase mais gratificante de todo o curso em termos de ampliação de conhecimentos. O objetivo desse trabalho prático seria o de levantar, ao nível de campo, os parâmetros básicos da vegetação que possam ser utilizados na confecção de chaves de interpretação, aplicáveis em fotografias aéreas, com o fim último de estimar o volume de madeira de uma dada área.

Os participantes do curso foram deslocados para o distrito florestal de Harthausen e, trabalhando em grupos de quatro pessoas em diferentes povoamentos (espécie, idade, condições fitossanitárias, etc.), foram medidos os diâmetros (DAPs) e as alturas de vinte árvores escolhidas através de uma sistemática ao acaso e ainda foram estimadas a porcentagem de composição do povoamento (para o povoamento considerado só havia indivíduos "Spruce"), a sua densidade de copa e idade média. O diâmetro e a altura média, bem como a idade e o conhecimento da espécie, são úteis para a determinação do volume médio por ha, através de tabelas de volume já confeccionadas. A esse volume médio por hectare são efetuadas reduções oriundas da porcentagem de composição do povoamento e densidade de copa. Uma vez conhecido esse volume médio por hectare, foram considerados que todos os povoamentos que apresentavam na fotografia aérea ou em outros produtos de sensoriamento remoto uma aparência similar ao povoamento visitado no campo teriam um volume médio bastante próximo do es timado. Desta forma pode-se estimar o volume de áreas mais extensas sem a necessidade de ampliar os trabalhos de campo. Esta metodologia é viável em locais para os quais foram elaboradas as tabelas de volume. Para o caso da Alemanha isto significa todo o país, o que não é válido para o Brasil, pois somente umas poucas empresas, ditas verticalizadas, do setor florestal elaboram tais tabelas para suas áreas de interesse.

A Tabela 1, elaborada por todos os participantes do curso, ilustra o procedimento para o cálculo do volume total do povoamento, com base no volume fornecido pelas tabelas de volume convencionais locais.

Além de fotografias aéreas infravermelhas de grande escala (1:4500), utilizaram-se também fotografias pancromáticas na escala 1:20.000, outra também pancromática, mas produzida por uma câmara métrica colocada a bordo do "Spacelab 1" e, finalmente, uma imagem MSS/LANDSAT. Cada um desses produtos foi analisado no sentido de avaliar o nível de detalhamento oferecido na identificação dos parâmetros observados no campo. Ao final dos trabalhos um representante de cada grupo apresentou aos demais participantes seus resultados e conclusões, os quais foram amplamente discutidos por todos.

DIA 29/05

Foi feita uma excursão a um distrito florestal localizado na região alpina de Murnau. A escassez de terras passíveis de reflorestamento obriga os bavarianos a ocupar as íngrimes encostas dos Alpes com a atividade florestal. Foram ressaltadas as dificuldades de manejo dessas áreas bem como os de sua conservação.

TABELA 1

DETERMINAÇÃO DE VOLUME

Tree no.	Diameter	Height
1	55	31
2	56	30
3	43	26
4	36	26
5	50	30
6	30	25,5
7	27	24
8	46	27
9	29	26
10	39	29
11	39	32
12	33	26,5
13	49	33
14	[illegible]	30
15	48	28
16	45	28
17	31	28
18	41	31
19	[illegible]	31
20	31	25
Total	773	573
Σ/20	38,65	
Σ/20		38,65

Timber Volume determination
Training area No : 5
stand No. : 53

general data

age class: 90 years

crown density: 70 - 60 % ground cover

stand composition

	%	species
1		
2		
total	100	

Timber volume (Norway spruce only)

1) timber volume according to age class, average diameter and height, given by volume table:

(Sum. 1): 595 m³/ha

2) Reduction by percentage of stand composition:

(Sum. 1) 595 x – % / 100 = – m³ (Sum. 2)

3) Reduction by percentage of crown density:

(Sum. 2) 595 m³ x 65 % crown density = 386,8 m³ (Sum. 3)

4) Total timber volume determination:

(Sum. 3) 386,8 m³ x 1,17 ha stand area

= 452,5 m³ timber volume (Norway spruce)

Average Diameter (cm)	
Average height (m)	

FONTE: Tabela elaborada pelos participantes do Curso Internacional de Sensoriamento Remoto aplicado a "Village Forestry", 1987.

DIA 02/06

Este foi o último dia de atividades do curso quando foi aberto um espaço para perguntas e discussões e, ao final da tarde, foi dada a oportunidade aos participantes de elaborarem a avaliação de todo o curso.

O Dr. Howard distribuiu a todos os participantes um documento (Apêndice C), no qual ele manifesta suas idéias sobre os mecanismos de cooperação internacional em aplicações em sensoriamento remoto.

3. AVALIAÇÃO DO CURSO

Os comentários seguintes serão concentrados especificamente no que se refere aos aspectos técnicos do curso, já que quanto à logística, ou seja, condições oferecidas de alimentação, alojamento, deslocamento, etc., o curso causou ótima impressão e admiração. Acredita-se que este será um fator fundamental para quem esteja realizando qualquer atividade fora de sua cidade ou país de origem, uma vez que tal atividade geralmente tenha de ser cumprida num espaço de tempo tal que impossibilite uma perfeita adaptação física e mental por parte de quem lhe cabe executar. Preocupações com logística dificultam o bom rendimento dos trabalhos, chegando até a inviabilizá-los. Seria excelente se fosse possível oferecer aos estudantes do curso de treinamento em sensoriamento remoto do INPE condições semelhantes às oferecidas pelo DSE.

Quanto ao curso propriamente dito, podem ser destacados os seguintes aspectos:

a) Por que "Village Forestry"?

Parece estranho que um curso especificamente elaborado para técnicos florestais atuantes em países do terceiro mundo enfatize o uso de técnicas de sensoriamento remoto no manejo de um tipo de floresta inexistente nesses mesmos países. A própria filosofia desse manejo demonstra um distinto nível de anseio da comunidade usuária dessa floresta, quando comparado com os anseios das comunidades do terceiro mundo. A consciência do povo europeu, ou pelo menos do povo alemão, no que se refere à exploração de suas florestas, é muito diferente da do povo brasileiro, se é que se tem alguma. As "Village Forestry" são como um modelo da exploração racional dos recursos naturais renováveis de um dado local, não se atendo seu conceito a uma idéia puramente florestal ou vegetal. Elas são a manifestação do espírito de sobrevivência de um povo, algo muito distante ainda do Brasil. Foi válido o conhecimento deste conceito tão interessante, mas teria sido preferível que o curso tivesse levado em consideração as grandes extensões de cobertura vegetal ainda existentes no terceiro mundo, para as quais as imagens orbitais apresentam um grande potencial de utilização. Evidentemente não se deve desprezar o uso de fotografias aéreas, pelo contrário, seria excelente se se pudesse obter recobrimentos de todo o Brasil nas mais variadas escalas e qualidades de filmes; contudo isto se torna inviável quando se possui 8 milhões e meio de quilômetros quadrados. As fotografias aéreas são utilizáveis em trabalhos de pesquisa e aplicações no Brasil, e serão ainda durante muito tempo. No entanto, não se justifica centrar toda a atenção de um curso sobre um alvo cujo manejo só pode ser auxiliado através de fotografias aéreas, quando esse mesmo alvo não existe na maioria dos países de origem dos alunos convidados.

b) O sensoriamento remoto

Para as pessoas menos esclarecidas nesse campo do conhecimento, porventura presentes no curso, o sensoriamento remoto orbital pode ter parecido algo obscuro e ineficiente, já que ao nível de manejo das "Village Forestry" ele se torna realmente ineficiente. As técnicas de análise digital apresentadas foram ineficientes, de maneira desordenada, sem conexão com um objetivo claro.

Especificamente para os representantes do INPE, houve benefício com o que foi visto na DFVLR pois, dada a natureza dos trabalhos desenvolvidos no Brasil, pôde-se fazer uma análise crítica dos equipamentos, softwares, instalações, etc. Foi possível também trocar informações com os técnicos daquele instituto e aprender muito com esta interação, contudo o mesmo não aconteceu com alguns dos colegas do curso.

c) Objetivos propostos x objetivos alcançados

Objetivo proposto 1: Aperfeiçoamento do uso de técnicas de sensoriamento remoto para análises em imagens e mapeamento temático em países do terceiro mundo.

Comentário: O cumprimento desse objetivo deve ter variado de caso para caso, ou seja, dependendo do nível de conhecimento sobre o assunto de cada participante. No caso dos participantes brasileiros não se percebeu que o conteúdo do curso tenha aperfeiçoado as técnicas já existentes de análise de imagens e mapeamento temático. Não obstante, é necessário ressaltar que muito do que foi visto com relação ao uso de fotografias aéreas no levantamento de informações sobre as "Village Forestries" será de grande valia e, sem dúvida, ampliou o conhecimento dos três participantes brasileiros sobre o assunto.

Objetivo proposto 2: Transferência de Know-how em aplicações de sensoriamento remoto na área de recursos da terra.

Comentário: Primeiramente poder-se-á discutir o que se considera aqui o termo Know-how. Supondo seu conceito isento do significado "tecnologia-equipamentos", acredita-se que houve uma boa visão de novos procedimentos destinados ao levantamento de informações da cobertura vegetal através do uso de técnicas de sensoriamento remoto, restando contudo suas adaptações às nossas realidades. Se for analisado agora o termo Know-how, incluindo "tecnologia-equipamentos", basta mencionar que houve uma visita à indústria Karl Zeis, na qual foi apresentada uma palestra específica sobre um sistema de armazenamento, superposição e manipulação de informações regionais. Tais esforços podem não ter transferido a tecnologia em si, mas deram uma boa idéia do que já existe à disposição no ramo.

d) O impacto de nossa palestra

Como foi mencionado anteriormente, uma palestra sobre as atividades do DPA foi apresentada pelos participantes brasileiros. A informalidade da apresentação possibilitou a aproximação entre os outros participantes e os brasileiros que, com freqüência, procuravam obter maiores detalhes sobre o INPE. Desta forma aprendeu-se muito sobre alguns dos problemas enfrentados por esses técnicos em seus países de origem, inclusive pôde-se notar que existe muita gente pelo mundo "em desenvolvimento" tentando desenvolver e adaptar novas metodologias em sensoriamento remoto aplicáveis à solução de seus problemas. Espera-se que daquelas simples trocas de idéias e informações surja uma maior interação entre os pesquisadores de países com problemas semelhantes.

No final do curso o Sr. Anders, coordenador do curso, procurou os brasileiros, e interessado em como fazer para contactar o INPE, manifestou também o interesse em estreitar o relacionamento entre o INPE e a DSE. Este interesse foi um aspecto positivo do curso.

e) Validade do curso

Acredita-se que o maior mérito do curso tenha sido exatamente possibilitar o intercâmbio de informações entre técnicos com chances mínimas de se reunirem em outras condições; além é claro das possibilidades oferecidas de conhecer outras instalações e trabalhos realizados por institutos com tradição na área de sensoriamento remoto. Com isto, uma nova consciência profissional foi adquirida, a qual sem dúvida reverterá em benefícios para o INPE. Existe ainda a possibilidade de os especialistas brasileiros serem procurados por outros elementos do curso, a curto e a médio prazo, para trabalho conjunto.

APÊNDICE A

CURSO INTERNACIONAL DE SENSORIAMENTO REMOTO APLICADO A "VILLAGE FORESTRY"

PROGRAMA

DSE

BAYERISCHE STAATSFORSTVERWALTUNG

International Training Course

REMOTE SENSING IN VILLAGE FORESTRY

P R O G R A M M E

May 7 - June 3, 1987

in

Feldafing

Federal Republic of Germany

TK 78-301-87

1. Introduction

In August 1982 the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82) was convened in Vienna. The recommendations of UNISPACE 82 stressed the fact that there is a serious lack of skilled and competent manpower in the field of remote sensing applied to the development of the earth's resources and that extended scientific and technical training must take place to enable developing countries to make more use of remote sensing techniques for the benefit of development projects and programmes, especially in rural areas.

In line with recommendations of UNISPACE 82 and conscious of the growing importance of adequate rural development, the Government of the Federal Republic of Germany is extending the emphasis given to remote sensing technology for rural development in its technical cooperation programme. Within this frame the Deutsche Stiftung für internationale Entwicklung (DSE) has been entrusted with the organization and implementation of relevant training programmes and courses.

Starting in 1983, international training courses on remote sensing applications in rural development, particularly agriculture, have annually been conducted by DSE in cooperation with the FAO of the United Nations and the German Aerospace Research Establishment (DFVLR) and were held in Feldafing, Federal Republic of Germany, from 1983 through 1986.

This 5th international training course will deal with remote sensing in village forestry and will be organized by DSE in cooperation with the FAO of the United Nations and the Bavarian State Forest Service.

2. Objectives

The main objectives are:

- the improvement of the use of existing remote sensing facilities suitable for imagery analysis and thematic mapping in Third World countries
- the transfer of know-how on remote sensing applications in the area of land resources.

The potential user of remote sensing data should be enabled through participation of this course:

- to identify applications of remote sensing in their field of responsibility
- to work out project plans using remote sensing techniques for renewable resources
- to estimate cost and benefit of remote sensing projects
- to analyse remote sensing data and imagery and to prepare the extracted information for use in planning and decision-making
- to recognize development trends in the field of remote sensing helpful to developing countries.

3. Course content

- Remote sensing techniques and data processing with special emphasis on new sensors (Metric Camera, MOMS, TM, SPOT, SLAR, SAR)
- Analog analysis of airborne data
- Digital and analog analysis of satellite data on earth resources
- Application areas in the field of village forestry, e.g. afforestation, soil survey, land degradation, forest protection, yield prediction

- Cooperation of users in planning and conducting projects for rural development
- Future developments in the field of remote sensing applications.

4. Methods of instruction

The course will be composed of lectures, problem-solving exercises and guided discussions. Emphasis will be on the practical application of imagery analysis and thematic mapping and will include contributions of participants from their own field of experience. The DFVLR technical facilities will be used for exercises on digital imagery analysis. Policy decision-making processes will be simulated with the help of case studies.

5. Target group

The course is intended for candidates

- holding a university degree (or equivalent) in forestry or agriculture with a major in forestry
- with at least three years of professional project experience in a branch of remote sensing (e.g. photo-interpretation, photogrammetry, satellite imagery analysis).
  No previous experience in digital analysis is required.
- with a good working knowledge of the English language.

Invitations will be extended to countries in Africa, Asia and Latin America.

6. Resource Persons

The course program is designed by

Dr John A. Howard — Chief, Remote Sensing Centre
FAO, Rome
Italy

and

Mr Hubert Tränkner — Remote Sensing Section
Forest Research Institute
Bavarian Forest Service
Munich
Federal Republic of Germany

Staff members of both institutions will be responsible for parts of the program. In addition, experts from other institutions and universities will act as guest lecturers.

7. Venue and Date

The course will take place in Feldafing, Federal Republic of Germany, and is scheduled from Mai 07 through June 02, 1987.

8. Finance

For participants admitted to the course, DSE will cover the following costs:

- Round trip economy class air fare using excursion fare where available for the shortest route between the airport of departure in the participants' country of residence and Munich international airport (München-Riem). This does not apply to participants from China as by agreement of the joint commission of the governments of China and the FRG the international travelling costs will be borne by China.
- Group transport from the airport to Feldafing arranged for by DSE. Other expenses in the home country for travel abroad will not be covered by DSE.

- accommodation (single room/shower) and full board in the DSE Training Centre in Feldafing
- daily pocket money of DM 15.-- for the duration of the course, which will, however, not cover the personal expenses in all cases. Additional personal funds might be useful.

9. Application procedures

Completed application forms should be submitted in duplicate not later than February 25, 1986 to the Embassy of the Federal Republic of Germany in the applicants' country of residence.

Accepted candidates will be notified by mid-March 1987 of the Selecting Committee's decision and thereafter these candidates will be invited and provided with further information.

10. Information

Further details can also be obtained on request from

Deutsche Stiftung für internationale Entwicklung (DSE)
attn. Dr O. Anders
Wielinger Str. 52
8133 Feldafing
FR Germany

Telex: 526 436 dsezl d

Course Directors:	Dr. John A. HOWARD Remote Sensing Center FAO of the United Nations
	Mr. Hubertus TRÄNKNER Research Institute Bavarian Forestry Service
Chairman:	Mr. G. EDELBAUER
Assistant Chairman:	Mr. K. MARTIN
Lecturers from FAO:	Dr. J. A. HOWARD
	Dr. P. REICHERT
	Dr. K.D. SINGH
Lecturers / Instructors from Bavarian Forest Service:	Mr. D. BRINKMANN
	Mr. B. FROMMELT
	Dr. R. HOLZAPFL
	Mr. A. REITER
	Mr. H. TRÄNKNER
	Mr. A. TROYCKE
Lecturers / Instructors from Other Institutions:	Prof. Dr. U. AMMER Faculty of Forestry University of Munich
	Mr. R.E. EILENBERGER Company of CARL ZEISS, Oberkochen
	Dr. W. FORSTREUTER GAF, Company for Applied Remote Sensing, Munich
	Ms. K. HERRMANN Faculty of Forestry University of Munich

Prof. Dr. H. KENNEWEG
Faculty of Landscape Development
Technical University of Berlin

Ms. B. KOCH
Faculty of Forestry
University of Munich

Dr. G. KRITIKOS
German Aerospace Research
Establishment (DFVLR),
Oberpfaffenhofen

Dr. P. REINARTZ
German Aerospace Research
Establishment (DFVLR),
Oberpfaffenhofen

Dr. J. SCHALLER
ESRI, Company for Systems
Research and Environment Planning,
Kranzberg

Dr. F. SCHLUDE
German Aerospace Research
Establishment (DFVLR),
Oberpfaffenhofen

Dr. W. TZSCHUPKE
Forest District of Freudenstadt
Forest Service of Baden-Württemberg

Dr. R. WINTER
German Aerospace Research
Establishment (DFVLR),
Oberpfaffenhofen

Mr. St. HAENEL
National Center for Environmental
Sciences (GSF), Munich

Dr. P. HUTZLER
National Center for Environmental
Sciences (GFS), Munich

Dr. H.-D. PAYER
National Center for Environmental
Sciences (GFS), Munich

DSE Course Organization and Coordination:

Dr. O. ANDERS

Ms. B. KILIAN

PROGRAMME SCHEDULE

Time Table

Working Hours:	Meals:
09:00 - 12:00 (break 10:30 - 10:45)	Breakfast: 08:00 - 09:00
14:00 - 17:00 (break 15:30 - 15:45)	(Sundays : 03:30 - 09:30)
	Lunch : 12:45
	Dinner : 18:30
if not indicated otherwise in the programme	

Date / Time	Topic	In Charge
Thursday, May 07		
	Arrival of participants and registration	DSE
Part 1	OVERVIEW	
Friday, May 08		
09:00-10:00	Opening	DSE/FAO/STAFO
10:00-10:30	Introduction to course programme	Reichert
10:45-12:30	Overview on forestry in the Federal Republic of Germany	Holzapfl
14:00-15:30	Overview on remote sensing in forestry (lecture)	Reichert
	Remote Sensing applied to forestry in Germany (lecture)	Tzschupke
15:45-17:00	Panel discussion	Reichert/Tzschupke
17:00-19:00	Presentation of participants and staff	Anders
19:30	Welcome drink	
Saturday, May 09	Free	
Sunday, May 10	Cultural programme	

Date / Time	Topic	In Charge
<u>Monday, May 11</u>		
09:00-10:00	Physical basis to remote sensing in forestry (lecture)	Reichert
10:45-12:30	Forest landscape and remote sensing (lecture)	Reichert
14:00-17:00	Aerial photography - photogrammetric or conventional a.p. - high altitude a.p. - low-level a.p. (lecture)	Kenneweg
	Choice of film and film characteristics (lecture)	Kenneweg
<u>Tuesday, May 12</u>		
09:00-12:30	Management and collection of remote sensing data (lecture)	Kenneweg
	Aerial photography for village forestry planning (lecture)	Kenneweg
	Flight specification, performance, documentation of results (lecture)	Kenneweg
14:00-17:00	Planning aerial photography for village forestry (workshop)	Kenneweg
<u>Wednesday, May 13</u>		
09:00-12:30	Other airborne data collection methods (lecture) - airborne MSS, including thermal - airborne SLAR/SAR	Koch/Reinartz
14:00-17:00	Workshop on above topics	Koch/Reinartz
<u>Thursday, May 14</u>		
09:00-12:30	Other satellite systems (lecture)	Schlude
	Collection of data by earth resources satellites (lecture)	Schlude
	Overview: imagery analysis of earth resources satellites data, e.g. SPOT and LANDSAT (lecture)	Schlude
14:00-17:00	Satellite imagery and local forestry (workshop)	Forstreuter

Date / Time	Topic	In Charge
Friday, May 15		
09:00-12:30	Instruments and analysis (lectures) - analogue (review) - digital (introduction to theory) - digital (processing and practical demonstration)	Schlude
14:00-16:30	Aerial photointerpretation at village level (workshop)	Tränkner
16:45-17:30	Panel discussion on weeks work (written questions and answers to them)	Tränkner/Koch/ Reinartz
Saturday, May 16	Free	
Sunday, May 17	Cultural programme	

Part 2	SURVEY AND CASE STUDIES	
Monday, May 18		
09:00-12:30	Planning of village forestry surveys (e.g. environmental resources, diseases) (lecture)	Singh
	Defining objectives, elements of information and statistical design (lecture)	Singh
14:00-17:00	Interpretation and mapping of land units for choice of species and prediction (workshop)	Koch/Herrmann/ Reinartz
Tuesday, May 19		
09:00-12:30	Photo and field mensuration (lecture)	Singh
	Data processing (lecture)	Singh
14:00-17:00	Photo and field mensuration (workshop)	Singh

Date / Time	Topic	In Charge
Wednesday, May 20		
08:00-18:00	A. Visit to DFVLR in Oberpfaffenhofen (digital analysis and village forestry)	Kritikos/Winter
	B. Visit to the Radiation and Environmental Research Establishment, Munich	Koch/Herrmann/ Haenel/Hutzler/ Payer
Thursday, May 21		
09:00-16:15	Case studies on the village forestry inventory work in development countries, showing the use of orthophoto maps etc. including photo information, data organization, storage and analysis.	Singh
16:30-17:30	Panel discussion on week's work (written questions and answers to them)	Singh/Koch/ Herrmann
Friday, May 22		
09:00-12:30	Storage, editing, and retrieval of data (lecture)	Schaller
	Geographic information system (GIS)	Schaller
14:00-17:00	Practical work related to planning with demonstration on micro-computers and including particulary a GIS-package (data base III)	Schaller

Part 3	PROJECT AND FIELD EXCURSIONS, PRACTICAL TRAINING ON REMOTE SENSING APPLIED TO VILLAGE FORESTRY	
Saturday, May 23		
09:00-12:30	Introduction to week's programme: contents of practical work, excursion plots, defining of aims, distribution of working material, grouping	Tränkner

Date / Time	Topic	In Charge
Sunday, May 24		
09:00-18:00	Cultural programme	
19:00	The day's programme ends in Oberkochen with checking-in in hotels there and a reception by the Company of ZEISS	
Monday, May 25		
09:00-17:00	Visit to the Company of ZEISS (remote-sensing instruments and large scale photointerpretation)	Eilenberger et al.
17:00	Return to Feldafing	
Tuesday, May 26		
08:00-17:00	Practical work in training stands in the forest district of Sauerlach (sampling, measuring, and mapping)	Tränkner/Herrmann/ Frommelt/Koch/ Reiter/Troycke
Wednesday, May 27		
08:00-12:30	Practical work in training stands in the forest district of Sauerlach (sampling, measuring, and mapping)	Tränkner/Herrmann/ Frommelt/Koch/ Reiter/Troycke
14:00-17:00	Collection and finalization of field data, preparation of analogue and digital material, storage and editing of data (workshop)	Tränkner
Thursday, May 28		
09:00-12:30	Preparation of a short report on the results, posters and cartography	Tränkner
14:00-15:00	Evaluation of results	Tränkner
15:15-17:00	Presentation of reports, posters and maps by each working group	Tränkner

Date / Time	Topic	In Charge
Friday, May 29		
09:00-13:00	Excursion to a forest district in the Alpine Region. Examples of village forestry management in the forest district of Murnau	Brinkmann
13:00-17:00	Lunch and folkloric afternoon in the forest district of Murnau	
Saturday, May 30	Free	
Sunday, May 31	Cultural programme	
Monday, June 01		
09:00-12:30	Presentation of remote sensing data, e.g. mapping, orthophoto mosaics, map accuracy (lectures)	Howard
14:00-17:00	Project preparation for village forestry using a.p. and simple instruments (e.g. sketchmaster 17mm - transferscope)	Howard
18:00	Farewell evening	
Tuesday, June 02		
09:00-12:30	Cost assessment for remote sensing applications to village forestry (lecture)	Howard
14:00-15:00	Mechanisms of international cooperation in remote sensing application (lecture)	Howard
15:15-16:15	Panel discussion on management aspects of remote sensing for village forestry (ideas, questions, answers)	Howard/Tränkner/ Holzapfl
16:15-16:45	Course evaluation by DSE and final discussion	Anders
16:45-17:15	Closing of Course	DSE/FAO/STAFO
Wednesday, June 03	Departure of participants	DSE

THE PROGRAMME MAY BE SUBJECT TO CHANGE

PRELIMINARY LIST OF PARTICIPANTS

ARGENTINE

ALLIANI, Raûl Cesar	National Institute of Agricultural Technology (INTA) Research Center of National Resources Castelar/Argentina Research Staff Member for Silviculture and Remote Sensing
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CYPRUS

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LARIN ALABI, Feiola B.	Federal Department of Forestry Ibadan/Nigeria Ass. Chief Forest Officer for Remote Sensing and Interpretation of Landsat Imagery for Land Use and Forest Management

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HANIF SHAH	North West Frontier Province Forest Department Abbottabad/Pakistan Divisional Forest Officer for Forest Research and Working Plans
JALALUDDIN	North West Frontier Province Forest Department Pre-Investment Center Peshawar/Pakistan Divisional Forest Officer for Forest Management and Photo-interpretation

PERU

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TURKEY

KONUKCU, Mustafa	State Planning Organization Ankara/Turkey Planning Expert for Forestry

ZAMBIA

MWIMA, Henry	National Parks and Wildlife Service Lochinvar National Park Monze/Zambia Wildlife Research Officer for Ecological Studies in National Parks

APÊNDICE B

CONSIDERAÇÕES SOBRE INVENTÁRIO FLORESTAL EM "VILLAGE FORESTRY"

APÊNDICE B

SUGGESTED OUTLINE OF REPORTS ON VILLAGE FOREST INVENTORY

1 - OBJECTIVES

WHAT FOR?

2 - BROAD SCOPE

ALL BIOMASS?
PLANTS ONLY?
TREES ONLY?
WHAT PARTS OF A TREE?
ONLY PRODUCTION OR CONSUMPTION?
ONLY SURVEY OR EVALUATION?
OR ALSO PLANNING?

3 - MAIN VARIABLES TO BE INCLUDED?

PARTICULAR ROLE OF REMOTE SENSING?
HOW TO ESTIMATE PRODUCTION?

4 - TYPE OF SURVEY

ONE TIME OR CONTINUOUS?
INTERVAL OF SURVEYS?
WHAT VARIABLES TO USE IN STRATIFICATION OF VILLAGES?
SAMPLING UNITS DEFINITION?

5 - MAIN TABLES IN A VILLAGE SURVEY REPORT

APÊNDICE C

POSSIBILIDADES E MECANISMOS DE COOPERAÇÃO INTERNACIONAL: APLICAÇÕES DE SENSORIAMENTO REMOTO

RSC Series 18

CAPACITY AND MECHANISMS OF INTERNATIONAL COOPERATION: REMOTE SENSING APPLICATIONS

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

CAPACITY AND MECHANISMS OF INTERNATIONAL COOPERATION:

REMOTE SENSING APPLICATIONS

J. A. Howard
Chief, Remote Sensing Centre (AGLT)
FAO, Rome, Italy

Presented at the International Training Course on Computer Assisted Remote Sensing applied to Land Resources (Federal Republic of Germany in cooperation with FAO) (with slides)

Bonn, 27 October 1983

CAPACITY AND MECHANISMS OF INTERNATIONAL COOPERATION:

REMOTE SENSING APPLICATIONS

J. A. Howard
Chief, Remote Sensing Centre (AGLT)
FAO, Rome, Italy

I. INTRODUCTION

When we speak of the mechanisms of international cooperation in remote sensing, we need to take into consideration not only the willingness and capacity of donors, but also the needs and capacity of the recipients and the channels through which international cooperation can be best achieved. Also, we will probably all agree that satellite remote sensing not only lends itself to international cooperation, but can stimulate international cooperation.

Some of the developing countries, which were not advanced in technology 40 years ago, have now achieved distinction in specialized fields, including space research and space development. Surprisingly, this has often been against a background lacking both in capital resources and organization specifically designed for the purpose; but has demonstrated vividly the vital roles of international technical copperation and the forms of cooperation which can have immense implications for developing countries in the future.

There are many problems, particularly of the developing countries, which thrust themselves upon the world scenario and to which remote sensing inputs may be useful or sometimes vital. This is a scenario in which much abject poverty will be the burden of the future poorest people, and in which, with the population growth at 2.5% to 3%, the present estimated world population of about 4,500 million is expected to exceed 6,000 million by the year 2,000 (FAO, 1981). At the same time the rural population problem is likely to become acute in some of the poorest regions - 60% of the population being in Africa and south Asia.

Aggravated by this rapid population growth, and probably far more serious than pollution and energy supply, will be accelerating threats to agriculture caused by deforestation, by soil degradation, by increased desertification, by difficult communications and by balance of payment problems. Even to sustain an estimated population of 6,000 million, agricultural production will need to be increased by 60% between 1980 and 2000 (FAO, 1981). Further, as indicated by recent FAO agro-ecological zone studies, the semi-arid tropics with a crop growing period of less than 150 days, usually has already twice the number of people that can be supported by low inputs to land productivity (Dudal, Higgins and Kassam, 1982).

II. CONSTRAINTS ON THE CAPACITY OF COOPERATION IN REMOTE SENSING

It is against this background that the present and future capacity of remote sensing cooperation must be assessed and major constraints identified. Any analysis of capacity must necessarily be related to declared project objectives and related to the methods recommended for the attainment of these objectives and the resources available in the future. Capacity will have a vital influence on the "character" of a project in terms of the objectives established for a particular programme and the content of the programme.

It may also be asked for what purpose should the capacity of international cooperation be encouraged and expanded. The justification is seen to lie within the broad category of economic and social development of the UN system and its multitude of activities. While adoption and innovation of methods and techniques must be sought, there is probably little prospect of entirely new methods being evolved in the near future within many developing countries and hence technical assistance can be expected to continue primarily to take the form of experts, fellowships, training, supporting equipment, and the transfer of associated methods and techniques developed in the industrailized countries.

At least three major constraints on the capacity of international cooperation should be mentioned. The first is seen as the increasing difficulty in obtaining adequate funding and the need sometimes to employ the available funds more efficiently. The second constraint is the dearth of reliable facts and figures which would help to separate effective operational and quasi-operational systems and techniques from research and development activities. This is not only a major drain on capacity but is sometimes confusing to industrial as well as to developing countries. It is, however, probably inevitable as the price to be paid for very rapid expansion of remote sensing technology in the last three decades. It can be fairly safely stated that no one person today is fully informed of all aspects of remote sensing application methods and techniques. These extend from simple low-level observations using light aircraft reconnaissance (e.g. for livestock and wildlife surveys) to advanced digital, analogue and photogrammetric analysis of multi-spectral data collected by high altitude aircraft or by advanced satellite sensors and in the future transmitted to the ground from outer space via satellite communication systems (e.g. TDRSS).

The third major constraint on the capacity of cooperation is seen as associated with timeliness of providing effective results. In each phase of a programme there may be delays in several major elements requiring cooperation between the donors and the recipients. These include: (a) identification and development of the project idea; (b) project preparation; (c) project approval; (d) project implementation, including possibly a preparatory phase and involving recruitment of suitable experts and the training of national staff; (e) project evaluation after completion, which is seldom adequately pursued, and (f) follow-up, which is often ignored unless there is a second phase to the project.

The time from concept of the project idea to the commencement of the project implementation can easily be two years and the time required to transfer the technology in an operational mode to a developing country may be five years or more. This time frame is often overlooked or inadvertently shortened. In fact, the UN in its 1969 report pointed out that some really long multi-purpose development projects have taken over 50 years to germinate!

Between and within each stage delays occur, particularly as the donors or executing bodies are often large and involve several of their technical units and also as the recipient countries have developed safeguards to be followed including submission of the draft project to and consideration by national planning commissions. It is, however, difficult to envisage how this bureaucracy can be greatly reduced without resulting in disadvantages, including "scatterization" of efforts and self-perpetuation of projects.

III. UN SYSTEM

The last 30 years have seen the greatest peaceful transfer of political power in history and at the same time science and technology, which obviously includes remote sensing, have revealed and provided almost unlimited opportunities for progress. In this process the UN system has evolved and with the developing countries, has laid the foundations of vital and universal partnership (UN, 1979).

The system, from its concept, can be viewed as a "multilateral cooperative enterprise with the developing countries receiving the benefit of the cooperation (UN, 1969).

Within the system of UN bodies and UN agencies, of which FAO is the largest agency, the political coordinating role in remote sensing is played by the UN Committee on the Peaceful Uses of Outer Space (COPUOS) supported by the UN Outer Space Affairs Division. COPUOS provides a focal point for international cooperation in the peaceful exploration and use of outer space, has a membership of 53 countries, has the mandate to discuss the state-of-the-art and future developments in the peaceful uses of outer space, to review international co-operation in this area and to study practical and feasible means for giving effects to programmes which promote such cooperation. It also carries out the task of progressive development and codification of international space law and in undertaking these functions, the Committee is assisted by two permanent sub-committees (Legal, and Scientific and Technical), and can draw on the experience of the specialized agencies and other bodies invited to participate in its work (UNISPACE report, 1982).

The Committee, its working groups and its Scientific and Technical Sub-Committee are serviced by the UN Outer Space Affairs Division in New York, which has responsibility for implementing many of the recommendations of the Committee and its subsidiary bodies related to the promotion of inter-national co-operation and peaceful uses of outer space. It provides expert advice to Member States, carries out studies requested by COPUOS, disseminates information on space events and maintains an international registry for objects launched into space. Through its Programme on Space Applications, the Outer Space Affairs Division organizes, sponsors and conducts a variety of seminars, panels and workshops, usually in cooperation with other UN bodies, including FAO. Also it services the ad hoc annual meetings on outer space activities of the UN Administrative Committee on Co-ordination; and this provides a forum for the exchange of views of the various bodies and agencies of the UN system.

Of increasing importance are the regional economic commissions of the United Nations which are making efforts to promote the regional use of modern technology to accelerate economic development. As part of this function, they are promoting at regional level the use of space technology, as appropriate to tackle the problem of the regions concerned. They have been actively involved in a number of activities aimed at enabling countries to derive benefits from space technology. The Economic Commission for Africa (ECA), the Economic Commission for Latin America (ECLA), the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic Commission for Western Asia (ECWA) help in organizing regional seminars on space applications. ESCAP has initiated the Asian Regional Remote Sensing Programme and is actively promoting this. ECLA is also involved in promoting regional cooperation in remote sensing in the Latin-American region. ECA has initiated the African Remote Sensing Programme and arranged financial and technical assistance for the establishment and development of the needed supporting facilities.

Within this framework FAO carries out remote sensing activities which are often associated with the execution of UNDP projects and trust funds in developing countries and components of the divisional regular programmes in the fields of agriculture, forestry, fisheries and land use. Also, in 1980 at the request of COPUOS, FAO set up its Remote Sensing Centre; and as noted in the final report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), endorsed by the UN General Assembly, the FAO Centre has the responsibility within the United Nations system for remote sensing applied to renewable resources.

The FAO Centre is therefore making every effort to fulfil this responsibility for remote sensing applied to renewable resources, in cooperation with other UN bodies (e.g. UNOSAD, UNESCO, WMO, UNDRO, UNEP), other organizations (e.g. ESA) and with the assistance of trust funds (e.g. Italy). On request, the FAO Remote Sensing Centre undertakes advisory services and technical assistance to Member States, provides training courses and workshops for developing countries, supports the FAO field and headquarters programmes, initiates pilot studies in developing countries, co-ordinates remote sensing activities at FAO headquarters and serves as the liaison point between FAO and other major organizations concerned with space applications (FAO, 1983). Technical support services within the Centre include a data bank on satellite imagery and aerial photography, digital and analogue equipment for training and project support, facilities for workshops to assist technical staff from developing countries, a terminal link to several organizations and shortly realtime reception of Meteosat imagery.

IV. CONTENT OF INTERNATIONAL COOPERATION IN REMOTE SENSING

The intricacies of remote sensing, due mainly to its inter-disciplinary and multidisciplinary nature and the rate of change in methods and techniques in the last decade, makes it difficult to arrive at a comprehensive appreciation of mechanisms of cooperation. The transfer gradient of remote sensing, as an advanced technology, can never be as steep as that of many village level activities e.g. sickle to scythe, to mower to combine harvester. Although quantitive analysis is of use in measuring various aspects of remote sensing systems (e.g. shortfall of quantitative performance against planned targets), such data is not always available. We have therefore to rely frequently on qualitative analysis, even at a very general level and to make decisions under conditions of subjective risk or subjective uncertainty in order to provide valuable guidelines to more effective action.

International co-operation in remote sensing is either bilateral between donor and receiver or multi- lateral. The latter includes the regular programmes of the UN agencies, agency-executed trust funds and special regular programme activities, e.g. FAO Technical Cooperative Programme (TCP). This co-operation is seen as falling under four main headings which will now be briefly considered. It will also be of interest to learn from this meeting whether these headings highlight adequately and cover the main areas of future cooperation in remote sensing: (a) education and training; (b) advisory services, pilot studies and major projects to assist institution buildings; (c) equipment, and (d) follow-up.

(a) Education and Training

Education and training have always been considered one of the main functions of technical assistance, which has been mainly achieved through the granting of short-term and long-term fellowships. These, inter alia, provide post-graduate university studies, study tours and the expert-counterpart relationship. Unfortunately, follow-up action in education training is often not programmed and insufficient attention may be given to the training component of the expert-counterpart relationships.

FAO's experience in short-course training in remote sensing applications in the last decade has shown that the requirement of developing countries far exceeds the current capacity to fulfil these needs. In the single field of short-course training, the number of trainees that can be accepted is about 25% of the total applications. Of the applicants, probably between 65% and 90% have qualifications and experience which make them basically acceptable candidates.

In summary, the following types of training have been provided by FAO in remote sensing applied to land use and increasingly involve components on computer assisted techniques:

(i) on-the-job (for small groups);

(ii) individual fellowships to universities and technical institutes;

(iii) national workshops (10-20 participants);

(iv) regional seminars along TCDC lines (25-40 participants);

(v) inter-regional problem-oriented courses (20-25 participants).

Training is frequently associated with field projects and extends to fellowships at leading technical institutes and intensive practical training at the FAO Centre in Rome. More recently the FAORSC, in association with several Member States, particilarly Italy, is providing national problem-oriented workshops (e.g. Ethiopia, Chile, Pakistan, Nepal, Somalia); and this year the Centre will hold its first regional training course at a regional remote sensing centre in Africa (i.e. in Kenya).

In addition, courses and seminars in the spirit of TCDC (technical cooperation between developing countries) have been held over several years in close cooperation with the UN Outer Space Affairs Division (one a year by UN Economic Regions) (9th in Niger 1983; 10th in Pakistan in 1984). The inter-regional problem-oriented training courses are held annually at FAO in Rome in cooperation with the UN, WMO, UNESCO, ESA and other organizations and emphasise problems in remote sensing applications considered to be of key importance in the use of remote sensing for national development. Again, it would be interesting to learn of other types of training activities requiring highlighting, or which have been omitted.

(b) Advisory services, pilot studies and major projects to assist institution buildings

This invariably starts with a project idea and possibly a pre-investment survey, which is then developed concurrently between donor and recipient and in realization of sources and amount of possible funding. Care requires to be exercised that a balanced relationship is maintained between the project idea, its formulation, its implementation and the priority needs of the recipient government; and that bias in various forms does not intervene into the granting of the technical assistance. Instances can be quoted for example, where national remote sensing development has been over-capitalized in equipment or is at too advanced level for continued operation in the country after the project ends.

At the present stage of transfer of remote sensing applications technology to developing countries, it is suggested that pilot studies will often hold the key role to development in the next few years by providing the necessary link between education and training and institution building and can provide the basis to establish technical sub-regional networks of cooperation in specialized fields of remote sensing applications.

In this respect is is important to avoid absence of linkage between on-going pilot studies in remote sensing applications and previous and future studies of similar technical nature and major government non-remote sensing efforts which should have a remote sensing component.

Further, the objectives of the major project(on the basis of cooperation)require carefully defining, particularly to avoid being too broad or too vague, and to cover adequately the time scale for sub-contracts (e.g. aerial photography) and the delivery of equipment. Also the completion period needs to be realistic and time must be allowed for sufficient discussion and comparison of alternatives - including who does what. The latter must be reflected in the carefully prepared workplan of the project.

In order to avoid dispersal of efforts and scatterization of project results, schemes must be developed which link multi-lateral and bilateral project development and implementation. For example, after a particular multi-lateral pilot study as a bridging operation to further development, bilateral aid was obtained as a follow-on. Unfortunately this resulted mainly in replication of the results of the pilot study in a different region of the same country and not stepwise national development as was the aim.

(c) Equipment

This is deliberately placed as a separate heading, since the supply of remote sensing equipment is often contained in the requests of developing countries for assistance and may be important to project success. Remote sensing equipment can be expensive when digital analysis or photogrammetry is involved, is highly specialized and must be installed in advance of its use in the project. Late delivery of specialized equipment is a frequent cause of delays in project execution and inadequate training and on-the-job experience of national staff may lead to its reduced use or abandonment after the project ends.

In international cooperation it is essential to ensure that the equipment from an industralized country is suitable to the environment and skills in operation and maintenance of the developing country. Delays are likely to occur due to necessary equipment modifications (e.g. conversion to 220 volts, 50 cycles), delivery time, customs clearance, installation, on-the-job training, after-sales service, supply of spare parts, etc. High air temperatures, dust density, poor water supply, erratic electricity supply, etc. may all need cooperative effort in preparing the equipment specifications,in its installation and in its operation. It is essential that key newly trained national staff to operate the equipment is not transferred after training to other more senior duties or to other government departments.

(d) Follow-up

It must be recognized that completion of a project does not imply follow-up is not required. This could involve simply and at relatively low cost, the visit of a suitable consultant periodically for one or more years; but unfortunately, due mainly to budgetary procedures, it is often not provided as a valuable after-project service. Often technical staff in developing countries, who are faced with continuation of the work initiated in the project, will benefit from after-project consultation of suitable experts. These experts in the future could be increasingly from developing countries of the region and this calls for only a small but important TCDC contribution.

Also, that a project does not produce the desired result, should not be used as justification for no follow-up (UN, Vol. II, 1969). Any such conclusion could be misleading since financial investment is only one aspect of follow-up. If a project shows the unsoundness of investment, it may still have served a useful purpose by preventing needless future waste of scarce financial resources by the country concerned or it may warrant a fresh and alternative attack on the problem.

V. DISCUSSION AND CONCLUSIONS

This paper has provided a scenario in which options on international cooperation in remote sensing are carried out. It would be incomplete, however, if further emphasis were not placed on the mechanisms or the ways in which international cooperation is achieved. At the same time, it would be inappropriate to state which options are preferred since the final choice, including translating agreed general principles into projects, is fundamentally a matter for each donor and recipient country. As mentioned previously, the writer from practical experience, views five years or more as a reasonable period for the transfer of major remote sensing know-how.

Perusal of reports on the results of international cooperation in remote sensing for the benefit of developing countries will suggest that international cooperation is limited in the commercial sector although specific tasks or contracts are often usefully undertaken commercially (e.g. aerial photography). As the capabilities and capacity of developing countries increase in the future, there will be a tendency to replace commercial contracts by self-reliance, even when this results in the inability of the developing country to employ the most up-to-date equipment and techniques. An example of the latter is the almost total absence in developing countries of high altitude aircraft and the most modern high resolution cameras to provide very small scale colour infrared photographs for land use and land suitability studies. Again commercial radar (SLAR) equipment is only available on hire from USA and a successful contractor, for example in Europe, will need to hire the SLAR sensor from the USA to undertake the work in the developing country.

It would be advantageous therefore to many developing projects if some types of modern equipment could be made available at subsidised rates. This would not necessarily compete with or weaken the contribution of the commercial undertaking, but would act as a stimulus. A major disadvantage of commercial contracts, although they may provide very timely results, is that there is usually little opportunity of developing and leaving adequate expertise with counterpart staff of the country.

Future international cooperation is seen primarily as being provided through bilateral government to government agreements and multi-lateral projects of the UN system including trust funds in which the international agency (e.g. FAO) executes, as third party, the project on behalf of the donor and developing country. The mechanisms of cooperation need to focus on these main channels and the capacity of the suppliers and receivers in the transfer of remote sensing technology.

Whatever the choice, this will be influenced greatly by the practicality of the transfer mechanism that exists on each option, and it will become necessary to identify the central means that arise within each option and to subject these to critical analysis with the goal of finding the most suitable mechanism. Such mechanisms must be financially solid, technically progressive, internationally responsible and have sufficient lead and implementation times.

In conclusion, the writer wishes to make five suggestions. In his view, these would be beneficial to future international cooperation in remote sensing applied to renewable natural resources, which is the field of responsibility within the UN system of the FAO Remote Sensing Centre.

1) Action is needed to extend the opportunities to participate in problem-oriented training in remote sensing applications. As indicated by the on-going national, sub-regional, regional and inter-regional training activities of the FAORSC, the number of courses, using the existing mechanisms of multi-lateral cooperation, require to be at least doubled or possibly trebled.

2) A comparable action-oriented multi-lateral or trust fund programme of short-term pilot studies (e.g. 6/15 months) needs to be launched as soon as possible in developing countries. This would promote sub-regional networks of technical cooperation, help to build up in-country remote sensing application capabilities (i.e. institution building) and would help provide a meaningful bridge-head in the country with the real user of the remotely sensed data. Also important may be the low-cost follow-up, either by occasional visits of experts of the donor or from more advanced countries of the sub-region.

3) Remote sensing equipment and methods of the industrialized countries need to be tested and modified for use in conditions existing in developing countries. This is well illustrated by the need to have low-cost digital equipment which is robust, easy to operate and not requiring air conditioning or a dust-free environment.

4) For the monitoring and development of renewable resources, it would be useful to have a small bank of well-tested advanced equipment (e.g. cameras, SLAR, high altitude aircraft) and expertise available at nominal cost for use on request in developing countries in association with projects and as part of national development.

5) Cooperative study is needed now on improving the mechanisms of international cooperation in remote sensing applications. This is certainly pertinent to the transfer to developing countries of computer-assisted remote sensing technology.

VI. REFERENCES

Dudal, R., Higgins, G.M. and Kassam, A.H. 1982. Managing soil resources to meet the challenges to mankind. Land resources for the world's food production. 12th International Congress of Soil Science. New Delhi, India.

FAO 1981. Agriculture: Toward 2000. pp. 160. FAO, Rome.

FAO 1982. Remote sensing applied to renewable resources. RSC Series 6. pp. 48, FAO Rome.

FAO 1983. Remote Sensing Centre - Role and Activities. RSC Series 12. pp. 18. FAO, Rome.

Howard, J.A. 1969. Aerial photo-ecology. Chapter 8. Economic considerations. Faber and Faber, London.

United Nations. 1969. A study of the capacity of the United Nations Development system. Vols. 1 and 2. pp. 500, UN, New York.

United Nations. 1982. Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space. Vienna, 9-21 August 1982. Document A/CONF.101/10.

United Nations. 1983. General Assembly Thirty Eighth Session Agenda Item 79(a). pp. 37.

US Dept. of Commerce. 1983. Study to examine the mechanisms to carry out the transfer of Civil Land Remote Sensing Systems to the private sector. pp. 105.