Farming systems research in north east Thailand and the role of the Farming Systems Research Institute

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Australian Co-operation with the National Agricultural Research Project.

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AUSTRALIAN CO-OPERATION
WITH THE
NATIONAL AGRICULTURAL RESEARCH PROJECT
THAILAND

FARMING SYSTEMS RESEARCH IN NORTH
EAST THAILAND AND THE ROLE OF THE
FARMING SYSTEMS RESEARCH INSTITUTE

DR. DAVID A. IVORY

NOVEMBER 1986
2.7 บทสรุปและข้อเสนอแนะเกี่ยวกับงานวิจัยระบบการทําการฟาร์ม ในการพัฒนาเอกชนสู่ชุมชนแห่ง ประเทศไทยในอนาคต

จากการที่ได้ปรากฏขึ้นในโครงการวิจัยระบบการทําการฟาร์มหลายๆ โครงการในภาคตะวันออกเฉียงเหนือของประเทศไทยในอนาคต

1. ต้องมุ่งมั่นการวิจัยและพัฒนาระบบการเกษตรที่ก้าวหน้า ที่มีการพัฒนาทันสมัยและสามารถพัฒนา

- ให้มีการพัฒนาการประมงขนาดที่เพียงพอ
- กำหนดแนวทางที่เหมาะสมในการทําการวิจัยก้าวตามกัน
- สนับสนุนให้ชุมชนมีส่วนในการพัฒนาชุมชนและชุมชนที่พัฒนาได้ในไทย
- กำหนดแนวทางให้เป็นการวิจัยที่มีคุณค่า
- สนับสนุนการพัฒนาและการตอบต่อวิจัยที่ก้าวหน้าและการวิจัยระบบการทําการฟาร์ม

2. โครงการวิจัยระบบการทําการฟาร์มที่ชุมชนที่มีกับเกษตรกร มีทั้งเสริมและ

- ขึ้นรูปการทางการเกษตรที่เหมาะสมในการทําการและพัฒนา
- จัดการวิจัย กระตุ้นการวิจัยของเกษตรกร และการพัฒนา
- โครงการวิจัยในพื้นที่ภาคตะวันออกเฉียงเหนือให้มีการพิจารณาต่อเนื่อง

ที่มีโครงการ ให้ชุมชนมีส่วนในการพัฒนาที่ดีและชุมชนที่พัฒนาได้ในไทย (ดูข้อ 2.2.4)
3. การวิจัยระบบการท้อง แนวสมมุติเรื่องวิทยาศาสตร์และสังคม ควรใช้การประมาณงาน ที่มีอยู่ในงานอื่น ๆ ได้ ทางเทคนิค ให้มาก สมมุติการระบุให้ความผิดพลาดในเรื่อง ที่ก้าวกระโดดทางการ และว่าการมีวิชาการเกษตร กรมสุขภาพ และกรมประมง ในการแจ้งความรับจ้าง บนการท้อง

4. ความมีการศึกษาครั้ง ที่ทรงค่าที่ช่วยผนวญีระบบการท้องในพื้นฐาน การกระทำของแนวคิดของโพสการสังคมการละลายเรื่องที่ ที่เป็นการใด้ฤทธิ์ ทบทวนรายละเอียดหลักวิเคราะห์เรื่องและ "Sustainable Forestry Participation Project" ซึ่งเป็นโครงการของพันธมิตรประเทศเกษตร (ดูข้อ 2-6.1)

5. ขุดโครงการวิเคราะห์ ส่งผลในทางรายละเอียดสุขภาพในรูปแบบ ทั้งด้านทรัพยากรที่มีอยู่ในประเทศ ที่ที่เป็นการปฏิบัติอยู่ $category.ภาพความสัมพันธ์ ลักษณะการเจรจาคิดนโยบายของพืช รายละเอียดแบบงาน สภาพวิจัยระบบการท้องในการใช้รูป การที่พัฒนาอย่างมาก อนึ่ง ผ่านโครงการพันธมิตรเกษตรเพาะปลูกพืชผลวิถี ขยับสะอาดในประเทศ ในรายละเอียดสมมุติและผลกระทบที่โครงการวิจัยระบบการท้องความดำมีการอยู่ (ดูข้อ 2-2.2)

6. ในหลาย ๆ กรณี ระบบการท้องร่วมทางการเกษตรในระบบ สามารถสร้างระบบที่ผลักดันไปเวียนสู่กันที่เพาะปลูก และราชการที่มีการใช้ ผลักดันโดยที่มีการเกิดของสิ่งแวดล้อมต่าง ๆ ของพืชที่เปลี่ยนแปลง ใช้zew ส่งเสริมเกษตร คือเกษตรในประเทศไทย ที่พัฒนาโดยโครงการ FAO/UNDE/THA ในการ เลือกตั้งที่สำเร็จงาน แบบการท้องร่วมของกรมวิชาการเกษตร

7. ควรเน้นการทดลองการ เพื่อปรมาณการผลการปลูกพืชหลายพันธุ์ข้าวพันธุ์ที่เกี่ยวกันทุก ๆ ปี ซึ่งการปฏิบัตินี้เป็นเรื่องสำคัญ เมื่อมีการปลูกพืชหลายพันธุ์ในการปรมาณ

8. ควรเน้นการวิจัยเกี่ยวกับการดูดเบื้องจากเรื่อง ในการศึกษาผล ขาว รายละเอียดของทางการใช้ประโยชน์ให้แก่ชุมชน ลักษณะการที่เกิดของสิ่งแวดล้อมกับปัจจุบัน สิ่งแวดล้อมเป็นผลิตพันธุ์พืช และ/

(ก) การ测试พืช ปัจจุบันตั้งแต่วันที่กับปัจจุบันก่อนพันธุ์พืช ปัจจุบัน เครื่อง

(ข) ความสัมพันธ์ระหว่างวิทยาศาสตร์ปัจจุบันต่าง ๆ

(ค) ประโยชน์ของขาว แสง และปฏิกิริยาส่งปัจจุบัน กับสภาพแวดล้อม เป็นการสำคัญ ของพันธุ์ สายพันธุ์พืชใช้ได้ ทางการใช้ประโยชน์พืช ทางเลือกเมื่อปัจจุบันอยู่ที่
9. บรรณภัณฑ์ตามหนังสือการวิจัยในการกำหนดสมมุติฐานทางวิชาการเพื่อเป็นแนวทางในการวิจัย ควรเป็นวิธีการที่มีความชัดเจน ไม่สับสน และมีการใช้การวิจัยที่มีความสอดคล้องกัน สำหรับการวิจัยที่มีความสอดคล้องกัน และจะทำให้การวิจัยมีประสิทธิภาพในการถือธรรมชาติและการวิจัยที่มีความสอดคล้องกัน

10. งานวิจัยระบบการทุ่มงบประมาณการวิจัยในการกำหนดสมมุติฐานทางวิชาการ ควรเป็นการวิจัยที่มีความชัดเจน ไม่สับสน และมีการใช้การวิจัยที่มีความสอดคล้องกัน สำหรับการวิจัยที่มีความสอดคล้องกัน

11. ข้อมูลที่ได้จากการวิจัยระบบการทุ่มงบประมาณการวิจัย ควรเป็นการวิจัยที่มีความชัดเจน ไม่สับสน และมีการใช้การวิจัยที่มีความสอดคล้องกัน สำหรับการวิจัยที่มีความสอดคล้องกัน

12. การควบคุมงานวิจัยประจุณ ของโครงการวิจัยระบบการทุ่มงบประมาณการค้าหนังสือภัณฑ์ในกรมวิชาการ-

13. โครงการวิจัยระบบการทุ่มงบประมาณการวิจัยการค้าหนังสือภัณฑ์ในกรมวิชาการ-

14. โครงการวิจัยระบบการทุ่มงบประมาณการวิจัยการค้าหนังสือภัณฑ์ในกรมวิชาการ-
3.5 ข้อมูลที่เกี่ยวกับการข้อมูลที่เกี่ยวกับการคาดการณ์

จากการรายงานฉบับนี้ จำนวนเรื่องต่าง ๆ ที่เป็นภูมิศาสตร์ของการพัฒนาขึ้นใน ๆ ไป ของสถานีวิจัยระบบการทำฟาร์ม นิยามและกล่าว ข้อเสนอแนะต่อไปนี้ คงจะจะเป็นข้อเสนอแนะที่เฉพาะเจาะจง ซึ่งเปลี่ยน งานวิจัยระบบการทำฟาร์มในส่วนของกรมศิลปการเกษตรจะทำได้อย่างมีประสิทธิภาพ ข้อเสนอแนะดังนี้

1. สถานีวิจัยระบบการทำฟาร์ม ควรกำหนดใหม่ให้เป็นกองวิจัยการเกษตร และเติมฟังก์ชันใหม่ "การวิเคราะห์การปลูกพืช" (Cropping System Research Division) ให้มีกลุ่มงานวิจัย 3 กลุ่ม คือ กลุ่มระบบการปลูกพืช (Cropping Systems), กลุ่มภูมิอากาศเกษตร (Agroclimatology) และกลุ่มเครื่องมือระบบ (Systems Analysis)

2. ความมีการปรับปรุงโครงสร้าง ของสถานีวิจัยระบบการทำฟาร์ม ให้มีกลุ่มงานวิจัย 3.

3. งานวิจัยของสถานีวิจัยระบบการทำฟาร์ม ควรมีแผนค้นหาในการค้นหาวิจัยระบบการปลูกพืช

4. กลุ่มสุขภาพด้านขนาดภูมิอากาศเกษตร และกลุ่มภูมิศาสตร์ระบบ جريนิคที่มีการเรียนรู้ใน

5. Use of crop models in forecasting ความมีการโยกย้ายไปประจำปฏิทินจำลองสูญเสียต่าง ๆ ได้เป็นการศูนย์วิจัยพืชไอ และพิสูจน์ ซึ่งไม่มีปัญหาเช่น จำนวนปัญหาของ

6. จำนวนปัญหาที่เกิดปัญหาในกลุ่มระบบการปลูกพืช ความมีการโยกย้ายไปประจำปฏิทินจำลองสูญเสียต่าง ๆ ได้เป็นการศูนย์วิจัยพืชไอ และพิสูจน์ ซึ่งไม่มีปัญหาเช่น จำนวนปัญหาของ สถานีที่อยู่ในประเทศไทย ซึ่งไม่มีปัญหาที่เกี่ยว

iv
6. เจาหนาที่ต่าง ๆ ในกลุ่มภูมิภาค เอกสาร และกลุ่มภูมิภาค ที่มี การประสานงานระดับชาติ ของกลุ่มระดับการปกครอง และกลุ่มที่ทำหน้าที่เป็น เลขาธิการ การประสานงานระดับประเทศ ที่มีผลลัพธ์การขององค์กรอุตสาหกรรม

7. การประชุมวิชาการ การประชุมงานของสถาบันฯ ไปประจำปฏิบัติงานภูมิภาค โดยมี นักวิชาการ เอกสารร่วมของสถาบันฯ เป็นพี่หน้าในการประสานงานระดับประเทศ ที่มี 4 คือ ภาคเหนือ ภาคตะวันออกเฉียงเหนือ ภาคกลาง และภาคใต้ของประเทศไทย

8. ภายใต้แนวทางการมีส่วนร่วมของสถาบันฯ สื่อสารชี้แจงวิเคราะห์ความขัดแย้งที่เกิดขึ้น กลับกล่วของสถาบันภูมิภาค การตกลงเนื้อหาโดยมีการประสานงานและปรับใช้ จนเกิดขึ้นจาก

9. ที่หน้าบ้านที่หน้าสถาบันฯ ในแต่ละภาค ตอกย้ำวิจัยและรัฐต่อไปในการตามกฎหมาย

10. ความมีการประสาน สมมติเห็นปฏิบัติการประจำจังหวัดภูมิภาค หรือระดับชาติ ที่เกี่ยวข้องกับการพิจารณาตามกฎหมายในสถานะของตน การประสาน ที่จะมีการปฏิบัติการประจำผู้อยู่ในภาพรวมสมมติในช่วงวิเคราะห์ความ แล้วก็

11. ความมีการสื่อสื่อสาร ในการวางแผนงานพื้นดิน วางแผนการสื่อสารและการมีการรัฐต่อไป รัฐต่อไป เพื่อจะมีการประสานงานภูมิภาคของสถาบันฯ
12. กรณีการพิจารณาถือว่าเป็นเจ้าหน้าที่ในงานวิจัย ลักษณะงานวิจัยระบบการพิจารณามีการจัดการข้อมูลที่มีอยู่อย่างชัดเจนและเป็นไปตามกฎหมายของประเทศนี้ ตามที่ได้รับงานไปแล้วในการรายงานฉบับนี้ ตรงส่วนซ้ำนั้น ในการวางแผนงานวิจัยในอนาคตของสถาบันฯ ในภาคีนี้

13. กรณีการพิจารณาลดงานในงานหลักของ หน่วยงานวิจัยที่เป็นระบบที่มีการคัดเลือก

พื้นที่ วัตถุประสงค์ของงานวิจัย และงบประมาณ ผลิตภัณฑ์ผลการทดสอบ และ

การผ่อนแปรใช้สู่พื้นที่เป็นเจ้าหน้าที่สังกัดการกำหนด

14. กรณีการพิจารณาให้มีการลดสนับสนุน โครงการพัฒนาปฏิกิริยาศาสตร์ทางบุคคล วัฒนธรรม

เพื่อการพัฒนาวิธีการมาตรฐานงานวิจัยและต้องงบประมาณงานวิจัย

ระบบการเทียบวัฒนธรรมเพื่อพัฒนาทางวัฒนธรรมและสถาปัตย์ แล้วจัดทำเป็นเอกสาร

หุ้นทางวิชาการ (ภาษาไทย) เพื่อให้เจ้าหน้าที่ที่มีงานของกระทรวงศึกษาธิการและ

สถาปัตย์และผู้ที่มีพิจารณาในโครงการพิจารณาต่าง ๆ ต้องปฏิบัติในโครงการพิจารณาในเรื่อง

เกษตร (ข้อ 2.4.2)
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Short Term Consultancy for ACNARP - Dr. D.A. Ivory

1.1 GENERAL:

The Consultancy is intended to investigate the separate administration and separate operation of the large number of farming systems research projects in the North-East. The problem is typified by the existence of three separate NARP research centres around Ubon (Rice, Field Crops and Horticulture) plus an independent unit of F.S.R.I. There are at least five other F.S.R. projects in the region, all operating independently. ACNARP believes that F.S.R. is an important basis for research program development at the regional centres, and that it is the key to effective research-extension linkages.

While the consultancy has a farming system bias, its major focus is upon the use of F.S.R. methodology in the problem definition phase of program development at the research centres.

1.2 SPECIFIC

(i) Review the scope and principle results of past and present research in farming systems in the North-East, with emphasis on rain-fed systems for light soils.

(ii) Review the nature and effectivenses of present linkages between the various farming systems research projects in the region and the research planning process of the Department of Agriculture.

(iii) Investigate the linkage between the various farming systems research projects and the Department of Agricultural Extension.

(iv) Develop specific recommendations for the effective linkage of farming systems research with the research activities of DOA and the extension activities of DOAE.

(v) Provide a report and recommendation to the ACNARP Coordinator within four weeks of completing the consultancy.

(vi) A request was also received from Dr. Yookti Sarikaphuti at the commencement of the consultancy to review the function and organization of the Farming Systems Research Institute.
2. PART A - A REVIEW OF FARMING SYSTEMS RESEARCH (FSR) IN NORTHEAST THAILAND.

2.1 INTRODUCTION

The North-East region of Thailand occupies about 30 percent of the Kingdom. Within this region, crop production is the most important farming activity, accounting for 80 percent of farm income. The most important crop is rice, which occupies 75 percent of the total crop area. Farmers in the region are generally poor with per capita incomes only 65 percent of the national average.

In order to raise the general income of farmers in the region, the Thai Government has supported and promoted research to increase crop and livestock production and more recently fish culture, and thereby increase the income of the farmers. In recent years it has been recognized that an integrated interdisciplinary approach to research is likely to be more successful than single discipline lines of research in introducing new technologies to farmers. This is because the successful introduction of a new technology needs to be not only biologically feasible but also complimentary to all farm activities and the socio-economic situation of the farmer. This holistic approach to on-farm testing of new technologies is generally termed farming systems research (FSR).

2.2 PHYSICAL RESOURCES, CLIMATE AND LAND USE IN NORTHEAST THAILAND

The possibilities and potential for improving agricultural production in Northeast Thailand, by improving existing production systems, the introduction of new crops or crop sequences or animal production systems, is severely constrained by the physical resources and climate of the region.

2.2.1 Physical Resources

The Northeast region (figure 1) occupies an area of 17 million hectares and is bounded by high hills in the west and south and by the Mekong River in the north and east. The land in between forms a plateau which is gently undulating and slopes to the south-east where it is drained by the Chi and Mun rivers.

Geologically the plateau is composed of fine-grained sandstones, mudstone and shale strata which are over-
lain in the valley depressions by alluvial and river terrace deposits. Thirty-five soil groups have been identified in the region, but five major soil groups cover 79 percent of the area. Land use is closely related to topography and associated soils. The land form is generally separated into five categories, viz. flood plain, lower, middle and upper terrace and upland areas.

The recent alluvial soils are the ustifluvents, which occur on the natural levees of rivers, and the tropaquepts and dystropepts which occur on the adjacent flood plain. The levee soils are fine to medium textured, well drained and slightly acid, while the flood plain soils are fine textured and poorly drained. The lower terrace soils are paleaquults and are poorly drained while the paleaquults on the higher terraces have a low water-holding capacity.

The majority of soils in the region are acid, poorly structured and coarse textured with low clay content, organic matter and cation exchange capacities and consequently are generally infertile. These factors provide a major constraint to crop growth and yield and to the crop species which are adapted to these soil conditions.

2.2.2 Climate

The annual rainfall of the Northeast region varies from less than 1100 mm in the south-west to greater than 1800 mm in the north-east (figure 2). The wet season commences with light rain during February to April, with the main part of the wet season occurring from May to October. The rainfall pattern during the wet season is bimodal with the first part dominated by the south-west monsoon from the Indian Ocean and the second, wetter period dominated by tropical cyclones from the South China Sea. One of the most serious limitations to choice of crop and stability of yield is however the extreme variability in rainfall both within and between years.

2.2.3. Land use

The total area of land classified as farm holdings is 8.3 million ha or 49 percent of the Northeast region (Craig and Pisone, 1985), of which 70 percent is classified as rice land, 20 percent used for field crops, 5 percent irrigated and 5 percent for other purposes, such as vegetables and fruit trees.

The topography of the region dictates that rice land will occupy the flood plain and lower-middle terrace areas, with rice grown opportunistically on the upper terraces in wetter years. The variation in annual rainfall across the region
Figure 1: The Northeast Region showing Changwat (provincial) boundaries.
(figure 2) ensures that a higher percentage of cultivated land will be planted to rice in the east compared with the west of the region (Limpinuntana et al., 1982).

The upland areas occupy about 25 percent of the cultivated land. The major crops grown on this land in decreasing order of importance are cassava, kenaf, sugar cane, upland rice and leguminous crops such as peanut and mungbean. These are usually grown as monocrops during the wet season. The hill lands are found in the more mountainous areas in the south and west of the region and the Phu Phan range (figure 3). The hill soils are usually more fertile than lowland soils and usually produce good yields of maize, upland rice, cotton and a variety of other crops in the wet season.

The majority of farmers in the region are smallholder, subsistence farmers. Commonly, several production systems are included in their whole farm enterprise. Livestock production is an integral part of crop production. There were about 3.9 m buffalo, 1.6 m cattle and 1.2 m swine in the Northeast region in December 1985 (Anon, 1985), which represented about 64, 40 and 22 percent of the national population of buffalo, cattle and swine, respectively. Chicken and duck production and fish culture are also other important production systems which are integrated with the whole farm enterprise.
Figure 2: Annual rainfall isohyets (mm) for the Northeast region.
Figure 3: Topography of the Northeast Region
2.3 INSTITUTIONAL AND ORGANIZATIONAL PARTICIPATION IN FSR IN NORTHEAST THAILAND

There have been many attempts to define what constitutes FSR. Generally, FSR is conceived as a research approach aimed at improving the socio-economic welfare of the farmer by better focusing agricultural research to generate and test improved technologies, having regard for the interdependencies and interrelationships which exist between the elements of the farm system and their interaction with the farm environment. The need for FSR has developed because agricultural research has tended to become more specific and discipline-oriented and a recognition that farm systems are diverse and complex production systems that require a multidisciplinary approach in any off-farm research and technology development. The beginnings of FSR in Northeast Thailand seem to have been associated with the inception of programs such as the Department of Agriculture (DOA) "Upland Crop Improvement Project", which was funded by World Bank and commenced in 1976, and the University of Khon Kaen (KKU) "Cropping Systems Project", which was funded by the Ford Foundation and commenced in 1975. Both projects had similar objectives, namely to develop cropping systems suitable for rainfed agriculture. In addition, the DOA project sought to develop an integrated crop/animal husbandry technology and the KKU project sought to provide a research framework for problem-solving at the farm level. Subsequently a number of national and international sponsored FSR projects commenced in the early 1980's in Northeast Thailand. These projects have focussed on studying alternative crop, livestock, fish culture and forestry production systems in 'on-farm' situations. The various agencies which are currently engaged in cooperative FSR activities include World Bank, the Food and Agriculture Organization (FAO), the United Nations Development Program (UNDP), the European Economic Community (EEC), the United States Agency for International Development (USAID), the International Development Research Centre (IDRC) and the Australian (ADAB), Japanese (JICA), Netherlands and Thai Governments.

In order to provide a more definite focus and responsibility for FSR within the DOA, a Farming Systems Research Institute (FSRI) was established in 1982. The structure, functioning and research of FSRI will be reviewed in detail in PART B of this consultancy report. Briefly, the stated objectives of the FSRI are, to conduct problem-oriented research which will result in the development of integrated cropping/farming system packages, to develop an effective methodology for FSR and a system of monitoring and evaluating new technologies, and to provide in-service training for staff and develop effective means of communication with other MOAC departments and farmers. Because of the structure and staffing of FSRI, this organization has
largely been concerned with cropping systems component research.

Clearly a number of organizations, both national and international, and Departments within the MOAC and Universities, are involved in FSR but there appears to be little coordination of their various activities. At least in part to redress this situation, a "Research and Development of Agricultural Systems" National Sub-Committee was formed in April 1986 to establish policy guidelines for farming systems research in Thailand. This sub-Committee is under the chairmanship of the Permanent Secretary for Agriculture with the Director of the FSRI, the Sub-Committee Secretary. The representatives on the sub-committee are as follows:

Permanent Secretary for Agriculture (chairman)
DG Department of Agriculture
DG Department of Agricultural Extension
DG Department of Animal Husbandry
DG Department of Fisheries
DG Department of Land Development
DG Department of Irrigation
DG Department of Cooperative Promotions
DG Department of Forestry
Secretary General Office of Agricultural Economics
Secretary General Office of Agricultural Land Reform
Dean, Faculty of Agriculture, Kasetsart University
Dean, Faculty of Agriculture, Chiang Mai University
Dean, Faculty of Agriculture, Khon Kaen University
Dean, Faculty of Natural Resources, Prince of Songkhla University
Dean, Faculty of Economics and Business Administration, Kasetsart University
Chairman, Central Committee Thailand Farmer Groups
Chairman, Implementation Committee for Centralizing Agricultural Cooperative of Thailand
Director, Farming Systems Research Institute, Department of Agriculture (secretary)
Director, Agricultural Economics Research Division, Office of Agricultural Economics
Representative, Farming Systems Research Institute, Department of Agriculture.

The powers and responsibilities of this Sub-Committee are:

(i) To formulate the direction and planning objectives for research and development on farming systems and technology transfer to farmers.

(ii) To supervise, monitor and liaise with research and development projects on farming systems to ensure they conform with stipulated direction and objectives.
(iii) To report on the progress and obstacles to project implementation, to the Policy and Development Committee for Agriculture and Cooperatives.

(iv) To establish any required Working Committees.

To date the National Sub-Committee for "Research and Development of Agricultural Systems" has not met to formulate guidelines for FSR in Thailand. Obviously there was an attempt to include representatives of all interested organisations but this has unfortunately meant that it is a very large committee. This creates difficulties in finding a suitable date to meet. I believe however that it is imperative that the committee meets and immediately forms some smaller, more practical Working Committees, to address the responsibilities listed above, formulate appropriate guidelines and establish an effective coordinating linkage with the multitude of FSR projects in Thailand.
2.4 SCOPE AND ACHIEVEMENTS OF FARMING SYSTEMS RESEARCH PROJECTS IN NORTHEAST THAILAND.

There are currently a large number of FSR projects being implemented in Northeast Thailand. The projects visited covered a wide range of component research but the majority of projects were oriented towards cropping systems research. It is possible that there are a number of other projects which were not visited which have a major emphasis on livestock, fisheries or forestry systems research. The farming systems projects visited are listed in table 1. Summaries of the objectives, research programs and principle results are given in the following sections.

2.4.1 Ley Farming on Upland Soils Project

The Ley Farming Project was a Netherlands Government funded project executed by the Mekong Secretariat. The Thailand counterpart agency was the Faculty of Agriculture, Khon Kaen University, which after the cessation of the Mekong Secretariat involvement in October 1984, assumed full responsibility for the project.

The objectives of the project were to identify viable ley farming systems for the infertile uplands of north-east Thailand, to evaluate the benefit of ley systems to upland crop systems and to demonstrate and extend the best ley farming system to farmers.

The project was located in the Nam Phong Dam district of Khon Kaen province. Experimentation was commenced in 1979 and the first phase completed by December 1984. A complex split plot design experiment was conducted which included a part factorial comparison of four forage legumes grown for 1, 2 or 3 years prior to cassava cropping, as well as intercropping of cassava with forage legumes and with and without fertilizer addition to the legume leys.

The conclusions from the rotation experiments were that siratro (Macroptilium atropurpureum) and verano stylo (Stylosanthes hamata) were suitable legume ley species and if fertilized and grown for one full year would approximately double the yield of subsequent test crops of kenaf or cassava (Gibson, 1984a). The maximum benefit from leys was obtained from a two year ley and the benefit of the ley to the subsequent crop lasted for a maximum of two succeeding crops. In addition, the legume ley had to be fertilized with non-nitrogenous fertilizers (PK and S) to obtain a reliable, large benefit to a succeeding crop. Other agronomic experiments also examined inter-cropping treatments, other ley and green manure species, various
Table 1: Farming systems research projects visited in Northeast Thailand

<table>
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<th>Project title</th>
<th>Sponsor</th>
<th>Major Implementing Agencies</th>
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<td>Faculty of Agriculture, Khon Kaen Univ.</td>
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<td>2. Northeast Rainfed Agriculture Development</td>
<td>Royal Thai Govt., USAID</td>
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<tr>
<td>3. Northeast Crop Development</td>
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<td>Royal Thai Govt., World Bank</td>
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<tr>
<td>5. Crop-Livestock Integration</td>
<td>Royal Thai Govt., IDRC</td>
<td>Ministry of Agriculture and Cooperatives, Khon Kaen Univ.</td>
</tr>
<tr>
<td>6. Integrated Farming Systems</td>
<td>USAID</td>
<td>Khon Kaen Univ.</td>
</tr>
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<td>7. Tung Kula Ronghai</td>
<td>Royal Thai Govt., Aust. Govt.</td>
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</tr>
<tr>
<td>9. Intergrated Rainfed Farming Research and Development</td>
<td>Royal Thai Govt. UNDP, FAD.</td>
<td>Ministry of Agriculture and Cooperatives</td>
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</table>

strategies of land preparation, fertilizer treatments and ley pre-treatments on crop establishment.

However, a second phase was needed to determine how farmers could obtain a return from the ley pasture phase. The aim of the extension subproject (Dairying on Ley Pastures) of the Ley Farming Project was to determine the inputs and outputs...
and practical problems of adoption by poor farmers of an integrated dairy/ley pasture/crop rotation farming system. The subproject was designed to study a low cash input system where no concentrates were purchased, except for locally produced rice bran and mineral supplement, and all other feeds were either home-grown or found around the village.

There were no major problems in adoption by farmers of dairying on ley pastures and farm produced feed (Gibson, 1984b). The major practical problem was milk transport, but this was seen as a function of the small size of the Project and its distance from a main road. Currently there are more than 100 rai of ley pastures used for dairying in the district.

The advantages of dairying on ley pastures were seen as:

(i) the improvement and conservation of upland soil resources which results in improved crop yield and reduced soil erosion.

(ii) it is a low-cash input system, after the initial purchase of stock, with consequent reduction in risk.

(iii) it results in a reduction in the sale of cassava because of the increased consumption by animals on farm.

(iv) it improves the income, health (through increased consumption of milk) and on-farm employment of poor smallholders.

(v) dairy raising is much more profitable than beef and at least equals the total farm income from all other agricultural enterprises.

2.4.2 Northeast Rainfed Agricultural Development Project (NERAD)

The NERAD Project is funded from the Ministry of Agriculture and Cooperatives, Department of Technical and Economic Cooperation and USAID, with the University of Kentucky, College of Agriculture providing technical assistance.

The NERAD Project commenced in September 1982 to determine if less risky, farming systems can be found to help farmers in the Northeast region to stabilize their family food supply and increase cash income.

There are eight cooperating agencies associated with the project. These are the Department of Agriculture, Department of Agricultural Extension, Department of Fisheries, Department of Land Development, Department of Livestock Develop-
ment, Department of Cooperative Promotion, Office of Agricultural Economics and Royal Forestry Department. The Northeast Regional Office of Agriculture and Cooperative at Tha Phra, Khon Kaen Province, is responsible for integrating the project efforts of these agencies and providing overall project leadership. The Department of Agricultural Extension performs a similar coordinating role at the tambon (district) and village level. Considerable efforts have been made to integrate research and extension programs, to promote closer links and involvement of farmers and agricultural officers, to improve planning, two-way information flow and implementation of appropriate technologies. To this end Tambon Councils and Village Development Committees were established in each area.

Nine tambons were selected in four provinces in the Northeast region as project sites. Initially, assessments were begun to determine the needs of the principal villages in each tambon. In-depth interviews were conducted with sample farmers, maps drawn of all land in the village and project activities planned in response to what villagers identified as their needs and what the scientists knew to be technically feasible (see Limpinuntana and Patanothai, 1982; and Limpinuntana, Conway and Patanothai, 1982).

Within the Project five management working groups were formed. Each working group has several participating agencies. Currently 51 activities are implemented under three major working groups:

* Cropping Systems and Extension
* Village Water Resources Management
* Village Common Lands Management

Two smaller working groups were also formed
* Integrated Pest Management
* Marketing and Economic Analysis

Recently the Marketing and Economic Analysis work group has been subsumed into the three major work groups. The management work groups usually meet monthly for a situation review of activities in farmers' fields. In addition to the technical aspects, which are central to the activities of these work groups, there is considerable interest in using the work group activities to document and perfect the technology development process and to promote closer liaison between research and extension in this process.

The Cropping Systems and Extension work group is the largest in the project. During 1983 and 1984 two types of trials were conducted:

(i) Cropping intensification trials over the entire tambon following DOA recommended practices for planting dates, fertilizer rates, etc.
(ii) Trials conducted in only one principal village per tambon which were designed to solve current farmer problems identified during an interdisciplinary, needs assessment, conducted in each village.

Almost 100 trials, generally replicated over 5 farms, were conducted. In order to set priorities for future work a technical workshop was held to review the results of all trials and to classify the technologies into 3 categories:

(i) Successful technologies which were considered suitable for expansion through extension demonstrations.

(ii) Promising technologies which still require further testing or modification by component technology research.

(iii) Technologies which under present or expected future conditions are unlikely to significantly benefit farmers.

Technologies assigned to category 1 are then demonstrated in an extension phase by DOAE with technical support from DOA and category 3 technologies are discontinued or passed back to the research stations, but regularly reviewed to determine if technological advances or economic circumstances have changed sufficiently to warrant further testing. Category 2 technologies continue in the project's cropping systems trials with an intensive series of on-farm trials including superimposed, component technology work to solve the remaining problems and develop the systems until they are ready for the extension phase.

In lower paddy areas cropping systems research has concentrated on defining suitable double cropping patterns with rice. Crops which have been grown preceding rice include mungbean, Thai and Cuban kenaf, cowpea as a crop or green manure, peanut, yardlongbean, sesame, baby corn and sweet corn, red sorghum and cucumber. In the upper paddies, numerous double cropping patterns have been examined. Only a few combinations have included rice. Crops tested have included white and black sesame, peanut, mungbean, Thai and Cuban kenaf, water melon, sweet corn, jute and red sorghum.

Experimentation by the project has led to the firm belief that soil improvement is a necessary pre-requisite for the Northeast region to increase crop production and farm income. There are therefore two main thrusts to the cropping systems research programs:

(i) Evaluation of fertility of soils in Northeast Thailand with respect to the effects of pH, liming and seasonal conditions on nutrient availability and
nutrient requirements of crops.

(ii) Soil fertility improvement through cropping systems development which maximizes residual fertility from fertilizers, crop residues, legume crops, green manures, mulching and composting.

The Village Water Resources program is aimed at providing better control of runoff and water management during the wet season and increased supplies of water during the dry season. The construction of diversion weirs raises the water levels in streams and allows rice paddies to be flooded more continuously and reliably. In addition, the rehabilitation of swamps, construction of shallow wells and tanks has increased the supply of domestic water and allowed small-scale, irrigated production of high-value crops.

The Village Common Lands Management program is concerned with introducing an effective program for conserving and improving the resources of common lands. Common lands support a wide variety of uses including: livestock grazing, cropping, firewood production, hunting and gathering, mulberry production, market places, recreation and holy places. Generally they are located in upland areas and are covered with a mixture of pasture, bush and forest vegetation but have suffered considerable exploitation by overgrazing and wood gathering. The working group is devising a means of:

(i) Increasing productivity of grazing use and wood production of these common lands.

(ii) Designing research and extension pilot projects to test possible management systems to overcome traditional constraints to common land productivity.

The NERAD project has been concerned about the various projects developing their own FSR methodologies. Craig (1986) therefore has proposed that a FSR and Extension Methodology (FSRE) workshop be convened. The purpose of this workshop would be to define a FSRE methodology that was appropriate for use by the MOAC and document this in the form of a Thai language technical manual. This would provide some standardized procedures in FSR activities and allow comparisons of results between projects and regions and help facilitate the definition of the developmental status of various technologies.

2.4.3. Northeast Crop Development Project (NECDP)

The NECDP is sponsored by the Royal Thai Government and the European Economic Community. The NECDP commenced in 1983 following the signing of a 'Autolimitation Agreement' between the EEC, Thailand and other Southeast Asian
countries which aimed to restrict the tonnages of cassava exported to the EEC and to minimize the impact of an expected decrease in the price of cassava.

The overall objective of the project was to prepare farmers of the Northeast region for the time when cassava prices fall to a level where production is no longer economic and diversification is necessary to maintain their level of income. It was hoped to achieve this principally by a program of adaptive research aimed at increasing the cropping intensity per unit area of alternative crops and sequences and raising yields. An underlying aim of the project was also to promote a greater interaction between Research (DOA) and Extension (DOAE), thereby ensuring that small-farmer related problems would be more quickly and efficiently resolved in the future.

The NECDP is guided by an executive committee beneath which are subcommittees for research and extension which are responsible for planning and implementing their components of the project. Project management is vested in a six-man team from DOA, FCRI, FSRI, DOAE, NEROAC and a technical adviser from EEC. Although the Project has a strong orientation to FSRI in the Adaptive Research program, there is scope for component research and extension under two additional programs, Contract Research and Extension and Demonstration.

The Adaptive Research Program is carried out principally by FSRI, with support from FCRI on upland crops, RRI on rice and HRI on horticultural crops. This program is based on five locations in four provinces covering three rainfall zones. Sites were selected on two principal criteria.

(i) their importance in terms of cassava production
(ii) their differing agroecological conditions.

Research in the three zones is concentrating on testing various double cropping patterns. In zone 1 (Udon Thani, 1400-1500 mm rainfall) the patterns tested are mungbean/upland rice, sesame/peanut and peanut followed by mungbean or sesame. In zone 2 (Ban Thai/Boraber, 1200-1400 mm) the patterns tested are mungbean/upland rice, sesame/peanut and kenaf followed by mungbean or sesame. In zone 3 (Don Khu Tod/Sikhin, less than 1200 mm) the patterns tested are peanuts followed by maize or sorghum, maize/sorghum or sesame/upland rice.

In zone 1 the most promising pattern was peanut/mungbeans with the peanut/sesame pattern showing some potential. In zone 2 it was found kenaf would be better grown as a monocrop and that sesame/peanut cropping sequence showed promise. In zone 3 the maize/sorghum sequence was found to be best suited.
The Extension Component of the Project has concentrated on fruit tree, sericulture and principal village programs. The fruit tree program is promoting the planting of mango, jack fruit, tamarind and jujube in a number of areas, while the village program is promoting the planting of peanut, kenaf, sweet corn, sesame and maize, as well as chicken and duck programs.

Contract Research is for component technology research by the DOA, and other institutions as follows:

(i) Field Crops Research Institute-component technology and upland crop development

(ii) Rice Research Institute - upland rice breeding

(iii) Office of Agricultural Economics - socio-economics and marketing surveys

(iv) Horticultural Research Institute - horticultural crops (fruit trees and vegetables)

(v) Khon Kaen University - fibre crops and cowpea

(vi) Kasetsart University - oilseed breeding

(vii) Livestock Department - research on fodder crops

(viii) Land Development Department - research on upland soil conservation and soil fertility maintenance

(ix) Northeast Regional Office of Agriculture and Cooperatives - basic research and component technology work

(x) Farming Systems Research Institute - agroclimatology and crop suitability modelling.

In many instances, these contract research programs do not seem to be working satisfactorily. Problems encountered include the fact that the actual experimental program can vary greatly from that proposed and agreed to, and from budgetary problems (see for example the NECDP 7th Quarterly Report - October, November, December 1985).

For the future the project management has identified needs for:

* more survey baseline data of principal villages, using rapid assessment methods

* more component research

* more involvement with agricultural extension activities
2.4.4 Rainfed Agricultural Pilot Project

This project commenced in 1983 with a loan from World Bank. The project is coordinated by the Office of Agricultural Economics with participation by DOA and Department of Land Development.

The main aim of the project is to redevelop an area of 2500 rai north of Khon Kaen with each family in the project area having 15 rai. The land is undulating and therefore one of the primary objectives has been to improve water conservation and minimize erosion. Following an initial topographical survey, land development activities concentrated on constructing contour banks and small dams and ponds (average capacity 4500 m³).

Within the development project a small pilot project has been initiated to test various cropping patterns for suitability to the soils and climate of the area. The cropping patterns are tested on farms with the project supplying loans of seed and fertilizer to the farmer, which are then repayable from crop production.

The cropping patterns tested included safflower as a monocrop, kenaf and cassava with legumes (cowpea, pigeon pea, peanuts) and sesame followed by sorghum or cotton. The performance of safflower was poor and cassava intercropped with peanuts appeared the most promising cropping pattern.

Another promising cropping pattern appears to be ricebean intercropped with corn. Sugarcane is also grown in small areas and areas of papaya have been established using trickle irrigation from the ponds.

The major problems highlighted by the pilot project are associated with prevention of soil erosion and the highly variable plant growth associated with some undefined soil variability. This causes very uneven growth in crops such as mungbean, soybean and peanuts.

2.4.5 Crop-Livestock Integration Project - Ban Phai

This project is sponsored by the International Research and Development Centre (IRDC) and implemented by DOA, DOAE, DLD and KKU. The main objectives of this project are:
- to identify suitable cropping patterns which are complementary to animal production
- to more efficiently utilize farm by-products
- to assess the performance of alternative technologies
- to increase the efficiency of utilization of farm resources and
- to identify constraints to increased farm production.
Following a preliminary survey, cooperative farmers were selected and classified into three groups for further study. 

* animal dominant enterprises  
* crop/animal production enterprises  
* crop-based farm production

The cropping patterns being studied include corn followed by peanut or cowpea and cassava followed by peanut or corn in the upland areas and corn or peanut followed by rice in upper paddy land.

The aspects studied in animal production systems are the utilization of various sources of feed available on farm and their effect on liveweight changes. The benefits of supplementary feeding of sown grass/ legume pasture on production of milking cows is also being studied.

The socio-economic component of the project is concentrating on baseline surveys of farms and farm book recording.

2.4.6 Lam Nam Oon Integrated Rural Development Project  
Sakhon Nakhon

This irrigation project was established in 1978 with the signing of a loan agreement between the Royal Thai Government and USAID. The agencies involved in the implementation of the project are the Royal Irrigation Department, the Department of Agricultural Extension, the Department of Agriculture, Department of Fisheries, Community Development Department and Non-Formal Education Department. The objective of the project is to increase agricultural production in the irrigated area and therefore improve the quality of life of the 12,000 downstream farmers.

The irrigation system developed consists of 520 million m3 reservoir and 313 km of main and lateral canals which serve a downstream area of 185,800 rai in the wet season and 63,000 rai in the dry season. Rice is grown as the main wet season crop. The project has been required to initiate adaptive research in order to identify suitable crops for the dry season. A range of crops, including peanuts, tomatoes, cucumbers, corn, sorghum and watermelon are being tested for their productivity with irrigation in the dry season. In addition fish pond culture has been promoted since 1981 and the FSRI has an involvement in integrated farming research with crops/fish ponds/pigs/ chicken and ducks/biogas production.
The Integrated Farming Systems Research Project, Khon Kaen University

Khon Kaen University (KKU), with financial support from USAID, initiated the Integrated Farming Systems Research Project in January 1984. The project is a continuation of the previous Cropping Systems Project, funded by the Ford Foundation, but expanded to include the animal subsystem in the FSR activities. In the project, the three major components, crop, animal and social sciences, are integrated into a full interdisciplinary FSR approach. The information technological development, methodology and training and communication outputs generated by the project are aimed at the Government action agencies, although the ultimate target is the rainfed farmers of the Northeast.

The specific objectives of the project are:

(i) To develop and test farming technologies and define the type of farm system and its environments where they will be suitable and beneficial

(ii) To derive classificatory information on agroecosystems and farming systems, their environments and their constraints to technological development

(iii) To develop and test methodologies for undertaking the above research

(iv) To promote training and communication with action agencies in the above techniques and technological development.

In initiating this project, several workshops on human ecology, agroecosystem analysis and rural rapid appraisal were held in order to build up a systems approach and interdisciplinary thinking of the FSR team. A philosophical point of view was adopted that the project should aim at generating a range of technologies from which farmers could choose one or several technologies which would fit their resources and circumstances, and that the farmers themselves should be the integrators of the technologies or enterprises.

There are two types of research activities in the project:

(i) the implementation of an indepth FSR study in a project village,

(ii) specific studies outside the project village.

The indepth studies are conducted at a village (Ban Hinlad) in Amphoe Muang, Khon Kaen and include site description, monitoring of farming practices, household record keeping, socio-economic studies of families in the village and the testing of some promising cropping patterns from the pre-
vious cropping systems project, such as cowpea and peanut after kenaf, peanut after rice, sesame before rice and vegetables. Some examples of component research in the village are yield loss in kenaf due to jassids; soil survey, classification and nutrient deficiency identification; direct seeding of rice; storage methods for cowpea seed; and monitoring of dry season soil moisture regimes.

Activities in animal production include the use of crop residues for animal feeding, dairy farm production in relation to other farm activities, production systems for chickens and swine and small pond and paddy fish culture.

Social science activities include studies of household record keeping, village history, nutritional status of village children, labour exchange in the village, food habits of farmers, acceptance of crop technology by farmers as well as economic studies.

Further information on project activities can be found in the "Summary of Works for FY 1985 and Research Plan for FY 1986", KKU-USAID Farming systems Research Project.

2.4.8. Thai-Australian Tung Kula Ronghai Project.

In 1976 the Royal Thai government recognized the need to accelerate development in the Tung Kula Ronghai, an area of 337,000 ha in the central Korat Basin which is prone to regular flooding in the wet season and salinity problems. Assistance was requested from Australia for rural development planning. The RTG carried out prefeasability and flood irrigation studies in 1977 and 1978. Following this, the Australian Development Assistance Bureau (ADAB) provided assistance with land development in two phases from 1979 to 1982. Subsequently, Australian support for a limited Phase III was approved, which included studies of groundwater, soil fertility and surface water control. A Phase IV began in October 1984.

The following components are now incorporated in the Project:

(i) Land remodelling - development of a system of bunds and drains which will both impound water at a level suited to rice production and permit floodwaters to drain quickly

(ii) Groundwater development - construction of shallow tubewells capable of irrigating 4 rai each for dry season cash cropping, and some wells for domestic use

(iii) Water resources study - preparation of a definitive statement of the potential and priorities for surface
water resource development in TKR.

(iv) Fisheries - renovation and construction of fish ponds and increased DOF extension and fingerling supply activities.

(v) Upland reaforestation study - contains three sub-projects: forestry, soil conservation and pastures. Up to 1000 rai of upland will be planted to Eucalyptus camaldulensis and to Stylosanthes hamata pasture. The study is aimed at testing the hypothesis that the development of forests with pasture for grazing between the rows of trees will cause the ground-water table in lower land areas to fall, with consequent decrease in salinity problems and increase in rice yields.

(vi) Community development - in association with the Community Development Department this program is aimed at involving farmers in all aspects of the Project's technical components which affect them and increasing the effect of the project benefits at the village level.

(vii) Road maintenance - provides upkeep of laterite roads in TKR.

(viii) Research and Extension - the DOA, DLD and DOAE are involved in the three subcomponents: agronomic research, land improvement research and agricultural extension. The causes of low crop production, i.e. low cation exchange capacity, soil salinity, soil infertility and flooding or drought, are well known. Research is aimed at soil amelioration, water control and agronomic practices for rice, upland crops, vegetables and sericulture. Soil improvement technologies which are being tested include the addition of compost, animal manure, green manure and the addition of an artificial soil ameliorant to soils. The benefit of inorganic fertilizers, alone or in combination with Azolla, organic mulches, manures and leguminous crops is also being investigated. Other investigations into the improvement of saline soils include liming, deep ploughing and application of gypsum and compost.

Component research on varietal adaptation of field and horticultural crops and crop protection is also undertaken. In the uplands, a number of horticultural crops are under evaluation. These include pineapple, sweet tamarind, mangoes, cashew nuts, mulberries and vegetables.

Experiments on-farm during 1986 have included comparisons of broadcast and transplanted rice both on and
off the remodelled land area, upland crops prior to rice and evaluation of early maturing crops. Amongst the cropping sequences with rice, kenaf appears the most economic, peanuts has problems with periodic flooding, sesame is very prone to waterlogging at seeding (because it is a small seeded species) while farmers are not generally interested in cowpeas as a green manure. Small areas of Sesbania rostrata are being grown to evaluate its usefulness as a green manure.

2.4.9 UNDP/FAO/THA Integrated Rainfed Farming Research and Development

The Project was initiated in August 1980 with funding support from FAO/UNDP to the Farming System Research Institute (FRSI) and Rice, Field Crops and Horticulture Research Institutes of the DoA. Cooperating staff are also included from Agriculture Engineering and Botany and Weed Science Divisions of DoA and staff of DOAE. The specific assistance given by the Project to FRSI includes the provision of in-service training to FRSI staff, equipment, technical assistance and to assist with the implementation of the field programs. There are three main aims of the Project:-

(i) Improve the existing farming systems of the project areas and expand the range of alternative systems
(ii) Increase crop productivities and incomes of the small rainfed farmers in the project areas
(iii) Integrate crops and livestock into systems

In order to achieve these aims, the following tasks were set:

(i) Define the agroclimatic and socio-economic environments where farming technologies are to be improved or developed
(ii) Relate the environments of the project areas to other parts of the country
(iii) Package the technologies to be tested
(iv) Organize the people/agencies to do the testing, and define and delineate functions
(v) Conduct the trials and evaluate the effect of the technology on production stability, increase in yield and income of farmers
(vi) Develop the method of monitoring the results and
modules of disseminating the technology.

The Project selected four sites for FSR, two in North Thailand (Phayao and Sukhothai) and two in Northeast Thailand (Surin and Mahasarakham). Agroecological classification (based on soil and rainfall classes) and production stability classification has been completed for these four sites as well as classification maps for the whole of Thailand. Sites were chosen for FSR within the four provinces. Three sites were chosen in Surin and one in Mahasarakham. Surveys were undertaken to describe the physical resources, nature of the existing farming systems and socio-economic status of farmers at these sites. These surveys provided information on crop production statistics, livestock populations, calendar of existing cropping patterns, land use classification and details of land, size of household, crop and livestock production per farmer family and gross income from various on-farm sources and off-farm income.

The farming systems research programs have evaluated a range of cropping patterns in an attempt to increase and intensify crop production. In the northeast region a number of double cropping patterns have been tested, including mungbean, jute, kenaf and sesame before rice and peanut following rice and cassava/peanut in upland soils. The promising technologies which have emerged from the project include the direct seeding of rice, jute/rice and kenaf/rice cropping patterns and the integration of crops with pig fattening and with ducks and fish ponds.
2.5 SCOPE AND ACHIEVEMENTS OF FARMING SYSTEMS RESEARCH IN RESEARCH CENTRES OF MOAC IN NORTHEAST THAILAND

The activities of the research centres and stations of the MOAC are mainly concerned with component research. For this research to be effective in increasing agricultural production and to improve the socio-economic welfare of farmers in the northeast region, there is a need for the research to be directed to solving problems at the farm level. Component research provides an important backup to the provider of technologies to be tested on farms or for solving problems generated or identified by on-farm research. In the following sections, the component research and FRS of these centres is briefly reviewed.

2.5.1. Agricultural Development Research Centre (JICA) at Khon Kaen

A five year Agricultural Development Research Project in Northeast Thailand was initiated in December 1983 with the aim of strengthening research activities in the region with regard to:

(i) Assessment of natural environment and available resources for planning proper land use

(ii) Identification and elimination of existing production constraints

(iii) Development of agronomic technology adaptable to each locality

The Project is sponsored by Japan, U.S.A. and the Kingdom of Thailand. The cooperating agencies which are implementing this project are the Office of the Permanent Secretary, the Departments of Agriculture and Land Development and the Faculty of Agriculture, Khon Kaen University. Technical assistance is also provided by Japan.

The research programs are divided into three main groupings:

(i) Assessment of the natural environment and resources
   - land classification and land use planning
   - stochastic analysis of rainfall

(ii) Improvement of crop performance
   - interaction of environment, water stress and crop performance
   - development of drought tolerant crops for the Northeast region

(iii) Improvement of soil conditions
   - amelioration of soil salinity
- recycling of organic matter
- conservation of soil fertility.

Currently the DOA has 27 programs, LDD has 15 programs and KKU has 17 programs. Research emphasis is given to programs associated with the lateritic (upland) soils, saline soils associated with the Chi and Mun river systems and the sandy soils in Yasothon and Ubon Ratchathani provinces.

2.5.2. Northeast Regional Office for Agriculture and Cooperatives (NEROAC)

Both the NERAD and NECDP projects are associated with this office. The NEROAC is responsible to the Permanent Secretary for Agriculture. The office has between 65-100 staff of which 45 are technical core staff drawn from DOA, DOAE, Department of Fisheries and Office of Agricultural Economics. Staff have responsibility to their own departments for activities as well as participation in integrated projects. In addition to its coordinating role with the NERAD and NECDP projects, the NEROAC is implementing a number of integrated projects:

(i) Small scale water resources project which helps to build small ponds for use by livestock and fisheries

(ii) Virus-free papaya program which presently involves 510 villages where infected material is eradicated and new virus-free material is introduced after a waiting period of 2 months

(iii) A resettlement pilot project which aims to resettle people on an area of 1-15 rai per family and provides help in establishing upland rice, fruit trees and native chicken farm enterprises

(iv) Pilot project in association with the Royal Irrigation Department.

2.5.3. Field Crops Research Centre - Khon Kaen

The research at this centre is mainly component research where the main crops under study are peanut and kenaf. There is currently no FSR associated with this centre.

2.5.4. Field Crops Research Centre - Ubon Ratchathani

This research centre has special responsibility for castor, cowpea and sesame. Component research includes varietal
improvement, agronomy (cultural practices) and plant nutrition. On farm research is examining cropping patterns with soybean, peanut, mungbeans and vegetables after rice. There are also studies on rice/fish culture in farmer's fields. Other projects such as NERAD, UNDP and NECDP have associated programs with the Field Crops Research Centre at Ubon.

2.5.5 Rice Research Centre - Ubon Ratchathani

The component research at this centre is concentrated on varietal improvement and fertilizer requirements for rice. FSR is confined to fertilizer studies and yield trials in farmers' fields. Other projects such as NERAD and NECDP have associated programs.

2.5.6 Horticulture Research Centre - Si Sa Ket

Component research is undertaken in research units such as breeding; germplasm introduction and evaluation; budwood, seed and root stock production; intercropping and planting arrangements; fertilizer requirements; and pests and diseases. Commodity research is undertaken with cashew, fruits (mango, papaya, tamarind, soursop and pineapple), vegetables (chilli, onion, shallot, garlic, asparagus, tomato, pumpkin, watermelon and cabbage), flowers and ornamentals (jasmine, roses, gladioli and native flowering plants) and mushrooms. FSR is aimed at utilizing available land between fruit crops during the early years before the trees become productive. Fruit trees are being planted in zones, hedgerows or in mixed plantings with intercropping with vegetables, flowers and dryland crops. Fruit trees usually take three years to become productive during which time 80, 60 and 40 percent of the inter-tree space is available for intercrops in successive years after planting the trees.

In the zoning experiment the tree crops are cashew, two mango varieties, lime, anona and sapodilla which are intercropped with sweetcorn/ mungbean, tomato/ chilli, papaya, garlic, banana, black pepper, eggplant, jasmine and onion.

In the hedgerow experiment the tree crops are guava, cashew, four varieties of mango, jackfruit and tamarind, which are intercropped with papaya, jasmine, onion, garlic, peanut, sweet potato, black pepper and eggplant.

In the mixed species experiment the tree crops are four varieties of mango, cashew, jackfruit, tamarind and anona which are intercropped with onion, garlic, chilli, peanut, sweet potato, sapodilla, banana, jasmine, gladioli (Thai variety) and papaya.
In the first year of these experiments the hedgerow system gave the highest economic returns from the intercrops. These experiments will continue for many years to assess the various intercrops during the first three years and their effects on subsequent fruit crop yields.

Other activities away from the centre include evaluation of horticultural crops on farms in Roi Et and Chaiyaphum provinces and in three districts near the Thai-Kampuchea border. A number of FSR experiments are also conducted within the NERAD project around Srisaket.

2.5.7. Farming Systems Research Institute (FSRI)

The FSRI is undertaking a wide range of FSR activities in the Northeast region in association with foreign sponsored projects and DOA Research Centres and Stations, as mentioned in previous sections. A detailed listing of experiments conducted during 1985 is given in Appendix 2. These activities are reviewed in Part B of this report.

The FSRI has also been assisted in their fish culture integration program by volunteers from the Canadian Universities Service Overseas (CUSO) program. Two CUSO volunteers are working in association with Sakhon Nakhon Rice Research Station and Ubon Ratchathani Field Crop Centre to help develop and promote fish culture systems in association with flooded rice culture. While these programs are very closely associated with the implementation of fish culture technologies by farmers, several studies have been undertaken to study the biology and food cycle chains of fresh water fish species and the effect of their presence on rice yields.
2.6 EFFECTIVENESS OF PLANNING, EXPERIMENTATION AND COORDINATION OF FSR IN NORTHEAST THAILAND

There are a large number of international and national agencies and research centres and stations involved in a wide range of farming systems research activities in Northeast Thailand. Within the projects which are sponsored by international agencies, project implementation occurs through a number of agencies within the MOAC or other ministries. Thus most projects have set up an executive committee and program committees to decide general project policy and to implement the programs of the project. FSR activities are implemented by staff from regional research centres and stations, research institutes of the DOA, and staff from other departments who are associated with the projects. In this section the issues of (i) how effective are the planning and coordination processes within and between projects and (ii) how effective are the FSR programs, are addressed and consideration given to possible areas for future FSR activities.

2.6.1 Planning and Coordination

The involvement of several agencies in the implementation of projects necessarily means that coordination and planning are principal ingredients to the success of the project. It is not intended to discuss this aspect in detail for individual projects. Most externally funded projects have their own internal reviews which address these issues. However some general comments seem relevant.

It is apparent that varying degrees of cooperation have been achieved between the various agencies involved in projects. With time some agencies have contributed less to the project. However, for many projects the greatest improvement in cooperation and involvement in project activities has been between DOA research institutes/divisions and the DOAE staff. Many projects have seen this as one of their major priorities and achievements. It is quite clear that the closer linkage between farmer, extension officer and researcher is the key to better problem identification, program planning, research implementation and technology transfer to the farmers. Goulder (1986) has addressed this issue in detail and developed the theme that a natural and effective linkage can be achieved between research and extension on the basis of a jointly agreed definition of farm problems which have high priority for resolution and a shared interest and commitment by both towards improving the farmer's situation.

However at the regional level there seems to be no effective
coordination or planning of FSR, despite the efforts of the NEROAC. Certainly there has been the opportunity for closer cooperation between the NECDP and NERAD projects because of their direct association with the NEROAC. However for other projects any linkages that occur are based on individual people having informal discussions or meeting on aspects of project activities. The formation of the "Research and Development of Agricultural Systems" National Sub-Committee (see Section 2.3) was obviously initiated in response to a perceived lack of coordination and planning between projects. Such a committee can in principle ensure that there is some degree of coordination between projects so that communication between projects is improved, opportunities for cooperative research are highlighted, there is a sharing of results and technology development, there is an avoidance of unnecessary duplication of research, there is an opportunity to develop and adopt standard methodologies in FSR, where practical, and that cooperation between participating agencies is improved. Some coordination between projects can be obtained indirectly because the Director of the FSR is a committee member of several projects. However, it might be worthwhile the National Sub-Committee on FSR considering the role that the regional offices of the MOAC could play in implementing the powers and responsibilities of this committee at the regional level to ensure closer cooperation and coordination of FSR activities. There would also be some obvious benefit for the DOA or National Sub-Committee on FSR to sponsor regional and national workshops to review the development of cropping technologies and other FSR activities.

A number of more specific issues were highlighted from discussions with staff of the various projects in relation to aspects of planning and coordination:

(i) Research definition. It was apparent in several instances there was a need for closer involvement of farmers, extension and discipline specialists in problem definition, identification and formulation of research programs and execution of FSR and the need for these to be closely linked to the farm situation. Inadequate definition of on-farm problems is an obvious limitation to the success of FSR. Some of the fault for failure of on-farm trials was however suggested to be due to a general lack of appropriate basic research information and research information that was insufficiently broad based for technology development, as a result of the poor definition of research priorities on research stations or centres. It was apparent, however, that in many instances this was a result of insufficient feedback to research centres on problems generated by on-farm research. This highlights the importance of two-way information flow between discipline specialists and FSR scientists and the important contribution that basic
research can provide to FSR.

(ii) Extension activities. The importance of extension staff in almost all FSR activities cannot be overemphasized. The linkage with farmers and FSR is critical to the successful development of new technologies. It appeared that extension staff may not be able to participate in FSR as much as would be desirable because a large proportion of their time is associated with the collection of statistical information, policy implementation and regulatory activities. In addition there was some indication that extension officers may have an inadequate technical background or understanding of the extension process. Currently the Thai-Netherlands Government "Small farmer participation project" is conducting training programs for extension officers of the DOAE in the Northeast region. These programs are using group discussion methods to examine all aspects of the extension process together with four selected farmers to inform the extension officers of how they view the extension process. In these group discussions, farmers have indicated that in some instances extension officers do not understand their farming system and are often giving bad or irrelevant advice. Obviously these extension training programs are very beneficial to extension officers to better understand the extension process and farmer attitudes and problems. These training programs should be encouraged to be continued and include staff from the FSRI.

(iii) Communication. It was indicated that there was a need for better communication between projects and within groups concerned with the extension process. As previously mentioned, poor communication between projects can lead to duplication of research and lack of opportunity for more broad-based discussion or review of research results. This is very evident with unsuccessful cropping patterns or technologies where a wider forum for discussion may have better identified the problems or limitations of these technologies and overcome the constraints more readily. It was also indicated that there was a need for better information dissemination, including the use of pamphlets, newspapers, television and radio, in the extension process of new technologies.
2.6.2. Research Objectives, Experimentation and Evaluation

In the Northeast region there appears to be three major factors which have to be considered in testing, developing and introducing new farming system technologies:

(i) Farmers are generally poor and therefore have very little surplus cash to invest in new farming system technologies. Therefore new technologies should not require large cash inputs.

(ii) Farmers are mostly subsistent and rice production for home consumption is the most important farm activity. Therefore new farming system technologies should not interfere with, but should complement or improve, rice production.

(iii) For the majority of farmers, off-farm income is a significant part of their total income. Therefore the introduction of any new farming system technologies should minimize any interference in time to pursue off-farm income.

In addition to these socio-economic constraints to the introduction of new technologies, the other major constraint to improving farming systems is the difficult agroclimatic environment of the region. As described in section 2.2, the particular limitations are the bimodal nature of rainfall in the wet season, which can lead to periods of drought during the wet season, the high variability in rainfall that occurs within and between years, and soil factors, particularly those associated with poor plant nutrient availability.

As detailed previously (refer sections 2.4 and 2.5) there is a lot of research activity in the Northeast region which comes under the general heading of "farming systems research". Most activities however are confined to "crop systems research", as there appears to be relatively little work on FSR for livestock or fisheries. Possibly the Livestock Development Department or Department of Fisheries has a range of FSR activities in the Northeast region, but if this is so it would indicate a substantial gulf in cooperation and coordination between crop systems research and livestock and fish systems research.

The general direction and focus of FSR (i.e. the testing of new crops and cropping patterns, the intensification and diversification of crop production and integration of cropping with livestock, poultry and fish culture) in the Northeast region is basically very sound. However I have some reservations about the way cropping systems research is being conducted. Such criticisms are given constructively and are generalizations that are not necessarily applicable to all situations. It is apparent that in many instances a lot of important information is overlooked or not collected,
or misleading or worthless information is being collected because of inadequacies in experimental design and experimental techniques. The following sub-sections address some of these issues:

Resource data. In some instances there appears to be a general lack of good base-line data which should detail the basic farm resources, the existing farming systems, the socio-economic and biological determinants and constraints of the farming systems being studied. The more widespread use of rapid rural assessment techniques, reconnaissance soil maps of DLP, tambon statistics, etc., should aid this process, especially when combined with an attempt to group and classify areas which have similar farming systems and agroecological resources. This should be the starting point for problem definition.

Systematic approach to experimentation. Agricultural research is very expensive. A systematic approach to research can make it more cost effective. If experiments are located in a random fashion or simply wherever a cooperating farmer can be conveniently located a lot of valuable data is lost. Such data may have little predictive value. It is more appropriate to locate experiments on farms in a systematic way so that the same treatments or cropping patterns are located on a range of soils or environments within the target area. The monitoring of climatic, soil, disease, pest and yield factors then allows a better opportunity to define limiting factors and to predict in what areas this technology would be suitable. Yield prediction may also require some crop and water balance modelling combined with data on nutrient availability.

Experimental design. In some instances there seems to be a lack of scientific rigour used in on-farm experimentation, in terms of experimental precision, degree of involvement of scientists at all operational levels, general knowledge of the experiment (in terms of objectives, operational activities, etc.) and the delegation of many activities to the farmer without any monitoring of how and if the farmer carries out these scheduled activities. Another impression obtained was that in some instances crop sequences were tried in a non-selective or random manner with little appreciation of the basic fundamentals of experimental design, nutrition and interactions between crops used in the cropping sequence. This can result in:

- inappropriate fertilizer treatments, because of lack of soil analyses or lack of recognition or identification of limiting nutrients or soil factors;

- separate sets of treatments in each crop in the cropping sequence so that result are completely confounded in the second crop with respect to treatments imposed in the first crop.
very little use of control (check) or current farmer systems (i.e. single rice crop) to evaluate the benefit of the new cropping pattern against the existing system.

continued use or testing of crops that are clearly uneconomic or ill-adapted to the environment or soil.

Long-term experimentation. There appears to be a lot of emphasis placed on having many experimental sites each year with little or no emphasis given to monitoring a cropping pattern over a long period of time. The temporal effects are just as important as the spatial effects in determining the suitability and benefits of particular cropping sequences. Long-term cropping sequences can highlight positive effects such as gradual changes in soil fertility or negative effects such as slow build-up of pests and diseases. Such experiments also highlight environmental effects in all phases of crop development.

Soil fertility. I believe that soil fertility is the most important limitation to yield increase in the Northeast region. The NERAD project has highlighted the soil factors which are limiting yield increases and fertilizer responses. There is a need for a greater assessment and understanding of the effect of organic matter on nutrient supply and crop yield. Such experiments should be necessarily long-term and examine the benefits of pasture leys, leguminous crops, alley crops, green manures, animal manures and crop residues on crop yield.

There seems to be an insufficiently precise understanding and definition of fertilizer requirements for the various crops and soils. Because fertilizers are one of the most important input costs there should be a more precise resolution of what nutrients are required, what is the most effective product to use and what is the economic rate of application. There appears to be a tendency to use standard NPK mixtures that take little account of the particular soil, previous fertilizer history and crop species. NPK mixes are almost universally applied to leguminous crops. An effective Rhizobium symbiosis is obviously a much cheaper source of nitrogen. There appeared to be no farm trials concerned with the response to nutrients other than N and K. There is a suggestion that different compound fertilizers have different levels of other nutrients, for example S and micronutrients, which may confound the interpretation of fertilizer experiments and be partly responsible for the responses obtained.

There is little evidence of the use of soil testing as a means of assessing fertilizer needs or developing relationship between crop yield and soil tests and climatic information. The value of lime application and its interaction with soil pH, nutrient availability, organic matter
additions, CEC of soil, fertilizer application and crop yield should be further examined both at research stations and on-farm.

Economic evaluation. Some projects regularly assess the value of cropping sequences tested in terms of gross margins. This is very important and a fundamental aspect of FSR. However there are many projects or FSR in which there appears to be no economic evaluation of the cropping sequence tested on-farm. Economic analyses do not have to be complex; a simple calculation of gross margins can give a good indication of the economic viability of the system under study.

Research evaluation. All projects have end-of-season reviews of research results in order to plan their experimental programs for the following year. Where there are a number of experiments examining the same cropping sequence it sometimes appears that if there is no crop yield that data is not included in the average yield result for that sequence. The fact that no result is obtained in certain circumstances is just as important as a positive result. The identification of the factors which caused the crop to fail is very important in defining areas of crop adaptation or needs for further research. The need for feedback of constraints or problems identified by on-farm research to discipline specialists is again emphasized. Where a particular crop or cropping pattern fails it doesn't necessarily mean that the concept is not valid, it may only mean that one part of the system needs adjustment or change.

There is considerable merit in the DOA or FSRI reviewing all cropping systems being researched to categorize their stage of technological development, as has been done by the NERAD project and UNDP/FAO/THA project. In this way priorities for future FSR by projects can be more sharply focussed.

Conclusion. While it might seem that I have raised many issues that require some consideration and reassessment, the changes suggested to research objectives, experimental design and methodology are mainly directed at improving the quality of research, not the general direction of research.
2.7 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE FSR IN NORTHEAST THAILAND

The visits to the many FSR projects in the Northeast region was necessarily brief. There was no opportunity for an indepth study of all the FSR programs being implemented. A wide range of FSR activities are being undertaken covering aspects of cropping, livestock, poultry and fish culture farming systems. Most emphasis and research input was found to be related to cropping systems research. Specific instances were seen where the FSR methodology used could be improved. While some of the following recommendations are quite specific there are many which are necessarily generalizations and do not relate to any one specific project, but relate to issues or areas which individual projects should consider in planning their future research activities:

1. It is suggested that the 'Research and Development of Agricultural Systems' National sub-committee should meet regularly and take an active role in:
   - developing closer linkages between projects
   - highlighting opportunities for cooperative or collaborative research
   - encouraging the sharing of results and technology development
   - discouraging unnecessary duplication of research
   - promoting the development and adoption of standard methodologies in FSR.

2. It is suggested that FSR projects should ensure a closer involvement of farmers, extension and discipline specialists in problem definition, identification and formulation of research programs, execution of research programs and subsequent evaluation. The NERAD project has placed considerable emphasis on these aspects and all FSR projects should be encouraged to follow the methodologies developed by the NERAD project to ensure a systematic approach to problem definition and technology development (refer section 2.2.4).

3. It is suggested that there should be a greater involvement of staff from other MOAC departments in crop/livestock FSR. The National Sub-Committee should provide the means for initiating closer collaboration and cooperation of the DOA with the Departments of Livestock Development and Fisheries in FSR activities.

4. It is suggested that training programs for FSRI staff in extension methodology should be considered. Such a course should be modelled along the lines of the extension training program provided by the Thai-Netherlands Government "Small Farmer Participation Project", which is implemented by the DOAE (refer section 2.6.1).
5. It is suggested that projects be encouraged to collect better base-line data on the basic farm resources, existing farming systems and socio-economic and biological determinants and constraints of the systems being studied. Methodologies which have been successfully developed by Khon Kaen University and the MERAD project should be used by the FSRI for obtaining better base-line data in regions where they are undertaking FSR activities (refer section 2.4.2).

6. It is suggested that in many instances a more systematic approach to FSR is required. Cropping patterns being tested should not be located randomly but systematically so that a range of soils and environments are sampled within the target area. The agro-ecological zones of Thailand, developed by the FAO/UNDP/THA project, should be used as a basis for site selection for FSR activities by the DOA.

7. It is suggested that more emphasis be given to long-term experimentation where a cropping sequence is evaluated over a number of years on the same area of land. This is particularly important where leguminous crops are involved in the cropping sequence.

8. It is suggested that greater research emphasis should be given to various aspects of soil fertility. There needs to be greater emphasis and understanding of:

(a) long-term crop yield responses to organic matter inputs via pasture leys, leguminous crops, alley crops, green manures, animal manures and crop residues.

(b) fertilizer requirements for the various crops and soils.

(c) the value of lime application and its interaction with soil pH, nutrient availability, organic matter additions, soil CEC, fertilizer application and crop yield.

There should be extensive reviews of previous research on these topics as a basis for further research planning by the commodity Institutes, FSRI and Soil Science Division of the DOA.

9. It is suggested that greater scientific rigour and understanding is required in experimental design, experimental precision, operational involvement by scientist and monitoring of research activities to avoid erroneous results and confounded or unsuitable treatment effects. It is therefore suggested that training courses in experimental design and techniques
of field experimentation should be provided for scientists and technical staff.

10. It is suggested that all FSR on farms should have control treatments of usual farmer practices, so that the comparative advantages of the new technology can be properly evaluated.

11. It is suggested that all data generated by FSR should be subjected to economic analysis. Cooperation in these analyses should be sought from other relevant agencies in the MOAC, if necessary.

12. It is suggested that annual research reviews of all FSR projects in the DOA should highlight constraints or problems identified by on-farm research for research action by discipline divisions and specialists.

13. It is suggested that a national register of FSR projects should be compiled. This logically should be the responsibility of the National Sub-Committee for FSR in Thailand.
3. PART B - A REVIEW OF FSR ACTIVITIES, STRUCTURE AND FUNCTION OF THE FARMING SYSTEMS RESEARCH INSTITUTE.

The major aim of the Thai/World Bank National Agricultural Research Project (NARP) is to increase the efficiency of agricultural production in Thailand. It is anticipated that this will be achieved through a restructuring of the Department of Agriculture, including the upgrading of research stations into regional centres and manpower training. As part of this restructuring a Farming System Research Institute (FSRI) was established in 1982. Two previous reviews (Cox 1983, 1984) have considered the function and structure of the FSRI in farming systems research in Thailand and progress that had been achieved by those times. Two other reviews have considered the needs for increasing staffing and manpower training in the FSRI for systems analysts (Martin, 1984) and in agroclimatology (Fitzpatrick, 1985).

3.1 STRUCTURE AND STAFFING OF FSRI

Within the FSRI there are two official research groups, the Cropping Systems Group and Crops Environment Group (figure 4). These two group are internally organized into three further sections. In addition to these research groupings the FSRI also has a training program at the Suphanburi Experiment Station and Training Centre. Short courses are provided on request from within the Department of Agriculture for technical training in FSR. Recently an international short course on FSR was organized for participants from ASEAN countries in collaboration with staff from Kasetsart University.

DIRECTOR

Secretariat ----------------- Training, Monitoring and Evaluation Section

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| Cropping Systems Group | Crop Environment Group |

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| Rainfed Irrigated Integrated Crop | Soils Pest | 
| cropping cropping farming | ecology water management systems systems systems |

Figure 4: The present organization of the FSRI.
There are presently 66 graduate staff and 58 non-graduate staff in the FSRI. The majority of FSRI staff were transferred from the former Rice and Technical divisions of the DOA at the inception of the Institute. Amongst the graduate staff, 3 have PhD degrees and 26 have MS/MSc degrees. Since the formation of the FSRI there has been a deliberate policy to increase the proportion of graduate staff at country locations, but at present only 30 percent of graduate staff (20 graduates) are located at country centres. Of these, however, 7 staff are located in both the north and northeast and 6 staff in the central region with no staff in the eastern or southern regions.

All except one of the graduate staff located at country centres are attached to the Cropping Systems Group, with 13 graduate staff located at Rice Experiment stations, 3 at Rice Research Centres and 4 at the Chiang Mai Regional Office of the MOAC. There are no staff located at Field Crops or Horticulture Research Stations or Centres. The staff located at country centres are however generally more junior and less well qualified than FSRI staff based in Bangkok (table 2). There are many PC06 staff with postgraduate qualifications who should be transferred to regional centres to provide the necessary experienced leadership.

Table 2: A comparison by qualifications and seniority of country versus Bangkok-based staff of FSRI, October 1986.

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Degree</th>
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<th>Percentage</th>
<th>Seniority</th>
<th>Grade</th>
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<td>PC 08</td>
<td>1</td>
<td>100</td>
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</tr>
</tbody>
</table>
3.2 THE ROLE OF THE FSRI

The objectives of the FSRI are closely related to the government policy on agriculture, as defined under the fifth five-Year National Economic and Social Development Plan. The emphasis of this policy is on the development of integrated agriculture to boost the income of the rural sector.

The immediate objectives of the FSRI were defined by Anon (1982) and can be summarized as follows:

1. To develop integrated cropping/farming system packages for upland and lowland rainfed and irrigated areas.

2. To provide an effective methodology for conducting on-farm trials.

3. Conduct problem-oriented and impact type of research.

4. Develop a system of monitoring and evaluation for comparing new farming system technology with the present and with special emphasis on socio-economic impact.

5. To provide in-service training for institute staff.

6. To transfer new technology, through training courses and reports, to subject matter specialists of the Department of Agricultural Extension.

In the long run it was envisaged (Anon, 1982) that the FSRI could

a. Act as a central point in co-ordinating and integrating farming systems research between institutes, department and agencies.

b. Improve the income of the rural poor, the rainfed farmers and the irrigated progressive small holders.

c. Assist and share farming systems research and development in other countries and international agencies.

Cox (1983) suggested that these objectives could be simplified to (i) help the definition of research problems and priorities (ii) conduct on-farm research to evaluate and develop new technologies and (iii) provide an effective means of transferring new technologies to extension workers. From these general set of objectives Cox (1983) defined more specific objectives for each of the groups and sections of FSRI.
It is clear from these objectives that the role of the FSRI is:

- to conduct multidisciplinary research on farms to overcome problems or constraints to agricultural production that have been identified by farmers and extension specialists.

- to conduct innovative multidisciplinary research on farms and research stations to develop new technologies or opportunities to intensify or diversify farm production.

- to develop close links and involvement of discipline and extension specialists and farmers in problem identification, research and technological development.

- to identify and encourage research by discipline specialists on specific problems which occur in production systems on farm.

In order to fulfill this role the FSRI staff should be closely associated with the regional research centres to complement their role by integrating specific crop recommendations into a whole farm system.

Although it is not clearly stated in the above objectives, there was an expectation or understanding that the FSRI would undertake research activities in all aspects of farm production, including livestock, poultry and fish culture. However few staff have experience or training in animal sciences and together with the fact that the FSRI is within the DOA, this has dictated that most FSRI activities are in cropping research with very little research on integrated animal production systems. I believe that all research within the FSRI should concentrate on aspects associated directly with cropping research but that opportunities for cooperative research on crop/livestock production systems on farm should be encouraged as joint research projects with other relevant departments of the MOAC. The FSRI should only provide the cropping research inputs to such projects.

3.3 FARMING SYSTEMS RESEARCH IN FSRI

The experiments conducted by the FSRI during 1985 are listed in Appendix 2 according to the six research sections in the FSRI. A significant number of these experiments are conducted in cooperation with a number of externally funded projects such as NERAD, NECDP, IRDC and UNDP/FAO projects which have been reviewed in Part A of this report. Some 103 experiments are listed for 1985 covering a wide range of systems research. The larger number of experiments conducted by the Cropping Systems Group merely reflects the much greater proportion of staff associated with this group.
The large number of experiments conducted obviously reflects an enthusiasm and commitment to on-farm research.

It is impossible to critically examine the objectives, design, methodology and results of these experiments as the Annual Report of FSRI for 1985 is written in the Thai language. Also during the visit to the Northeast region only a small number of experiments of the FSRI were visited. However the impression obtained was that some of the suggestions and observations made on FSR generally in section 2.6.2 would also apply to research in the FSRI. It is perhaps unfair to be too critical on the basis of visits to only a few experiments but I would suggest that the opinions expressed in section 2.6.2 should be kept in mind by program leaders and scientists when considering future experimental programs in the FSRI.

3.4 ORGANIZATION AND FUNCTION OF THE FSRI

Part of the brief of the consultancy was to consider the present function and operation of the FSRI. During this consultancy I was not able to visit and discuss all activities of the FSRI. However it was apparent from discussions with many people that although the FSRI has developed a wide ranging experimental program the FSRI has not firmly established an assured role in the DOA. In the following section I have suggested how the activities and function of the FSRI may be improved.

The present location of staff suggests that the FSRI still has a long way to go to achieve true decentralization. It is clear that the FSRI will only become an effective research unit of the DOA if attention is given to the following considerations:

(i) A regional concept of operations must be adopted where FSR is coordinated and controlled at the regional level.

(ii) FSRI staff should be based at regional centres (with some at regional experiment stations) where FSRI staff can be actively associated with promoting and aiding interdisciplinary research and cooperation with DOAE staff and farmers.

(iii) To achieve the above there needs to be a major transfer of staff, particularly senior staff to the regional centres to enable good regional leadership and research experience at these centres.

(iv) Consideration needs to be given to the location of FSRI staff in the east and southern regions to support the research activities of the DOA in
these regions.

(v) Staff should be transferred to selected Field Crop and Horticulture Research Centres where presently there are no FSRI staff.

If these suggestions are accepted in principle the first issues which arise are (a) from which research groups or sections should staff be transferred to country locations, and (b) whether the present groupings and disciplines included in FSRI are appropriate.

The ever diminishing source of research funds and the accountability a Department has to the Government and the taxpayers for those funds, dictates that funds should be efficiently utilized. No countries in the world can afford undue duplication of research staff in different sections of the same organization. The FSRI has an important role in satisfying the specific needs of agricultural research and development that cannot be supplied by other divisions or institutes within the DOA. These are:

(i) the need to integrate discipline based research into systems or technologies for testing and development for use by farmers.

(ii) the need for resource information on the environment, physical resources, farming systems and socio-economic factors which affect the requirement and type of technology which is appropriate.

(iii) the need to analyse new technologies and predict where they will be successful and what will be the expected economic or sociological returns.

(iv) the need to provide a close link between research, extension and the farmer.

There is no need for the FSRI to duplicate the activities of existing research disciplines, such as soil science pathology and entomology, that are already well catered for in existing discipline divisions in the DOA. The FSRI will necessarily require inputs from these disciplines to their on-farm research program but it should be achieved by encouraging multidisciplinary research at the regional centres where a number of discipline specialists of the DOA and extension officers from DOAE join together in solving a common problem or developing a farming technology. I believe therefore that there is a need to reorganize the groupings and research disciplines of staff in the FSRI.

Returning to the first issue of which staff should be transferred to country centres. I believe that the majority of the scientists in the cropping systems group should be transferred to regional centres. There only needs to be a
small senior group in Bangkok to coordinate and supervise the regional programs at a national level. The present Crop Ecology group should be renamed an Agroclimatology group with its main functions to provide special emphasis to promoting a stronger biological and physical basis for assessing the suitability of cropping systems to the given climatic environments of particular regions, as detailed by Fitzpatrick (1985). Another group should be formed to cover aspects of Farm Resources, Systems Management and Economics, which are presently not covered. Specialists are required in farm resource survey, farm management, systems analysis, sociology and agricultural economics. The FSRI has moved to remedy part of this deficiency by appointing two agricultural economic graduates who are presently undertaking post-graduate study. The needs of this group are more fully explained in the report of Martin (1984).

It is suggested that the FSRI be restructured as shown in figure 5. Thus staff belonging to the Cropping Systems Group would be mostly deployed at the regional centres and could be loosely subdivided into areas of FSR activities such as dryland crops, irrigated crops, etc., if deemed necessary. The other two major groups would have most of their staff in Bangkok with responsibility for providing technical inputs into the regional programs.

**Figure 5** Suggested restructuring of FSRI.
If the FSRI was restructured in such a way I would suggest that the name of the FSRI be changed and it should become a technical division, the Cropping Systems Division, in a similar manner to other technical divisions such as the Soil Science Division. The reasons for this suggested change of name are as follows:

(i) the use of the term 'institute' suggests that there is a need for the construction and development of a number of centres for FSR in a similar way to those developed for the other commodity institutes. I do not believe the development of FSRI centres can be justified. Cox (1983) has expressed similar views. FSRI activities will be focussed at a number of sites in Thailand and should be primarily based on farms. Of course facilities such as offices and laboratories will be required but this could be provided at the existing regional centres. There is justification however for all staff who remain in Bangkok to be placed together in one building, a divisional headquarters.

(ii) The input that the FSRI staff can supply to agricultural research is similar to other discipline divisions, if the proposed staffing and structural changes are accepted. Such a division would provide technical services and expertise to the regional centres which cannot be provided by other discipline divisions. However they would do more than this because an important role would be to promote and encourage multidisciplinary research between staff of the commodity institutes and technical divisions both at the regional centres and on farms in the region.

With a major deployment of staff at the regional centres and the adoption of a regional concept of FSR activities, consideration would have to be given to the most appropriate line of command and responsibility of staff. It would seem that the most appropriate structure would be to have four regional FSR leaders for the North, Northeast, Central and Southern regions, respectively. FSRI staff located at regional centres or field stations would be responsible on a day to day basis to the directors of those centres or field stations but their general research activities would be coordinated by the regional research leader in association with the directors of relevant centres or field stations. Research proposals and research progress reviews should be the responsibility of centre or station committees which include the regional FSRI research leader and the Director of the FSRI. Both the regional FSRI research leader and the Director of the FSRI would be required to endorse all research proposals and allocate sufficient funds for the
execution of the research programs.

A natural apprehension with the deployment of FSRI staff to the regional centres is that this would mean the loss of staff from the FSRI to the commodity institutes. This should be unjustified if there is goodwill and commonality of purpose on all sides. Such an arrangement should permit FSRI staff based at centres to have a dual responsibility and interest, i.e. to the regional centre for interdisciplinary research and to the FSRI for development of their own and the FSRI's disciplinary expertise.
3.5. RECOMMENDATIONS

Throughout this report a number of issues which I believe are constraints to the further development of the FSRI have been discussed. The following recommendations are more specific suggestions as to how I believe farming systems research in the DOA can be made more effective:

1. It is suggested that the FSRI be redesignated as a technical division within the DOA and named the Cropping Systems Research Division.

2. It is suggested that the FSRI be restructured so that there are three official groupings of research activities, namely Cropping Systems, Agroclimatology and Systems Analysis.

3. It is suggested that FSRI research activities be confined to cropping systems research and therefore FSRI staff should not provide research in animal sciences, pest management or soil sciences. FSRI should encourage cooperative interdisciplinary research from DLD, Botany & Weed Science, Plant Pathology and Microbiology, Entomology and Zoology and Soil Science Divisions where appropriate and necessary to their FSR activities on-farms or at research centres.

4. It is suggested that the Agroclimatology and Systems Analysis groups be strengthened. This would require the appointment of further staff and/or postgraduate training to provide expertise in the areas of crop modelling and computer technology, systems analysis, farm management, agricultural economics and rural sociology.

5. It is suggested that the majority of staff in the Cropping Systems Group be transferred to the regional centres, especially to Field Crop and Horticultural Centres, which presently have no resident FSRI staff, and to South Thailand where there are also no resident FSRI staff.

6. It is suggested that the majority of staff in the Agroclimatology and Systems Analysis groups, plus a few senior coordinating staff of the Cropping Systems group and the Secretariat be located together in Bangkok in one building which constitutes the Divisional Headquarters.

7. It is suggested that a regional concept of FSRI activities be adopted, where activities of the FSRI are coordinated by a senior research leader in each of four regions, namely North, North-East, Central and Southern Thailand.
8. It is suggested that under a regional concept of operations, research activities should be dictated by the priorities of the region and be implemented only following discussion and agreement by the regional centres at which FSRI staff are based. Regional leaders and the Director of FSRI or his nominee should meet with the Director of the regional research centres several times a year to decide on general research policy, consider research proposals and review research progress. Sufficient funds should be allocated to the centres or stations for FSRI staff to execute their research programs. Day to day responsibility should be to the directors of the regional research centres or stations.

9. It is suggested that regional leaders would have prime responsibility for supervising research of FSRI staff in their region, providing an effective link to the Director of the FSRI, promoting and encouraging interdisciplinary research at the regional centres and promoting and encouraging close cooperation with staff of the DOAE, farmers and other MOAC departments.

10. It is suggested there be annual, regional and national, seminars or workshops where staff based in the regions have the opportunity to present results of research in their region. Such meetings provide an opportunity for staff to maintain and improve their own disciplinary competence.

11. It is suggested that a training program is required for FSRI staff on experimental design, research methodology and analysis, in order to improve the quality of FSRI.

12. It is suggested that consideration be given to research recommendations for FSRI in Northeast Thailand, given in Part A of this report, when planning future research activities of the FSRI in that region.

13. It is suggested that consideration be given to a reduction in the number of experiments conducted with more emphasis given to a systematic approach to site selection, research objectives and subsequent evaluation of results and dissemination of information to extension staff of DOAE.

14. It is suggested that consideration be given to supporting the NERAD project proposal to develop a standard farming systems research and extension (FSRE) methodology which is appropriate to the MOAC and document this in a technical manual (in the Thai language) to be used by officials of the MOAC line agencies and special projects for implementing FSRE activities on farms (refer section 2.4.2).
I am very grateful to the many people in the Northeast of Thailand and the Department of Agriculture in Bangkok who made this consultancy both interesting and informative. The visits to the projects and research centres in the Northeast were unfortunately necessarily brief but very enjoyable. In particular, I wish to thank Mr. Bryan Gorddard, Dr. Damkheong Chandrapanya and Khun Nichai Thaipanich for arranging the itinerary and accommodation and providing helpful advice, background information and good companionship while travelling in the Northeast. I am also grateful to Khun Wipada and Khun Sushida for typing this report.
5. REFERENCES


APPENDIX 1

ACNARP Short-Term Consultant Work Program

13 September 1986
Travel Jakarta - Bangkok

14 September 1986
No consultancy-related activities

15 September 1986
Meeting with Dr. Damkhoeng Chandrapanya, Director, FSRI; ACNARP and NARP staff including, Mr. Bryan Gorddard and Dr. Vijai Nopamornbodi; and Dr. Yoorki Sarikaphuti, Director General, Department of Agriculture and Mr. Amphol Senanarong, Deputy Director, Department of Agriculture. In afternoon travelled to Khon Kaen. Visited the Agricultural Development Research Centre which was built and equipment under the technical cooperation program of the Japan International Cooperation Agency (JICA). Discussions, were held with Dr. Paitoon, Director, on functional operation and research at the centre.

16 September 1986
Field visit to number of sites in Na Kam district about 40 kms north of Khon Kaen associated with the Ley Farming Project. Discussions were held with Mr. Trevor Gibson, who was previously associated with the project, and Dr. Suchint Simaraks, Animal Science Dept., KKU. Accompanied on visit by Mr. Bryan Gorddard and Dr. Ross Gutteridge, ACIAR Consultant. In afternoon we were joined by Dr. Damkhoeng.

17 September 1986
In morning visited the Northeast Regional Office for Agriculture at Tha Phra. Met with Dr. Uthai Pisone, Director, and his staff and Dr. Charles Orton and Dr. Iain Craig of the Northeast Rainfed Agriculture Development Project (NERAD) and Mr. John Townend of the Northeast Crop Development Project (NECDP). A general discussion session was held on farming systems research from all agencies. In afternoon visited Faculty of Agriculture, KKU. Had discussions with Drs. Aran Patanothai, Anake Toparkngarm and Viriya on FSR at KKU.

18 September 1986
Visited Field Crop Research Institute at Khon Kaen and had discussion with Dr. Montien, Director.

Visited Rainfed Agricultural Pilot Project in Nam Phong district about 30 km north of Khon Kaen. Were given general introduction to project and visited part of development area.
In afternoon visited field sites of Crop-Livestock Integration Project in Ban Phai district about 45 km south of Khon Kaen.

19 September 1986
Travelled to Sakhon Nakhon and visited DOA Rice Research station. FSRI staff not available but had discussion with Greg Chapman, a Canadian volunteer (CUSO) working on rice/fish culture. In afternoon visited Lam Nam Oon Integrated Rural Development Project. Given general introduction to irrigation project and cropping patterns used with visit to local farmer with complex crop/livestock enterprise.

20 September 1986
Travelled to Ubon Ratchathani. Visited Ubon Field Crop Research Centre and had general discussion on activities of the Institute with Mr. Thanom, Director, and associated activities of Centre with farming systems research projects. Inspected new buildings at Institute. In afternoon visited rice/fish culture on farms with John Sollows, a Canadian volunteer (CUSO).

21 September 1986
Visited Srisaket Horticulture Research Institute and had general discussion with Mr. Prasert, Director, on activities of the Centre, followed by an inspection of intercropping experiments. In afternoon visited five on-farm NERAD sites to inspect farming systems research.

22 September 1986
Visited Ubon Rice Research Centre. Had discussion with Mr. Chamrat, Director, on staffing and research activities of the Centre followed by brief inspection of research farm. In afternoon travelled to Suwannaphum and visited Tung Kula Ronghai Project. Had discussions with Mr. Terry O'Sullivan and Dr. Harry Nesbit on general scope and activities of the project and visited areas where some farming systems research was being undertaken.

23 September 1986
Visited western portion of Tung Kula Ronghai Project. Given outline of activities in this area by Professor Ernst Lohffler and visited number of research sites in association with group of young German students who were conducting various short-term studies. In afternoon travelled to Khon Kaen.

24 September 1986
Travelled to Bangkok. Had discussions with Dr. Ed Pantastico, Chief Adviser, FSRI.

25 September 1986
Reading and summarizing large number of reports collected on trip to NE Thailand.
26 September 1986
In morning, preliminary report writing. In afternoon, discussions with Bryan Gorddard

27 September 1986
No consultancy related activities

28 September 1986
Some preliminary report writing.

29 September 1986
Studying research reports and preliminary report writing.

30 September 1986
Studying research reports from Farming Systems Research Institute. Visit to Asian Institute of Technology and discussion with Dr. Peter Chudleigh and Dr. J. Gartner on farming systems post-graduate programs.

1 October 1986
Discussions with senior staff of FSRI on research activities and staffing in each of major discipline sections. Preliminary report writing in afternoon.

2 October 1986
Presented preliminary report to Mr. Amphol Senanarong, Deputy Director, DOA and Mr. Bryan Gorddard, Team Leader, ACNARP on review of farming systems research in NE Thailand and organization and functioning of Farming Systems Research Institute.

3 October 1986
Meeting with Directors of Institutes and divisions of DOA who were undertaking a study tour of Australia to review organization and function of regional centres in New South Wales, Victoria and Western Australia.

4 October 1986
Depart from Bangkok - Jakarta.
Research Programs in FSRI in 1985

I. Rainfed section.

1. Intercropping (?) rice/mungbeans
2. Cropping systems study under rainfed conditions.
3. Cropping systems testing under rainfed condition in Southern Thailand
4. Upland cropping patterns testing under rainfed conditions in farmers fields Lop Buri Province.
5. Upland cropping patterns testing under rainfed conditions in farmer fields Payao Province.
6. On-farm trials planting mungbean and corn before deep water rice in rainfed areas, Ayudthaya and Prachin Buri.
7. On-farm trials on planting mungbean before rice in rainfed areas Ratchaburi, Lopburi and Chainat Province.
8. Rainfed rice-based cropping systems testing in farmers fields, Surin Province
9. Rainfed rice-based cropping systems testing in farmers fields, Khon Kaen Province
10. Rainfed rice-based cropping systems testing in farmers fields, Sri Sa Ket Province
11. Rainfed rice-based cropping systems testing in farmers fields, Nakhonphanon Province
12. Testing on jute, mungbean and sesame before rice under rainfed conditions at Roi Et Province
13. Rainfed rice-based cropping patterns, Mahasarakham
14. Rainfed rice-based cropping patterns, Chiang Rai
15. Rainfed rice-based cropping patterns, Roi Et
16. Rainfed upland cropping systems testing, Chiyaphum
17. Rainfed rice-based cropping systems test, Chiyaphum
18. Soybean intercropping with upland rice, Chiang Mai
19. Studies on upland rice-based intercropping 3 crops systems Prae and Phitsanulok Province

20. Cropping systems in crop-livestock integration under rainfed conditions, Amphoe Ban-Phai, Khon Kaen

21. Study on cropping systems in the Kings Project, Khao Kin Son

22. Study on intercropping of jute and dry-seeded photoperiod sensitive rice.

23. Short duration rice varieties testing, planted before deepwater rice in farmers fields, rainfed condition.

24. Suitable seed ratio in mungbean mixed cropping with deepwater rice in farmers fields, rainfed condition.

25. On-farm testing of jute or kenaf/rice cropping pattern under rainfed conditions: Nakhon Ratchasima Province

26. Multilocation testing on jute/rice pattern under rainfed condition at Mahasarakham Province

27. Study on cropping systems: sesame/rice in upper paddy terraces; Mahasarakhan Province

28. Study on rainfed rice based cropping system in Phatthalung key site

29. On farm trials on mungbean and peanut before rice in Nakhon Sawan Province.

30. Study on upland rainfed cropping systems at Udon Thani

31. Study on residual effects of fertilizer application under rainfed upland cropping systems at Udon Thani

32. Study on residual effect of fertilizer application under rainfed upland cropping systems at Nakhon Ratchasima

33. Study on residual effects of fertilizer application under rainfed conditions at Khon Kaen and Maharasarakham

34. Rainfed upland cropping patterns testing at Nakhon Ratchasima

35. Study on cropping pattern for cassava replacement Khon Kaen
36. Study cropping pattern for cassava replacement in Mahasarakham.

37. Multi-location testing on mungbean/rice cropping pattern in Lampang.

II. Irrigation Section.

1. Study on rice-based cropping systems, Khon Kaen.
2. Test on cropping system under upland condition in irrigated farms field at Phrae Province.
3. Effect of some field crops on growth and yield of castor bean in intercropping system.
4. Studies on residual effect of two levels of corn fertilizer to rice yield on rice based cropping system.
5. Studies on rainfed rice based cropping system at Tung Hula Ronghai area.
6. Effects of peanut plant population on yield of castor bean and peanut in intercropping system.
7. Studies on row arrangement of green corn in yield of soybean and green corn in intercropping system.
8. Study on rice-based cropping system in irrigated farmers field Rayong Province.
9. Effect of Rhizobium, weeding and foliar fertilizer application on growth and yield of soybean drilling in rice stubble of cropping system in paddy field.
10. Studies on rice-based cropping system in irrigated farmers fields at Phrae Province.
11. Studies in input use of soybean on rice-base cropping system.
12. Study on rice based cropping system in Mae-Phaeg Irrigation Project, Chiang Mai.
13. Study and test on rice-based cropping system under Lam Man Oon irrigated project, Sakonnakhom.
14. Studies on intensive rice-based cropping system.
15. Effect of planting date/chicken dung rates on yield of garlic and bulb storage in rice based cropping system.
16. Test on cropping systems of Chai Nat Province

17. Cropping systems trial in irrigated area of Payoa Province

18. Comparison of growth stage and yield among rice varieties differing in growth duration for rice-rice pattern

19. Physiological study on some Thai rice varieties from abroad in rice-rice pattern

20. Study on the plant density and fertilizer application for pre-germinated seeding in rice-rice pattern

21. Study on rice based cropping systems in irrigated farmer field at Ubon Ratchathani

III. Integrated Section

1. Integrated farming system studies in irrigated area at Amphoe Muang and Watsing, Chai Nat Province

2. Integrated farming system studies in rainfed area with partially underground water at Amphoe Watsing, Chai Nat

3. Study on farm diversification at Reysite Ampohoe Bang-Plama Suphanburi Province

4. Study on integrated farming system at key site Amphoe Bang-Plama, Supanburi Province.

5. Studies on crop-livestock-fisheres integration in irrigated area of Phrae Province

6. Study on farmers status on socioeconomic in Tumbol Ban Leam, Amphoe Bang Plama, Suphaburi

7. Study on farm diversification at Amphoe Muang and Amphoe Watsing, Chainat

8. Preliminary study on egg production and hatchability of Thai native chicken in farming system research and development project at Suphanburi key site

9. Study on growth rate of Thai native chicken in farming system research and development project at Suphanburi key site.

10. Study on rice-fish integrated farming system in irrigated and rainfed farmer's field at Ubon Province
IV. Crop Ecology Section

1. Agro-technical practices for minimizing mutual shading of cassava on legumes in intercropping.

2. Potential studies of agro-ecological zone R3S5 for peanut and cassava intercropping system.

3. Possibility of peanut, sweet corn and pineapple for sequence cropping in rainshadow area.

4. Study on suitable cropping pattern and alternative cropping pattern along with onset and cessation of rainfall, Amphoe Muang, Phrae.

5. Study on suitable cropping pattern in unstable productivity area.

6. Influence of rain distribution to suitable cropping pattern in agro-ecological zone R3S5 at Amphoe Bankhai, Rayong.

7. Relative performance of graded broad bed and furrow method of cultivation compared with traditional flat techniques in intercrop rainfed condition.

8. Mapping of crop suitability for major economic crops in NE rainfed areas.

9. Studies on suitable spacing for planting sweet corn and mungbean intercropping.

10. Study on mutual shading effects of cassava/peanut intercropping in R3S5 agro-ecological zone.

11. Comparative studies on cropping system and traditional cassava growing in R3S5 agro-ecological zone at Rayong Province.

12. Cropping pattern studies in R2S6 agro-ecological zone in Chantaburi Province.

13. Cropping pattern of field corn and legumes and some suitable technical practices for normal onset of rainfall at Nakhonsawan Field Crop Research Centre.

14. Study on cropping patterns to meet the erratic and low rainfall at Suphanburi Crop Research Centre.

15. Alternative practices for cropping patterns of maize and mungbean for late or early cessation of rainfall at Nakhonsawan Field Crop Research Centre.

16. Suitable cropping pattern and some technical practices for early onset of rainfall at Nakhonsawan Field Crop Research Centre.
17. Study on suitable cropping pattern for R5S1 area of maize and upland rice at Nakhomsawn Field Crop Research Centre

18. Crop geometry to minimize mutual shading in mungbean intercropped with kenaf cropping pattern

19. Relative performance of graded broadbed and furrow method of cultivation compared with traditional flat technique in maize and upland rice intercropping

20. Comparison of cropping patterns in cassava based R5S1 agro-ecological zone, Amphoe Muang, Mahasarakham

21. Study on rice based cropping system with Kings Project at the Pinak Daeng Education & Development Centre

V. Pest Management Section

1. Yield loss assessment due to insects on soybean grown after rice

2. Yield loss assessment due to weeds and diseases on mungbeans grown after rice

3. Effects of weed control in cropping system of pregerminated mungbean seed.

4. Test on the integrated counter measures for rat control in cropping system research site

5. Test on zinc phosphate and alpha-chlorohydrin (Epibloc) for rat control

6. Effects of upland rice intercropping soybean on the abundance of insect pests and their natural enemies

7. Test on crop protection technology in irrigated farmers fields in Sukhothai and Phrae

VI. Soil and Water Management Section

1. Nitrogen and rock phosphate trial for cropping system of rice-rice at Suphanburi key site

2. On farm cropping systems at Sukhothai groundwater development project

3. Efficiency of various planting methods for irrigated soybean.
4. Water requirement of cropping pattern soybean-mungbean-rice

5. Effects of tillage and no tillage cultivation on irrigation efficiency for soybean

6. Testing on mungbean-rice pattern to improve soil fertility at Chainat province

7. Study on long term residual effect of mungbean crop for rice in cropping system.