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IMPROVEMENT OF AGRICULTURAL STATISTICS
IN ASIA AND PACIFIC COUNTRIES
(GCP/RAS/171/JPN)

Proceedings of the

First Meeting of Focal Points

and the

Seminar on Remote Sensing for Agricultural Statistics

Held in Bangkok, Thailand

7 to 11 June 1999

Volume I
Report of the Meeting and seminar

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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INTRODUCTION

1. The back-to-back First Meeting of the Focal Points of the Regional Project: Improvement of Agricultural Statistics in Asia and Pacific Countries and Seminar on Remote Sensing for Agricultural Statistics, organized by the Regional Office for Asia and the Pacific (RAP) of the Food and Agriculture Organization (FAO)of the United Nations and the Improvement of Agricultural Statistics in Asia and Pacific Countries (GCP/RAS/171/JPN) was held in Bangkok on June 7-11, 1999. It was attended by focal points from 15 participating member countries of the project, 18resource persons, observers and representatives from FAO.

2. Dr Prem Nath, the Assistant Director General and Regional Representative for the Food and Agriculture Organization of the United Nations (FAO) in Asia and the Pacific, welcomed participants to this back-to-back meeting. He expressed appreciation for the support being provided by the Government of Japan for this first regional project for the improvement of agricultural statistics in the Asia-Pacific Region. He also conveyed the greetings from Mr Ladislav Kabat, Director, FAO Statistics Division in Rome to the representatives from Japan and to all participants.

3. He reviewed the evolution of the project which started from a recommendation adopted at the sixteenth session of the Asia and Pacific Commission on Agricultural Statistics (APCAS) held in Tokyo during November 1996. He informed the participants that the regional project has set to accomplish two main objectives. The first involves the study of national systems of food and agricultural statistics and the organization of national/regional seminars on the production and use of agricultural statistics and of national/regional workshops on specific areas. In addition, it also aims to formulate a plan for the establishment of database and equipment facilities to provide a capacity to transfer data in electronic format both to and from countries in the region, and the FAO, using common concepts, standards and classifications. This First Meeting of Focal Points and the Seminar on Remote Sensing were viewed as major steps towards meeting these two objectives.

4. In addition to focusing on the current situation of agricultural statistics among participating countries, this First Meeting of Focal Points would alsodiscuss future project activities at country and regional levels in the context of data exchange systems, databases and the Internet. During the Seminar on Remote Sensing for Agricultural Statistics, participants would be offered an opportunity to present and discuss the results of the latest research and experience with its application in some countries of the region.

5. Mr Masaaki Sasaki, Director, Japan's Office of International Affairs, delivered the statement on behalf of the Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries of Japan. He explained the original idea of the project and the need for international co-operation in the field of agricultural statistics in the Asia and Pacific region.

6. He said that the project evolved in response to the challenges to agricultural statistics introduced by globalisation and increasing interdependence among counties in the region both as neighbours and trade partners. It highlighted the recognition of the role of FAO and specifically APCAS, as an important forum for member countries. Following the resolution adopted during the 16^{th} session of APCAS, the Japanese Government agreed to provide financial and technical support for the implementation of this project. He reiterated that the project aims to promote discussions among FAO

Member Nations with the view to formulating a plan for co-operation in the area of agricultural statistics, including the improvement of these statistics and the establishment of a data information exchange.

7. Mr. Sasaki pointed out that statistics were originally developed to meet the needs of national policies and to guide socio-economic development of countries in the region. He highlighted the use of agricultural statistics as a guide for the development of policies for agriculture, rural areas and food supplies and the need for achieving sustainable growth for the national economy. He noted that many countries were unable to produce sufficient volume of accurate and reliable statistics in support of this role.

8. Increasing trade of agricultural products, he said, coincided with a growing recognition of the need to share agricultural statistics and exchange of technology and knowledge required for improving the availability and sharing of these statistics across national borders. Technical assistance from FAO in addressing these problems was being supplemented by exchange of views and strategies for improving statistics through APCAS. Therefore, this regional project was designed to enhance these activities by promoting discussions among participating countries leading to the formulation of a plan for co-operation to support improvement and exchange of agricultural statistics.

9. He also highlighted the need for recognition of climatic variation and diversity in both the history and the traditions associated with social systems and agriculture. This recognition of national variation in crops, animal and farming systems further amplified the need for countries to share experiences, technology and knowledge associated with the application of universal theories and statistical methods for the conduct of censuses and surveys in the field of agriculture. Finally, he noted that the project's focus on regional co-operation highlighted the recognition that agriculture statistics belong not only to one nation, but to all people on this planet.

10. Mr Ryuki Ikeda, Agricultural Statistics Expert for the Project, reviewed the evolution of the FAO Regional Project for Improvement of Agricultural Statistics in Asia and Pacific countries. He said that the project was initiated in response to the regional need for strengthening co-operation and establishing a regional system for the collection and dissemination of agricultural statistics. It was the first FAO regional project to focus on agricultural statistics throughout Asia and the Pacific.

11. He opened the Meeting by highlighting the importance of face-to-face discussions about agricultural statistics. The programme for the back-to-back meeting was reviewed and its special features were noted.

FIRST MEETING OF FOCAL POINTS FOR THE IMPROVEMENT OF AGRICULTURAL STATISTICS IN ASIA AND PACIFIC COUNTRIES

REGIONAL PERSPECTIVE ON AGRICULTURAL STATISTICS
(Session 1)

12. The document entitled “Regional Perspective on Agricultural Statistics in Asia and the Pacific” was presented by Mr Hiek Som, Senior Statistician of the FAO RAPIt highlighted the diversity among countries and noted that the region was very large geographically. In terms of population, some countries were very large, such as China and India, others relative small, such as Fiji, but still others, such as Cook Islands and the Maldives, were even smaller. The wide variation among countries had also been reflected in the development of their national agricultural statistical systems. It was noted that the main task of producing relevant and timely statistics remained with the statistical agencies of the governments in these countries.

13. The document provided an overview of the evolution of agricultural statistics during recent decades. It noted the increase in both theproduction and availability to users including their use as input to the system of national accounts. Over the last thirty, forty or fifty years, it was noted that countries improved their programmes and while many countries conducted agricultural censuses every ten years, some countries conducted it more frequently. It highlighted the recent completion of the first agricultural census in Myanmar, Vietnam and the People’s Republic of China as well as the preparations being undertaken in Lao PDR.

14. The Meeting was informed of new areas in agricultural statistics that responded to the mandates from global meetings. Generation of gender statistics and further disaggregation of statistics on employment from agricultural censuses and surveys were highlighted along with new developments in local level statistics and databases on women. Environmental statistics was another new area that responded to UN mandates. The Meeting noted that recently, FAO developed and released a publication on the methodological guidelines on the collection of structural information on aquaculture. The Meeting was further informed that the FAO also has plans for the preparation of guidelines on acquaculture production as input to the System of National Accounts (SNA).

15. The Meeting noted additional areas requiring further improvements by countries in the region. Statistics on livestock was specifically cited as a weak area. Few countries have sufficient programmes; some countries do not conduct regular national surveys of livestock holdings; othersdo not produce any livestock statistics. The Meeting acknowledged the difficulties in collecting information about livestock and recognized it may be even more difficult when production takes place in large companies that may not wish to disclose the data.

16. The Meeting noted the need for new surveys responding to user needs. In addition to surveys in the new areas cited above, the importance of cost of production and household surveys for estimating the income of farmers was also brought to fore. The utility of the household budget survey for data on food consumption at the household level was also cited. Indonesia would like to see development of agribusiness

statistics. Sri Lanka wanted to improve market information and price statistics. Pakistan wanted to improve the information on horticultural crops. It was also noted that adequate attention should be given to improving data on non-wood forest products.

17. The Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) was introduced as a comprehensive food security information system with three components; namely, crop monitoring and crop forecasting, market information and household food security and nutrition surveillance. This system approach was new and it responded to concerns about food insecurity identified at the World Food Summit in 1996. Market information focused on the market situation or the movement of prices and food, specially during shortages. Household consumption or household budget surveys monitored the nutrition situation at the household level. The Meeting noted crop forecasting as an important feature of the system.

18. FIVIMS was introduced as a system or network of systems that assembled, analysed and disseminated information about people who were food insecure or at risk. Monitoring nutritional surveillance was suggested as useful for identifying areas where food shortages existed or were likely to exist. The objective of FIVIMS was to identify people who were food insecure or vulnerable to it. FIVIMS also was identified as useful in situations of food shortages and when people were in need of food aid.

19. The Meeting noted the features of the Programme for World Census of Agriculture 2000. Its new aspects included the identification of items having a bearing on the environment. Another new feature was its supplements, such as one on employment, on supplementing agriculture statistics, on aquaculture and another on employment on women with tabulations by gender. It was highlighted that the focus on aquaculture was recommended by the15th APCAS Session in the Philippines. The region was supplying 90 percent of the world's aquaculture production. The new *Guidelines on Collection of Structural Information on Aquaculture* was very much appreciated. It highlighted the distinction between agri-aqua holdings and aquaculture holdings. The Meeting also welcomed the new supplement on *Multiple Frame Agricultural Surveys* which included discussions of remote sensing and area and list frames..

20. The Meeting also expressed its appreciation to FAO for coming up with the supplement on the *System of Economic Accounts for Food and Agriculture* (SEAFA). It recognized FAO's effort to come up with a complementary guide to the 1993 System of National Accounts (SNA). It acknowledged FAO's efforts to give priority attention to SEAFA and noted its recent technical assistance to Mongolia in developing agricultural economic accounts at both the provincial and national levels. Three types of SEAFA accounts for agricultural households were identified. In addition, there were supplementary accounts, or satellite accounts. SEAFA recommended the compilation of satellite accounts and one of these accounts was the food balance sheet.

21. Countries with economies in transition were identified as those formerly under planned economies but have now started to adopt a more open market economic system. Their statistical systems relied almost completely on administrative reporting systems. As the economic liberalization was gaining momentum, the traditional system of collecting information could no longer be implemented smoothly. Marketing statistics was identified as an area requiring greater improvement in these countries. In these countries, information systems were changing, but there was limited expertise in sampling and little experience with the conduct and processing of sample surveys.

22. The Meeting accorded particular emphasis on the needs for strengthening national capacity in data analysis to enhance agricultural statistical system's support to FIVIMS, economic accounts, and compilation of socio-economic indicators to monitor agricultural development and agrarian reform.

REVIEW OF CURRENT NATIONAL STATISTICAL SYSTEMS IN ASIA AND PACIFIC COUNTRIES: PRELIMINARY FINDINGS

(Session 2)

23. Mr Ryuki Ikeda, the regional project Agricultural Statistics Expert, informed the Meeting of the preliminary results of the survey initiated by the project to assess the current situation of agricultural statistics among participating countries. It was pointed out that the review was preliminary, as some questionnaires were not yet available and, as a result, the forms in the appendix did not cover all activities of the sixteen countries that were participating in this project.

24. The national agricultural statistical systems in participating member countries could be classified as either centralised or decentralised according to their functional operation. In a centralised system, sole responsibility for agricultural statistics was assigned to either the National Statistical Office (NSO)/Central Bureau of Statistics (CBS), or to the Ministry of Agriculture (MoA). Such was the case in Bangladesh and Viet Nam where the CBS/NSO was responsible for all agricultural statistics. In the case of Japan, however, the Ministry of Agriculture, Forestry and Fisheries (MAFF) assumed sole responsibility for statistics

25. Other countries in the region adopt a decentralised system through allocation of responsibilities for agricultural statistics among several organizations. While these systems were often discussed as forming a clear dichotomy, the Meeting noted that the distinction was not always clear and that the organization of agricultural statistics was complex in many countries. In some countries with a decentralised system, the CBS/NSO and the MoA share responsibility for statistical surveys, such as in the Islamic Republic of Iran, Philippines, Republic of Korea and Thailand. In other countries, these organizations conduct agricultural surveys with overlapping items, such as in Cambodia, Lao People's Democratic Republic, Sri Lanka, Australia and France .

26. In nearly all countries in the region, the NSO/CBS assumed sole responsibility for agricultural census; in France and Japan, the responsibility for the agricultural census has been assigned to MoA; in Bhutan and Lao People's Democratic Republic, on the other hand, both NSO and MoA share the responsibility for the census. While most countries conducted the census every ten years, Japan and the Republic of Korea conducted it at five-year intervals and Australia conducted it more frequently through mail inquiry. Most countries participated in the 1990 round of World Agricultural Censuses (WCA) and they had plans to do another census under the 2000 WCA round sometime between 2000 to 2003.

27. In many countries, annual agricultural surveys were in general, conducted by the MoA. However, the forestry and fisheries surveys were usually conducted by the organizations with primary responsibilities for these sectors. The main focus of major crop surveys in the region was on paddy rice. All countries conducted sample surveys,

but the frequency and methodology varies. Sample surveys were being implemented in Australia, Bangladesh, France, Japan, Philippines, Republic of Korea and Thailand. The reporting system was being extensively used in Bhutan, Cambodia and the Lao People's Democratic Republic. Indonesia, the Islamic Republic of Iran and Viet Nam combined these two methodologies to generate agricultural statistics.

28. Stratified multi-stage sampling scheme was the preferred survey design in many countries. Sample selection for the interview method was derived from a list frame, either coming from agricultural censuses or administrative records. Countries conducting objective area and yield surveys generally rely on area frames for sample selection. The crop cutting method was the most reliable and popular method used for yield measurement among many countries in the region.

29. With regard to the livestock surveys, the Meeting noted that almost all countries had conducted sample surveys of livestock holdings and use with varying frequencies. Sample surveys were being conducted several times a year in France, Philippines, Republic of Korea, Thailand and Viet Nam. Livestock surveys were being conducted in the main production areas of France, Indonesia and Lao People's Democratic Republic. In contrast, Bhutan, Cambodia and Lao People's Democratic Republic conducted sample surveys whenever budget permitted, but they relied on the reporting system for the periodic livestock statistics. Indonesia had conducted a sample survey of livestock holdings as well as a census of slaughterhouses.

30. Farm economy and household budget surveys were being implemented by many countries, but they were infrequently conducted in developing countries. The Meeting noted the need for increasing the frequency of such surveys to support the formulation of socio-economic policies that would enhance farm household-level decision-making on matters affecting food demand and supply relationships. As a corollary, it was pointed out that marketing information was provided daily in France, Japan and the Republic of Korea, and it was noted that the demand for timely collection and dissemination of such information was rising.

31. The Meeting observed an increasing number of countries using the internet as a medium for the dissemination of their agricultural statistics. An increased interest among countries in exploring the use of remote sensing approach for agricultural statistics was also noted.

32. The Meeting was also informed that the 1997 Statistical Act in Indonesia distinguished responsibilities for three types of statistics. The responsibility for basic statistics has been lodged soley in the Central Board of Statistics. Sectoral statistics could be collected by main line ministries for their internal use only; and special statistics could be collected by the private sector. This act required main line ministries and the private sector to submit abstracts of their activities to the Central Board of Statistics, as the national clearinghouse for statistical information. This requirement also supported national efforts to avoid duplication of data collection activities. This information was also being given to the Planning Board and, then, to the Finance Department to avoid budget duplications.

33. The Meeting was further informed that the Central Board of Statistics would try to construct a new frame for agricultural statistics based on the results of the population census to be conducted in June 2000. Moreover, the Meeting was informed that the

livestock surveys in Indonesia, whetherhousehold- or establishment-based required much improvement

FUTURE ACTIVITIES FOR THE PROJECT

(Session 3)

34. The Meeting made a more thorough discussion of the merits and demerits of the centralised and decentralised systems of national statistical service. In some countries adopting the centralized system, the CBS/NSO involved line ministries at the onset of planning for any agricultural statistical activity. Line ministries were consulted on the content and drafting of questionnaires. Thereafter, they were involved in the pilot survey and, finally, in analysis of the results. These relationships flowed from the shared view that producers were not only dependent on users, but statistical products must be useful to users. Main line ministries were also involved in training, where they provided operational clarifications.

35. In other countries, while the Central Government (i.e., MoA) was given the responsibility for coordination and prescription of methodology for collecting agricultural statistics, the state (sub-national) governments were the ones actually doing field data collection activities. f state funds were not forthcoming, field operation activities were not conducted at the same time, e.g. states conduct their censuses in different years and some do not conduct any census. As a result, quality and timeliness of national level statistics were being affected. The Meeting also noted that under a centralized system, cross-validations and checks and balances were either weak or completely non-existent.

36. There was concurrence in the Meeting that due to its history and evolution, it was difficult to change existing national statistical systems from one form to another. As alternative to support the strengthening of agricultural statistics, the Meeting highlighted the need to correct system deficiencies and to encourage the use of scientific methodologies for sample and survey design. The Meeting called for the FAO to support this effort with recommendations for institutional reforms and the production and dissemination of timely agricultural statistics. Moreover, the need to maintain the independence of the statistical office from intervention by any other government instrumentality was emphasized.

37. The Meeting also raised the need to examine errors arising from statistical operations. The case of overestimation of harvest area/production was raised. Errors could have occurred because the responsibility for data collection was being shared by two or more institutions. Suspected errors could also surface when statistics from one statistical activity was being compared with another activity (e.g., production statistics derived from production surveys being compared with statistics derived from consumption surveys)

38. The Meeting also expressed the need to collect more information on other agriculture-related parameters, such as price statistics, as these may be potentially useful for enhancing information exchange among governments. The expansion in the subject matter content of agricultural statistics could also help in the planning for human resource development (e.g. recruitment and education of people to conduct surveys), identifying ways to improve or secure the neutrality of the organization and formulation of mechanisms to synchronise the supply and demand for agricultural statistics.

39. The Meeting also concurred with the 1999 project schedule and plan of work. The Meeting endorsed the focus on the in-depth reviews and the conduct of national seminars in five countries, namely: Cambodia, China, Nepal, Bhutan and Myanmar.

PRACTICAL USE OF DATABASE AND INFORMATION EXCHANGE SYSTEMS: FAO WORLD AGRICULTURAL INFORMATION CENTRE (WAICENT)

(Session 4/5)

40. The reference document was presented by Mr Kurt Vertucci, Systems Development Specialist, Technical Systems Group, Information Systems and Technology Division, WAICENT, FAO Rome. The Meeting was provided a demonstrtion on the use of the FAO World Agricultural Information Centre (WAICENT) that was available on the FAO homepage. The Meeting was informed of the WAICENT mission to collect, analyse and disseminate information, provide information management, form synergies among information partners, reduce cost by eliminating duplication of efforts and combining information and enhance the quality by improving validation methods. FAOSTAT was introduced as one component of WAICENT. It was highlighted that WAICENT was a unique, integrated and interactive database of international statistics on agriculture, nutrition, fisheries and forestry.

41. It was reported that about 1.5 million time series records were currently available through the FAO homepage. The FAO received over 2,500 database accesses per day on the Internet and 1500 queries per year through e-mail and letters. Over 100,000 records per day were downloaded. Twenty-eight percent of these accesses were in education (e.g. primarily from universities), 27 percent from organizations, 25 percent (and increasing) from commercial and civil society users, 15 percent from the Internet (e.g. NGOs, small research institutes and individual consultants) and 4 percent from governments.

42. The Meeting was informed that FAO was developing complementary homepage in Chinese and Arabic. This could later on be expanded to include Japanese, Korean and Thai versions. Moves were also underway for the FAO questionnaires to be on-line by next year. This would make it possible for governments to fill them in the information on-line. Yearbooks would soon be available on the Internet. Besides, the FAO was developing mapping capacity using Java and it was considering the creation of mirror sites.

43. The demonstration of WAICENT and FAOSTAT was concluded with some recommendations. Standards for information management and information technology were absolutely required, as they furnished essential support for common solutions to common problems. To save money, time and effort, there was a need for a common data model as support for cross-validation and ensure consistency. Standards supported flexibility and migration, especially allowing the use of the same software and coding schemes.

44. The Meeting was further informed of the on-going software development for FIVIMS. This software involved a web-based decentralised information system for posting and distributing FIVIMS related information, data and maps through the Internet.

The Meeting reviewed the prototype that would shortly furnish a global information database for various food insecurity thematic data sets. The objective of the software was to identify food insecure populations at a global, regional and local levels. The FIVIMS database would cover all factors and indictors, such as dietary energy supply, prevalence of wasted, undergrowth and stunting among children, some of the causal effects and environmental conditions, etc. These data would vary from country to country. As many countries had a sophisticated digital mapping system for monitoring food security, the FIVIMS system would enhance user access to these GIS data.

45. The member countries were encouraged to explore the possibility of constructing a regional data exchange system as part of WAICENT. It was pointed out that it was possible to create a regional view of the data, whereby entry to FAOSTAT would provide access to the areas and items of interest and importance to say, Asia and the Pacific. It was added that a ranking function would soon be available, which would enable users to examine the top five or ten crops, as example. The Meeting was likewise informed that WAICENT was extremely interested in this regional project. The Meeting then explored in detail the potential of WAICENT for exchange of agriculture statistics.

INTRODUCTION OF INTERNET HOMEPAGES FEATURING AGRICULTURAL STATISTICS

(Session 6)

46. Several focal points for the project demonstrated their official government homepages which included agricultural statistics which could be accessed through the Internet in the following addresses: Central Board of Statistics Indonesia (http://www.bps.go.id), Department of Census and Statistics, Sri Lanka (http://www.statistics.gov.ik), Ministry of Agriculture, the Islamic Republic of Iran (http://www.moa.or.ir), Ministry of Agriculture and Fisheries, France (http://www.agriculture.gouv.fr), Ministry of Agriculture, Forestry and Fisheries Japan (http://www.maff.go.jp), National Agricultural Statistical Service, the United States of America (http://www.usda.gov/nass) and India (http://www.nic.in/agricoop).

47. Indonesia's homepage contained concepts and definitions, census data and macro-economic statistics including agriculture. Sri Lanka's homepage which was expected be launched within the week featured statistics on labour force, agriculture, trade, prices and wages, and national accounts. Paddy statistics were displayed for the biannual survey and production data would be available by district. Iran's homepage featured agriculture data on horticultural crops, harvested areas and yearly crops from 1991 to 1995, along with data for production and crop exports. The Meeting noted that the homepage for France was a display rather than a disposal of data. Monthly forecasts for production, price and marketing were available for downloading, along with summaries of analyses contained in small books issued every three months. Japan's homepage provided bilingual Japanese and English access feature. It included preliminary statistics and results from the 1995 census along with abstracts of various statistics; preliminary data on structure and households; fisheries and management statistics. Production, marketing and consumption data were likewise highlighted along with data for cultivated land. The U.S.) homepage on the other hand, featured report schedules, the 1997 census of agriculture, crop statistics, weather information, agriculture markets, economic reporting, the world agricultural outlook and statistical research, including satellite-based data. The Meeting was informed that when new

publications were issued, the same were simultaneously placed on the Internet where they could be downloaded. The homepage of India, meanwhile, featured history, structure and functions of the MoA along with its publications. All India area production and yield of food grains were available, along with statistics for specific crops, procurement, minimum support prices, consumption and stocks, imports and exports, per capita available and input data. State-wise data were available, along with survey results for small holdings (production, such as livestock for wool and milk, eggs and fish) and production costs for important crops. China adopted a dual system for its homepage, that is, it had two homepages covering a wide range of statistical information such as livestock and crop production, per capita food availability and land use data.

PRACTICAL USE OF DATABASE AND INFORMATION EXCHANGE SYSTEM
(Session 7)

48. The Meeting discussed and explored various approaches for meeting project objective of establishing a regional database and information exchange system. It agreed that the internet would be one of the major medium to operationalize data exchange among countries. The Meeting also endorsed the participation of member countries in FAOSTAT and WAICENT. It was a consensus that the FAOSTAT/WAICENT window offered opportunities for facilitating regional co-operation and enhancing the construction of the regional database including the transformation of data in electronic format both to and from countries in the region, on the one hand, and to the FAO, on the other, using common standards and classifications, which was envisaged as a major objective for the project.

49. The philosophy of WAICENT as a co-ordinating body and a gateway for the dissemination of information was highlighted. Concerns about equipment and facilities, such as hardware and computers, were raised and discussed in light of the rapid pace of technological development. Constraints in access to the Internet were also discussed, along with introduction of mirror sights as a possible option to resolve them. The potential for exchange of forecast figures was also raise in terms of the possible expansion of FAOSTAT menu.

50. The Meeting recommended to organize a session in the next meeting of APCAS in 2000 to discuss issues related to the provision by member countries of common data to the planned regional information exchange system. This discussion was expected to provide guidance on the agenda to be included in the next meeting of focal points scheduled for 2001. The Meeting also cautioned international agencies to refrain from undertaking activities that would increase the reporting burden of governments.

51. The Meeting also highlighted the importance of carefully formulating the design for a regional database in response to different views, perspectives and requirements. The Meeting recommended that the forthcoming process of in-depth review in participating countries should be used as a venue to help in the identification of these design requirements .

SEMINAR ON REMOTE SENSING FOR AGRICULTURAL STATISTICS

INTRODUCTION TO REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

(Session 1)

52. Dr Lal Samarakoon, Senior Research Specialist, Asian Centre for Research on Remote Sensing (ACRoRS), at the Asian Institute of Technology (AIT) introduced to the Seminar the basic concepts for understanding the use of remote sensing and Geographical Information Systems (GIS) in agricultural statistics. The Seminar was informed that remote sensing as a method of data collection was based on the unique forms and intensities of energy emitted from forests, other forms of land use, crops and other agricultural production items. The unique energy emitted in the form of electro-magnetic radiation was being detected by remote sensors operating from earth observation satellitesand transformed into image data. Remote sensing could thus be used as an alternative data collection methodology in agricultural statistics for identifying and distinguishing among land cover and land uses.

53. Energy could be detected by sensors through reflection or emission. The sun radiated electro-magnetic energy that provided input for visible and reflective infrared remote sensing. Land cover or land use was the source of radiant energy in thermal infrared remote sensing, as energy was emitted in the form of electro-magnetic radiation. Microwave detection involved both passive and active types of remote sensing. In the passive form, the microwave radiation emitted from a land object was being detected, while the back scattering coefficient was being detected in active microwave remote sensing.

54. The Seminar was informed that the main objective of remote sensing as a data collection technique involved interpreting the features of the resulting image data. These data were processed automatically by computer and/or manually interpreted by researchers for use in identification of variations in crops and other agricultural production, land use, forestry and environmental conditions within a minimum detectable area. This area, or distance on the ground, is called ground resolution. Image enhancement would convert image data to achieve a more understandable image interpretation. The potential for image enhancement depend on the resolution, the number of bands and the scale of presentation. Enhancement techniques included the use of colour displays for effective visual interpretation. The Normalised Difference Vegetation Index (NDVI) was the most frequently used enhancement technique. Its use for monitoring vegetation growth was demonstrated for identifying seasonal and annual changes in land cover and land use.

55. The Seminar was provided with a demonstration on the use of remote sensing with GIS-- the image data were overlaid onto maps prepared based on a wide range of databases. Land cover maps or vegetation maps classified from remote sensing data were overlaid onto other geographic data that allowed the monitoring of environmental changes, such as changes in land cover. Remote sensing data were also combined or analysed in conjunction with other geographic data to obtain a higher accuracy of classification or estimation.

GENERAL FEATURES OF AREA SAMPLING FRAME SURVEYS AND OTHER OPERATIONS RELATING TO REMOTE SENSING IN THE FRENCH AGRICULTURAL STATISTICS APPARATUS

(Session 2)

56. The document entitled " General Features of Area Sampling Frame Surveys and Other Applications Relating to Remote Sensing in the French Agricultural Statistics Apparatus" was presented by Mr Jean Iotti, Senior Agro-Statistician, Central Service for Statistical Surveys and Studies (SCEES), Ministry of Agriculture and Fisheries, France. He introduced the SCEES activities in the context of its relationship with the Statistical Office of European Communities (Eurostat).

57. The Seminar was informed that the common approach in agricultural statistics in Europe involved geo-located statistics combining GIS with remote sensing technologies. It was noted that the trend was toward decreased scale of statistics (e.g. local statistics in response to the development of local politics) and a growing need for making geographic maps, to supplement statistical maps.

58. Three SCEES teams managed the area sampling frame surveys and the remote sensing technologies. One unit handled the sample frame and its use for the land use and land cover annual survey (TERUTI, Enquete sur l'utilisation du Territoire). Another unit dealt with the arable land yield and technical practices of annual survey. The third unit was responsible for tele-detection (remote sensing) involving satellite imagery statistical applications. While it was necessary to assess the relevance and reliability of the nomenclature and to compare them over time and space, it was highlighted that cost efficiency was the most important parameter. The various experiments using remote sensing by SCEES, began in 1980, and indicated that many of them were too expensive due to imagery cost. Moreover, their results were insufficiently accurate to meet user requirements for distinguishing among classes of agricultural land use.

59. An overview of Monitoring Agriculture with Remote Sensing statistics (MARS STAT) project activity B that Eurostat initiated during 1990 was also presented. It aimed to provide forecasts for fifteen crops at the European level (encompassing the 15 Member States of Eurostat). One area figure per crop for annual change was produced by monitoring a sample of 60 sites (measuring 1 600 square kilometres) with a set of three to four satellite images per year. Discrimination among crops was made possible from a high level of knowledge about the site and its crop distribution, crop phenological calendar and meteorological conditions.

60. The Seminar noted that remote sensing was useful for identifying cereals, especially rice, but it also underscored that it was not yet possible to adequately distinguish among other crops, especially among mixed crops in the European context of plot size. This insufficient discrimination among crops was based on experience of using high resolution data from Land Remote Sensing Satellite Multispectoral Scanner (LANDSAT MSS), Land Remote Sensing Satellite Thematic Mapper (LANDSAT TM) and from the even higher resolutions from the French Satellite for Earth Observation (SPOT, Satellite Pour l'Observation de la Terre).

61. The Seminar noted that the MARS STAT sample was tailored to produce figures for crop area changes at the European level andas such, national level result would not have the sufficient level of reliability. While the results would be fully satisfactory for an area sampling frame using only remote sensing, similar types of information for the fifteen Member States of Eurostat could be had at a lesser expense for the same level of reliability. It was reported that the MARS STAT project was abandoned for these reasons.

62. During the last thirty years, the area sampling frame (ASF) of TERUTI had been used annually for national surveys in France. TERUTI features 550 903 observation points. It supported the production of annual estimates for land use and land cover with a highly detailed nomenclature using an aerial photography at a scale of 1: 5 000. Samples that provide accurate estimates at the level of administrative units (averaging 5 000 square kilometres) were drawn sans any kind of stratification. These aerial photographs were also being used for the ground survey for these points whereby about 1 200 to 1 500 surveyors annually visit them for ten to fifteen days during the months of May to June.

63. The Seminar was informed that the major advantages of this methodology was the absence of stratification, which limited the sampling biases introduced by bad stratification, and the use of very large number of sampling points, which reduced sampling errors. The Seminar was further informed that SCEES was preparing for the revision of TERUTI using ortho-photo or satellite images of very high resolution, e.g. under one square meter, as replacement for aerial photographs made of paper. This methodology was being developed under a bilateral collaboration with Bulgaria for construction of an area frame using a more modern approach to sample selection using survey documents constructed based on GIS technology combined with an extract from a LANDSAT TM image and an overlaying topographic map.

64. The Seminar was also informed that while remote sensing was useful for picking the point, but there was still a need for verification by ground surveys. Difficulties arising from cloud cover impeded efforts to obtain quality images. Moreover, remote sensing was an expensive technique; each SPOT image would cost about US$5 000 and, thus, acquiring the 200 images required to produce a national sample tended to be very expensive. As an alternative, the European Community was building an area sample frame. The sample frame consisted of 97 000 areas of reference and millions of sample points, from where a sample of 15 000 points were needed to produce national estimates for France. It was thus suggested that the remote sensing approach should be used in combination with other techniques and that it should be for specific applications, rather than as an independent tool for production of agricultural statistics.

65. The Seminar was informed that difficulties associated with cloud cover could be circumvented using microwave images in lieu of optical sensors. Microwave images could identify humidity and relief (e.g. ice or oceans) and could distinguish among forests, fruit trees and rice. However, microwave image data were not as yet, providing accurate information for agriculture. It was intimated that there could be some potential in combining optical images with microwave images to distinguish among stages of crop growth at different times of the year.

66. The Seminar further noted that while SCEES was using remote sensing technique for estimation of 15 crops, the resulting estimates were only good for five or six crops, with year to year variation. Moreover while the methodology could provide

forecasts up to ten years, it could not provide sufficient guarantee that the year-on-year forecasts would all be reliable. Eurostat was still combining remote sensing with close observation through ground surveys. Meanwhile, new sensors and new resolution involving microwave sensors were awaited. It was also indicated that SPOT 5 would furnish more accurate results.

THE APPROPRIATE ROLE OF REMOTE SENSING IN U.S. AGRICULTURAL STATISTICS

(Session 3)

67. Mr Robert Hale, Head, Area Sampling Frame Section, Research Division, National Agricultural Statistics Service (NASS), Department of Agriculture, United States of America (USA) presented the document “The Appropriate Role of Remote Sensing in U.S. Agricultural Statistics.”

68. The process of area frame construction was the largest NASS operation involving the application of remote sensing. NASS began using area frame sampling in the 1950s, followed by its national application during the middle of the 1960s.

69. Prior to 1978, NASS used aerial photography as the source for stratification. From 1978 to present, LANDSAT imagery with its 30 meter resolution was being used. Beginning in 1988, NASS shifted the stratification process from a manual image interpretation into an almost entirely digital process. This conversion was achieved by combining LANSAT TM (Thematic Mapper) digital data with digital line graph map data from the USA Geological Survey, supplemented by SPOT images for identification of city and urban boundaries.

70. The NASS area frame was being used to collect data for planted area of major crops. This frame also supplemented the list frames used for livestock and economic surveys in addition to supporting ground truth data for crop acreage estimation using remote sensing. The resulting data from the area frame were sufficiently accurate to produce national estimates for the major crops like corn, soybeans, wheat and cotton. It was also reported that NASS was conducting multipurpose surveys, where farmers were asked about crops grown, grain stock, livestock and poultry, and some economic data about the farm and farm household. Farmers also were asked about the expected yield for crops, which NASS used as a basis for forecasting.

71. NASS also used digital categorisation of LANDSAT TM data for the current year to produce estimates of crop acreage. Furthermore, data collected by enumerators during an area frame survey provided an excellent source of ground truth data for training computer classifiers in the enumeration of crop area. NASS used the imagery data for production of area estimates for rice, soybeans, corn and winter wheat. It was noted that the NASS prepared estimates based on two images, one before crop emergence and the other during the peak vegetative state. Besides, NASS trained computer classifiers to interpret these TM images using ground truth data acquired from the ground surveys. As correction for human errors and possible visual misinterpretation, NASS introduced a regression estimator sometime in the 1970s to produce more accurate area estimates by crop. This estimator combines survey data from farmers with the digital categorised LANDSAT TM data.

72. Because of the high costs involved in purchasing and processing of LANDSAT

TM data, NASS was only able to use this procedure for selected states, especially important crop states or regions where this method provided substantial information on crop acreage and related land covers. As areas covered by the LANDSAT TM satellite could vary from year to year due to the cloud cover, NASS combined area frames and regression estimators to come up with consistent estimates for the specific subject area, such as the entire state or major crop producing areas of a state. It was pointed out that this combination of methods significantly reduced the variance for the estimate.

73. NASS also used remote sensing for crop condition assessment of large areas. The Advanced Very High Revolution Radiometer (AVHRR) data from the polar orbiting weather satellites launched by the National Oceanic and Atmospheric Administration (NOAA), which resolution was one square kilometre, was providing basic input to this activity. The AVHHR data was providing an indication of crop condition and was being supplemented by the Normalised Difference Vegetation Index (NDVI) to generate a coterminous vegetation condition indicator every two weeks. These indices served as supplement to the existing system for crop growth stage monitoring, consisting of extensive data sets on crop growth stage and crop conditions, yields reported by farmers and other objective counts and measurements of crop yield.

74. The Seminar was informed that for crop yield modelling for forecasting and estimation NASS was using data from sample surveys, either from interviews with farmers or from yield surveys based on actual measurements method, such as crop counts made throughout the season. The yield modelling aimed to examine the utility of remote sensing data when combined with other data sources. These other data sources included models for plant processes and type, weather and soil data, AVHRR data, NASS data from the weekly crop stage and condition survey and categorised data for specific crops from the LANDSAT TM satellite. NASS was using this yield model primarily for research purposes, and not for the operational purposes of forecasting and estimation.

75. The Seminar was informed that to reduce respondent burden, area frame samples were being replaced at the rate of two states per year, following a statistical review. It was also informed that agricultural conditions in some states have not changed much and, as such, the 1970s frames were still good. A twenty percent annual rotation was built into the sample, thus the primary sampling units (PSUs) were being replaced every five years to reduce respondent burden. The surveys were being conducted in August and forecasts were issued in November and December. State level estimates were being prepared by NASS either through the use of satellite images or regression methods. The Seminar was further informed that unlike in many developing countries in Asia, shifting agricultural cultivation/production was not being extensively practiced in the United States.

76. The Seminar also noted that because remote sensing viewed mountains as flat, field area images were skewed . This skewness would be greater in images with resolutions below 30 meters. Remote sensing technique was also found to be insensitive for crops grown under trees. For this reason, the simultaneous use of ground survey and aerial photography, e.g. colour infrared photography was recommended .

FEASIBILITY STUDY OF AREA SURVEY WITH REMOTE SENSING IN JAPAN

(Session 4)

77. Mr Hidemi Keira, Deputy Director, Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries, Japan presented a paper entitled: " Feasibility Study of Area Survey with Remote Sensing in Japan." The paper focused on the use of satellites data for producing acreage estimation for paddy fields and compared them with results from the conventional method of area survey.

78. The Seminar was informed that the first step in the study involved identification of water surface areas (including paddy fields, rivers and lakes) for nine test sites (cities and villages) using cluster analysis for land cover classification of images acquired after the rice was planted. The open water areas were distinguished from the paddy fields and removed from the selected land areas. Thereafter, the ratio of the paddy field in each pixel of the satellite was calculated from an estimation model and these site data were aggregated.

79. Then the estimates from TM data were compared with the results obtained from the conventional method of area surveys. It was reported that the error for the aggregated sites was minus one percentage point and the error range among the test sites were from minus seven to plus two percentage points. The optical sensor data made it possible to estimate the rice planted area and, combined with geographical data, the entire cultivated land could also be estimated.

80. Hokkaido, which was located in the northern part of Japan, where generally would have fine weather during the planting season and the field sizes were larger compared to other parts of Japan, would also be included in the study in 2001. The feasibility of this methodology for Hokkaido however, may not include areas where thick clouds would make it more difficult to obtain data from optical sensors during the rainy season. The Seminar was informed that the study might consider the use of more sophisticated methodology based on data images from microwave sensors which had capability for producing data images though thick clouds to cover such difficult areas. A national area survey would begin in 2004 if the study would succeed good results.

81. The Seminar was informed that significant improvements in analysis accuracy were obtained from microwave sensor data, but achieving higher precision estimates required further technical development of methodologies for removing image noises. Cloud cover during the rainy season in Japan required the use of remote sensing technology from both optical sensors and microwave sensors, that would be on the Advanced Land Observing Satellite (ALOS), scheduled to be launched in August 2002.

82. The Seminar noted that the efficiency, stability and cost reduction were important in acquiring satellite images, and satellite images do not show demarcation lines among

nations. The importance of strong international co-operation to support and promote the use of this advanced technology for improving agricultural statistics was therefore highlighted.

CROP AREA ESTIMATIONS USING REMOTE SENSING

(Session 5)

83. Dr Shigeo Ogawa, Senior Researcher of Remote Sensing, National Institute of Agro-Environmental Sciences, Ministry of Agriculture, Forestry and Fisheries, Japan presented a paper focusing on the accurate production of annual estimates for crop field area using remote sensing technology examined the technical aspects of the feasibility study of area surveys using remote sensing in Japan that was discussed in Session 4 of the seminar.

84. The Seminar was informed that Japanese agriculture involved many crops and small fields. The standard paddy field measured about 30 meters by 100 meters while other fields were very narrow. Many kinds of crops were being planted in one unit at different stages of maturity making it difficult for satellite data to distinguish the crops.

85. Moreover, Japan was located in a monsoon area with high intensity of cloud cover during the crop's growing season. This accounted for a low percentage of LANDSAT TM data acquisitions with a cloud coverage of less than 20 percent. Cloud cover frequently limited image acquisition to only one or two data sets during the planting season. Remote sensing technique required a number of data sets in order to come up with estimates within two percentage points of accuracy for each district. Experiences however showed that it was impossible to assemble a sufficient number of acceptable data sets during the rice planting season from remote sensing satellites with optical sensors.

86. This research involved the estimation of paddy field areas using three sets of RADARSAT Synthetic Aperature (SAR) data, on the one hand, and three sets of LANDSAT TM data combined with one set of RADARSAT SAR data on the other. RADARSAT SAR is a microwave sensors made it possible to acquire the RADASAT SAR data during all weather conditions as complement to the LANDSAT TM data from its optical sensors.

87. The Seminar was informed that the RADASAT data was transformed into a backscatter coefficient and, compared to the rice growth index of fresh weight, dry weight Leaf Area Index (LAI) and the height of the rice. The results showed the backscatter of paddy field was low during flooded seasons, but it increased as the rice grew until it was covered fully with canopy. The method made it possible to distinguish paddy fields from other land cover, but it was difficult to distinguish among crops, due to the limitations of SAR data, arising from its single band and the speckle noise of radar.The Seminar also noted thatclassified images produced by combining data collected by optical and microwave sensors, made it possible to produce precise estimates of paddy field area during all weather conditions.

88. The estimation proceeded by combining the two sources of data as overlays using GIS. The overlaying paddy field candidates of RADARSAT and LANDSAT TM data made it possible to identify the paddy field. Thereafter, total paddy field area was

estimated from the number of pixels. The differences between this estimated area and the statistical area, derived as an estimate from the usual sampling survey, for the two test sites were minus 1.5 percentage and plus 1.0 percentage. It was pointed out that if the paddy field area being estimated were at high elevations, its position would give rise to a fore-shortening phenomena which, in turn, would contribute to area underestimation. The digital elevation model (DEM) could then be introduced as a correction methodology.

89. The observations obtained from this study confirmed that due to cloud cover, it was impossible to rely on paddy field candidates from LANDSAT TM data every year. At the same time, RADARSAT SAR data would also be untrustworthy, due to its speckle noise which reduces the accuracy of estimations for paddy field area. However, the results of this research highlighted the potential for producing estimates with high accuracy under any weather conditions by combining the use of paddy field candidates from RADARSAT SAR and LANDSAT TM data.

ACTIVITIES OF REMOTE SENSING ON AGRICULTURAL STATISTICS IN THAILAND

(Session 6)

90. The document "Activities of Remote Sensing on Agricultural Statistics in Thailand" was presented by Dr Supan Karnchanasuthan, Director, Centre for Agricultural Information, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives (MoAC), Thailand.

91. The construction of area sampling frame (AFS) in 1975 was used to produce area, yield and related information for rice. The AFS concept involved dividing the total area to be surveyed into small blocks without any overlap or omission. Aerial photographs and topographic maps were used for this purpose. The sampling method involved a stratified two stage process. The sampling units were segments, measuring about 80 acres (324 hectares). Interviewers collected data inside each of the 5,000 segment selected for the crop survey. However, as boundaries on the aerial photographs were difficult to identify and often out-of-date, this method of AFS construction was no longer used.

92. The Seminar was informed that monthly forecasts for ten major crops in Thailand were being released from May to November. Production forecasts were calculated as the product of estimated acreage and yield. Planted area was calculated as a linear function of price and area for the previous year. Yield forecasting used a combination of historical data for annual rainfall and yield data.

93. Yield moisture index (YMI), defined as weighted averages for monthly rainfall during the crop growing period, with variable weights by crop and by month was used to estimate crop yield during the 1986-1987 crop year, but the results were not satisfactory due to the insufficient quality of rainfall data and other factors. For paddy rice, corn and soybean, Thailand was now using the objective method of yield surveys in selected provinces.

94. The paper also presented an overview of an experimental study of yield forecasting that used satellite data from the National Oceanic and Atmospheric

Administration (NOAA). The Seminar was informed that the advantages of NOAA data resulted from the optical sensor, which covered a large area, and the daily orbit of the satellite on the same path. Such advantages minimised the problem of cloud cover by making it possible to produce weekly composites of image data without cloud cover. These data then were subjected to econometric models for identifying the potential crop failure, such as the Normalised Difference Vegetation Index (NDVI).

95. The Seminar also took note of the use in Thailand of remote sensing in combination with GIS for determining the suitability of agricultural land for production of specific crops. It was pointed out that the national concern for land use suitability stemmed from the observed relatively low rice production per rai for Thailand. This relatively low yield tended to suggest that the agricultural land could be more suitable for other crops. Thus, the GIS was utilised to help identify and rank suitability areas for specific crops. The methodology involvedthree basic steps-- digitising of maps, data analysis and map reproduction. The study, using a scale of 1:250 000, resulted in the identification of land areas suitable for rice, jasmine rice, cassava, sugar cane, soybean, corn, natural rubber, oil palm and pineapple.

MONITORING CROP GROWTH AND PRODUCING YIELD ESTIMATION BY COMBINING SATELLITE DATA AND A SIMULATION MODEL OF GROWTH

(Session 7)

96. Mr Atushi Tomita, Researcher of Remote Sensing, National Institute of Agro-Environmental Sciences, Ministry of Agriculture, Forestry and Fisheries, Japan, presented a paper demonstrating the results of a research aimed to develop a framework of synergetic application of satellite data and a crop simulation model for monitoring crop growth (biomass) and crop yield. The simulation model of rice growth served to interpret weather data and planting information as support for analysis of satellite data. This simulation model produced crop yields for rice, biomass and the Leaf Area Index (LAI). Spectrum analysis was used to compare the data on the same dates.

97. The Seminar was informed that the simulation growth model was applied to weather data, measuring daily temperature, daily solar radiation and day length in terms of the crop calendar for the rice growing season. The Leaf Area Index (LAI) monitored changes in the leaf area density associated with photosynthesis. LAI increased throughout the growing season until the heading season when it reached a saturation point. Thereafter, LAI declined throughout the reproductive stage of rice growth.

98. The research involved combining remote sensing data on weather with a simulation model of crop growth using the LAI, which was calculated from satellite data using a reflective model. The result was a crop production model of time series plots. The Seminar was informed how the satellite data was used for calculating the growing curve. This simulation model for rice growth used planting information, cultivation and transplanting data, daily temperature and solar radiation as input data. The resulting simulation model functioned to interpret these various data giving rise to daily NDVI, LAI, biomass and, finally, yield in each mesh.

99. The Seminar also noted the use of LANDSAT TM data and a map of daily radiation. The remote sensing data was compared with daily solar radiation data and plotted on a linear graph. NDVI was being derived from various satellites; namely, the Marine Observation Satellite-1 (MOS-1), Japanese Earth Resources Satellite-1 (JERS-1), the European Remote Sensing Satellite-1 (ERS-1), RADARSAT, SPOT and LANDSAT TM.

AREA SAMPLING FRAME CONSTRUCTION – FIJI EXPERIENCE
(Session 8)

100. Mr Jone Ratuvuki, Senior Agricultural Assistant, Economic Planning and Statistics Division, Ministry of Agriculture, Fisheries and Forests, Fiji presented a paper on Fiji's experience in the construction of an area sampling frame (ASF) using aerial photography.

101. The Seminar was informed that ASF construction began with stratification of the 15 provinces, according to importance, intensity and type of agriculture. Boundaries for enumeration areas (EAs) were borrowed from the population census, and these 895 EAs were classified into nine strata. Using photo interpreters (e.g. topographic maps, land use maps, contract aerial photographs, etc), the country was stratified into 21 substrata according to land use for crop (e.g. sugar cane, mixed crops, temporary crops), special farms and so forth. The number of segments was calculated based on its measured area. EA segments were identified in a serpentine pattern. The boundaries of the segments were permanent physical features. Sample segments were systematically selected within each independent stratum.

102. The Seminar was informed that for Fiji's next census, a multiple frame approach using a combination of the list frame and area frame would be used. It was also clarified that census results provided province-level estimates. Moreover, existing agricultural surveys in the country were limited to collecting production data. Socio-economic characteristics of farmers/households were not included in the survey.

103. It was further clarified that FAO was providing technical assistance to the country in the construction of an area sampling frame to update the previous frame used in the census conducted in 1991. A pilot survey was conducted in 1998 and an annual survey of agriculture was going to be conducted on August 1999 A sample of 200 segments had been selected for this purpose. Publication of the results was expected to be completed in 2000.

REMOTE SENSING APPLIED TO AGRICULTURAL STUDIES IN THAILAND (Session 9)

104. The document "Remote Sensing Applied to Agricultural Studies in Thailand" was presented by Dr Surachai Ratanasermpong, Senior Scientist, National Research Council of Thailand (NRCT).

105. The paper provided an overview of the application of remote sensing to natural resources monitoring. The methodology using LANDSAT TM5 images could distinguish variations in land use such as agriculture land and forest land, and rain-fed land and rice fields. Changes in the coastal zones could also be discerned. Illustrations were given to show salt water intrusion into mangroves. Sample images were displayed to show the subsequent closure of shrimp farming areas. that the capability. Images showing changes in major crop production, e.g. from sugar cane to cassava, degraded forest, land use for rubber plantations and durian production were also presented to highlight the capacity of higher resolution of SPOT images to enhance monitoring activities. The Seminar noted that JERS-1 data could provide greater detail on the structure of land use. One of the interesting highlights of the demonstration of the uses of remote sensing was the illustration on the extent of deforestation along the border of Thailand with Cambodia. It was pointed out that ground surveys were not possible to apply to the area for identification land use due to landmines.

CONSTRUCTION OF AREA FRAMES AND MONITORING OF CROP GROWTH FR LARGE GEOGRAPHIC AREAS ENCOMPASSING MANY COUNTRIES

(Session 10)

106. Mr John Latham, Remote Sensing Officer, Environment and Natural Resources Service (SDRN), FAO Headquarters, Rome Presented the document "Enhanced Agricultural Information System in Developing Countries".

107. The document was prepared by FAO in response to an increasing demand for timely, reliable and comprehensive food and agriculture statistics. The participants were given an overview of alternative systems for agricultural data collection and the use of list, area and multiple frames. The presentation shared the observation of a gradual trend toward standardisation and harmonisation of approaches, accuracy levels and effectiveness.

108. The Seminar was informed of the features of the multiple frames sampling method. It was informed that the method involved combining a probability sample of land areas called segments, which were selected from an area frame, with a complementary short list of special agricultural holdings to be completely enumerated during the data collection in a field.

109. The area sample design consisted of a stratified probability sample of segments drawn through a replicated selection procedure. The area sampling frame divided the territory into a number of strata by land use, defined by the proportion of cultivated land, predominance of certain crops or other land use and other features. Sample selection involved the complete subdivision of each land use stratum (either by similarity of agricultural characteristics or following a geographic distribution criteria) into areas with equal number of substrata or zones, which form an additional level of stratification within each stratum. The area sample consisted of a number of independent replicates. The result was also being referred to as a stratified cluster sample of tracts, in which one tract consisted of the part of a holding or of non-agricultural areas.

110. The inclusion of a complementary list sample component of special holdings, significantly contributed to the improvement of total estimate. It was noted that special

holdings with the largest total area, largest area for a given crop, largest number of livestock and poultry, highest revenues, or largest number of agricultural workers were usually the target of the list. Special holdings could also include localised production or specialised types of production. The technical difficulties associated with adding lists to area frame designs, were relatively minor.

111. The advantage of multiple frames as compared to list frames and pure area frames, derived from the more precise estimates for agricultural areas, main crop areas and other key variables contained in multiple purpose agricultural surveys. It was pointed out that the area sample component of multiple frames involved an objective procedure for measurement of agricultural areas based on aerial photos. The same was also being used for selection of a probability sample for crop cutting yield surveys that provide objective crop production and crop forecasting estimates.

112. The Seminar was provided a step by step illustration of the use of multiple frame survey technology using a particular survey conducted earlier in Sudan.

113. The establishment of area frames in African countries being undertaken under the Land Cover Map and Geodatabase for Africa Project (AFRICOVER) was also discussed.

114. The Seminar was informed that AFRICOVER aimed to use satellite data to produce comparable land cover maps at national and regional level in homogeneous, same scales and age, same type of the legend, etc. It would provide each country with the basis for an area frame, to be used either as a complement or as a replacement for the current sampling frame. The project involved creation of a harmonised classification of land cover. In this context, a global classification system had been developed by the FAO, the United Nations Environment Programme (UNEP) and Eurosta, and was currently under review by national institutes of North America, Africa and Asia.

115. AFRICOVER project could supply many outputs such as the new high resolution and geometrically corrected data images for land cover and land systems and printed maps. AFRICOVER also provided the basis for an integrated continuous database both for the whole continent of Africa and for each individual country. Further, the project also furnished new hardware and software in the participating countries, while simultaneously contributing to national capacity building. The Seminar however noted that the cost of establishing an agricultural area frame, such as expensive satellite imagery, impeded the development of area frame in many countries.

116. A parallel ASIACOVER was also being planned for Asia. The forthcoming meeting of Ministers of Science and Education in Delhi during November 1999 would serve as a venue for discussing this project. The Seminar was informed that the planned ASIACOVER would initially cover South East Asian countries and would eventually be expanded in stages, based on geographic and economic subregions.

117. The Seminar was also informed of the features of the FAO Land Cover Classification System (LCCS) for providing a consistent system and basis for stratification. An overview of the Africa Real Time Environmental Monitoring Information System (ARTEMIS) as an information management and access system for large area vegetation monitoring was also presented. The Seminar noted its capability to identify changes in rainfall on a half hour basis and of plant growth and other information that could provide useful inputs to an early warning system on drought conditions.

118. ARTEMIS was developed and implemented from 1985 through the combined efforts of FAO, the Netherlands and a number of universities. It was designed as a system for automated acquisition, pre- and thematic processing, archiving and distribution of hourly thermal infrared data from the Cold Cloud Duration (CCD) Satellite (METEOSAT). Daily data from the Advanced Very High Resolution Radiometer (AVHRR) sensor on the NOAA satellites provided data for generation of the Normalised Difference Vegetation Index (NDVI). ARTEMIS supported monitoring and assessment of rainfall and vegetation conditions. It also provided useful data for early warning systems of food insecurity and desert locust surveillance and preventive control.

119. The basic products of ARTEMIS for the African continent such as daily, ten days and monthly CCD, number of rainfall days (NRFD), estimated rainfall (ERF) and the normalised difference vegetation index (NDVI) were presented. The Seminar was informed that ARTEMIS was being upgraded and extended from Africa to Asia, Latin America and Central America. The current view for further development of ARTEMIS was to make it a comprehensive and proactive central repository for satellite derived spatial environmental data and related value added information products.

120. The Seminar noted that remote sensing assistance to agricultural statistics encompassed local, national, regional and global contributions. Effective use of remote sensing as data collection required an information system for the satellite derived spatial environmental data. This would involve the establishment of appropriate network links and their technical and applications support to immediate users at the global, regional and national levels. Effective use also required co-operation among countries in the establishment of an information system that responds both to different users and needs. It was suggested that a new systems approach was needed and the importance of identifying everyone as users and access to Internet were likewise highlighted.

121. In response to a query as to what would be considered the smallest piece of CASS (Computer Assisted Stratification and Sampling System), the Seminar was informed that the scale would 40 million; by class it would be about 25 acres taking into consideration the objective of harmonisation.

VISIT TO THE ASIAN CENTRE FOR RESEARCH ON REMOTE SENSING (ACRORS) AT ASIAN INSTITUTE OF TECHNOLOGY (AIT)

(Session 11)

122. A visit to ACRoRS at AIT was included in the Seminar's agenda to provide the participants hands-on experience on remote sensing activities in Thailand. Dr Kiyoshi Honda, Director, ACRoRS, AIT, briefed the participants on the activities of ACRoRS. The participants were given overview of the current research of ACRoRS including activities focused on the receipt of NOAA data, the use of GIS for planning the Asian highway, the advanced Geographic Positioning System (GPS) and the monitoring of volcano activities by researchers of ACRoRS.

123. The Seminar was informed that as one of the receiving stations for images from satellite launched by the National Oceanic Atmospheric Administration (NOAA), ACRoRS was fitted with radar to receive data with computer software for its geometric revision before providing image data to a range of users. An exclusive line operated the

transfer of these image data to its main research institute users. The centre also archived NOAA image data.

124. The Seminar was also informed of the project featuring differential GPS and kinematics Global Positioning System (GPS) database creation as the newer and more advanced GPS system at ACRoRS. The GPS involved a small receiver for microwave data from many stationary GPS satellites, defined in terms of longitude and latitude. The researchers in the field were equipped with a small radar receiver connected both to a computer and a mobile telephone for communication with the centre. The centre, which previously measured the positioning, served as the main radar site for this system, but the use of the centre as the standard point continuously modified field positioning. The research demonstrated that the use of this advanced GPS system significantly reduced the errors in field positioning.

125. The application of remote sensing and GIS to road network database management was also explained. Image data from remote sensing was combined with mapping data and a wide range of other information. These data overlays were demonstrated in various combinations which to illustrate its use for providing a sound basis for guiding decisions associated with planning the Asian highway.

126. The Seminar was also briefed on the use of remote sensing for monitoring hazards associated with volcano eruptions. The Seminar was informed of the centre's on-going comprehensive study for hazard mitigation of the Mayon Volcano in the Philippines. The Seminar was also informed that remote sensing data could be used to identify a comprehensive range of disaster relief and restoration activities.

APPLICATION OF REMOTE SENSING AN GEOGRAPHIC INFORMATION SYSTEMS IN THE MINISTRY OF AGRICULTURE OF IRAN

(Session 12)

127. Mr Alireza Majd, Chief of the Remote Sensing and Geographic Information Systems Office, Agricultural Statistics and Information Department, Ministry of Agriculture, Islamic Republic of Iran made a presentation on the application of remote sensing and GIS in Iran

128. The Seminar was informed that the pilot project with the FAO was implemented in 1990 to estimate the crop area using Landsat TM data. Agricultural land was stratified and divided into four strata and thereafter, 44 ground samples of 100 hectares were selected and transferred onto the TM images. It was noted that the tract boundaries were introduced from the higher resolution images of SPOT. Ground data were collected and applied for correction of the crop classification. The results were expanded using the regression estimator to produce area estimates with accuracy of about 95 percent.

129. Another project involving co-operation with the FAO used satellite data for identification of range land capacity. The land was classified into three categories: flat, hilly and mountainous land. Sample areas of 60 square were selected within each category and three plots of one square meter were selected within each square. A complete listing of plant species and their coverage was made for each plot by clipping and weighing of green biomass. This information was combined with the Vegetation Index to classify range land in terms of six classes of green biomass.

130. In 1993 estimates of pistachio hectare were produced using TM data. Initially, visual interpretation was used to stratify the pistachio orchards. Thereafter, ground samples of pistachio orchards were selected from a classification system distinguishing among low, medium and high density for cultivated area. Digital processing was applied and the results yielded area estimations for townships with pistachio cultivation.

131. Tea estimates were difficult to produce from traditional surveys due to geographical conditions and distribution of farmers. TM data for tea cultivation areas were used to prepare tea area estimates. The timing of the image was crucial to the process, as tea was grown under trees. An automatic classification separated out agricultural areas. Ground samples were selected in tea cultivated areas. Thereafter, a supervised classification of tea areas was carried out using the ground samples. The Global Positioning System (GPS) was used to control the results. As tea was primarily grown on slopes, a separate procedure was necessary to reduce area underestimation by correcting the TM image using the Digital Elevation Model (DEMs).

132. Area estimation for rice used TM data and followed the same general procedure used for the other crops. GIS was used for mapping images. The use of TM images in combination with topographic maps using GIS allowed for the discrimination of major crops, e.g. wheat, barley, alfalfa, potatoes, sugar beets, etc.. The high correlation between GIS and TM images supported area estimation and the preparation of digital maps. Iran also prepared the land use atlas contained 58 maps.

133. The Seminar noted that remote sensing technique was used not only for area estimation but also for creating advanced statistics.

JAPANESE REMOTE SENSING ACTIVITIES

(Session 13)

134. Dr Masahiko Honzawa, Deputy Senior Research Scientist, Thailand Liaison Office, Remote Sensing Technology Centre (RESTEC) of Japan reported on the remote sensing activities in Japan.

135. The Seminar was informed of the Japanese Earth Resources Satellite–1 (JERS-1), launched in 1992 by the National Space Development Agency of Japan (NASDA), as an earth observation satellite to support national land surveys in agriculture, forestry and fisheries, environmental protection, disaster prevention and coastal monitoring for resource exploitation. This satellite observed the earth through the high performance Synthetic Aperture Radar (SAR) and the Optical Sensor (OPS). OPS produced data in seven bands, from visible to short wave infrared bands, and it was highly useful for identifying stones, rocks and minerals. OPS operation involved a Visible and Near-Infrared Radiometer (NVIR) and a Short Wave Infrared Radiometer (SWIR). The SWIR had four bands further subdivided between short wave and infrared bands. The effectiveness of SWIR was verified by LANDSAT TM. VNIR made stereoscopic viewing possible for topographic observation.

136. JERS-1 also observed the earth using SAR as an active sensor which transmitted microwave and received back scattered waves from the target of observation during all weather conditions. SAR transmitted 1 500 pulses per second from its

antenna, and its very long antenna array was synthesised by moving a small physical antenna along a flight path, while transmitting, receiving and storing the back scattered signals. Signals were coherently summing the echoes received from a target while the radar travels to provide the signal. SAR achieved fine resolution through the combination of these pulse compression and synthetic aperture techniques.

137. The Seminar was also informed of the Advanced Earth Observing Satellite (ADEOS) launched in 1996 to acquire global observation data for international monitoring of global environmental changes, such as global warming, destruction of the ozone layer, degrease of tropical rain forests, occurrence of climatic anomalies, etc. It also supported a platform bus and inter-orbit data relay technologies to support the next generation of earth observation systems. The satellite was equipped with the several sensors, including an Advanced Visible and Near-Infrared Radiometer (AVNIR) and an Ocean Colour and Temperature Scanner (OCTS) and six additional sensors from other satellites.

138. The Seminar noted that RESTEC kept in close cooperation with the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). RESTEC organized pilot projects featuring practical application of Japanese satellite data in Thailand and Indonesia. The Seminar also noted several training and seminars on remote sensing technology and GIS being sponsored by Japan.

139. The Seminar was also informed that future programmes for the Japanese Earth Observation Satellite included the November 2000 launching of the Advanced Earth Observing Satellite-II (ADEOS-II). Its development responded to concerns about the global environment. ADEOS-II would showcase sensors developed by NASDA, such as an advanced microwave radiometer, a scattering meter, an improved spectrometer for measuring infrared radiation at the ends of the atmosphere and an earth surface reflection measuring device. This combination of sensors would enhance the prospects for monitoring climatic phenomena related to environmental shifts, such as global warming.

140. In August 2002, Japan would launch the Advanced Land Observing Satellite (ALOS). It would feature support use in cartography, regional observation, disaster monitoring and resource surveying. ALOS would enhance prospects for improvements in agriculture statistics from its three remote sensing instruments. First, the Panchromatic Remote Sensing Instrument for Stereo Mapping (PRISM) would support Digital Elevation Mapping (DEM), required for observation of mountains and other elevated terrain. Second, the Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) would facilitate more precise observation of land coverage. Third, the Phased Array type L-band Synthetic Aperture Radar (PALSAR) would support land observation for all weather conditions, day and night. Essentially, PALSAR was SAR using an L-band frequency. The high resolution mode of PALSAR would support detailed regional observations and repeat pass interferometry. PALSAR also would include the Scan SAR mode covering about 250 to 350 kilometres, or about three to five times wider than conventional SAR images. These wider ScanSAR images were especially useful for rain forest monitoring.

UTILIZATION OF REMOTE SENSING FOR AGRICULTURAL STATISTICS

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141. The Seminar included a session focused on the discussion of country-specific activities such as estimation of crop planted area and yield and the construction of area frames currently underway in selected countries participating in the seminar. The participants also discussed their current activities, desires and future plans for application of remote sensing to agriculture statistics.

142. In Bangladesh, the need for an effective early warning system was highlighted. It was reported that the Ministry of Defence provided data for cyclone warnings and flood damage assessment. The Seminar was also informed of an on-going stuy on rice estimation for acreage and yield, but the results were not yet forthcoming. The need for further assistance from international donor community such as FAO and Japan for setting up a good system to support the use of remote sensing for agriculture surveys, estimation and early warning forecasts was expressed.

143. In Bhutan, it was indicated that a land use project using GIS generated the basic data for the whole nation by district and block. Remote sensing techniques were currently being used to update these data. Some staff members were receiving training outside the country. Some remote sensing maps have been acquired that highlighted mountain ranges. While the Statistics Unit, Ministry of Agriculture was trying to use these techniques, it was shared that difficulties existed for producing land use estimates in this mountainous country. The practice of multiple cropping in Bhutan would further limit its application.

144. In Cambodia, it was reported that the Ministry of Agriculture used remote sensing to produce detailed maps of land use for three provinces during the middle of the 1980s. From 1996 to 1997, the Department of Forestry in the Ministry of Forestry used remote sensing to identify forest areas.

145. In China, remote sensing was one of the most significant methodologies used for crop forecasting. It was being used to estimate crop areas and assess changes in various land resources, farm land, grass land, fallow land and other types of land use. Remote sensing was also being used in the estimation of crop yield, which included forecasting for corn, wheat and rice during the early stage of growth. It was also used as a supplementary method to validate results from sample surveys and other survey methods. It was also indicated that China involved various co-operative arrangements with other countries, including European countries. Two problems were highlighted, however -- high cost and the need for improved accuracy of yield forecasting.

146. Fiji received assistance from the Economic and Social Commission for Asia and the Pacific (ESCAP) in undertaking a survey on the application of remote sensing and GIS. The forestry division of the MoA was currently combining GIS and remote sensing technology and digital analysis of forest cover. Fiji was planning the establishment of GIS in agriculture.

147. In India, there was recognition of remote sensing as important for agriculture. Ine 1988 it launched its Indian Remote Sensing Satellite (IRS). Decisions about its subsequent use for agriculture statistics was incorporated in its initial plan featuring crop estimation, flood mapping and drought area monitoring. Remote sensing was currently used as a cross check for area and yield estimations of rice, wheat, sorghum, cotton,

rapeseed, mustard seeds, ground nuts and sugarcane. It was cited that achieving desired precision for mixed crops was difficult and should be the issue for the future. It was also reported that a special section was being formed to integrate all aspects of remote sensing and simulation methodologies for producing estimates, combining remote sensing data, agro-methodology parameters and land based observation through surveys or crop cutting.

148. Indonesia began studying the use of remote sensing during the early 1980s. A Satellite Assessment for Rice Production (SARI) was initiated in 1998 with assistance from the European Community to the Agency for Technology and Advancement, but the resulting estimate for rice area production was not yet available. The problems of cloud cover and of mixed cropping were highlighted and noted it limited the accuracy of results of remote sensing as compared to ground estimates. Big differences were cited in figures from studies in Java, where most of the rice production takes place.

149. In Lao People's Democratic Republic it was reported that remote sensing was used by the forestry department to assess forest cover. The desire for a pilot study was expressed, with support from the FAO, following completion of the agriculture census at the end of the year.

150. In Myanmar, it was reported that remote sensing was being used, but not for agriculture statistics. The availability of trained people and equipment was stressed, but the lack of data was cited, due to its cost, as the major factor limiting its use.

151. It was reported that Nepal had no programme for introducing remote sensing in agriculture statistics. The Seminar noted that there were plans for the inclusion of GIS in the next five year plan. It was added that the department of forestry had a project for assessing government forest. Land use mapping was another project focus associated with conduct of the population census in 2001.

152. In the Philippines, it was reported that a small experiment in the 1980s yielded inconclusive results and, as a result, remote sensing had not been used in the country. It was reported that the technology and trained people were available. However, the cost was formidable.

153. In Sri Lanka, it was indicated that Agricultural and Environmental Statistics Division, Department of Census and Statistics was responsible for producing crop production data. Rice estimates were somewhat sound, but there were problems with estimations for 60 to 80 highland crops. Technical assistance was requested for development of an area frame to meet the needs of planners for crop forecasts.

154. Vietnam acknowledged the importance of remote sensing for agriculture statistics, but the cost of technology was prohibitive. The desire for support for the initiation of a project on the use of remote sensing technology for the agricultural statistics was expressed.

155. The Seminar noted the diversity of responses from the participating countries. Some countries were at the stage of introducing remote sensing. Others were concerned about data accuracy from their satellite but many were concerned about the costs involved.

156. The Seminar acknowledged some positive features of using imagery to build frames for agricultural surveys. Unlike list frames which required frequent updating, a good area frame would remain stable and thus useful for many years. Furthermore, updating an area frame appeared to be easy when new images were used to identify what had changed. Updating an area frame thus become less time consuming than updating a list frame. It however emphasized that if remote sensing was to be used to validate ground data, images must be purchased annually. Many developing countries would not have the means to sustain the annual acquisition of images. Moreover the Seminar noted that while remote sensing offered some advantages, problems would arose from cloud cover, a common occurrence in South East Asia The Seminar further highlighted that remote sensing would not replace the need for surveys. The Seminar concurred that as recommended in the FAO report, the combination of area frame and list frame to form a multiple frame survey was useful. This combination would support a more precise estimate. Finally, the Seminar concluded that Governments should make decisions based on methodology that best fit their country and resources.

V APPENDIX

A Program

I. Focal Points Meeting of the Project
June 7 – 8, 1999

7 June 1999 (Monday)

09:00 - 09:30 hrs.	**Registration**
09:30 - 10:00 hrs.	**Inauguration** - Statement by Dr. Prem NATH, Assistant Director General, FAO/RAP - Statement by Mr. Masaaki SASAKI, Director, Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries of Japan as a donor country for the Project.
10:00 - 10:15 hrs.	Introduction of Meeting and Seminar and its Objectives Mr. Ryuki IKEDA, Agricultural Statistics Expert, GCP/RAS/171/JPN, FAO/RAP
10:15 - 10:45 hrs.	Coffee/Tea break
10:45 - 11:45 hrs.	**Session 1** Regional Perspective on Agricultural Statistics Mr. Hiek SOM, Senior Statistician, FAO/RAP
11:45 - 13:15 hrs.	Lunch
13:15 - 14:15 hrs.	**Session 2** Review of National Statistical Systems in the Asia and Pacific Countries: Preliminary Findings Mr. Ryuki IKEDA, Agricultural Statistics Expert, GCP/RAS/171/JPN, FAO/RAP
14:15 - 14:30 hrs.	Coffee/Tea break
15:00 - 16:30 hrs.	**Session 3** Discussion of Future Activities of the Project

8 June 1999 (Tuesday)

08:30 - 09:30 hrs.	**Session 4** Practical use of DataBase and Information Exchange Systems: FAO World Agricultural Information Center (WAICENT) Mr. Kurt VERTUCCI, Senior Officer, Systems Development Specialist, Technical Systems Group, Information Systems and Technology Division (AFIS), WAICENT, FAO Rome
10:00 - 10:15 hrs.	Coffee/Tea break
10:15 - 11:45 hrs.	**Session 5** Practical use of DataBase and Information Exchange Systems: FAO World Agricultural Information Center (WAICENT) Mr. Kurt VERTUCCI, Senior Officer, Systems Development Specialist, Technical Systems Group, Information Systems and Technology Division (AFIS), WAICENT, FAO Rome
11:45 - 13:15 hrs.	Lunch
13:15 - 14:15 hrs.	**Session 6** Introduction of Internet Homepage concerning Agricultural Statistics in participating countries (Introduction and Demonstration)
14:15 - 14:30 hrs.	Coffee/Tea break
14:30 - 16:00 hrs.	**Session 7** Practical use of Data Base and Information Exchange System (Discussion)

II. Seminar on Remote Sensing for Agricultural Statistics June 9 – 11, 1999

9 June 1999 (Wednesday)

08:30 - 09:30 hrs.	**Session 1** Introduction of Remote Sensing and Geographic Information System Dr. Lal SAMARAKOON, Senior Research Specialist, Asian Center for Research on Remote Sensing (ACRoRS)
09:30 - 10:30 hrs.	**Session 2** General Features of Area Sampling Frame Surveys and Other Operations Relating to Remote Sensing in the French Agricultural Statistics Apparatus

	Mr. Jean IOTTI, Agro Statistician, Service Central des Enquetes et des Etudes de l'Agriculture et la Peche, France
10:30 - 10:45 hrs.	Coffee/Tea break
10:45 - 11:45 hrs.	**Session 3** The Appropriate Role of Remote Sensing in U.S. Agricultural Statistics Mr. Robert HALE, Head, Area Sampling Frame Section, Research Division, National Agricultural Statistics Service, Department of Agriculture, U.S.A.
11:45 - 13:15 hrs.	Lunch
13:15 - 13:45 hrs.	**Session 4** Feasibility Study of Area Survey with Remote Sensing in Japan Mr. Hidemi KEIRA, Deputy Director, Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries, Japan.
13:45 - 14:45 hrs.	**Session 5** Crop Area Estimations Using Remote Sensing Dr. Sigeo OGAWA, Senior Researcher of Remote Sensing, National Institute of Agro-Environment Sciences, Ministry of Agriculture, Forestry and Fisheries, Japan.
14:45 - 15:00 hrs.	Coffee/Tea break
15:00 - 15:30 hrs.	**Session 6** Activities of Remote Sensing on Agricultural Statistics in Thailand Mr. Supan KARNCHANASUTHAM, Director, Center for Agricultural Information, Office of Agricultural Economics, Ministry of Agriculture and Co-operatives, Thailand
15:30 - 13:50 hrs.	**Session 7** Monitoring Crop Growth and Producing Yield Estimations by combining satellite data and a simulation model of growth Mr. Atushi TOMITA, Resercher of Remote Sensing, National Institute of Agro-Environoment Sciences, Ministry of Agriculture, Forestry and Fisheries, Japan

10 June 1999 (Thursday)

08:30 – 09:00 hrs.	**Session 8** Area Sampling Frame Construction- Fiji Experience Mr. Jone RATUVUKI, Senior Agricultural Assistant, Economic Planning & Statistics Division, Ministry of Agriculture, Fisheries & Forests, Fiji

09:00 - 09:30 hrs.	**<u>Session 9</u>** Remote Sensing as Applied to Agricultural Studies in Thailand Dr. Surachai RATANASERMPONG, Senior Scientist, National Research Council of Thailand (NRCT)
09:30 - 10:50 hrs.	**<u>Session 10</u>** Construction of Area Frame and Monitoring of Crop Growing Conditions Over a Large Geographic Across many Countries *Mr. John LATHAM, Environment and Natural Resources Service (SDRN), FAO/ HQ*
10.50 - 12:00 hrs.	Leaving for Asian Institute of Technology (AIT) from FAO RAP office
12.00 – 13.00 hrs.	Lunch
13:00 - 15:00 hrs.	**<u>Session 11</u>** Visit to Asian Center for Research on Remote Sensing (ACRoRS) of AIT.
15:00 – 16:00 hrs.	Back to FAO/RAP office from AIT

11 June 1999 (Friday)

08:30 - 09:00 hrs.	**<u>Session 12</u>** Application of RS/GIS in Ministry of Agriculture of Iran. Mr. Alireza MAJD, Chief of RS/GIS office, Agricultural Statistics & Information Department, Ministry of Agriculture, Iran.
09:00 - 09:30 hrs.	**<u>Session 13</u>** Japanese Remote Sensing Activity Dr. Masahiko HONZAWA, Deputy Senior Research Scientist, Thailand Liaison Office, Remote Sensing Technology Center (RESTEC) of Japan
09:30 - 09:45 hrs.	Coffee/Tea break
09:45 - 11:30 hrs.	**<u>Session 14</u>** Utilization of Remote Sensing for Agricultural Statistics. (Discussion)
11:30 - 11: 45 hrs.	Closing Session

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C List of documents

1 Inauguration

- Opening statement
- Statement by the delegation of Japan
- Programme for the first meeting of focal points for the project and seminar on remote sensing for agricultural statistics

2 First meeting of focal points, 7 to 8 June 1999

Session 1	Regional perspective on agricultural statistics in Asia and the Pacific
Session 2	Review of current national statistical systems in Asia and Pacific countries: Preliminary findings

3 Seminar on remote sensing for agricultural statistics, 9 to 11 June 1999

Session 2	General features of area sampling frame surveys and other activities using remote sensing for agricultural statistics in France
Session 3	Appropriate role of remote sensing in agricultural statistics of the United States of America
Session 4	Feasibility study of area surveys with remote sensing in Japan
Session 5	Crop area estimations using remote sensing
Session 6	Activities of remote sensing on agricultural statistics in Thailand
Session 8	Area sampling frame construction – Fiji experience
Session 10	Enhancing agricultural information systems in developing countries
Session 12	Application of remote sensing and geographical information systems in Ministry of Agriculture of Iran
Session 13	Japanese Remote sensing activities of Japan

D Opening statement

Dr Prem Nath
FAO Assistant Director-General and
Regional Representative for Asia and the Pacific

Distinguished Delegates,
FAO Colleagues,
Ladies and Gentlemen,

It is my great pleasure to extend to you a warm welcome to the First Meetings of Focal Points and Seminar on Remote Sensing for Agricultural Statistics. All staff of the FAO Regional Office for Asia and the Pacific will do their best so that the meeting and seminar will proceed as smoothly as possible.

As you know, the meeting and seminar is held under the FAO Regional Project "Improvement of Agricultural Statistics in Asia and Pacific Countries" (GCP/RAS/171/JPN). This is the first opportunity for focal points from participating countries to get together under the project. I note however that not only focal points of the project but also many resource persons and observers from advanced countries, international organizations and the FAO are kindly gathering here. Some more experts will join the forum later in the week.

At the outset, I would like to inform you that Mr Ladislav Kabat, Director, FAO Statistics Division, Rome expressed keen interest in the meeting and seminar. He conveyed his greetings to all the participants, especially the representatives from the donor country of this project, Japan. He is confident that the strong FAO team at this meeting - composed of headquarters, regional office and project staff - will make useful contributions to the future activities of the project.

(Introduction of the project)

Many of you will remember that this project was formulated following a recommendation of the sixteenth session of the Asia and Pacific Commission on Agricultural Statistics (16^{th} APCAS), held in Tokyo, Japan, in October/November 1996. At the session, the importance of strengthening co-operation and the establishment of a system for collection and dissemination of statistics among member countries of the Commission were discussed. Japan expressed willingness to contribute in this matter and offered a budget for a trust fund project to be executed by the FAO.

As a result, this project was approved and it actually started its activities in September 1998. Today delegates of Japan are also present here. I would like to express, through them, FAO's appreciation to the Japanese Government for funding the project.

The two objectives of this project are:

1) Study national systems of food and agricultural statistics, organising national/regional seminars on production and use of agricultural statistics, and national/regional workshops on specific areas; and

2) Formulate a plan for the establishment of a database and equipment facilities to provide a capability to transfer data in electronic format both to and from countries in the region, and the FAO, using common concepts, standards and classifications.

The meeting of focal points and the seminar on remote sensing will contribute to both objectives.

Over the last several years, a number of country projects have been implemented at national level by the FAO and other international organizations. This regional project is the first one to include most countries in our region in the field of agricultural statistics, after the previous project covered twelve Pacific countries one decade ago.

Currently many issues on agriculture concern international matters, such as trade, environment, freedom from hunger, and so on. Accurate figures indicated by good statistics can greatly contribute to finding solutions on these matters. Demand for accurate and comparable statistics among countries will be ever increasing. In this connection, I expect that this project will eventually contribute to meet these needs.

(Purpose of the Meeting and Seminar)

In the First Meeting of Focal Points, future project activities at country and regional level will be discussed. And as part of the second objective for the project, utilisation of data exchange systems, such as databases and the Internet, will be presented.

At the Seminar on Remote Sensing for Agricultural Statistics, results of latest research, present state of application in some member countries will be reported. As you know remote sensing technique can allow us to obtain data or information on vast geographic areas. It has been studied in various fields of application in the world. In the field of agricultural statistics, many studies have been conducted at local, national or regional levels. Nowadays, remote sensing is actually used in agricultural surveys, for example on land utilisation, planted area and so on. However, there are still many issues or problems to be solved before remote sensing technique become fully operational in agricultural statistics.

Experiences and experiments carried out outside our region will also be presented at the seminar.

(Closing)

Finally I would like to encourage you to be frank during your discussions. I expect that the meetings will be beneficial not only to the project but also to your countries and the whole region of Asia and the Pacific.

My best wishes for a fruitful meeting with positive outputs and for an enjoyable stay in the City of Bangkok.

Thank you.

E Statement by the Delegation of Japan

Mr Masaaki Sasaki
Director, Office of International Affairs
Statistics and Information Department
Ministry of Agriculture, Forestry and Fisheries of Japan

Mr Chairman,
Dr Prem Nath, Assistant Director General of FAO, Regional Representative of RAP,
Distinguished Delegates,
Ladies and Gentlemen:

It is my great pleasure to be able to give this statement at the opening of the First Meeting of Focal Points for the project on behalf of the Statistics and Information Department of Ministry of Agriculture, Forestry and Fisheries of Japan.

Taking this opportunity, I would like to explain the original idea of the project and needs of international co-operation in the field of agricultural statistics in this region.

Many persons attending here remember the 16th session of the Asia and Pacific Commission on Agricultural Statistics (16^{th} APCAS) held in Tokyo in 1996. At that session, we discussed the future development of the agricultural statistics and mutual co-operation among member countries. The outline of it was as follows.

Deepening of globalisation in the area of agriculture

As the globalisation of socio-economic activities is intensifying interdependence, every country is strengthening relationships with its neighbours and its trade partners in the world. As evidenced by the recent currency crisis in Asia that impacted on the world economy, today no single economy can exist alone. In the field of agriculture, trade in agricultural products has been expanding rapidly during recent years.

A bad harvest (being caused by natural disaster such as flood, drought or cold weather) in any agricultural area in the world will likely trigger a deficiency in grain supply on the international market and, in turn, contribute to confusion about world agricultural trade. We also should not ignore the enormous impact of El Nino on agricultural production in some countries. As a result, a balancing of the supply of food and the demand for food on a world-wide basis is a prerequisite both for ensuing an adequate supply of food and for stabilising this food supply in each country.

Challenges for agricultural statistics

Statistics were originally conducted to meet the needs of national policies. They also have been utilised for socio-economic development in each country. Agricultural statistics is thus playing an important role as an indispensable guide to implementation of policies for agriculture, for development of rural area, for ensuring adequate supplies of food to the people, and for achieving sustainable growth of the national economy.

With the recent increase in trade of agricultural products, every country must effectively utilise statistical data about overseas production and for prices on the international market. It is also necessary for countries to share agricultural statistics as a guide to problem solving, such as the stabilisation of food supplies and achieving its balance with demands for food, and preservation of the environment on a global basis.

Problems confronting statistical organizations

In many developing countries, satisfactory ranges of statistical surveys in agriculture have not yet been carried out due to financial, organizational, or technical limitations. This inadequate supply of accurate and reliable statistics makes it difficult for many countries to develop their agriculture, forestry and fisheries sector of the economy.

Developed countries, such as Japan, are facing a series of problems in conduct of statistical surveys in agriculture due to the combination of changing needs for statistics and increasing financial limitations. In response, these countries are forced to reduce both the operational costs and the number of staff engaged in conduct of statistical surveys.

Roles of the FAO and APCAS

The FAO extends a wide range of technical assistance to Member Nations for addressing these problems. As complement to these, the Asia and Pacific Commission on Agriculture Statistics (APCAS) plays an important role by providing a forum for these nations to meet and exchange views and opinions about the improvement of agricultural statistics in the region. However, APCAS meets only every other year and, as a result, it is virtually impossible for it to furnish a sufficient forum for this purpose.

Purpose of the project

In response to this recognition, the Government of Japan decided to contribute a trust fund to the FAO for conduct of this project. The aim of this regional project is to promote discussions among Member Nations leading to formulation of an action plan, whereby participating countries would co-operate in the area of agricultural statistics, including the improvement of these statistics and the establishment of an information exchange system.

The Government of Japan also has dispatched a staff member from the Department of Agriculture, Forestry and Fisheries to the FAO Regional Office for Asia and the Pacific in Bangkok to take an active part in the project. Even though its financial resources are inadequate, we envisage this regional project as a trigger, or initial action, leading to our future co-operation.

Closing

Every country has its own social system and agriculture based on their history, traditions or climatic conditions. Participating countries thus produce diverse crops, raise different animals and engage in a variety of farming patterns. Even so, the basic ideas and theories for statistics and methods of statistical surveys are universal. An inevitable consequence of this universality yields research findings and statistical developments in each country that can be shared with other countries. Rather, these must be shared.

This recognition of agricultural statistics as belonging not only to one nation but also to all the people (in all nations) on this planet means we must share its technology and its knowledge across our national borders. We thus must co-operate with one another.

Thank you.

F Remote sensing satellites

Name of satellite *Type of satellite data*	***Resolution*** *metres*	***Dimension of scene*** *kilometres*	***Number of Bands***	***Suggested Presentation Scale***
ERS-1 *European Remote Sensing Satellite*				
Radar	28.5	100 x 100	1	1: 50 000
IRS-1 *Indian Remote Sensing Satellite*				
Panchromatic	5	23 x 23, 70 x 70	1	1: 25 000
Multispectral	20	70x70;1400x140	4	1: 50 000
GMS-5 *Geostationary Meterological Satellite*	1 250 to	full		
Visible & Infrared Spin Scan Radiometer	5 000	hemisphere	4	1: 2 500 000
JERS-1 *Japanese Earth Resources Satellite*				
Radar	18	75 x 75	1	1: 50 000
Landsat *Land Remote Sensing Satellites*				
Landsat 5 Thematic Mapper (TM)			7	
Multispectral	30	185 x 185	6	1: 50 000
Thermal infrared	120	185 x 185	1	1: 200 000
			8	
Landsat 7 Thematic Mapper (TM)				
Multispectral	30	185 x 185	6	1: 50 000
Panchromatic	15	185 x 185	1	1: 25 000
Thermal infrared	60	185 x 185	1	1: 100 000
Meteosat *Meteorological Satellite*			3	
Visible	2 500	full	1	1: 2 500 000
Infrared water vapour absorption	5 000	:	1	1: 2 500 000
Thermal infrared	5 000	hemisphere	1	1: 2 500 000
NOAA *National Oceanic and Atmospheric Administration*				
Multispectral	1 100	4 200 x 4 200	5	1: 2 500 000
Radarsat *Radar Satellite*				
SAR (Synthetic Aperature Radar)				
Fine beam	8	50 x 50	1	1: 25 000
Standard beam	25	100 x 100	1	1: 75 000
Wide beam	30	150 x 150	1	1: 100 000
SCANSAR (Synthetic Aperature Radar Scanner)				
Narrow beam	50	300 x 300	1	1: 150 000
Wide beam	100	500 x 500	1	1: 250 000
SPOT HRV 1,2,3 *Satellite Pour L'Observation de la Terre (Earth Observation Satellite)*				
HRV (High Resolution Visible)				
Panchromatic	10	60 x 60	1	1: 25 000
Multispectral	20	60 x 60	3	1: 50 000
SPOT HRVIR 4 *Satellite Pour L'Observation de la Terre (Earth Observation Satellite)*				
HRVIR (High Resolution Visible and Infrared)				
Panchromatic	10	60 x 60	1	1: 25 000
Multispectral	20	60 x 60	3	1: 50 000
Passenger vegetation	1 000	1 000 x 1 000	4	1: 1 000 000

G Abbreviations and acronyms

ACRoRS
Asian Centre for Research on Remote Sensing

ADEOS
Advanced Earth Observing Satellite

AIT
Asian Institute of Technology

ALOS
Advanced Land Observing Satellite

AFRICOVER
Land Cover Map and Geodatabase for Africa

APCAS
Asia and Pacific Commission on Agricultural Statistics

ARTEMIS
Africa Real Time Environmental Monitoring Information System

ASF
Area sampling frame

AVHRR
Advance Very High Resolution Radiometer

AVNIR
Advanced Visible And Near-Infrared Radiometer

BBS
Bangladesh Bureau of Statistics

CASS
Computer Assisted Stratification and Sampling

CBS
Central Bureau of Statistics

CCD
Cold Cloud Duration

DCS
Department of Census and Statistics

DEM
Digital Elevation Model

EA
Enumeration area

ERF
Estimated rainfall

ERS
European Remote Sensing Satellite

ESCAP
Economic and Social Commission for Asia And the Pacific

ESSS
Statistical Development Service (FAO, Rome)

Eurostat
Statistical Office of European Communities

Eumetsat
Europe's Meteorological Satellite Organization

FAO
Food and Agriculture Organization of the United Nations

FAOSTAT
FAO Statistical Database

WAICENT
World Agricultural Information Centre (FAO, Rome)

FIVIMS
Food Insecurity and Vulnerability Information and Mapping System

GIS
Geographic Information Systems

GMS
Geostationary Meterological Satellite

GPS
Global Positioning System

HRV
High Resolution Visible

HRVIR
High Resolution Visible and Infrared

IRS
Indian Remote Sensing Satellite

JICA
Japanese International Co-operation Agency

JERS
Japanese Earth Resources Satellite

LAI
Leaf Area Index

Lansat
Land Remote Sensing Satellite

LCCS
Land Cover Classification System

MAFF
Ministry of Agriculture, Forestry and Fisheries

MARS STAT
Monitoring Agriculture with Remote Sensing

Meteosat
Meteorological satellite

MoA
Ministry of Agriculture

MoAC
Ministry of Agriculture and Co-operatives

MOS
Marine Observation Satellite

MSS
Multispectoral Scanner

NASDA
National Space Development Agency

NASS
National Agricultural Statistics Service

NDVI
Normalised Difference Vegetation Index

NOAA
National Oceanic and Atmospheric Administration

NRFD
Number of rainfall days

NSO
National Statistical Office

NRCT
National Research Council of Thailand

OAE
Office of Agricultural Economics

OCTS
0cean Colour and Temperature Scanner

PALSAR
Phased Array type L-band Synthetic Aperature Radar

PRISM
Panchromatic Remote Sensing Instrument For Stereo Mapping

PSU
Primary sampling unit

Radarsat
Radar satellite

RAP
Regional Office for Asia and the Pacific (FAO)

RESTEC
Remote Sensing Technology Centre

SAR
Synthetic Aperature Radar

SARI
Satellite Assessment for Rice Production

SCANSAR
Synthetic Aperature Radar Scanner

SCEES
Central Service for Statistical Surveys and Studies

SDRN
Environment and Natural Resources Service

SEAFA
System of Economic Accounts for Food and Agriculture

SNA
System of National Accounts

SPOT
Satellite for Earth Observation (Satellite Pour l'Observation de la Terre)

SWIR
Short Wave Infrared Radiometer

TERUTI
Land Use and Land Cover Survey (Enquete sur l'utilisation du territoire)

TM
Thematic Mapper

VNIR
Visible and Near-Infrared Radiometer

YMI
Yield Moisture Index