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Technical Report 18

IMPROVING FOOD AND AGRICULTURAL PRODUCTION

THAILAND

FERTILIZER EXPERIMENTS -
DATA ANALYSIS AND INTERPRETATION OF RESULTS



UNITED NATIONS DEVELOPMENT PROGRAMME



INTERNATIONAL ATOMIC ENERGY AGENCY

VIENNA 1991

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**FERTILIZER EXPERIMENTS -
DATA ANALYSIS AND INTERPRETATION OF RESULTS**

Report prepared for
the Government of the Republic of Thailand

by

the International Atomic Energy Agency
acting as Executing Agency for
the United Nations Development Programme

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ABSTRACT

Name of expert : Dr. Larry A. Nelson date : 14 September 1990

Title of Report : FERTILIZER EXPERIMENTS - Data Analysis and Interpretation
of Results

At the request of the Department of Agriculture, Government of Thailand, Dr. Nelson under the auspices of IAEA undertook a 21 day assignment from August 24 September 16, 1990, under the project, "Improving food and agricultural production with nuclear and related technology". Emphasis of the mission was on training staff of the Department of Agriculture and related institutions with regard to proper design of experiments, and analysis and interpretation of data. This training was carried out both in a classroom lecture format and also on a one-to-one basis with researchers. The goal was to emphasize good experimental design and technique and to introduce more advanced computing techniques to the Department of Agriculture staff. The sharing of data-handling facilities and existing techniques among the cooperating institutions was emphasized. Excellent facilitations made possible by the staff of the Isotope Laboratory of the Department of Agriculture were invaluable in reaching the appropriate institutions and individuals.

The following recommendations were made:

1. The expertise for designing experiments properly, and for analyzing and interpreting the results exists in the present

agricultural research institutional setting in Thailand, but it needs to be strengthened through more close cooperation of individuals who are engaged in the statistical and computing activities. This includes all agencies involved in nuclear research in agriculture as well as related institutions.

2. The preparation which Mrs. Amphai Satrusayang has made for computing, data analysis, and interpretation both in Thailand and during her study-leave for two months to North Carolina State University has provided her with the background necessary for doing the type of analyses and interpretation needed in the Isotope Laboratory. Now, more staff of the Laboratory need to spend time with her learning more about SAS and how it may be used to perform the analyses needed in the Laboratory. The SAS package will handle most of the computing needs of the project, but the staff needs to be very familiar with its operation. There should be at least two more individuals familiar with the operation of SAS to perform the Laboratory's analyses in addition to Mrs. Amphai. Two good possibilities are Mrs. Jittiwan Mahisarakul and Miss Chantana Siripaibool.
3. A new personal computer is needed in the Isotope Laboratory to replace the currently-used IBM 8088 PC. This currently used computer has only 5 1/4 " floppy disk drives and it is very slow. The new computer should have at least 2 MEG of RAM and a 40 MEG hard disk. Its processor preferably would be a 386 or 386SX. This will speed up statistical computing considerably and allow statistical packages to be stored

permanently on the hard disk. It will also provide for the possibility of two individuals to perform statistical analysis simultaneously, and also one hard disk based computer will serve as a back-up for the other in case of mechanical failure.

4. Continued technical assistance from specialists in Statistics and data processing to the Isotope Laboratory and cooperating organizations is encouraged as circumstances and resources permit.

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I. INTRODUCTION

A. Terms of Reference : Data processing and interpretation of data.

B. Background Information :

Status of work : The key point here is that in view of my impending assignment, the Isotope Laboratory in cooperation with the Project THA/85/004 sent Mrs. Amphai Satrusajang to the Statistics Department of North Carolina State University in Raleigh for two months during the Spring of 1990, and also obtained a 286-based computer capable of handling statistical analyses. My familiarity with Mrs. Amphai's training there in North Carolina and the availability of the new computer were very helpful in my work in Thailand. Mrs. Amphai is now very well prepared to proceed with the data phase of the Isotope Laboratory and for the responsibility of training others through her expertise in this area.

Another note that should be mentioned is that I spent six months in Thailand in 1974 working on Statistics, Data Analysis and Interpretation at Kasetsart University in the Department of Statistics. Contacts made then and background knowledge gained on the local setting were very helpful to my responsibilities during this return visit.

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II. WORK PROGRAMME

1. I presented informal training courses to the staffs of the Isotope Laboratory, Division of Agricultural Chemistry; the Statistics Section of the Planning Division; Soil Fertility Section, Division of Soil Science; Field Crops Research Institute; Ubonrajthani Rice Research Centre; and the Department of Soil Science of Kasetsart University on the following topics :

- The Interface Between Computing and Statistics in Agronomic Research
- The Importance of Planning in the Design of Experiments
- Experimental and Treatment Design of Fertilizer Response Studies
- Thirty Most Often Asked Questions to Statistical Consultants (with Answers)
- Analysis and Interpretation of Fertilizer Response Data (Including Economic Interpretation)

Approximately thirty persons were present for each lecture. Emphasis was on the applied aspects and an effort was made to maximize discussion so that I could learn the relevant issues in data analysis and interpretation in the organizations involved and address them.

Three all-afternoon sessions which were laboratories for selected students attending the above lectures were held. These focussed upon the use of the SAS microcomputer package for analyzing biological and agricultural data. Four computers

having hard disk drives and the SAS program were used to analyze six different data sets which were typical of the data sets which the students might encounter in the future. Students worked in groups of three per computer to gain hands-on experience in the operation of the computers and SAS. Unfortunately we did not have enough computers for all students attending the morning sessions to participate in the afternoon laboratories.

II. August 29, 1990. A meeting was held with selected staff of the Statistics Section, Planning Division, Department of Agriculture concerning design of experiments, data processing, and interpretation of data. I noted a definite need for more microcomputers in this facility. (approximately 10 individuals present).

III. September 7, 1990 I met with selected staff (as a group) of the Chiang Mai Field Crops Research Centre at Mae Jo, near Chiang Mai to answer questions about experimental design, data processing, and interpretation of data.

IV. September 7, 1990 I provided the staff and faculty of Chiang Mai University and related agricultural research agencies in the Chiang Mai area with a lecture on the topic :

The Interface Between Computing and Statistics in Agronomic Research.

Forty individuals were present at the lecture.

V. Consultations were carried out with individual members of the staff of the Isotope Laboratory. These dealt with design of

experiments for the future and analysis and interpretation of existing and future data. Individuals were as follows :

Mrs. Pornpimol Chaiwanakupt - Statistical aspects of her joint paper, "Evaluation of the Appropriate Non-N₂-fixing Species to Quantify Nitrogen Fixation by Soybean Using the ¹⁵N Isotope Dilution Method" which is to be presented in the forthcoming symposium in Vienna, Austria in October, 1990. I also prepared two SAS computer programs for her to make necessary ¹⁵N calculations and analyses of variance of the resulting data on the Isotope Laboratory computer using SAS.

Mrs. Jittiwan Mahisarakul - Design of rotation experiments and also a training session in the use of SAS.

Dr. Sakorn Pongphan - Design of an experiment for measuring the effects of urease inhibitor.

VI. I consulted with Mr. Sootin Claimon of the Soil Science Division, Department of Agriculture, Bangkok on the analysis and interpretation of a set of fertilizer response data using linear-plateau models. We developed some model computer programs which he may use in the future for similar data.

VII. September 12, 1990 I presented an informal lecture to the staff and faculty of the Department of Statistics, Kasetsart University, staff of the Statistics Section, Department of Agriculture and staff and faculty of various departments in the Natural Sciences, Kasetsart University. The topic of the lecture was : "The Role of Statistics in Research Focussed on the Natural Sciences".

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I also presented two informal lectures to the staff and faculty of the Department of Statistics, Kasetsart University and the staff of the Statistics Section, Division of Planning, Department of Agriculture. The topics were as follows :

"Some Current Challenges to the Statistics Profession"

"The Changing Nature of Statistical Consulting on the University Campus"

Discussion of the current status of the statistics and the computing situation in Thailand followed and I made suggestions on how certain needed changes in the Statistics profession in Thailand might be implemented.

VIII. A brief visit was made to the Department of Product Development, Faculty of Agro-Industry, Kasetsart University to meet with graduate students concerning data analysis and interpretation. Some twenty students along with their faculty advisors attended.

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III. CONCLUSIONS AND RECOMMENDATIONS

A. Government

The obvious lack in computing equipment is the key item in the governmental agricultural research organizations with which the government should be concerned. The most obvious deficiency is in the Statistics Section of the Division of Planning, Department of Agriculture. It is very striking the number of analyses which are being required of this group as opposed to the very limited computing facilities available. This is a deficiency which should be taken care of very soon by the government.

B. Counterpart Institutions

More cooperation of the Kasetsart University Statistics Department with agricultural research organizations is recommended. This will help strengthen both the agricultural research in the country and also the staff and faculty of the Department of Statistics. There are some well - trained individuals in that Department who have specialized in Experimental Design but they are not interacting very much with the agricultural research organizations in the country outside of the University.

C. Agency

It is very important that the project be extended so that research which has been started can be brought to a successful conclusion and so that promising new projects might be carried

out. Much of the data analysis and interpretation will be necessary during the period of the proposed extension. Without the extension, this data phase would be given inadequate emphasis.

A new personal computer is needed in the Isotope Laboratory. The model recommended is a 386 based machine with a minimum of 4 MEG of RAM and a 40 MEG hard disk. This will augment the existing 286 machine and will replace the existing IBM PC which has become outdated for statistical purposes.

More interaction of Isotope Laboratory staff concerning computing and data handling aspects of the research is needed. The expertise is available in the Laboratory in Mrs. Amphai Satrusayang but she needs to train others in the Laboratory to handle the data analyses which are generated by the research efforts. Two individuals who should work closely with her on the data activities are Mrs. Jittiwan Mahisarakul and Miss Chantana Siripaibool.

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APPENDIX 1

NAMES OF RESEARCHERS ATTENDING THE LECTURES ON STATISTICS

BY DR. LARRY A. NELSON, STATISTICAL CONSULTANT

3-7 SEPTEMBER 1990

Statistics Section , Planning Division, Department of Agriculture

1. Mr. Suthiraporn Sirisingh
2. Mr. Sunantha Vesa-u-rai
3. Ms. Sauvanee Pisithapan
4. Ms. Vichitra Polyeam
5. Ms. Suvaree Pimsarn
6. Ms. Chantana Sornsiri
7. Ms. Suchada Nakatut
8. Ms. Nongyao Oonyawong

Isotope Laboratory, Division of Agriculture Chemistry,
Department of Agriculture

9. Ms. Chantana Siripaibool
10. Ms. Chittivan Mahisarakul
11. Ms. Amphai Satrusajang
12. Ms. Chitra Claimon
13. Ms. Pornpimol Chaiwanakupt
14. Dr. Sakorn Phongphan
15. Ms. Vimol Pinpaitoon

Fertilizer Testing Laboratory, Division of Agricultural Chemistry
Department of Agriculture

16. Ms. Wasana Yuwadee

17. Mr. Manop Mankosol

Soil Fertility Section, Division of Soil Science, Department of
Agriculture

18. Mr. Suthin Claimon

19. Mr. Sathien Pimsarn

20. Ms. Panjaporn Lerdrat

21. Mr. Pairoj Punpruk

22. Mr. Veerapol Chatchavalwongse

23. Mr. Monthien Jinda

24. Mr. Jirapon Prasitket

25. Mr. Dom Hanpichitvitaya

Field Crops Research Institute, Department of Agriculture

26. Dr. Chinda Jan-on

27. Mr. Sathit Areeruk

Ubonrajthani Rice Research Centre, Department of Agriculture

28. Ms. Somchit Kuntasuwan

Soil Science Department, Kasetsart University

29. Mr. Suradej Chintaganon

Department of Product Development, Kasetsart University

30. Ms. Savitree Chantranuruk

Chainat Field Crops Research Center, Department of Agriculture

31. Mr. Boonnom Oonkasem

32. Mr. Anat Watanasit

33. Mr. Matana Srihatakam

Horticulture Research Institute, Department of Agriculture

34. Mr. Surapong Chareonrat

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APPENDIX II

Names of persons met and institutions

Dr. Patoom Snitwongse

National Chief Technical Advisor, THA/85/004 :

Department of Agriculture :

Isotope Laboratory, Agricultural Chemistry Division:

1. Ms. Pornpimol Chaiwanakupt
2. Ms. Amphai Satrusajang
3. Ms. Jittiwan Mahisarakul
4. Dr. Sakorn Phongphan

Field Crops Research Institute :

1. Dr. Jinda Jun-ond
2. Mr. Tianchai Arayangkul
3. Mr. Wichit Kajornmalee
4. Mr. Viroj Vajanarnrach

Statistics Sub-division, Planning and Technical Division:

1. Ms. Sanga Duangratana - Head
2. Ms. Saowanee Pisithpun

Soil Science Division:

1. Mr. Sootin Claimon
2. Mr. Sathien Phimsarn

Kasetsart University:

Statistics Department :

1. Dr. Surin Niyamangkul - Head

Chiang Mai University :

1. Dr. Preuk
2. Dr. Suchart Jirapornchareon
3. Dr. Dusit Manajuti
4. Dr. Chatree Siddhikul