PN-AAX-079

NERAD PROJECT METHODOLOGY DOCUMENTATION SERIES

WORKING PAPER NO. M1

# A CROPPING SYSTEMS TECHNOLOGY DEVELOPMENT PROCESS: THE NERAD MODEL


PREPARED BY:

IAIN A. CRAIG, CROPPING/FARMING SYSTEMS SPECIALIST, NERAD

CHALERM SUKAPONG FARMING SYSTEMS RESEARCH INSTITUTE, DOA

SONGSAK SURATIKUL, PLANNING, DIVISION DOAE.


APRIL 1986


NORTHEAST RAINFED AGRICULTURAL DEVELOPMENT ( NERAD ) PROJECT

NORTHEAST REGIONAL OFFICE OF AGRICULTURE,

THA PHRA, KHON KAEN 40260, THAILAND.

NERADICS/ PCE-5001-0530

# PREFACE

This document has been printed and distributed by the Northeast Rainfed Agricultural Development Information and Coordination System (NERADICS) of the NERAD Project. The purpose of NERADICS is to establish, at the Northeast Regional Office of Agriculture, a system to manage Project-generated data and information in order to support the testing, transfer and dissemination of technologies, methodologies and approaches appropriate for integrated agricultural research and development in Northeast Thailand.

Technical working papers are produced with the objective of communicating project-generated information to the relevant research and development agencies in order to receive comments and feed-back and to help to ensure that the lessons learned within NERAD are made available to all interested individuals and organizations.

Working papers are produced on a number of topics and are grouped into three series according to their subject matter:

Technology Documentation Series

Documentation of technologies considered appropriate for rainfed agricultural development in Northeast Thailand

Methodology Description Series

Descriptions and methods of use of proven methodologies and techniques for the planning, analysis and evaluation of research and extension activities for rainfed agriculture.

Problem Definition Series

Situation papers on the problems or constraints currently facing rainfed agriculture and farm families in Northeast Thailand.

All papers in these series are listed in the Appendix of this report and are available on request from the Project Director. The papers are updated at appropriate intervals and NERAD invites comments and discussion from readers on any topic covered in the reports.

# A Cropping Systems Technology Development Process: the NERAD Model

## BACKGROUND AND OBJECTIVES

In the early years of NERAD many problems were encountered in designing, implementing and evaluating the cropping systems research and extension trials. The major problems included:

- Very little use was made of existing data and information during the planning stage for the cropping system trials.
- Technologies tested usually emphasized yield maximization and were often inappropriate for meeting the real needs of the farmers.
- There were no practical, clearly documented methodologies for conducting on-farm trials compatible with the resources of the responsible agencies.
- The collection and analysis of data from the trials was generally considered unimportant.
- There was completely inadequate documentation and use of data generated by the trials.
- There was little or no integration of the research and extension phases of the trials towards a common goal in a mutually supportive manner.

This document describes the overall process being developed within NERAD in an attempt to overcome these problems and to improve integration between the departments responsible for agricultural research (DOA) and agricultural extension (DOAE). It summarizes the status of the progress made within the project in developing such a process and presents it to interested parties in order to receive suggestions on how to improve it. Most important in this respect is feed-back from DOA and DOAE officials on its compatibility with their regular programs in order to refine the process or components of it into a form appropriate for every day use.

Although the process documented here was designed for cropping systems technology development, it is considered appropriate for the development of any agricultural technology. With minor

modifications it could be used for the development of: fruit-tree, forestry, sericulture, fish and livestock production and water resource development technologies.

Some cropping systems technologies within NERAD have now reached the multi-location phase of the development process but an entire cycle has not yet been completed for any technology. Consequently, the characteristics of the later phases presented here are still unproven by NERAD and are described in only general terms.

## DESCRIPTION AND METHOD OF USE

A diagramatic representation and definitions of each phase of the process are contained in Figure 1 and Table 1, respectively and more detailed characteristics of the phases are described in Table 2.

There are 3 key characteristics of the process which are considered essential for its success. First, it is a two way flow: technologies are tested, screened and improved at each stage of the process but information gained at each phase also 'feeds back' to previous phases. Secondly, the process is iterative and does not end with farmer adoption of the improved technology; as new technologies are adopted by farmers on a large scale, then new constraints will emerge as the farming system is adjusted to incorporate the improved technology. This will require identification of new problems and the process will begin over again. Finally, it must be flexible, as NERAD gains experience in utilizing the process, it will be continually improved and adjusted according to the lessons learned in each phase.

Figure 1. Cropping Systems Developmen

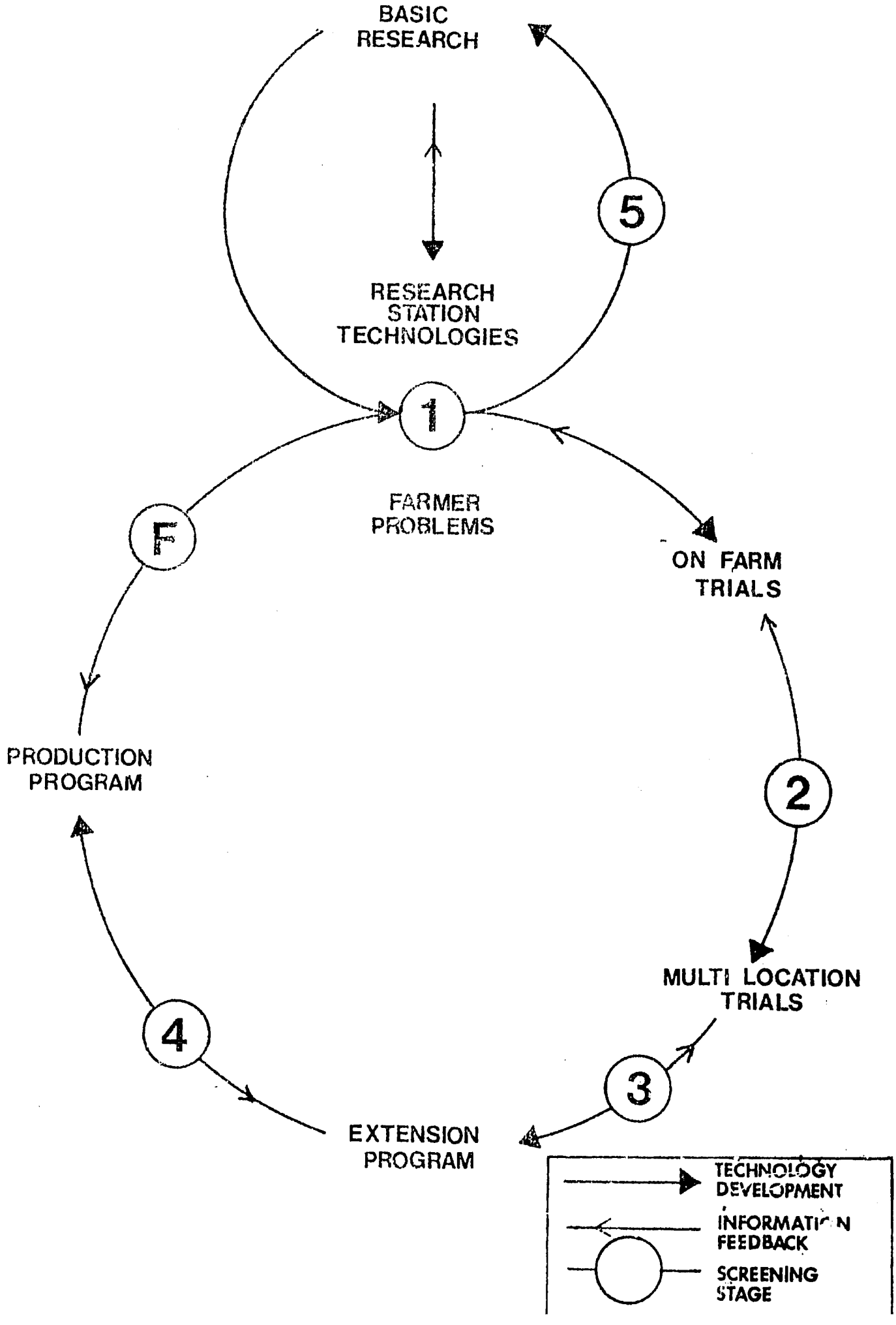


TABLE 1 DEFINITIONS OF THE VARIOUS PHASES OF NERAD'S CROPPING SYSTEMS DEVELOPMENT PROCESS.

| | |
|---|---|
| FARMER PROBLEMS | Problems that are significantly reducing the productivity or profitability of crop production systems OR constraints that are critically limiting development opportunities which are experienced by a significant proportion of farmers in the target area. |
| RESEARCH STATION TECHNOLOGIES | Currently available technologies that have been successfully tested on the local research station. |
| BASIC RESEARCH | Fundamental research within any discipline with the objective of discovering new techniques or solving problems associated with current technologies. |
| ON FARM TRIALS | A test of a research-improved technology in a farmer's field conducted jointly by a researcher and the farmer. The farmer supplies labor and makes some day to day decisions but management is essentially under the control of the researcher who also supplies all inputs |
| MULTI-LOCATION TRIALS | Extension and farmer testing of promising on farm trial technologies in farmers fields conducted jointly by extension, research and farmers under the leadership of extension. Technical advice and some essential inputs are supplied but the farmer is expected to make most management decisions himself and supply some of the input costs. |
| EXTENSION PROGRAM | A full extension campaign through demonstrations, field days, radio broadcasts, etc. to inform farmers about promising technologies from the multi location phase and to monitor farmer adoption patterns of the technology. |
| PRODUCTION PROGRAM | A program to match production potential in that area with market capacity through credit and market support programs,etc. in a way that best integrates local production patterns with national policy objectives. |

Table 2. Key Characteristics of Each Phase of NERAD's Cropping Systems Development Process

| Key Characteristic \ Development Phase | BASIC RESEARCH | RES. STN. TRIALS | ON-FARM TRIALS | MULTI-LOCATION TRIALS | EXTENSION PROGRAMS | PRODUCTION PROGRAM |
|---|---|---|---|---|---|---|
| EXAMPLES: | Breeding/lab work/ physiological studies | Varietal screening/ Planting-date studies | Cropping pattern testing with superimposed treatments | Farmer testing of promising technologies | Extension of promising technologies | Accelerated adoption from proven technologies |
| IMPLEMENTATION | DOA Technical Divisions/Institutes | DOA Institutes | DOA (FSRI)/DOAE | DOAE/DOA (FSRI) | DOAE | CPD/DOAE |
| SUPPORT | Feedback: DOA Institutes FSRI | Technical support: Technical Divisions other DOA Institutes Feedback: DOA (FSRI)/DOAE | Technical support: DOA Market Analysis: DCP/OAE ECON Data Analysis: OAE Feedback: DOAE/Farmers | Technical support: Technical Divisions DOA Institutes Feedback: Farmers ECON Analysis: OAE/CPD | Technical support: FSRI/NEROA Farmer Training: DOAE Demonstrations: DOAE/FSRI Field Days: DOAE/DOA Radio Broadcasts: DOAE/NEROA | Technical support: DOA Logistic support: NEROA Analysis: CPD/OAE |
| NO. OF TECHNOLOGIES TESTED | Many | Many | 4-6 | 2-3 | 1 | 1 |
| RESEARCH:EXTENSION (ratio) | 100:0 | 95:5 | 75:25 | 30:70 | 10:90 | 5:95 |
| MANAGEMENT: RESEARCHER:FARMER (ratio) | 100:0 | 100:0 | 70:30 | 20:80 | 5:95 | 0:100 |
| SUPPORT SERVICES: GOVERNMENT: PRIVATE SECTOR | 100:0 | 100:0 | 75:25 | 60:40 | 40:60 | 10:90 |
| TYPE OF DATA GENERATED | Highly detailed in one discipline | Detailed agronomic data | Basic agronomic and economic data | Simplified agronomic and economic data + detailed farmer-practice data | Information on: - Input supply problems - Marketing problems - Farmer adoption patterns | Information on: - Local production potential - Market potential |
| TRIAL DESIGN CHARACTERISTICS | - V. high degree of control - Sophisticated treatments | - High control - Complex treatments - Standard replicated designs | - Adequate control - Simple superimposed treatments - Replication across farms | - Minimal control - Zero or 1 simple treatment + check - Low level of control gives important information on farmer management | - 2 treatments according to farmer adoption: 1. Adopters 2. Non adopters(check) | - Production program area is experimental group |
| TYPE OF ANALYSIS | Sophisticated statistical analysis | Standard statistical analysis | Simplified/modified standard procedures (c.f. FSSP modules) | Simple hypothesis-generating type analysis for feedback to on-farm trials | Analysis of farmer adoption patterns; Analysis of infrastructure requirements | Analysis of interactions between production potential and national policy objectives |
| NUMBER OF PARTICIPATING FARMERS PER TAMBON | - | - | 5-10 | 10-20 | Early adopters | All farmers |
| FREE INPUTS SUPPLIED TO FARMERS | - | - | All excluding labor | Minimal but may be some guarantee against risk | None | On credit basis only |

## SCREENING/ANALYSIS STAGES IN THE TECHNOLOGY DEVELOPMENT PROCESS

Decisions have to be made at a number of critical stages in the technology development process in order to evaluate the results of previous phases and to effectively plan future trials. These screening or analysis stages are numbered 1-5 in Figure 1. Effective analyses are the key to successful technology development and act as the 'driving-force' within the technology development process. Screening requires clearly defined evaluation criteria and a systematic step-by-step procedure that integrates the perspectives of the multi-disciplinary team involved in the technology development process. The 'Agricultural Triage' technique has proved appropriate for this and the reader is referred to NERAD Methodology Series Paper M2 for more information on conducting triage.

The productivity, stability, sustainability and equitability measures of agroecosystem performance are also important criteria for screening cropping systems technologies and should be considered during triage. Although important for all stages, special attention is individually given to these properties at different phases of the technology development process (See Table 3).

Table 3. Properties of agro-ecosystem performance as criteria in screening cropping systems technologies at different phases in the development process.

| PROPERTY | IMPORTANT SCREENING STAGE | DEFINITION |
|---|---|---|
| PRODUCTIVITY | 3 | Average returns to land labor or capital, commonly measured as yield, profit, etc. |
| STABILITY | 4 | Variability about the mean productivity over both space and time. Can be measured as the inverse of the coefficient of variation. |
| SUSTAINABILITY | 5 | The long term potential productivity of the technology or its durability in the face of stress or disturbance. |
| EQUITABILITY | 5 | The distribution of the benefits of the technology among target farmers. |

Source: Craig, 1980; Gypmantasiri *et al.*, 1980; Conway, 1985.

## SCREENING STAGE 1.

## RESEARCH STATION TECHNOLOGIES/FARMER PROBLEMS ---> ON FARM TRIALS

Objective:

To match available agricultural technologies with real and significant farmer problems in the most appropriate manner.

Properties to be emphasised during screening

Productivity / Stability / Sustainability / Equitability

Questions to be answered:

(1). What are the most important, real problems of the farmers?
(2). What technologies are available?
(3). Which technologies are likely to help to solve these problems?
(4). How should these technologies be adapted/modified to be appropriate for local conditions?
(5). What are the major unanswered questions regarding these technologies and how should super-imposed component technology trials be designed to answer these questions?

Data/information required:

1. Climatic
2. Socio-economic
3. Local production pattern information
4. Soils
5. Marketing data
6. Research Station trial results summaries

Steps in the analysis:

(1). Conduct a site description which defines the local agro-ecosystem in terms of the important physical, biological, economic and social factors.
(2). List the farmer problems or development opportunities identified.
(3). Prioritize the problems in order of importance.
(4). List the technologies available for solving these problems.
(5). Match the most important problems with the technologies that have the highest potential for solving them.
(6). Select technologies for testing and plan on-farm-trials documenting their objectives and expected benefits.

Available tools to assist in the analysis:

1. Agro-ecosystems analysis (AEA)
2. Rapid rural appraisal (RRA/PAT)
3. Formal farmer surveys
4. Interdisciplinary assessment work shops
5. Agricultural triage

Departmental roles:

DOA - Research station trial results/climatic data
DOAE - Local production patterns/production resources
DLD - Soil maps/data on existing water resources
OAE - Socio-economic characteristics/price analyses
CPD - Market analysis
DOLD/RFD/DOF - Support data
NEROA - Coordination and logistic support

## SCREENING STAGE 2.

## ON FARM TRIALS ---> MULTI-LOCATION TRIALS

Objective:

To concentrate further testing on, and begin extension of those technologies which have the greatest potential for significantly benefitting the majority of target farmers.

Properties to be emphasised during screening

Productivity

Questions to be answered:

(1). Which technologies are unlikely to benefit farmers and why?
(2). Which technologies have potential but still have significant problems requiring further on farm research and what form should this research take?
(3). Which technologies have proved to be biologically feasible, economically viable and socially acceptable and what are the bio-physical, economic and social conditions necessary for their successful adoption?
(4). Are there any new technologies considered to merit on-farm testing as a result of the on-farm trials experience?

Data/information required:

- Agronomic performance data of the on-farm-trials
- Economic performance data of the on-farm-trials
- Farmer responses / modifications to the technologies tested in the on-farm-trials
- Climatic and soils data for the trial sites
- Price and marketing data and problems
- Information on interactions of the technology with other elements of the farm system.

Steps in the analysis:

(1). Evaluate the on-farm trials in terms of their agronomic feasibility, economic viability and social acceptibility.
(2). Triage or categorize the technologies tested in the on farm trials into:

- Those technologies unlikely to significantly benefit farmers.
- Those technologies with potential but still requiring further on-farm component research.
- Those technologies with high potential considered ready for expanded testing and early extension.

(3). Document the technology status for each of the above categories as follows:

(a) Technologies that under present or expected future conditions are unlikely to be successful:

- Document:
  - Objectives of the technology
  - Results summary
  - Major constraints to the technology achieving its stated objectives
  - Suggestions for further basic research needed at experiment stations.

(b) Technologies that have potential but need further on-farm component research:

- Document:
  - Objectives of the technology
  - Results summary
  - Major problems remaining
  - Recommendations for experimental treatments for the on-farm trials to overcome the remaining problems.

(c) Successful technologies considered appropriate for expansion in a multi-location phase:

- Document:
  - Objectives of the technology
  - Results summary
  - Conditions necessary for successful implementation of the technology
  - Recommended implementation practices

Tools available to assist in the analysis:*

1. Triage
2. Interdisciplinary analysis work shops
3. Participating farmer interviews (RRA or formal survey)
4. Cropping systems research analysis techniques

Departmental roles:

- DOA - Agronomic analysis of the technology
- OAE - Economic/price analysis of the technology
- DOAE - Assessment of farmer acceptability of the technology
- CPD - Market analyses preparation
- DLD/RFD/DOF/DOLD - Analysis of the interactions of the technology with the entire farm system
- NEROA - Coordination and support.

- - - - - - - - - -

* For an explanation of the triage process see NERAD Methodology Series Working Paper No. M2.

## SCREENING STAGE 3.

## MULTI-LOCATION TRIALS ---> EXTENSION PROGRAM

Objective:

To decide which technologies have potential for large scale farmer adoption and to plan an appropriate extension program to achieve this.

Questions to be answered:

1. How did farmers modify the technology in the multi-location trials and with what results?
2. Is farmer interest sufficient to warrant an extension program?
3. What type of demonstrations, training and dissemination is appropriate for the extension program?
4. What modifications should be made to the technology in the light of the multi-location trial phase?
5. How stable is the performance of the technology across different farms?

Data/information required:

1. Farmer modifications to technology and the effect of these on its performance
2. Farmer problems encountered with the technology
3. Performance data (agronomic, economic and social) for the technology and an analysis of the variability of results over farms.

Steps in the analysis:

(1). Evaluate the multi-location trials in terms of their social acceptibility, economic viability and agronomic performance.

(2). Trioge or categorise the technologies tested in the multi-location trials into:-

- Those technologies which need to be returned to on-farm trials for further component technology research
- Those technologies which require further multi-location testing
- Those technologies with good 'all-round' performance considered ready for extension through the extension program phase

(3). Document the status of every technology for each category as follows:

(a) Technologies which need to be returned to the on-farm trials phase for further component technology research:

- Document:
  - Objectives of the technology
  - Results summary
  - Problems necessitating further on-farm component research trials
  - Suggested treatments for on-farm trials to solve the above problems

(b) Technologies which require further multi-location testing:

- Document:
  - Objectives of the technology
  - Results summary
  - Reasons for further multi-location testing
  - Suggested improvements to the technology

(c) Technologies with good all-round performance that are considered ready for extension through the extension program phase:

Document:
- Objectives of the technology
- Results summary
- Recommended practices for the technology in the extension program.

<u>Tools available to assist in the analysis</u>:

1. Interdisciplinary analysis workshops
2. Modified triage
3. Farm record keeping analysis
4. Farmer surveys (RRA or formal)
5. Modified stability analysis.

<u>Departmental roles</u>:

- DOAE - Analyse farmer response to the technology
- DOA - Analyse agronomic problems encountered by farmers during multi-location trials
- OAE - Prepare economic and labor analyses of the multi-location trials
- CPD - Assess marketing problems and potentials
- DLD/RFD/DOF/DOLD - Analyse interactions of the technologies with other components of the farm system
- NEROA - Coordination and support.

## SCREENING STAGE 4.

## EXTENSION PROGRAM ---> PRODUCTION PROGRAM

### Objective

To match local production potential with market demand in a manner consistent with government policy.

### Properties to be emphasised during screening:

1. How many and what type of farmers adopted the new technology?
2. What are the main constraints to farmer adoption?
3. What effect will full adoption of the technology have on production and will markets be able to absorb this?
4. Are the results of the technology consistent with government policy?
5. Are there likely to be any negative environmental or social effects of large scale adoption of the technology and how can these be avoided?

### Data/information required:

1. Farmer adoption patterns.
2. Farmer problems encountered with the technology after adoption.
3. Local production potential.
4. Market potential and infrastructure requirements.

### Step in the analysis:

(1). Evaluate farmer adoption in terms of:

- Numbers and types of adopting farmers
- Farmer modifications to the technology after adoption
- Performance of the technology in the fields of the farmer adoptors.

(2). Evaluate:

- Local production potential
- Market demand and capacity
- Credit facilities available
- Policy - is the technology consistent with policy objectives?

(3). Adjust the local production patterns and credit facilities to be in line with market demand.

(4). Ensure that '(3)' above is in line with national policy objectives.

Tools available to assist in the analysis:

1. Interdisciplinary analysis work shops
2. Mini-evaluations
3. Agro-ecosystems analysis
4. Farmer seminars

Departmental roles

- Changwat Sub-committee - MOAC policy interpretations
- Ministry of Commerce - Marketing and promotional support
- Private enterprise - Input/output market development
- BAAC - Arrangement of necessary credit facilities
- NERCA - Coordination and support.

## SCREENING STAGE 5.

## FARMER PROBLEMS ---> BASIC RESEARCH

Objective:

To communicate important farmer problems to the appropriate research agencies to assist in setting basic agricultural research priorities.

Properties emphasised during screening:

Productivity / Stability / Sustainability / Equitability

Questions to be answered:

(1) Which major, common farmer-problems have no technologies available for their solution?

(2) What basic research (or experiment station research) needs to be conducted to produce these problem-solving technologies?

(3) Which is the most appropriate agency to conduct the necessary research and what is the most effective means of communicating the problem to them?

Data/information required:

1. Local production pattern data
2. Climatic/soils/marketing/social data
3. Information on local problems/constraints
4. List of available technologies and information on the conditions necessary for their success

Steps in the analysis:

(1) Divide the problems identified into:

- Those that have technologies available for their solution
- Those that have no technologies available for their solution

(2) Prioritize the unsolved problems using the criteria:

- size of the problem
- severity of the problem
- number of farmers experiencing the problem

(3) Document these problems stating the nature, severity and the reasons for the problem and sugggestions on the type of research needed for their solution

(4) Communicate these findings to the relevant research agency

Tools available tools to assist in the analysis:

1. Rapid rural appraisal (RRA/RAT)
2. Agro-ecosystems analysis (AEA)
3. Agricultural triage of on-farm trial results
4. Interdisciplinary seminars on the problems identified involving subject matter specialists.

Departmental roles:

DOA - Research station trial results, climatic data
DOAE - Local production patterns, farmer production resources
DLD - Soil maps, information on existing water resources
OAE - Socio-economic characteristics, price analysis
CPD - Market analysis
DOLD - Support data
RFD - Support data
DOF - Support data
NEROA- Arranging problem oriented, subject matter seminars coordination and logistic support.

## SCREENING STAGE F.

## APPROPRIATE TECHNOLOGIES ---> FARMER ADOPTION

Analysis and screening at this stage is conducted by the farmer who has to decide if the technologies being demonstrated really do meet his needs or help solve his problems. By understanding the criteria used by farmers in adopting or rejecting new technologies the technology development process itself can be improved. There are two important implications of this:

(i) Much can be learned from the technologies which are rejected if it is understood why they were unacceptable. With this knowledge the technologies can be modified or their appropriateness for other areas can be assessed. In addition, the information generated can be used to modify the technology development process itself.

(ii) The technology development process does not end with successful farmer adoption of a technology. As the adopter modifies his farm system to include the new technology new problems or constraints will emerge and the process should begin again.

## FUTURE DEVELOPMENT NEEDED

If true integration between DOA and DOAE is to be achieved and institutionalized, every effort must be made to integrate the regular programs of these two departments, namely the on-farm trials and the Training and Visit (T & V) systems, respectively. The multi location phase of the development process offers the opportunity of achieving this due to its strategic position as the key transition phase between research and extension (See Table 2, page 5).

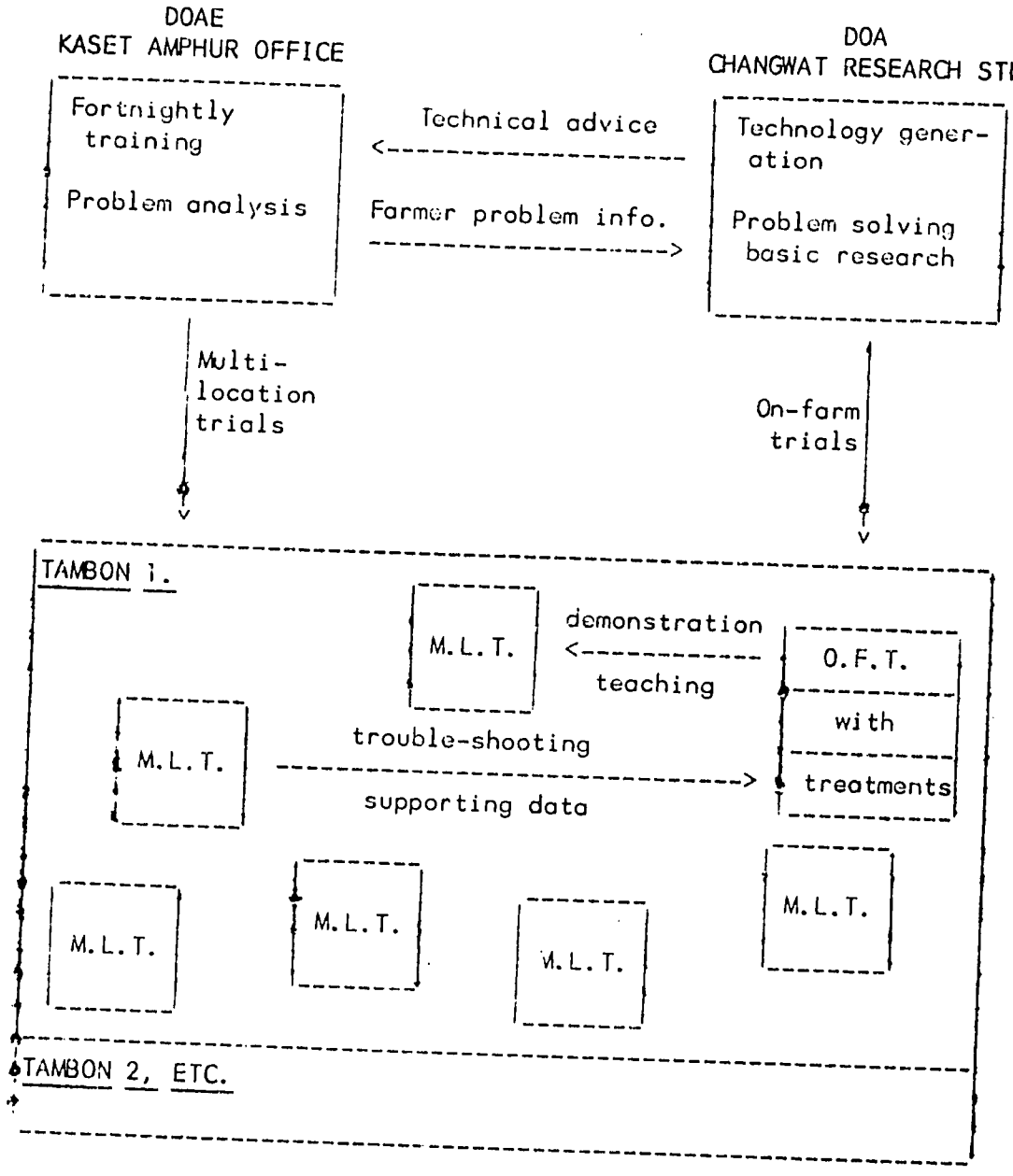
There are a number of possible ways of integrating DOA's on-farm trials and DOAE's T & V system and the most appropriate will need to be determined according to the needs of the two departments in close collaboration with their respective officials. As way of an example, one possible means of integration is presented here and summarized in diagrammatic form in Figure 2.

- Technologies appropriate for multi-location testing are agreed to by DOA and DOAE officials using triage or a similar analysis procedure

- DOA officials conduct training on the chosen technology for K.T.'s as part of the T & V fortnightly training program.

- Kaset Tambon select appropriate farmers to participate in the multi-location trials during their fortnightly visit schedule according to the technical criteria defined by DOA and implement the trials of the technology on these farms.

Figure 2. Diagramatic representation of one implementation model for improving integration between on-farm-trials and the T & V system.




- DOA conduct on-farm trial(s) of the technology in the same tambon (these trials will be more researcher managed and will have a number of superimposed component technology treatments).

- Plot visits by DOA and DOAE for trial monitoring and data collection are coordinated so that both on-farm and multi-location trials are regularly jointly inspected by both researchers and extensionists to facilitate exchange of information.

- Different cultural practices can be demonstrated to the participating multi-location farmers by using the superimposed treatments of the on-farm trials. These plots can also be used as a follow-up teaching tool for Kaset Tambons to supplement the lecture sessions of the fortnightly training with real field experience of the technology.

- Problems encountered in the multi-location trials are likely to be the same as on the on-farm trials and can therefore be discussed by Kaset Tambon with DOA officials thus giving him a valuable source of technical expertise when and where he needs it. In addition, the multi-location trials will give DOA useful information on the performance of the technology under farmer-managed conditions and the type of problems likely to occur with it in the future.

- At the end of (and during if desired) of the crop cycle when complete data for both sets of trials are available the fortnightly training session can be used for a joint DOA and DOAE technical review of the results in order to set research and extension priorities and to plan future trials.

Effort in the remaining 2 years of NERAD will concentrate on improving and adjusting the cropping system technology development process as the technologies currently under development pass on to the later phases and the cycle is completed. If requested by the MoU committee and under their guidence, every effort will be made to refine the development process into a form that is replicable within the MOAC. This will ensure that the lessons learned by NERAD are institutionalized after the project is over and that the participating departments are left with a useable product.

## BIBLIOGRAPHY


Conway, G.R. 1986. Agroecosystems analysis for research and development. Winrock International Institute for Agricultural development. Bangkok.

Craig, I.A. et al. 1980. Multiple Cropping in the Chiang Mai Valley: the complex relationships between components in multiple cropping systems. Proceedings National Cropping Systems Conference, Kanchanaburi, Thailand, 1980.

Gypmantasiri, P. et al. 1980. An interdisciplinary perspective of cropping systems in the Chiang Mai Valley: key questions for research. Chiang Mai University, Thailand.

Panothai, A. 1984. Issues on the development of an FSR approach. Proceedings, 1st National Farming Systems Conference. Surat Thani, April 2-5, 1984. (In Thai).

Pantastico, B. 1986. Farming systems research and development and extension linkages: FAO experience. Paper presented at an FSR consultation meeting of experts. Los Banos, Philippines.

## APPENDIX

The following NERAD Working Papers are available on request from the Project Director:

### NERAD Methodology Documentation Series

M1 A cropping systems technology development process: the NERAD model. Craig, I.A. et al., 1986. (Thai and English)

M2 Triage: a methodology for screening agricultural technologies and prioritizing research and extension activities. Craig, I.A. and Sukapong, C., 1987. (Thai and English)

M3 North East Rainfed Agricultural Development Information and Coordination System (NERADICS). Hopkins, J., 1987. (English)

M4 The Rapid Assessment Technique (RAT): a procedure for identifying farmer problems and development opportunities. Alton, C. and Craig, I.A., 1987. (Thai and English)

### NERAD Technology Documentation Series

T0 Executive Summary: NERAD Promising Technologies. Thamabood, S. (Editor), 1986. (Thai)

T1 Direct sown rice technology documentation. Craig, I.A. et al., 1986. (Thai and English)

T2 Cooperative buying groups in Thailand: results of a social experiment. Meyer, A.L. and Infanger, C.L., 1987. (English)

T3 Modified shallow well technology documentation. Ragland, J.L. and Thamabood, S., 1986. (English)

T4 Pre-rice green manuring: a technology for soil improvement under rainfed conditions in Northeast Thailand. Craig, I.A., 1987. (English)