PN-AAY-982

NERAD PROJECT TECHNOLOGY DOCUMENTATION SERIES

WORKING PAPER No. T3

Modified Shallow Wells: A Farmer Developed Technology for Northeast Thailand

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August, 1987.

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NERADICS PCE-4003-0830

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.

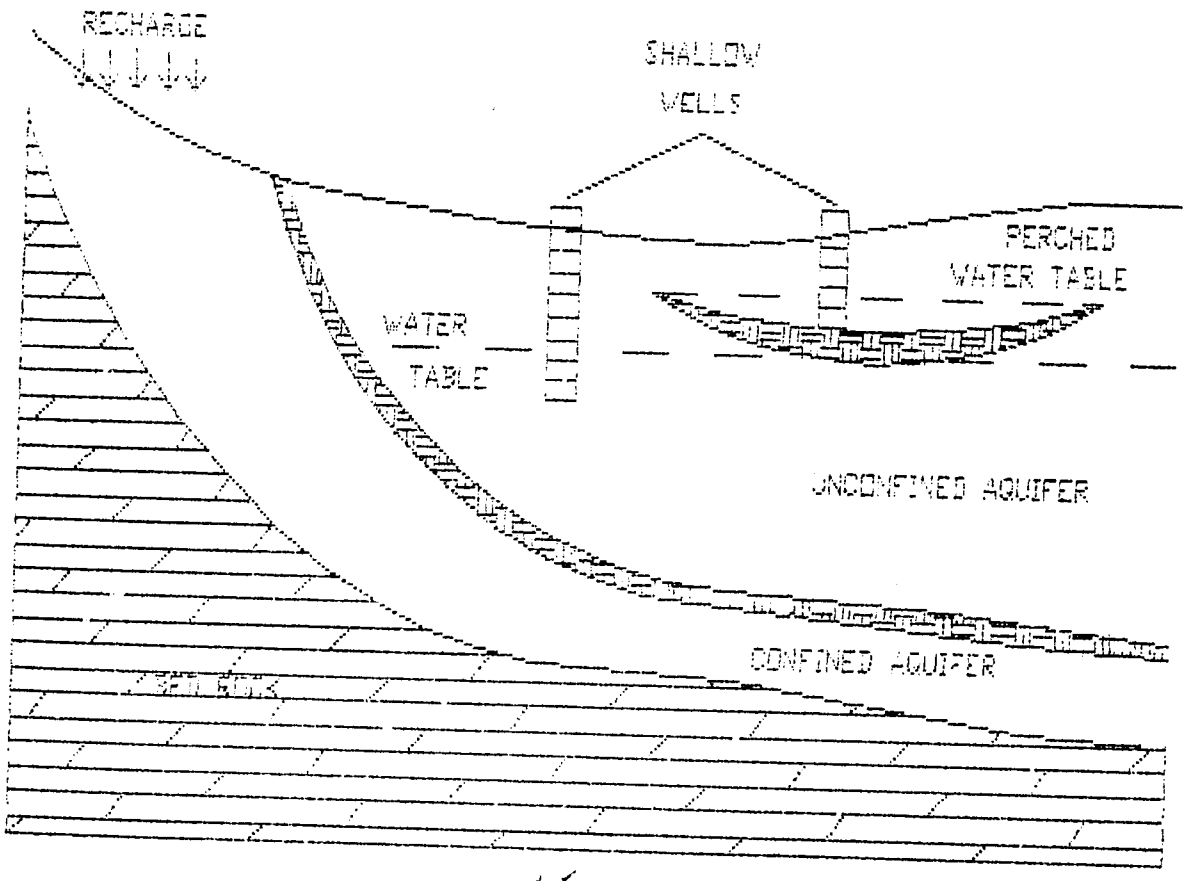
MODIFIED SHALLOW WELLS:
A FARMER DEVELOPED TECHNOLOGY FOR NORTHEAST THAILAND.

BACKGROUND:

Northeast Thailand is characterized by a distinct dry season from October to April each year when rainfall is generally insufficient to support crop production (Vorasoot, et al., 1984; Limpinantana et al., 1982; Craig, et al., 1985). However, the cool day and night temperatures during part of this period are favorable for vegetable production, market demand is high and subsistence needs for vegetables continue.

In some areas, water for vegetables and small plots of other high value crops can be obtained in limited quantities from shallow wells dug in the lower paddy fields which access either the perched or the unconfined aquifer water tables as shown in Figure 1. However, after about 2-3 months the water table recedes and is too deep to supply sufficient water for crop production. Traditionally these wells are used for subsistence vegetable production for 1-2 months after the end of the rains and are then abandoned, their walls have no structural support and they deteriorate during the rainy season and have to be re-dug each year.

FIGURE 1: DIAGRAMATIC REPRESENTATION OF THE NERAD SHALLOW WELLS



NERAD attempted to improve this traditional farmer practice by supplying concrete ring-liners to farmers who dug wells on their land. This had a number of advantages over the traditional system:

(i) Labor was saved as the wells did not have to be re-dug every year.

(ii) Wells could be dug deeper as they now had structural support and could therefore tap the receeding water-table longer into the dry season.

(iii) Vegetable production could begin earlier after rice harvest as the wells were already in place and the labor conflicts between rice-harvesting and well-digging were overcome. This meant that the vegetable crops matured during the cool period favorable to growth and at a time when prices were high.

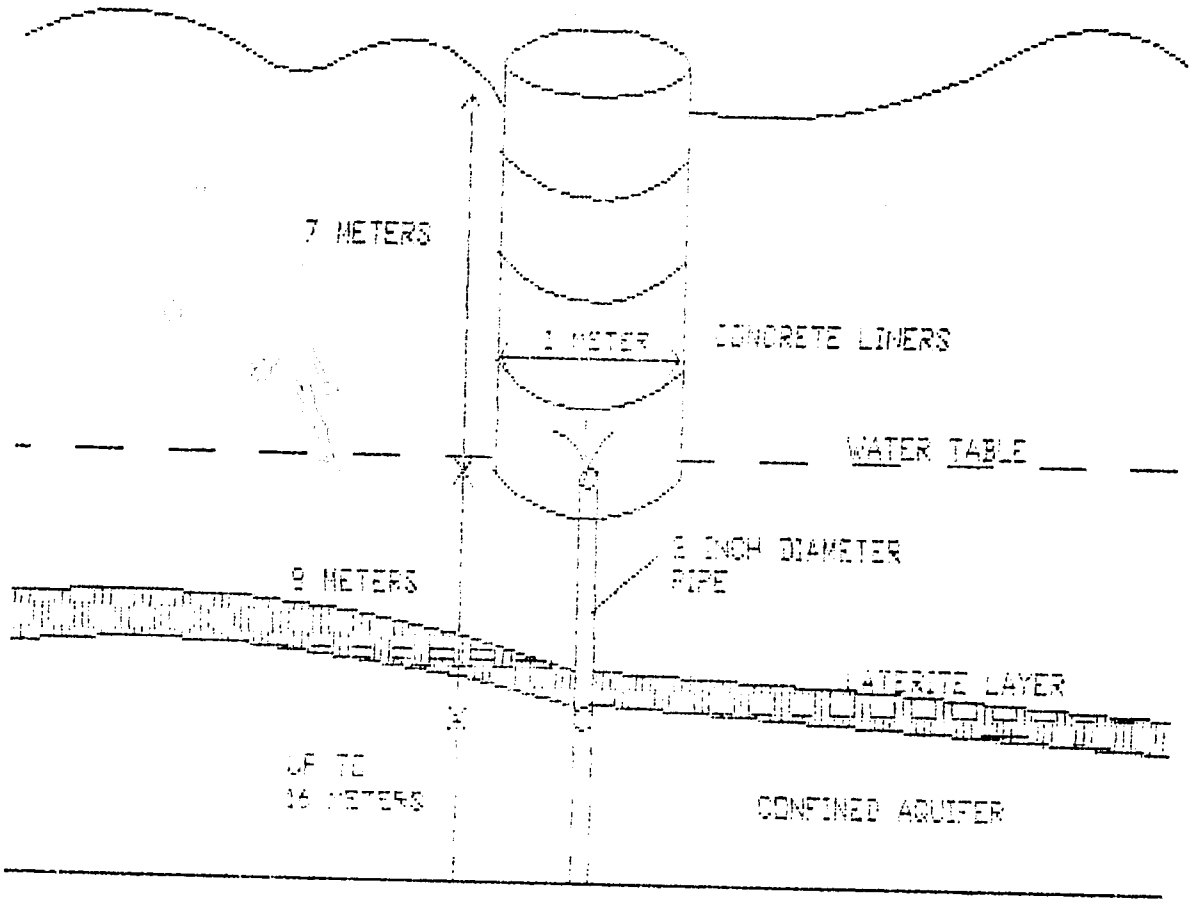
Farmer demand for the cement liners, grew rapidly and soon out-stripped the Project's budget for supplying them and, as a result, emphasis within NERAD changed to training villagers in cement ring construction, supplying construction materials and liner-moulds so that the technology would be available to a larger number of farmers.

There are two problems that usually limit the water available from these wells; the perched water table is used up before the rainy season begins or the horizontal movement of water is so slow that the time required to recharge the well is excessive.

In the NERAD site in Sri Saket the recharge rate of the shallow wells was rather slow and a hard laterite layer prevented the construction of hand dug wells through to the confined aquifer below. However, an innovative farmer in Tambon Tae of this Changwat who had been supplied with concrete ring-liners for a well by NERAD, modified the technology by constructing what has come to be known as a "modified shallow well".

This farmer believed there was a good water supply below the laterite layer which normally prevents farmers from digging wells deeper than 7 meters, and hired a commercial well-driller to bore a small diameter hole through the laterite layer at the base of his well to access the confined aquifer below (see Figure 2). Because the water was under pressure, making a hole through the laterite caused the water to flow upwards giving an "artesian" effect that kept the shallow well supplied with water.

FIGURE 2 NERAD MODIFIED SHALLOW WELL DESIGN



The NERAD Project Field Manager* identified the potential of this adaptation and worked closely with this innovative farmer to learn from, adapt and extend the technology that he developed.

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* Dr. Sawat Thamabood is now Director of the Poultry Improvement Section of the Department of Livestock at the Poultry Improvement Center, Chonburi.

TECHNOLOGY DESCRIPTION AND METHOD OF USE:

A commercial drilling rig was used to drill a hole from the soil surface down to and through the laterite layer until the confined aquifer was reached. A conventional iron pipe, with small holes in the walls at the lower end, was then forced into the bore-hole to a depth of about 8 meters in order to prevent erosion of the bore-sides in the soil layer (Figure 1). Following this, a conventional one meter diameter shallow well was dug around the pipe down to approximately 7 meters and the well was lined with concrete rings as used in the original technology. The iron pipe was cut off just above the laterite layer and the "artesian" water was allowed to fill the dug-well to whatever height the water pressure would support.

Most wells were found to fill to within approximately 2 meters of the soil surface. The reservoir formed by the concrete rings is an essential feature of the wells, and gives sufficient volume of water for 2 inch diameter electric or gasoline pump-irrigation of the land around the well. Water is usually sufficient to irrigate up to 3 rai of vegetables or field crops. Chemical analysis of the "artesian" water indicated that it was of local origin and a consultant hydrologist* therefore predicted that constructing many such wells in any area would not reduce the aquifer's capacity to supply water.

RESULTS OF RESEARCH AND FARMER TRIALS:

In 1984, NERAD provided funds for the drilling cost and concrete rings required to construct 36 modified shallow wells in Tambons Tae and Taket in Changwat Sri Saket (Table 1).

Table 1. Unit cost of modified shallow wells in Sri Saket, 1984.

COST ELEMENT (per well)	BAHT
Commercial drilling cost (The driller agreed to drill until the artesian water was reached or up to a maximum of 31 meters)	2,000
Iron Pipe	100
Concrete Ring Liners	1,440
Digging (labor supplied by farmer)	0
Total cost	3,540

* Consultant hydrologist to the Thai Australian Village Water Supply Project.

All but one of the 36 test wells yielded sufficient water for pump irrigation of up to 3 rai of field crops. This unusually high success rate created much interest in the wells with local farmers and an economic evaluation was subsequently conducted by the Office of Agricultural Economics to determine the economic viability of the technology for further expansion and to compare costs and returns with other types of small water resource development being implemented by the Project. The results of this analysis are presented in Table 2.

Table 2. Gross returns per water resource for NERAD water resource development activities, Sri Saket, 1984-85.

	Modified shallow well	NERAD lined well	Traditional un-lined well	Ponds
Area planted (rai)	1.8	1.3	1.4	1.2
Vegetables sales (Baht)	4,249	3,235	3,431	2,983
Number in sample	25	33	14	30

The results show that farmers with the modified shallow wells have increased annual incomes of only about 1,000 Baht over regular lined and unlined wells. This relatively poor performance is due to a number of factors:

(i) The opportunity costs of labor are not included in the analysis, but as has been explained, the opportunity costs of labor at rice harvesting, essential for traditional unlined wells, is high (See page 1.).

(ii) Analysis of the modified, shallow wells is based on the research costs using a commercial drilling contractor. However, by providing farmers with steel forms for making concrete rings and by using hand-operated drilling units the cost can be reduced from Baht 3,500 to Baht 1,400 per well.

(iii) The analysis is based solely on crop-production data rather than the increased 'water-yield', which once recognized by the farmers, is expected to lead to improved utilization, not only for crops but also for livestock, fruit trees and domestic purposes.

(iv) The analysis was conducted immediately after construction of the modified wells, before farmers had adapted their farming systems to make full use of the increased water yield available from them.

One hundred and fifty farmers in Tae and Taket were provided with modified shallow wells through the project as a multi-location test of the technology. The results were sufficiently encouraging that in 1986 the Department of Land Development decided to construct additional test wells as demonstrations in other project sites.

Modified shallow wells based on the Sri Saket design were provided to farmers in Tambons Nong Kaew and Namuang in Roi Et in 1986. All wells yielded water but recharge rates were somewhat variable. Most wells could not support continuous pumping and during irrigation the farmers would pump for a period and then have to wait to allow the well to recharge, usually for about 20 minutes, before continuing irrigation.

It was concluded that the local hydrological conditions in Roi Et differed from those in Sri Saket in a number of important respects:

(i) The laterite layer was both thicker and deeper in Roi Et,

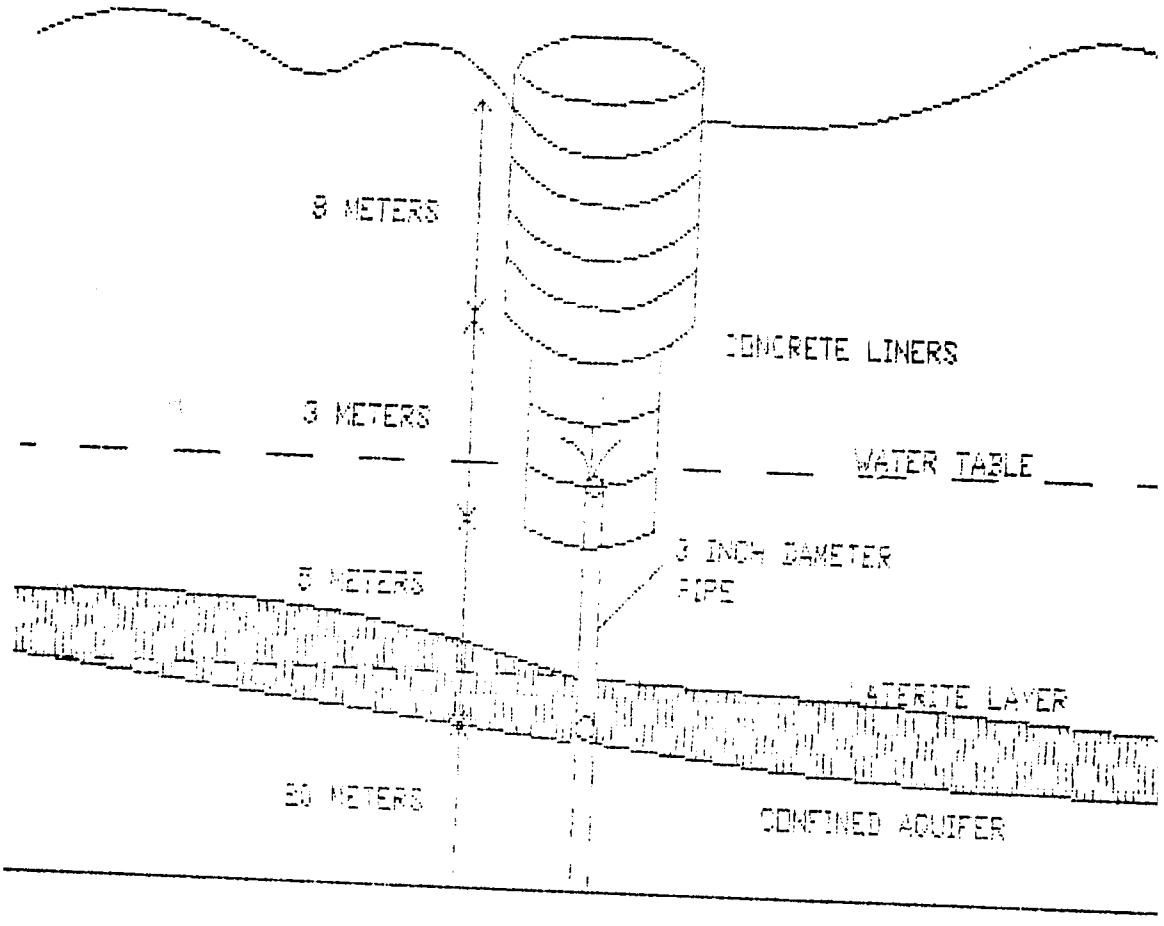
(ii) the confined aquifer was further from the soil surface in Roi Et,

(iii) the 'artesian' water-pressure was lower than in Sri Saket.

These findings were confirmed when a local farmer in Roi Et further modified his well as shown in Figure 3.

This farmer lowered the depth of the dug part of his well to a total depth of 11 meters and from there increased both the diameter and the depth of the bore to 2 inches and 25 meters respectively. The increased depth of the dug well overcame the problem of lower 'artesian' water pressure and the increased depth and diameter of the bore greatly increased the recharge rate. This well is now being used to irrigate large areas of vegetables, field crops, fruit trees and mulberry using a 2 inch electric pump. Pump irrigation is continued for long periods and the well has never dried out.

FIGURE 3. FARMER-ADAPTED MODIFIED WELL, ROI ET.



ADOPTION AND POTENTIAL BENEFITS:

Over 70 percent of the modified wells constructed with project funds in Sri Saket are being used for commercial vegetable production and a further ten such modified wells have also been constructed from entirely private sources by local farmers. Farmers in Sri Saket have been able to construct their own concrete ring liners and groups of farmers have used locally available hand-operated drilling equipment to bore down to the confined aquifer. Farmer interest in Roi Et is also extremely high and similar adoption patterns are expected there as more farmers see the demonstration wells.

There are approximately 900 farm families in Tambons Tae and Taket producing vegetables for shipping to Ubon, Korat and Bangkok. Assuming 25 percent of these growers construct modified shallow wells for themselves and they on average earn Baht 1,000 per year more as a result of this technology then the two tambons would receive Baht 225,000 greater income per year. If the life of a modified shallow well is assumed to be 10 years, then the

increased income would amount to Baht 2,250,000. Substracting construction costs for the modified shallow wells (225 wells x Baht 1,400/well) from the increased income, gives Baht 1,935,000 return on an investment of Baht 315,000 or an annual rate of return of approximately 400 percent.

There is not yet sufficient data available to make any projections about the potential benefits of the technology in Roi Et or other provinces in the Northeast.

FURTHER RESEARCH AND TECHNOLOGY DEVELOPMENT REQUIRED:

The Office of Agricultural Economics will conduct an expanded survey of this technology in the 1987-88 dry season. The study, will include the original 36 wells and also the new wells constructed since that time both under the NERAD Project and by individual farmers. The results will then be integrated with available marketing data to give estimates of the technology potential throughout the Northeast.

Crops other than vegetables need to be tested for when the fresh vegetable market might become saturated and crop water requirements and irrigation schedules for those need to be determined in order to maximise the efficient use of water from the wells. The potential for the wells to supply supplemental water for other farm enterprises such as fish raising, compost production and for livestock and poultry also needs to be explored.

Water yield in sample wells in Sri Saket should be monitored over time to determine if the aquifer is being exhausted and to provide information on the efficency of use of the additional water made available by the wells.

A hydro-geological assessment of the artesian phenomenon that supplies water to the wells is needed in order to determine its replicability in other areas ofn the Northeast. By this means, guidelines could be established for identifying locations where the technology is likely to be successful. This would replace the current "hit or miss" system of well siting being used by the Project.

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Vorasoot, N., Jintawet, A., Limpinuntana, V., Charoenwatana, T. and Virmani, S.M., 1985. Rainfall Analysis for Northeast Thailand. Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.

APPENDIX

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

NERADICS Methodology Documentation Series

M1 A Cropping Systems Technology Development Process: the NERAD Model. Craig, I.A., Sukapong, C. and Suratikul, S., 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 NERAD Project Agricultural Development Information and Coordination System (NERADICS): A Project Description. 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)

M5 Key Characteristics of the NERAD Full-cycle, Integrated Development Models. Songlin, R., 1987. (Thai)

M6 The NERAD Logical Framework: a Project Design Summary for Planning, Monitoring and Evaluation. NERAD, 1987. (English)

M7 Crop Protection and IPM for Rainfed Cropping Systems in Northeast Thailand. Amaritsut, W., Prasartsri, V. and Craig, I.A., 1987. (English)

NERADICS Technology Documentation Series

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

T1 Direct Sown Rice: a Cropping Systems Technology for the Upper Paddies in Northeast Thailand. Craig, I.A., Whattanabhuti, W., Sukapong, C. and Netpichit, W., 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 Wells: a Farmer Developed Technology for Northeast Thailand. Craig, I.A., Phensupha, N. and Raqland, J.L., 1986. (English)

T4 Pre-rice Green Manuring: a Technology for Soil Improvement Under Rainfed Conditions in Northeast Thailand. Craig, I.A., 1987. (English)

T5 Papaya Rinspot Virus: Cross Protection for an Important Subsistence Crop in Northeast Thailand. Gonsalves, D. and Prasartsri, V. (English)

NERADICS Problem Definition Series

P1 Effects of Paddy-bund-planted Eucalyptus Trees on the Performance of Paddy Field Crops. Craig, I.A. and Wasunan, S., 1987. (English)

P2 Overview of Rainfed Agriculture in Northeast Thailand. Craig, I.A. and Pisone, U., 1987. (English)

P3 The Upper Paddies in Northeast Thailand: The Current Situation and Implications for Development. Craig, I.A., and Baker, G.P., 1986. (English)

P4 Current Pest Management Problems Facing Farmers in Northeast Thailand: Key Research and Development Priorities. Katanyakul, W., Amaritsut, W., Keerati-Kasikorn, M. and Craig, I.A., 1987. (English)