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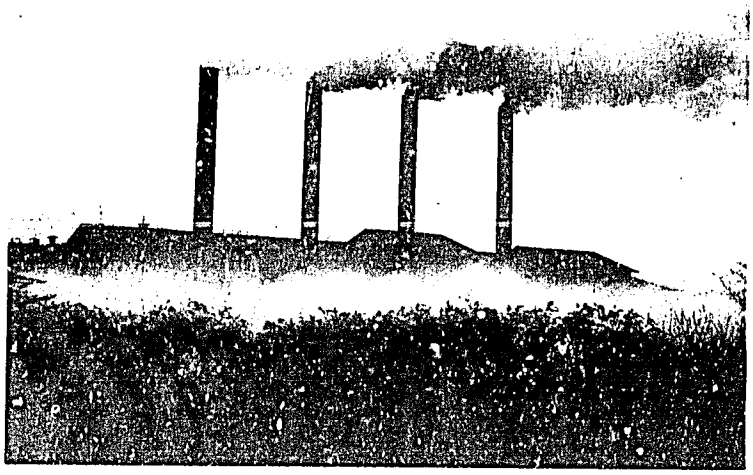
The 1990 TDRI Year-End Conference

INDUSTRIALIZING THAILAND AND ITS IMPACT ON THE ENVIRONMENT



Session: Natural Resources for the Future

Synthesis Paper No. 1

Natural Resources for a Sustainable Future: Spreading the Benefits

Dhira Phantumvanit
Theodore Panayotou

December 8-9, 1990
Ambassador City Jomtien, Chon Buri

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Industrializing Thailand and Its Impact on the Environment

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สรุป

ความสำเร็จในการพัฒนาเศรษฐกิจของประเทศไทยในช่วงสองทศวรรษที่ผ่านมา ทำให้การเจริญเติบโตทางเศรษฐกิจของชาติเป็นไปอย่างต่อเนื่อง รายได้ประชาชาติต่อหัวเพิ่มสูงขึ้นกว่า 4 เท่าตัว ผลักดันให้เกิดการเปลี่ยนแปลงโครงสร้างทางเศรษฐกิจที่พร้อมจะขยายตัวไปสู่ประเทศอุตสาหกรรมใหม่ในอนาคตอันใกล้นี้

อย่างไรก็ตาม ในช่วงเวลาของการพัฒนาประเทศดังกล่าว ได้มีปัญหาที่เกิดขึ้นควบคู่กับการพัฒนาเศรษฐกิจที่สำคัญ 3 ประการ คือ

1. ความเสื่อมโทรมของทรัพยากรธรรมชาติและสิ่งแวดล้อมที่เกิดขึ้นอย่างรุนแรง และกำลังจะถึงจุดวิกฤต
2. ความยากจนในชนบทที่ยังมีอยู่ และช่องว่างของรายได้ของคนในเมืองกับชนบทที่ขยายตัวแตกต่างกันมากขึ้น
3. การแก่งแย่งการใช้ประโยชน์จากทรัพยากรธรรมชาติ ที่กำลังเป็นปัญหาที่รุนแรงอยู่ในทุกภาคของประเทศและเกิดขึ้นกับทรัพยากรธรรมชาติทุกประเภทอยู่ในขณะนี้

ขอบเขตการวิจัย

ในการวิจัยนี้ได้ศึกษาทั้งในด้านมหภาคและจุลภาค โดยใช้ข้อมูลพื้นฐานที่สำคัญจากหน่วยงานต่าง ๆ ในระดับมหภาค รวมทั้งข้อมูลระดับจุลภาคที่ได้รับจากการสำรวจในสนามมาทำการวิเคราะห์และคาดประมาณ

ขอบเขตการวิจัยครอบคลุมประเด็นหลัก 4 ประการ คือ

<u>ความต้องการที่ดินเพื่อการเกษตรและป่าไม้</u> การใช้ที่ดินเพื่อการเกษตรมีความขัดแย้งกับการรักษาพื้นที่ป่าไม้มาโดยตลอด เมื่อพื้นที่ทำการเกษตรเพิ่มขึ้น พื้นที่ป่าไม้จะลดลง ดังที่ปรากฏมาในช่วง 20 ปีที่ผ่านมา ดังนั้น ความจำเป็นหรือความต้องการที่ดินเพื่อการเกษตรที่แท้จริงในอนาคต จึงเป็นข้อมูลสำคัญที่จะชี้ถึงแรงกดดันที่จะมีต่อป่าธรรมชาติที่มีอยู่ ซึ่งจะมีผลต่อความเป็นไปได้ในการดำเนินนโยบายของรัฐในการอนุรักษ์ป่า การวิเคราะห์ความต้องการที่ดินจึงมีหัวข้อที่สำคัญ คือ

1. การประมาณความต้องการพื้นที่เพื่อการปลูกพืช ในช่วงสองทศวรรษข้างหน้า
2. ผลของการทำลายป่าต่อผลผลิตทางการเกษตร
3. ปัจจัยที่ชี้ให้เห็นถึงสาเหตุของการขยายของพื้นที่ถือครองที่ไม่ได้ใช้ทำประโยชน์ ซึ่งจะมีผลอีกทอดหนึ่งต่อการบุกรุกพื้นที่ป่าไม้เพิ่มขึ้น

ผลจากการวิเคราะห์นอกจากแสดงให้เห็นถึงภาพรวมของพื้นที่เกษตรที่มีต่อป่าไม้ในอนาคตแล้ว ยังชี้ให้เห็นถึงจุดเปลี่ยนจากความขัดแย้งระหว่างการเกษตรและป่าไม้ที่เคยมีในรูปของการแบ่งปันกันใช้ที่ดินระหว่างพื้นที่เกษตรและการอนุรักษ์ป่าไม้ ไปเป็นความจำเป็นที่การเกษตรต้องพึ่งพาป่าไม้ในรูป

สิ่งแวดล้อม ซึ่งถ้าเป็นจริง ความขัดแย้งในการใช้ทรัพยากรดินเพื่อการเกษตรและป่าไม้ก็อาจเปลี่ยนเป็นแรงสนับสนุนจากป่าไม้ที่มีต่อการเกษตร และเป็นจุดสำคัญในการกำหนดนโยบายป่าไม้ของประเทศในอนาคต

<u>ความยากจนและการทำลายป่า</u> ในขณะที่ภาพรวมของการเกษตร และป่าไม้ช่วยให้การกำหนดนโยบายการใช้ทรัพยากรที่ดิน และการอนุรักษ์ป่าไม้มีความชัดเจนและเป็นไปได้มากยิ่งขึ้นก็ตาม แต่การบุกรุกป่ายังเกิดขึ้นอยู่ตลอดเวลา เพื่อให้นโยบายรวมมีความเป็นไปได้ในทางปฏิบัติมากยิ่งขึ้น การศึกษา ส่วนนี้จึงเน้นถึงตัวเกษตรกรที่อยู่ในเขตป่าสงวนแห่งชาติ โดยพยายามชี้ให้เห็นถึงปัญหาพื้นฐานที่ทำให้ "คน" ต้องบุกรุกป่าตลอดเวลา คำถามหลัก มีดังต่อไปนี้

1. การพึ่งพาป่าของเกษตรกรเป็นอย่างไร
2. รายได้ของครัวเรือนเกษตรกรที่ทำกินในเขตป่าสงวนแห่งชาติ เมื่อเทียบกับชาวไร่ ชาวนาโดยทั่วไปแตกต่างกันอย่างไร
3. วงจรของความยากจนและการบุกรุกทำลายป่าเป็นอย่างไร

การวิเคราะห์ด้วยตัวเลข เพื่อหาคำตอบข้างต้นจะชี้ให้เห็นถึงความผูกพันของเกษตรกรต่อป่าไม้ และสาเหตุที่ทำให้เกิดการบุกรุกป่าไม้เกิดขึ้นตลอดเวลาได้อย่างชัดเจนและเป็นรูปธรรมขึ้น

<u>ป่าธุรกิจหรือป่าชุมชนดี?</u> เนื่องจากชาวบ้านในเขตป่าสงวนแห่งชาติส่วนใหญ่เป็นเกษตรกรที่ยากจน นโยบายป่าไม้จึงส่งผลกระทบต่อกลุ่มคนดังกล่าวโดยตรง. คำถามหลักในส่วนนี้คือ นโยบายป่าไม้ที่มีอยู่ในปัจจุบันเอื้ออำนวยต่อชาวบ้านเพียงไร จะมีส่วนช่วยในด้านเศรษฐกิจของชาวบ้านได้ดีเพียงใด โดยใช้การปลูกป่ายูคาลิปตัสในจังหวัดฉะเชิงเทราเป็นกรณีศึกษา นอกจากนี้ยังได้ทำการศึกษาความเป็นไปได้ของการใช้โครงการป่าชุมชนในการส่งเสริมการรักษาป่า คำถามหลัก คือ

- ปลูกป่าเพื่อขายแล้วชาวบ้านได้อะไร?
- จะขยายป่าชุมชนให้ทั่วประเทศได้หรือไม่?

ทั้งหมดนี้ เป็นการวิเคราะห์ความหมายของป่าเศรษฐกิจ ว่านโยบายปลูกป่าเศรษฐกิจที่ระบุไว้ในนโยบายป่าไม้แห่งชาติตั้งแต่ปี 2528 นั้น มีโอกาสจะบรรลุเป้าหมายจริงหรือไม่?

<u>ทรัพยากรน้ำ อนาคตที่ไม่สดใส?</u> น้ำมีความเกี่ยวข้องกับดินและป่าไม้อย่างใกล้ชิด การทำลายป่าไม้ทำให้แหล่งน้ำต้นน้ำลำธารเสียหาย ส่งผลให้ทรัพยากรน้ำลดลงทั้งด้านปริมาณและคุณภาพ ในปัจจุบันปัญหาข้อขัดแย้งในการใช้ประโยชน์ทรัพยากรน้ำปรากฏอยู่ทั่วไป ในขณะที่น้ำในภาคเกษตรมีไม่พอเพียงในการปลูกพืชฤดูแล้งอยู่แล้ว การใช้น้ำในสาขาอื่น ๆ โดยเฉพาะเพื่อชุมชนเพื่ออุตสาหกรรมและ

การท่องเที่ยวก็มีแนวโน้มเพิ่มขึ้นอย่างรวดเร็วตามการเปลี่ยนแปลงทางเศรษฐกิจ จึงทำให้มีการแย่งกันใช้น้ำเพิ่มมากขึ้น

ประเด็นที่วิเคราะห์ได้เน้นความต้องการน้ำในสาขานอกการเกษตรโดยเฉพาะในเขตเมือง ในเขตอุตสาหกรรมและการท่องเที่ยวในอีก 2 ทศวรรษข้างหน้าและความเป็นไปได้ในการจัดหาน้ำ การจัดสรรการใช้น้ำในสาขาเหล่านี้อย่างเหมาะสม ซึ่งจะมีผลให้มีน้ำเหลืออยู่ในภาคการเกษตรมากขึ้นนั่นเอง

<u>ผลการวิจัย</u>

ในการศึกษาด้านทรัพยากรธรรมชาติไม่เพียงแต่จะต้องเชื่อมโยงความสัมพันธ์ระหว่างทรัพยากรกับมนุษย์เท่านั้น ยังต้องให้ความสำคัญกับความสัมพันธ์ระหว่างทรัพยากรธรรมชาติและการเปลี่ยนแปลงของภาคเศรษฐกิจอื่น ๆ ด้วย ประเด็นที่ทำการวิจัยนี้ได้พยายามครอบคลุมเนื้อหาสำคัญในการจัดการทรัพยากรธรรมชาติของประเทศ คือ ที่ดิน ป่าไม้ และน้ำ โดยมีภาวะการเจริญเติบโตของสังคมและเศรษฐกิจเป็นตัวแปรที่สำคัญ ผลการวิเคราะห์สรุปได้ดังนี้

<u>ความต้องการที่ดินเพื่อการเกษตรและป่าไม้</u> การใช้ที่ดินในการเพาะปลูกพืช ในปัจจุบันมีประมาณ 109 ล้านไร่ และคาดว่าจะค่อย ๆ ลดลงเหลือ 100 ล้านไร่ในอีกสิบปีข้างหน้า และจะเหลือเพียง 87 ล้านไร่ในอีกยี่สิบปีข้างหน้า

ภายใต้สถานะการณ์ที่เป็นอยู่ในปัจจุบัน การที่ความต้องการที่ดินเพื่อเพาะปลูกที่ลดลงไม่ได้ทำให้แรงกดดันต่อเนื้อที่ป่าไม้ลดลงแต่อย่างใด เนื้อที่ถือครองเพื่อการเกษตรที่ไม่ได้ทำประโยชน์จะเพิ่มขึ้น ทำให้การบุกรุกทำลายป่าเพิ่มมากขึ้น ทั้งนี้ เนื่องจากค่าเสียโอกาสในการใช้ประโยชน์ที่ดินเพื่อการเกษตรต่ำมาก และต้นทุน (ส่วนบุคคล) ของการบุกรุกทำลายป่าก็น้อย ในขณะที่มีต้นทุนทางสังคมสูง

จากผลการวิจัย เมื่อพิจารณาจากผลผลิตทางการเกษตรพบว่าผลตอบแทนต่อสังคมจะเริ่มลดลงตั้งแต่ปี 2530 หรือกล่าวอีกนัยหนึ่งคือ การทำลายป่าเพื่อขยายพื้นที่เพาะปลูกไม่ให้ผลคุ้มค่าทางเศรษฐศาสตร์อีกต่อไป ดังนั้น การเร่งฟื้นฟูสภาพป่าไม้จะส่งผลดีทั้งในการเพิ่มพื้นที่ป่าไม้ และการลดผลกระทบต่อสิ่งแวดล้อมโดยส่วนรวม

<u>ความยากจนและการทำลายป่า</u> จากการวิเคราะห์ข้อมูลในภาคตะวันออกเฉียงเหนือพบว่า <u>ความยากจน</u> จำนวน<u>ประชากร</u> และ<u>ราคาพืชผล</u>เป็นปัจจัยสำคัญในการบุกรุกป่า ความยากจนไม่ใช่เป็นเฉพาะสาเหตุเท่านั้นยังเป็นผลของการบุกรุกอีกด้วย ผลการศึกษาพบว่าผลผลิตเฉลี่ยต่อไร่ของพืชที่ปลูกในพื้นที่ป่าลดลงเรื่อย ๆ นับตั้งแต่เริ่มหักร้างถางพง ในเวลาเพียงไม่ถึง 10 ปี ผลผลิตของพืชต่ำจนไม่คุ้มกับการลงทุนทำให้ต้องแสวงหาพื้นที่เพิ่มขึ้นอีก สาเหตุส่วนหนึ่งเพราะไม่มีการลงทุนเพื่อเพิ่มผลผลิต และอีกส่วนหนึ่งคือพื้นที่ป่าที่บุกรุกในระยะหลังมีความอุดมสมบูรณ์น้อย

นอกจากนี้ จากการศึกษาแหล่งที่มาของรายได้พบว่าชาวบ้านต้องพึ่งพาผลผลิตจากป่า หลังจากที่เข้าทำกินในป่าสงวนแห่งชาติ ทั้งในรูปรายได้และการบริโภคเพิ่มขึ้นแทนที่จะลดน้อยลงตามเวลาที่เข้าอยู่อาศัย เนื่องจากรายได้จากการเกษตรลดต่ำลง

ระดับการศึกษาของสมาชิกครอบครัวมีบทบาทสำคัญในการเพิ่มรายได้ ทั้งจากการเกษตรและจากการรับจ้างภายนอก ครอบครัวใดที่ประกอบด้วยสมาชิกที่มีการศึกษาดี จะมีรายได้สูงกว่าครอบครัวอื่น ๆ

จะเห็นได้ว่าความยากจนนอกจากจะเป็นสาเหตุของการบุกรุกป่า ดังที่กล่าวอ้างกันโดยทั่วไปแล้วยังเป็นผลจากการบุกรุกป่าอีกด้วย เหตุผลที่สำคัญคือ ในการบุกรุกป่าเมื่อขยายมากขึ้นก็จะได้ที่ดินที่มีความเหมาะสมทางการเกษตรมาเพาะปลูกน้อยลงทำให้ผลผลิตเฉลี่ยต่ำ ในขณะเดียวกันเนื่องจากปัจจัยทางเศรษฐกิจและสังคมไม่เอื้ออำนวยให้มีการลงทุนเพิ่มมากขึ้น โดยเฉพาะอย่างยิ่ง เนื่องจากขาดความมั่นคง ขาดกรรมสิทธิ์ในที่ดิน ผลผลิตเฉลี่ยจะก็ลดต่ำลงทำให้ต้องขยายพื้นที่บุกรุกป่าต่อไปอีก ในขณะเดียวกันในพื้นที่ดังกล่าวการศึกษาของสมาชิกในครอบครัวซึ่งมีความสำคัญต่อรายได้ของเกษตรกรก็มีอย่างจำกัด ทำให้โอกาสเพิ่มรายได้ของครอบครัวยิ่งน้อยลงไปอีก

<u>ป่าธุรกิจหรือป่าชุมชน</u> จากการศึกษาผลดีผลเสียต่อเกษตรกรในการปลูกไม้โตเร็วเพื่อการค้าในกรณีของยูคาลิปตัส ปรากฏว่าการปลูกยูคาลิปตัสจะมีกำไรก็ต่อเมื่อปลูกเป็นแปลงขนาดใหญ่ เนื้อที่มากกว่า 100 ไร่ และการปลูกยูคาลิปตัสใช้แรงงานน้อยกว่าการปลูกพืชชนิดอื่น ๆ จึงไม่ใช่ธุรกิจที่มีการจ้างแรงงานสูง นอกจากนี้การสนับสนุนให้เกษตรกรรายย่อยในการปลูกยูคาลิปตัสจะไม่คุ้มกับการลงทุนเพราะเกษตรกรต้องรอถึงถึง 4-5 ปี จึงจะมีรายได้ พร้อมทั้งจะต้องกู้เงินมาลงทุนซึ่งจะต้องเสียค่าดอกเบี้ยอีกด้วย

ผลการจากการวิจัยยังบ่งว่าป่าชุมชนมิอาจขยายได้อย่างรวดเร็วตามต้องการ ป่าชุมชนจะประสบความสำเร็จหรือไม่ขึ้นกับเงื่อนไขที่สำคัญบางประการ จะเกิดขึ้นได้ถ้าชุมชนในพื้นที่ต้องอาศัยและได้ประโยชน์จากป่า เช่นเป็นแหล่งต้นน้ำที่ต้องใช้น้ำเพื่อการเพาะปลูก นอกจากนี้ โอกาสที่จะประสบความสำเร็จก็ขึ้นอยู่กับการทำมาหากินของชุมชนนั้นด้วยว่าต้องพึ่งพาการใช้ประโยชน์ที่ดินเพื่อการเพาะปลูกมากน้อยแค่ไหน ถ้าต้องพึ่งพามากโอกาสที่จะมีป่าชุมชนก็มีน้อย รวมทั้งกรณีที่รายได้ของครอบครัวมาจากการรับจ้างและการทำงานนอกภาคเกษตรมากขึ้น โอกาสที่จะปลูกและดูแลรักษาป่าก็น้อยลงเช่นกัน เพราะความจำเป็นในการรักษาป่ามีน้อยลง

องค์กรอิสระสามารถเข้ามามีบทบาทในการปลูกป่าชุมชน เนื่องจากมีความคล่องตัวในการดำเนินงาน สามารถกระตุ้นให้เกิดป่าชุมชนได้เร็วขึ้น ชุมชนในท้องถิ่นเจ้าของท้องที่น่าจะเป็นทางเลือกที่ควรสนับสนุนให้มีบทบาทในการอนุรักษ์ป่ามากที่สุด เนื่องจากเป็นคนในพื้นที่และมีความรู้เกี่ยวกับพื้นที่ดีที่สุด

<u>ทรัพยากรน้ำ อนาคตที่ไม่สดใส?</u> ปัญหาความขัดแย้งในการใช้ทรัพยากรธรรมชาตินอกจากจะเป็นเรื่องของที่ดินและป่าไม้แล้ว ความขัดแย้งที่มีอยู่อย่างเห็นได้ชัดอีกกรณีหนึ่งคือการใช้ทรัพยากรน้ำ ในการคาดประมาณความต้องการใช้น้ำในทศวรรษหน้าของสาขานอกการเกษตรนั้น ที่สำคัญที่มีต่อการใช้น้ำในเมือง คาดว่าการใช้น้ำในเขตการประปานครหลวง (รวมทั้งสมุทรปราการ) จะขยายมากกว่า 2 เท่าตัวในอีก 10 ปีข้างหน้าและเป็น 4 เท่าตัว ในอีก 20 ปีข้างหน้า การใช้น้ำในเขตอุตสาหกรรมซึ่งส่วนใหญ่เป็นน้ำบาดาลมีปริมาณมากกว่าประมาณไว้และจะเพิ่มขึ้นเป็น 3 เท่า ในอีก 20 ปีข้างหน้า ในสาขาท่องเที่ยวความต้องการใช้น้ำในเมืองพัทยาจะเพิ่มขึ้นมากกว่า 5 เท่าตัว ในอีก 20 ปีข้างหน้า ทั้ง ๆ ที่ในปัจจุบันเมืองพัทยาก็ขาดแคลนน้ำอย่างรุนแรงอยู่แล้ว

จากการศึกษาพบว่า ราคาน้ำทั้งส่วนกลางส่วนภูมิภาคและน้ำบาดาลในเขตป้องกันแผ่นดินทรุดไม่ได้สิ่งต้นทุนการผลิตที่แท้จริง เพราะยังไม่มีการพิจารณาถึงค่าเสียโอกาสของน้ำ ค่าลงทุนในการสร้างเขื่อนหรืออ่างเก็บน้ำ ตลอดจนผลกระทบด้านน้ำเสีย แผ่นดินทรุด และสิ่งแวดล้อมอื่น ๆ อัตราค่าใช้น้ำบาดาลก็ต่ำกว่าที่ควรจะเป็นและไม่สอดคล้องกับอัตราค่าน้ำประปา ทำให้มีการใช้น้ำอย่างไม่มีประสิทธิภาพ และส่งผลต่อเนื่องด้านสิ่งแวดล้อมโดยเฉพาะเรื่องน้ำเสียและแผ่นดินทรุด

<u>ประเด็นเพื่อพิจารณา</u>

<u>นโยบายป่าอนุรักษ์</u>

ในปัจจุบันพื้นที่ป่าสงวนแห่งชาติแบ่งเป็น 2 ประเภท คือ

1. ป่าอนุรักษ์ร้อยละ 15 ของพื้นที่ทั้งหมดของประเทศ
2. ป่าเศรษฐกิจร้อยละ 25 ของพื้นที่ทั้งหมดของประเทศ

การกำหนดพื้นที่ป่าไม้ร้อยละ 40 นี้ มาจากหลักการ 3 ประการ คือ

1. การรักษาปริมาณน้ำท่าเพื่อให้พื้นที่ป่าต้นน้ำลำธารมีมากพอที่จะรักษาปริมาณน้ำท่าของประเทศเอาไว้ได้
2. หลักการอนุรักษ์ดิน เพื่อไม่ให้มีการทำลายป่าไม้ในพื้นที่ที่มีความลาดชันสูง เนื่องจากจะส่งผลให้เกิดการชะล้างพังทลายของดิน
3. ความต้องการผลิตภัณฑ์ไม้จากป่า เพื่อสนองความต้องการการใช้ไม้ภายในประเทศ

หลังจากมีพระราชกำหนดปิดป่าเมื่อต้นปี พ.ศ. 2532 การทำไม้ซุงไม้ท่อนจากป่าในประเทศไทยจึงยุติลงโดยนิตินัย ในขณะเดียวกัน จากข้อมูลการสำรวจพื้นที่ป่าไม้ด้วยการวิเคราะห์ภาพจากดาวเทียม ของกรมป่าไม้ยืนยันว่าป่าธรรมชาติยังคงเหลืออยู่ถึง 28 เปอร์เซนต์ของพื้นที่ทั้งหมดของประเทศ ดังนั้นเมื่อไม่มีการอนุญาตให้มีการตัดทำไม้ในประเทศไทยอีกต่อไป รัฐบาลจึงน่าจะสามารถพิทักษ์ป่าธรรมชาติที่เหลืออยู่ทั้งหมดไว้ได้

ในการวิจัยเรื่องทรัพยากรแร่ ผลการวิจัยได้เน้นถึงความจำเป็นในการกำหนดเขตแหล่งแร่ โดยแท้จริงแล้วมีความต้องการทั้งหมดไม่เกินหนึ่งเปอร์เซนต์ของพื้นที่ป่าสงวนแห่งชาติ ถ้าหากยอมรับความต้องการเรื่องแหล่งแร่ โดยกำหนดเงื่อนไขให้ผู้ประกอบกิจการลงทุนฟื้นฟูและรักษาสภาพแวดล้อมด้วยแล้ว ก็จะอยู่ในวิสัยที่จะสามารถรักษาป่าธรรมชาติกว่า 25 เปอร์เซนต์ ไว้ได้

ข้อเสนอแนะ

1. เพิ่มเขตป่าอนุรักษ์เป็นร้อยละ 25 และลดพื้นที่ป่าเศรษฐกิจลงเหลือร้อยละ 15 โดยการเร่งรัดประกาศเขตอุทยานแห่งชาติและเขตรักษาพันธุ์สัตว์ป่าให้ครอบคลุมพื้นที่ป่าธรรมชาติที่มีอยู่ในปัจจุบัน
2. ให้สำรวจและชี้ดแนวเขตของป่าอนุรักษ์ดังกล่าวให้ชัดเจนโดยเร็ว พร้อมทั้งสร้างความตื่นตัวให้แก่ประชาชนโดยให้ประกาศการประเมินผลการสูญเสียป่าทุกๆ หกเดือนให้ทราบโดยทั่วไป

นโยบายป่าเศรษฐกิจ

ก่อนที่จะรักษาป่าไว้ให้ได้นั้น จะต้องแก้ไขปัญหาคนที่อยู่อาศัยและทำกินในเขตป่าไม้เสียก่อน ซึ่งเป็นผู้ยากไร้ที่มีจำนวนมากถึง 8.7 ล้านคน เพื่อให้ผู้ยากไร้เหล่านี้มีทางเลือกในการดำรงชีวิตที่ดีขึ้น นอกจากการบุกรุกทำลายป่า ผลการวิจัยชี้ให้เห็นว่า การบุกรุกป่าไม้ไม่ได้เป็นการแก้ไขความยากจน ในระยะแรกที่ชาวบ้านทำการเพาะปลูกในเขตป่าไม้ที่เพิ่งจะบุกรุก ผลผลิตจะสูงเนื่องจากคุณภาพของดินยังดีอยู่ หลังจากนั้นคุณภาพดินจะเสื่อมโทรมลง ทำให้ผลผลิตและรายได้ของเกษตรกรต่ำลง การเพิ่มรายได้และยกฐานะของเกษตรกรยากจน จำเป็นต้องเน้นทั้งในด้านการพัฒนาและการให้กรรมสิทธิ์ในที่ดิน ซึ่งทั้งสองอย่างนี้เป็นแนวทางการดำเนินการปฏิรูปที่ดินของประเทศไทยอยู่ในขณะนี้ จากการศึกษาของธนาคารโลกชี้ให้เห็นชัดเจนว่า เกษตรกรที่มีกรรมสิทธิ์ในที่ดินสามารถเพิ่มผลผลิตของตนเองได้มากขึ้นร้อยละ 10 ถึงร้อยละ 30 เนื่องจากสามารถหาแหล่งกู้ยืมเงินในอัตราที่ถูกกว่า โดยนำที่ดินของตนเองไปค้ำประกัน ความสามารถในการระดมทุนเพื่อพัฒนาที่ดินของตนเองเป็นสิ่งสำคัญในการยกฐานะของเกษตรกรผู้ยากไร้ของประเทศ

การให้กรรมสิทธิ์ในที่ดินพร้อม ๆ ไปกับการพัฒนาจึงเป็นความจำเป็นขั้นพื้นฐาน แม้กระนั้นก็ตามรายได้ต่อครัวเรือนในภาคเกษตรของประเทศโดยเฉลี่ยแล้วเป็นเพียง 1 ใน 9 ของครัวเรือนนอกภาคเกษตรเท่านั้น ในอนาคตช่องว่างระหว่าง 2 ภาคนี้จะขยายตัวเพิ่มขึ้นอีก ซึ่งหมายความว่าเกษตรกรในเขตป่าเศรษฐกิจที่รัฐบาลจะนำมาทำการปฏิรูปที่ดินจะยากจนลงไปทุกที การเร่งรัดพัฒนาและการให้กรรมสิทธิ์ในที่ดินจะช่วยพยุงฐานะของชาวไร่ชาวนาให้ทรงอยู่ได้ระหว่างรอความหวังที่ดีกว่า จากการเปลี่ยนอาชีพจากเกษตรกรรมไปสู่ภาคอุตสาหกรรมและภาคบริการในอนาคต

หากรัฐบาลนำพื้นที่ป่าเศรษฐกิจมาทำการปฏิรูปที่ดินแล้ว จะต้องมีการสนับสนุนและส่งเสริมให้เกษตรกรปลูกไม้ยืนต้นและไม้ผลแทนการปลูกพืชไร่ให้มากขึ้น เพื่อเป็นการเพิ่มพื้นที่ป่าเศรษฐกิจ ไม้ยืนต้นอาจจะรวมถึง ยางพารา มะม่วง ขนุน มะขาม และไผ่ เป็นต้น

การให้การศึกษาแก่สมาชิกของครัวเรือนที่ทำกินในเขตป่าถือว่าเป็นเรื่องจำเป็น นอกจากจะช่วยในการเพิ่มรายได้จากการเกษตรแล้ว ยังเปิดโอกาสให้สมาชิกได้มีโอกาสทำงานรับจ้างนอกภาคเกษตร การให้การสนับสนุนในการศึกษาโดยสนับสนุนด้านค่าใช้จ่ายโดยตรง รวมทั้งการปรับปรุงมาตรฐานของสถานศึกษาในพื้นที่ จะทำให้ครัวเรือนมีรายได้เพิ่มขึ้น ชีวิตและความเป็นอยู่จะดีขึ้นและลดแรงกดดันที่จะบุกรุกทำลายป่าต่อไป

<u>ข้อเสนอแนะ</u>

1. <u>นโยบายของกระทรวงเกษตรฯ และสหกรณ์ที่จะเร่งรัดการปฏิรูปที่ดินเพิ่มขึ้นจาก 2 ล้านไร่เป็น 4 ล้านไร่ต่อปีนั้น สมควรได้รับการสนับสนุนเป็นโครงการเร่งด่วน</u>
   <u>ทั้งนี้ ให้ดำเนินการตามกฎหมายปฏิรูปที่ดินโดยเคร่งครัด และให้ความสำคัญแก่เกษตรกรที่ไม่มีที่ทำกิน และกำหนดระยะเวลาสิ้นสุดโครงการในการปฏิรูปที่ดินภายใน 10 ปี</u>
2. <u>นโยบายการปลูกป่าเศรษฐกิจโดยให้เอกชนเข้าใช้ประโยชน์ในป่าสงวนแห่งชาติที่เสื่อมโทรมเท่าที่ผ่านมาสร้างความขัดแย้งระหว่างผู้ลงทุนกับเกษตรกรที่ทำกินอยู่เดิม การปลูกสร้างสวนป่าในเขตเศรษฐกิจจะทำได้ก็ต่อเมื่อชาวไร่ ชาวนา ได้รับประโยชน์โดยตรง โดยรัฐเป็นผู้กำหนดเขตการปลูกสร้างสวนป่าในบริเวณป่าเสื่อมโทรมที่ไม่เหมาะกับการปลูกพืชผลอื่น ๆ นอกจากนี้ การปลูกไม้โตเร็วเพื่อขายจะเป็นผลดีกับชาวไร่ชาวนารายย่อย ก็ต่อเมื่อมีการทำสัญญาซื้อขายที่แน่นอน (contract farming) โดยกำหนดราคาไม้ที่ให้ผลตอบแทนในอัตราตอบแทนสูงกว่าการปลูกพืชเศรษฐกิจอื่น ๆ</u>
3. <u>รัฐควรมีนโยบายที่แน่ชัดในการสนับสนุนการปลูกป่าชุมชน ทั้งโดยชุมชนในหมู่บ้านเองและโดยองค์กรอิสระ ทั้งนี้โดยดำเนินการอย่างค่อยเป็นค่อยไป ขึ้นกับความเป็นอยู่และความพร้อมของแต่ละชุมชนเป็นหลัก</u>

<u>นโยบายที่ดิน</u>

จะเห็นได้ชัดเจนจากผลงานวิจัยที่ผ่านมาว่า นโยบายป่าไม้กับนโยบายที่ดินจะต้องดำเนินการควบคู่กันไป การจำแนกที่ดินออกจากเขตป่าสงวนแห่งชาติเพื่อนำไปปฏิรูปที่ดินนั้น เป็นการย้ำถึงความสำคัญของการยกฐานะความเป็นอยู่ของชาวไร่ ชาวนา ที่ตั้งถิ่นฐานอยู่ในป่าสงวนแห่งชาตินั้นเอง ขณะเดียวกันนโยบายปลูกป่าเศรษฐกิจและรักษาป่าอนุรักษ์จะสำเร็จได้ก็ต่อเมื่อชาวไร่ ชาวนา ได้ประโยชน์โดยตรงทั้งจากการรักษาป่า และการปลูกไม้โตเร็วเพื่อขายแข่งกับการปลูกพืชเศรษฐกิจอื่น

นอกจากที่ดินในเขตป่าสงวนแห่งชาติแล้ว ประเทศไทยยังอุดมสมบูรณ์ด้วยพื้นที่เกษตรซึ่งกระจายอยู่ทั่วประเทศ ทั้งพื้นที่เกษตรชลประทานและเกษตรน้ำฝน การครอบครองที่ดินโดยไม่ได้ทำประโยชน์เป็นผลโดยตรงจากการขยายตัวของเศรษฐกิจ โดยเฉพาะอย่างยิ่งในรอบ 3 ปีที่ผ่านมา การเก็งกำไรและการซื้อขายที่ดินในระยะสั้นมีส่วนผลักดันให้มีการกว้านซื้อที่ดินที่เหมาะสมกับการเกษตร ที่มีระบบ

ชลประทานหรือมีน้ำซับตามธรรมชาติเพียงพออยู่แล้ว ในเขตชานเมืองใหญ่ ๆ เขตเศรษฐกิจใหม่ และในบริเวณใกล้ป่าเขาที่เหมาะกับการพักผ่อนหย่อนใจ

ผลจากการวิจัยชี้ว่า ในอนาคตเนื่องจากการครอบครองพื้นที่โดยไม่ได้ทำประโยชน์จะขยายวงกว้างขึ้น ส่งผลให้เกิดแรงกดดันต่อพื้นที่ป่าเพิ่มขึ้นต่อไป ถึงแม้ว่าการซื้อขายที่ดินจะถือได้ว่าเป็นดรรชนีที่ชี้ให้เห็นถึงความคล่องตัวของสภาพเศรษฐกิจ และเป็นโอกาสให้เกษตรกรส่วนหนึ่งสามารถปรับสถานภาพของตนเองไปสู่การมีรายได้และทรัพย์สินเพิ่มขึ้นอย่างรวดเร็ว อย่างไรก็ตาม ในสังคมเกษตรเช่นสังคมไทยยังมีช่องว่างระหว่างรายได้ของประชาชนอยู่อีกมาก รัฐควรหาวิธีการเพิ่มรายได้จากการเปลี่ยนมือซื้อขายที่ดิน เพื่อนำไปพัฒนาประเทศ ให้ก่อประโยชน์ต่อส่วนรวมและสร้างความเป็นธรรมในสังคมให้เพิ่มมากขึ้น ถึงเวลาแล้วที่รัฐพึงพิจารณาระบบภาษีก้าวหน้าที่ได้มีแนวคิดมาเป็นเวลานาน แต่ไม่เคยได้รับการผลักดันให้เป็นกฎหมายเพื่อนำไปสู่การปฏิบัติที่แท้จริง

<u>ข้อเสนอแนะ</u> <u>รัฐจะต้องเก็บภาษีที่ดินในอัตราก้าวหน้า เพื่อลดแรงจูงใจในการถือครองที่ดินผืนใหญ่ โดยไม่ได้ทำประโยชน์ และเพื่อจำกัดขนาดการถือครองให้เหมาะสมกับความต้องการใช้ประโยชน์เพื่อกิจกรรมนั้น ๆ พร้อมกับเก็บภาษีการเปลี่ยนมือการถือครองที่ดินในระยะสั้นให้เพิ่มขึ้นเพื่อลดการเก็งกำไรที่ดิน</u>

<u>นโยบายน้ำ</u>

ผลจากการวิจัยเน้นว่า ความต้องการน้ำเพื่อชุมชน เพื่ออุตสาหกรรม และเพื่อการท่องเที่ยวจะขยายตัวอย่างรวดเร็ว

การเพิ่มอัตราค่าน้ำให้ตรงตามสภาพความเป็นจริง โดยคิดจากค่าใช้จ่ายในการจัดหาและพัฒนาแหล่งน้ำจะช่วยลดการขัดแย้งในการใช้น้ำได้ แต่การเพิ่มค่าน้ำจะมีปัญหาสำหรับผู้มีรายได้น้อยในเมือง และการใช้น้ำเพื่อการเพาะปลูกในชนบท ทางแก้ในเรื่องนี้กระทำได้หลายวิธี เช่น 1) คิดอัตราค่าน้ำในอัตราก้าวหน้าเพื่อลดภาระของผู้มีรายได้น้อย 2) คิดค่าน้ำสำหรับอุตสาหกรรมโดยประมาณน้ำที่จะใช้ขั้นต่ำ ซึ่งจะต่างกันไปตามประเภทของโรงงานและปริมาณที่ใช้ โรงงานที่อยู่ในเขตการจ่ายน้ำจะต้องเสียค่าน้ำในอัตราของปริมาณขั้นต่ำที่กำหนด เพื่อป้องกันการลักลอบสูบน้ำบาดาลซึ่งจะส่งผลให้เกิดปัญหาแผ่นดินทรุดและน้ำท่วมตามมาอีก 3) สำหรับการใช้น้ำเพื่อการเพาะปลูกในเขตชลประทาน ควรจะให้ความสำคัญแก่ชุมชนหรือผู้ใช้น้ำเป็นผู้จัดสรรน้ำและเก็บค่าบำรุง

ด้วยวิธีการดังกล่าว จะช่วยให้รัฐสามารถระดมทุนเพื่อจัดสรรน้ำให้พอเพียงกับการขยายตัวของเมืองของอุตสาหกรรมและการท่องเที่ยว ปัญหาการขัดแย้งเรื่องน้ำจะลดลงและทำให้มีการประหยัดการใช้น้ำมากขึ้น

<u>ข้อเสนอแนะ</u> <u>รัฐจะต้องปล่อยให้อัตราค่าน้ำในเมืองใหญ่ ๆ สำหรับชุมชน อุตสาหกรรมและการท่องเที่ยวลอยตัว สามารถปรับอัตราค่าน้ำให้รับกับค่าใช้จ่ายที่จำเป็นสำหรับการลงทุนเพื่อจัดสรร</u>

น้ำในกิจการเหล่านี้ ทั้งนี้ให้เก็บค่าน้ำในอัตราก้าวหน้าเพื่อลดภาระของผู้มีรายได้น้อย และเพื่อกระตุ้นให้เกิดการประหยัดการใช้น้ำสำหรับผู้ใช้น้ำรายใหญ่

Chapter 1

Resource Conflicts and Challenges

In less than thirty years, Thailand has been transformed from a subsistence agrarian economy into a rapidly industrializing country: a rare accomplishment among developing countries. Thailand's rural natural resources—land, water, and forests—have made indisputable contributions to the country's industrialization and economic growth, ranging from food and materials to foreign exchange and labor at a critical stage of the country's development. The steadily falling share of natural resource sectors (agriculture, forestry and fisheries) in the gross domestic product (GDP) and exports and the concurrent, continued rise in their absolute contribution is a measure of the success of these sectors in fueling the diversification and sustained growth of the economy. The inherent risk is to infer from this inevitable structural change that rural natural resources no longer warrant attention since the share of the resource-based sectors is relatively small (under 20%), and is steadily declining.

THE RESOURCE CONFLICTS

Thailand is no longer an agricultural economy; agriculture's annual contribution to the GDP can be replaced by two years' nonagricultural production growth. Yet the majority of the Thai population are farmers, farm workers, and gatherers who depend for a living on the primary productivity of natural resources, especially land, water, and forests. These resources are partially degraded and depleted from past overuse, but they are called upon to meet the rising expectations of a much larger, and still-growing rural population. The burden on these resources is further increased because they are relied upon to reverse the growing disparity in income distribution.

Land and Forest

The land frontier, which has served as a source of agricultural growth and poverty alleviation in the past, is all but exhausted—not in the physical sense, but rather in the

economic sense of a steeply-rising (social and increasingly private) supply price of forestland to agriculture. Not only is the remaining forestland less suitable for agriculture because of its steeper slope, greater fragility, and lower productivity, but its clearing and conversion to agriculture involves heavy social costs in terms of loss of water control, of biological diversity, and ecological balance. Indeed, some of the previously encroached agricultural land has a social cost that exceeds private benefit, and ought to be reverted to forestry.

Of course high social costs are no guarantee against further forest encroachment in response to the declining productivity of already encroached lands. But even in private terms, further forest encroachment will come at a higher cost and a lower benefit since the remaining forestland tends to be steeper, more remote, and of lower sustainable productivity. Moreover, advancing deforestation deprives rural people of resources which they have traditionally relied upon for an income supplement and a variety of products such as wood for fuel, construction poles, food, and medicine for home consumption. As the forest recedes even the collection of nontimber forest products becomes unsustainable and detrimental to the resource base.

As if these pressures were not enough, mounting demands for rural natural resources emanate concurrently from the nonrural sectors. Growing urban centers and expanding industries demand and obtain prime agricultural land for urban development, industrial location, and commercial centers. Urbanization and the rise in income create further demands for recreational facilities and roads. The thriving tourist industry has become a major claimant of land in both coastal and upland areas. Rising land prices, expectations of continued rapid growth, and uncertainty regarding the location of new infrastructure have led to land speculation that diverts land from agricultural use to a "nonuse" state that costs little to maintain and promises much gain in return. While the percentage of agricultural land that is converted to other uses, including land speculation, is still small, it affects some of the best agricultural land both in terms of its productivity and its proximity to markets. At the same time large-scale, urban-based agroindustry, with official support, has been acquiring large tracts of land, including land in encroached forests, to establish industrial plantations to feed woodchip and pulp and paper mills for both domestic consumption and export. Clearly, both land and forests are under increasing pressure despite (or perhaps because of) the rapid industrialization and economic growth.

Water Resources

The growing demand for water by both the rural and nonrural sectors is no less dramatic. Only 20 percent of Thai agricultural land is irrigable. Virtually all suitable sites for construction of irrigation dams have been used; additional capacity can only come at a steeply rising supply price, both in terms of construction and environmental costs. Yet with the virtual exhaustion of the land frontier, productivity growth remains the only sustainable means of raising agricultural output and improving farm incomes.

Water is a critical element and is necessary for raising agricultural productivity—both directly, and by making other inputs, such as new crop varieties and fertilizers, more productive. Productivity growth itself is critical to containing encroachment. Therefore, water scarcity that inhibits productivity growth may bring about further water scarcity through continued encroachment and deforestation, since the margin of cultivated land has already reached important watersheds.

Another factor that would help contain the demand for agricultural land is the diversification of agriculture from land-extensive to land-intensive crops: from maize and cassava to vegetables, fruits, and fish. But the latter also require more and better controlled water resources.

At the same time, growing urban centers, expanding industries, and thriving tourist industry require ever-increasing quantities of water. Urbanization concentrates household demand for water in a few locations requiring water storage and conveyance from large distances, central treatment facilities, and extensive distribution systems. Income growth, especially in urban areas, raises the per capita demand for water as nonessential uses, such as watering of gardens, are added to the more basic uses of drinking and washing. The growth of businesses and institutions such as restaurants, food markets, and hospitals serving an increasingly larger and wealthier urban sector further compounds the urban demand for water.

The remarkable growth of the Thai tourist industry, which reached 5 million tourists (1989) and is expected to double in a decade, is a new major and growing source of water demand for cities like Bangkok and Chiang Mai and for tourist resorts such as Pattaya and Phuket. The per capita consumption of water by the average tourist (both directly and by hotel facilities and restaurants, etc.) is 1.25 cubic meters per day compared to 0.28 cubic meters per day for the local urban resident.

Industry uses water for a variety of purposes ranging from washing raw materials and equipment to cooling and condensation. Water is also used as a factor of production and is incorporated into the final product and used as a means of conveying other production inputs. It is estimated that the industry currently uses 2.1 billion cubic meters of raw water per year.

Annual urban, industrial, and tourist water consumption, while relatively small (4 billion cubic meters) in comparison to agriculture (40 billion cubic meters) and to total freshwater resources (199 billion cubic meters), faces the most acute scarcity for three reasons as follows:

1. Water for urban, tourism and, to some extent, industrial use needs to be of much higher quality than that used for agriculture or found in surface water bodies, especially those in proximity to urban and industrial centers. Therefore, it requires costly treatment and purification.
2. An effective water resource needs to be made into a large, concentrated, and reliable supply, regardless of local availability of raw water sources. Therefore, it involves high conveyance and distribution costs.
3. The water demand for nonagricultural uses, while relatively small at present, will quadruple in 15 years if current trends continue.

The main raw water sources around Bangkok and the Eastern Seaboard have already been tapped. The maximum daily withdrawal of 5.2 million cubic meters of raw water for Bangkok from the Chao Phraya irrigation system set by the Royal Irrigation Department (RID) will be reached by the end of the Seventh National Economic and Social Development Plan (1995). Already, plans are being made for an interbasin transfer from the Mae Klong River, which is located 100 kilometers from Bangkok.

Water shortages and water conflicts are widespread and are increasing in frequency and severity. In Pattaya water is being trucked to hotels and restaurants, and forthcoming new supplies will draw on a system which was initially planned for the use of the Eastern Seaboard. In the industrial province of Samut Prakan and other areas of the Bangkok Metropolitan Area (BMR), excessive groundwater pumping has led to land subsidence of 5 centimeters to 10 centimeters per year, affecting an area of 4,550 square kilometers and contributing to property damages equal to billions of baht.

As the demand for water by all sectors grows, its supply is being affected by deforestation and water pollution. Untreated municipal wastewater, toxic industrial

wastes, and leached agrochemicals find their way in increasing quantities into surface and groundwater sources.

Environmental Amenities and Resources for the Future

The demand for natural resources such as land, forests, and water is not abated by industrialization and growth. Resource conflicts and scarcities may both result from and constrain economic growth. Land, water, and forests are critical elements for alleviating rural poverty and improving income distribution. Water is equally critical to urban, industrial, and tourist industry growth. Yet the most latent, and perhaps the more potent, urban demand for rural natural resources over the long run is the demand for environmental amenities open spaces, parks, and recreation arising from income growth and urban congestion. This environmental and recreational demand for land, water, and forests is beginning to manifest itself in growing visits to national parks, coastal resorts, rapid growth in golf courses, and increasing support for the environmental movement. As incomes continue to grow and the environment of the cities deteriorates from pollution and congestion, growing numbers of people will demand the amenities of the countryside: open spaces, rural landscapes, natural forests, and unpolluted waters. Last and foremost, for development to be sustainable over the long run, the stock of resources and the range of options left to the future should not be diminished by current use.

POLICY CHALLENGES

The growing resource conflicts present policymakers with five fundamental challenges as follows:

1. How can agricultural growth continue, rural poverty be alleviated, and income distribution improve without further forest encroachment?
2. How can the rural population best share in the benefits of Thailand's successful industrialization and remarkable economic growth without losing the desirable aspects of rural life and acquiring the aggravation of urban congestion and pollution?
3. How can the country best conserve and protect its remaining natural forests and accelerate reforestation without depriving farmers in forest reserves of their means of livelihood and further exacerbating social conflicts?
4. How can water be adequately supplied to urban, industrial, and tourist users to ensure continued growth without depriving farmers and other rural water users of one of their most essential resources?

5. How is it possible to modify the driving forces of resource use from subsistence, speculation, and short-term profit to investment in long-term productivity, conservation, and management for a sustainable future?

RESEARCH QUESTIONS

To help address these challenges the three Thailand Development Research Institute (TDRI) research papers that are being synthesized under the theme of "Natural Resources for a Sustainable Future" address a set of analytical questions as follows:

1. Given the demographic growth and structural change projections and the likely trends in agricultural productivity and world commodity prices, what is the expected demand for agricultural land over the next 10 years to 20 years?
2. What explains the concurrent growth of unused prime agricultural land and the advancing encroachment of marginal forest lands?
3. In light of the recurring problems of flash floods, and droughts, soil erosion, and landslides related to the destruction of watersheds, has the relationship between agriculture and forestry turned from one of competition for land into one of complementarity?
4. How are rural poverty and deforestation interrelated?
5. Are farmers in encroached forests worse off than farmers outside these forests? What determines the income of farmers in the forests? Is it sustainable? How can it be improved?
6. Can commercial forestry help break the vicious circle of deforestation and rural poverty? What are the financial, economic, and social profitability and distributional implications of private commercial plantations?
7. Is community forestry a realistic alternative? What types of social forestry have been successful, and under what conditions? What is the scope for the expansion of community forestry beyond the few areas where it has taken root?
8. Given the changing demographics, income growth, structural change, and current trends in water consumption, what is the projected demand for water by nonagricultural users (urban centers, industry, and tourism) over the next 10 years to 20 years? How does the projected demand for water compare with available and planned supplies?
9. What is the marginal cost of water supply from alternative sources and the potential role of pricing in demand management and supply expansion?
10. What is the potential for using of water rights as an instrument for increasing water-use efficiency; for making available additional supplies of water to growing urban, industrial, and tourist centers; and for giving farmers a partnership in industrial and urban development?

The research aimed at answering these questions is ongoing, and the results reported here are sufficient to outline a consistent and effective policy response to the

five policy challenges. Some measures can be implemented right away, while others may take years. The emphasis here is not on details, but rather on concepts—not on stopgap measures and palliatives, but on long-term solutions and cures. This is necessary in dealing with issues of natural resource management and sustainable development. This does not mean that the problems are not urgent and the solutions overdue; it only means that the response to great challenges should not be stopped by the difficulties and expediencies of the moment. In fact, we see a great urgency in dealing with irreversible process such as deforestation and soil erosion and destabilizing trends such as the increasing income inequality.

In the following chapters, the main analytical findings from our research on the ten questions are reviewed, and policy measures are proposed for responding to the five challenges.

Chapter 2

Agricultural Land Demand and Forest Encroachment

THE DEMAND FOR AGRICULTURAL LAND

In the past, agricultural growth was accomplished largely through land expansion into forest reserves. From 1961 to 1988, 89 million rai of forestland was cleared and 80 percent of that area was turned into cropland (see Appendix Table 1). The end of the land frontier is approaching, but encroachment continues unabated. The national forest policy calls for 40 percent forest cover, but one-third of the designated area, or 38.4 million rai, is claimed by farmers as agricultural land. To determine whether the agricultural pressures on the forest will continue and whether the national forest policy is realistic, it is necessary to project the demand for agricultural land in the next 10 years to 20 years. We hypothesize that the demand for cultivated agricultural land depends on the following factors:

- Price of agricultural crops relative to the price of nonagricultural products reflecting relative profitability of land use
- Agricultural population reflecting subsistence demand for land (primarily paddy land)
- Agricultural productivity, a composite index of the yields of major crops, reflecting both higher expected return from cultivation of existing farmland and reduced pressures for opening new land
- Relative profitability of land-intensive (land-saving) crops leading to diversification away from land-extensive (land-using) crops
- Growth of nonagricultural production reflecting nonagricultural employment and structural change (industrialization index)

The empirical estimation of a land demand function, using national data from 1961 to 1988, has confirmed the hypothesized determinants of demand for cultivated land. All hypothesized determinants of land demand were statistically significant and

with the expected sign. The model explained more than 98.7 percent of the total variation in land demand. Detailed results of the estimation are reported in Appendix, Table 2. The following five findings are of significance:

1. A 10 percent increase in the relative **crop price** (lagged by one year) results in a 0.8 percent increase in the demand for land: a rather limited response.
2. In contrast, a 10 percent rise in **the agricultural population** results in a 13 percent increase in the demand for farmland, a potent response. Rural/urban migration, by reducing the growth of agricultural population, reduces the demand for agricultural land.
3. Productivity growth has two opposing impacts on the demand of cultivated farmland. On one hand, the more productive the land the higher the demand for farmland. On the other hand, the higher productivity of *existing* farmland means lowered pressure for opening new land. In the case of Thailand, the second effect is expected to overwhelm the first because the opening of new land is driven to a large extent by stagnating or falling productivity on much of rainfed cropland. Indeed, a 10 percent growth in productivity (lagged by one year) reduces the demand for cropland by 2.8 percent. This finding provides a potent instrument for slowing down encroachment and reducing the pressure on the remaining forests.
4. Diversification away from land-extensive crops such as cassava, maize, and rainfed rice and towards land-saving crops such as vegetables and fruits reduces the demand for land. A 10 percent increase in the profitability of the latter results in 1.5 percent reduction in the demand for farmland. This is relatively small because of the inclusion of irrigated rice and sugarcane in the land-extensive crops, and the still very limited land area under trees and vegetables (only 13 percent of the total).
5. Finally, the **structural transformation** of the economy from agriculture to industry shifts the demand for agricultural land downward because of increased off-farm employment opportunities relative to on-farm opportunities. A 10 percent increase in the industrialization index, all other things being equal, reduces the land demand by 3 percent. Therefore, macro projections of continued structural change well into the next century would have a down-pulling effect on the demand for farmland and on the share of farmland that is actually put to cultivation. Yet there is still a very strong positive time trend in the demand for agricultural land which would ensure no abrupt drop in the demand for farmland, despite the fundamental structural changes taking place.

Based on these land-demand elasticities and projections of the independent variables (land-demand determinants), **the demand for agricultural land under cultivation is projected to level off during the early 1990s, and to decline through the 1990s and the early part of the 21st century at the rate of 0.5 percent annually.** The decline will accelerate after 2005 to 1.7 percent annually. By the year 2010 the demand

for agricultural land for cultivation will stand at 88 million rai, which is only 19 percent lower than the 1989 figure of 109 million rai (see Figure 1).

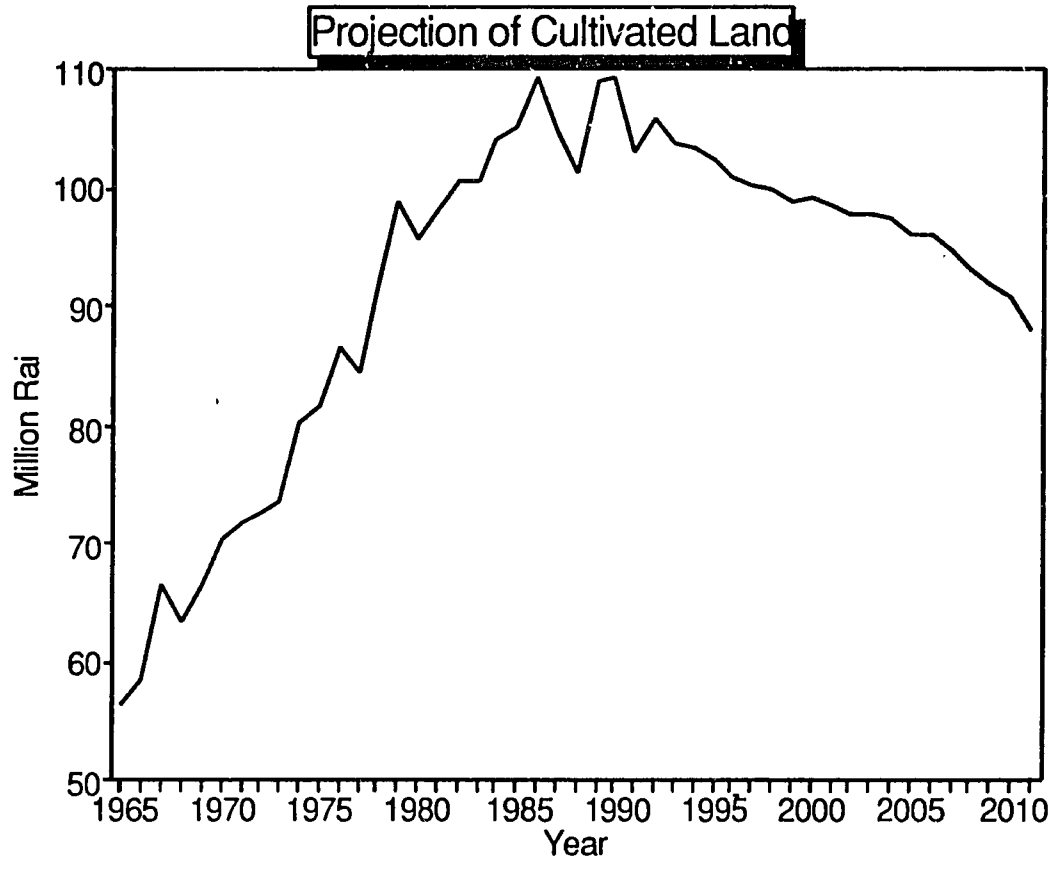


Figure 1

Therefore, land currently under cultivation will begin to be left idle, or will be shifted to other uses. By the year 2001 as much as 11 million rai of land, which is currently being used for agriculture, will be taken out of production, and by the year 2010 an additional 11 million rai to 15 million rai will be retired from agriculture under the base scenario. This will be in addition to some 33 million rai of farmland that currently remains unused. With the increasing area of unused land, some of which is prime agricultural quality, the encroachment of marginal forestland for farming should cease, and more land should be made available for forestry. As it is shown in the next section this is not necessary the case.

To examine the sensitivity of cultivated land projection to policy interventions, a number of policy simulations were carried out: (a) a farm price support that leads to 2 percent annual increase in real crop price index; (b) a three percent annual increase in agricultural productivity; (c) a capital subsidy for the industrial sector that leads to a 10 percent reduction in labor demand by the industrial sector from its base case level; and (d) an average 2 percent lower growth rate for the non-agricultural sector during 1990-94 due to the higher oil prices arising from the Gulf crisis. The results of these policy simulations (reported in Table 1) show most sensitivity of land demand for cultivation to policy interventions.

Table 1 Demand for Agricultural Land: Policy Simulation Results

(Million Rai)

Year	Base	Farm Subsidy	Productivity Growth	Capital Subsidy	High Oil Price
1990	103.25	103.25	103.25	103.66	103.66
1995	101.13	102.01	95.90	104.57	104.57
2000	98.69	100.84	91.37	.102.05	102.05
2005	96.05	99.03	86.77	99.35	99.35
2010	87.94	91.84	77.86	. 90.93	90.93

UNUSED LAND AND FOREST ENCROACHMENT

In any given year, a substantial portion of agricultural land (farm holdings) is left unused for a variety of reasons that include a drop in productivity, poor rainfall, low prices, flooding, fallow requirements, etc. Farmland is also left unused when labor has better, alternative employment opportunities. Land is also converted from farming to other uses when the expected return from such uses is higher, but such land should no longer be classified as farmland, or unused land. Unused farmland has ranged from a high of 29 percent in 1972 to a low of 14 percent in 1985. Since 1985, however, it rose to 25 percent in 1988 and it is expected to rise further in the future (see Figure 2).

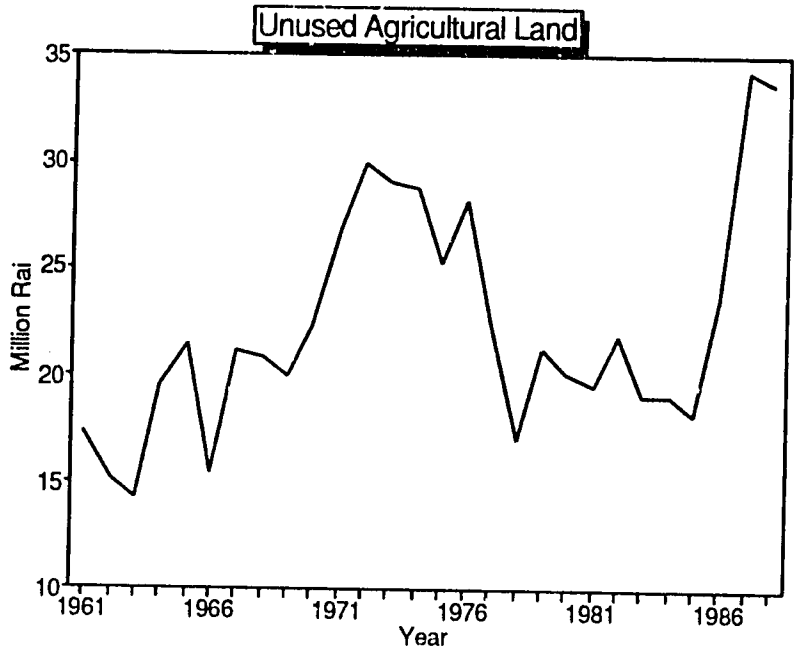


Figure 2

Source: Calculated from the data reported by Agricultural Statistics Office

In order to predict the area of unused farmland in the future, historical variations in unused land were analyzed to determine their causal factors. Ninety percent of the variation in unused land from year to year (from 1962 to 1988) was explained by crop price, land productivity, average holding, size of agricultural population, differential return between agricultural and nonagricultural activities, and time trend (see Appendix, Table 3). The results obtained were as follows

1. A 10 percent drop in **price** the real crop results in a 3.8 percent increase in unused land, while a similar drop in productivity results in much higher (6.3%) rise in unused land.
2. A drop in agricultural population by 1 percent results in a 0.96 percent rise in unused land. The figure implies that an increase by one additional farmer would result in a decrease of unused land by 0.74 rai. The rest of the land needed for cultivation is probably obtained from forest encroachment. An increase in farm holding per farmer by 10 percent increases unused land by 38 percent.
3. The increases in the **differential return** between the agricultural sector and other sectors in favor of the latter result in a proportional increase in unused land. Other factors being equal, unused land tends to decline over time. Unused land fell to its lowest level in proportion to the total amount

of farmland during the period from 1979 to 1985 because of sluggish growth in nonagricultural production.

Therefore, unused land is driven by the availability of better alternatives for labor and capital outside agriculture, and the low cost of keeping land idle. The opportunity cost of idle land is especially low under conditions of depressed prices and low agricultural productivity.

In contrast, **forest encroachment** for crop cultivation results from (1) lack of better alternatives, and (2) the low cost of obtaining and clearing new land. It is largely driven by poverty. This is not true of other forms of forest encroachment such as illegal logging, land accumulation by the wealthy, and encroachment by commercial plantations, although there is a fair amount of overlap and interaction. For example, illegal logging may be carried out by local villagers on behalf of influential entities, but poor farmers are rarely the encroachers of first instance. They usually follow loggers into an area after it has been logged, or purchase land from wealthier farmers or influential people who have already staked a claim on large areas of the forest. Such claims are not legally recognized by the government, but they are respected by local people. There is an active market for encroached land, which sells at about 50 percent of the price of equivalent titled land. The small and landless farmers' needs for land to eke out a livelihood provides a physical and moral cover for encroachment by other groups and interests. Therefore, any reduction in the demand for *new* land for farming would help contain other forms of encroachment as well.

An increase in the demand for land for cultivation is satisfied from various sources as follows:

1. Reduction in unused farmland
2. Other sources such as grasslands and unclassified lands
3. New land clearing through forest encroachment.

For example, the increase of demand for cultivated land by 4 million rai from 1984 to 1985 was satisfied by returning to cultivation 0.91 million rai of unused land, by encroaching 1.54 million rai of forest, and by obtaining the rest from unclassified land. An analysis of the sources of land supply to satisfy changes in land demand indicates that **for every 100 rai of land that is added to cultivated land, 140 rai of forest is being cleared.** Of that amount, 27 rai go to replace retiring farmland that reverts to the unused

land category, 7 rai go to grasslands, aquaculture etc., and 6 rai go to unclassified lands (see Appendix, Table 4).

Alternatively, 71 percent of deforested land is put under cultivation, 4 percent under urban use and the rest either remains unused or turned into grasslands (see Figure 3)

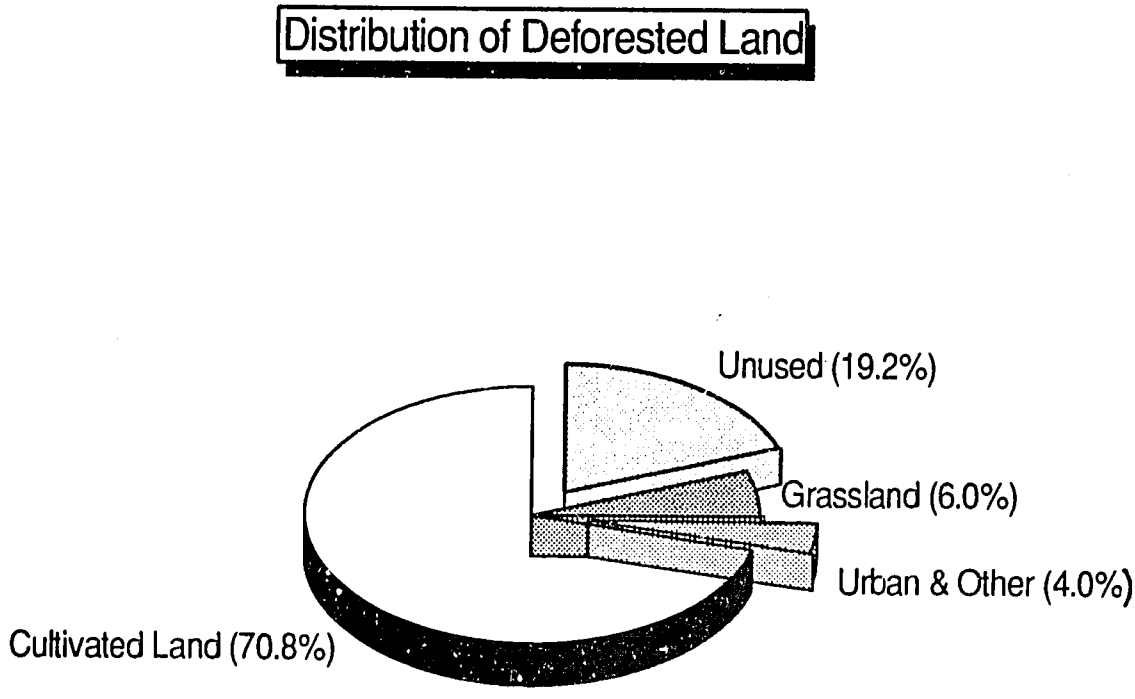


Figure 3

AGRICULTURE AND FORESTRY: COMPETITIVE OR COMPLEMENTARY?

If forest encroachment is expected to continue while unused farmland is not likely to be reverted to forest for economic and ecological reasons, what would be the impact of continued deforestation on agricultural production? In the past 30 years agricultural production has increased steadily through deforestation and farmland expansion. Since less forest means more land for agriculture, the impact of the deforestation on agricultural production has been positive. Of the 85.3 million rai of forest cleared between 1961 and 1988, 81.9 million rai were converted to farmland (although only 60 million rai are being used) contributing, on the average, 550 baht per rai (in 1972 prices) to agricultural Gross Domestic Product (GDP) after adjustment for a 1.35 productivity growth during the period. This is probably an overestimate since the considerably higher productivity growth in the irrigated areas of the Central Plains and the North raises the average productivity.

There is no doubt about the contribution of forest clearing to agricultural growth. Maize, cassava, and sugarcane, which are the major crops replacing the forest (in all regions except the South), are reported by The Office of Agricultural Economics (OAE) to generate profits of 142 baht, 648 baht, and 592 baht per rai, respectively (average profit over the decade from 1978 to 1988). A Thailand Development Research Institute (TDRI) survey in Chachoengsao Province has also recorded income from cassava of 500 baht per rai (1989) which includes the opportunity cost of family labor. Is it, therefore, safe to assume that agricultural production will continue to rise with deforestation as has been the case in past? Will the conventional, competitive relationship between agriculture and forestry continue until all forestland is replaced by farmland? At any rate, what are the social costs of forestland in terms of agriculture? Is there any negative feedback?

There is accumulating evidence at the micro level that loss of forest cover, especially on steep slopes and in watersheds, leads to increased runoff, soil erosion, and loss of water control. The downstream environmental impacts include the flooding and sedimentation of water bodies and the decreased availability of water during the dry season. For example, the Department of Land Development (DLD) reports that **39 million rai of agricultural land under upland crops, rubber, and shifting cultivation suffers from severe to very severe erosion, between 100 tons and 967 tons of soil per**

rai per year, compared to a loss of between 0.01 tons and 5.00 tons per rai per year for forests and paddies (see Onchan 1990).

A study in the Northeastern provinces of Sakhon Nakhon and Kalasin showed a loss of 15-16 tons of soil per hectare per year from land under shifting cultivation and about 21-25 tons of soil per hectare per year for bare soil compared to only 2-4 tons of soiloss per hectare for forests (Pairin et al. 1982). Another study indicates that **a loss of 5 centimeters of topsoil results in a 22 percent drop in the yield of maize, and a loss of 15 centimeters results in a 50 percent drop in maize yields.** (Thailand Development Research Institute 1986). The sedimentation of reservoirs, the landslides that occurred in the South in November 1988, and the recurrent floods and droughts, all of which have some impact on agricultural production, are not unrelated to deforestation, although quantitative assessments of impacts are lacking. It is possible, however, to learn something from any covariation that may exist between deforestation and agricultural production provided all other variables are controlled that are major determinants of agricultural production.

We thus hypothesize that agricultural production (GDP in real terms) is determined by cultivated land area, fertilizer use, irrigation, rainfall, agricultural labor (agricultural population), and the rate of deforestation. All variables, except the last one, are direct inputs in crop production and standard variables in agricultural production functions. Deforestation is the only innovation here and is introduced as a surrogate of forest-related environmental impacts on agriculture. Its introduction in the agricultural production function is a recognition of linkages and externalities between the two largest spatially-based sectors.

Given the strategic upland domain of forests and the passive downstream domain of agriculture as well as the encroachment of the former by the latter, three effects are expected as follows:

1. Deforestation results in more land available for agriculture, hence, there is a positive relationship with agricultural output. This effect is fully taken into account by the inclusion of the land variable in the equation.
2. Newly cleared land is generally more marginal, more fragile, and on steeper slopes and, therefore, on the average, it is of lower sustainable productivity than existing agricultural land. Hence, deforestation results in lower agricultural production per rai (yield) than previously opened land. This is the on-site environmental impact of deforestation on agriculture.

3. Denuded hillsides and watersheds under shifting cultivation or upland crops such as cassava and maize result in increased runoff and flash floods that might accelerate nutrient leaching and soil erosion downstream, especially on lower uplands, as well as sedimentation of water bodies and flood damage. This is the watershed effect, or off-site, environmental impact, of deforestation on agriculture. Based on the presumption that these factors are present and significant, efforts are being made to protect watersheds and to increase the area under forest cover. The scientific evidence, both in Thailand and around the world, while still inadequate, supports the hypothesis of a watershed effect.

The hypothesis has been tested in a macro production function that explained 99.6 percent of the total variation in agricultural output between 1962 and 1987. All the agricultural inputs made a statistically significant contribution to the agricultural output, with the exception of labor. The results are reported in the Appendix, Table 5. Deforestation which was significant at the 95 percent confidence interval had a negative sign indicating an inverse relationship with agricultural production. **A 10 percent increase in the rate of cumulative deforestation results in a 4.4 percent reduction in agricultural output. This corresponds to a loss of agricultural output of 227 baht (1972 prices) per rai of forest loss.** This should be compared with the agricultural gain from deforestation. According to our estimates from the same equation, one additional rai of farmland at the margin generates an output of 292 baht (in 1972 prices). Therefore, during 1962 to 1987 cumulative deforestation has generated a net loss to the agricultural GDP equal to 45 baht per rai (in 1972 prices) or 153 baht per rai in current prices. To study the cumulative deforestation effects on income in earlier time periods, the output model is re-estimated with data from 1962 to 1978, from 1962 to 1980, and from 1962 to 1984. The income gain and loss from deforestation in each time period is shown in Table 2 below.

Table 2 Effects of Deforestation on Agricultural Income (1972 prices)

(Baht/Rai)

Gain/Loss	1978	1980	1984	1987
Gain from land expansion	213.19	186.74	174.88	182.38
Loss from deforestation	183.28	159.25	161.51	227.36
Net gain	+ 29.91	+ 27.49	+ 13.37	- 44.98

The table indicates the net effects of deforestation on income, which have been positive in earlier periods, have become negative in the late 1980s. The Table also shows that the gain from land expansion is declining. An increase in income (gain) in 1987 could have come from (1) higher productivity, (2) higher prices, and (3) a shift to higher-value crops. In contrast with the income gain trend, the income loss from deforestation is increasing.

The net income gain from deforestation is certainly on a downward trend. In 1978 clearing one rai of forest yielded a net benefit of 30 baht in 1972 prices (102 baht in current prices). The same activity, however, caused a net loss of 45 baht (153 baht in current prices) in 1987. The trend is rising for four reasons as follows:

1. Due to cumulative effects, past deforestation also has downstream effects on current production partially captured here.
2. Deforestation is increasingly moving onto steeper, more fragile and more ecologically critical lands resulting in increased environmental disturbance.
3. As cultivated land increases and agricultural production grows, there is more property and value to sustain damage.
4. In recent years deforestation has slowed down, resulting in higher damage per rai of forest loss at the margin.

The forest cover affects agricultural production through its impact on agricultural productivity. To test this, a model was formulated to explain agricultural productivity (a composite index of crop yields per rai) during the period from 1962 to 1987. The significance of the following variables including rainfall, irrigation, fertilizer use, agricultural research, agricultural extension, education, average capital input, and forest area were tested to capture any externalities between forest production and agricultural productivity. All variables were rejected as insignificant or perverse, except for education, forest area, irrigation, and rainfall which were significant and together explained over 62 percent of the variation in productivity.[1] **A 10 percent increase in the average number of years of schooling increases agricultural productivity by 2.2 percent,** collaborating findings of earlier studies (see Appendix Table 6).

An increase in irrigation per unit of cultivated land apparently increases productivity. A 10 percent increase in forest area results in a 1.8 percent increase in agricultural yields. This puts the value of one additional rai of forest to agriculture in 1988 at 260 baht, or about 26 percent of the Royal Forestry Department's (RFD) estimate of 1,000 baht per rai cost of reforestation.[2] These findings suggest that agriculture and

forestry no longer cumpete for land in social terms, though in private terms there are still gains to be made from forest encroachment and land clearing for cultivation.

End notes

1. Variables such as, fertilizer, research, and extension could be significant at a more disaggregated or micro level.
2. The Royal Forestry Department's reforestation cost figure is probably an underestimated. In Indonesia it costs the equivalent of at least 2,000 baht to reforest one rai of land.

Chapter 3

Poverty and Deforestation: A Vicious Circle

FARMERS IN THE FOREST: INCOME ANALYSIS

It is widely believed that farmers in the forest who obtain farmland through encroachment are worse off than farmers outside the forest. To assess the incomes of farmers in the forest, the results of village surveys conducted by the Office of Agricultural Economics (OAE) during 1983 to 1986 in 24 forest sites in 11 Northeast provinces, 7 forest sites in the Lower North area, and 6 forest sites in the Central Region were analysed. The surveys were carried out under the Land Reclassification Program and involved 18,697 samples from a total of 144,401 settlers in forest reserves.

Since the surveys were taken in different years, for comparison across provinces, all figures were converted into 1976 prices. The highest family cash incomes were found in the provinces of Kamphaeng Phet, 30,365 baht; Prachuap Khiri Khan, 25,655 baht; Lop Buri, 24,740 baht; and Petchabun, 23,497 baht. The lowest cash incomes were found in the provinces of Nong Khai, Loei, Nakhon Phanom; and Sakon Nakhon: about 7,500 baht per household per year. Between the highest and lowest cash incomes, there was considerable variation with relatively high incomes in the Central Plains and low incomes in the Northeast and the North.

To obtain a rough measure of the relative income position of farmers in the forest reserves vis-a-vis the population at large, we compared net cash income in current prices with the provincial average net cash income from the OAE's 1982/83 and 1986/87 Farm Household Income and Expenditure Survey. Half the sampled forest reserves had net cash incomes below the provincial average, and half were above it. This suggests that **farmers in forest reserves are generally not in worse socio-economic condition than farmers in general: their income level depends on the specific forest reserve and**

province they live in. In the Central Region, farmers in forest reserves were in worse economic condition than the average farm family in the province, while in the North, the reverse was true. The situation in the Northeast was mixed, with farmers inside the forest in six provinces, notably Khon Kaen and Chaiyaphum, being better off and five provinces, notably Nong Khai and Nakhon Phanom, being worse off than the average farmer in the province (see Table 3).

Table 3 Annual Family Net Cash Income of Sampled Households Residing in Forest Reserves Compared with the Average Net Income of Farm Households in the Province, Northeastern Region.

Provinces	Family net cash income (baht)		
	Study sites	1982/83	1986/87
Khon Kaen	27,976	16,136	18,368
Chaiyaphum	22,351	16,905	14,201
Maha Sarakham	22,151	11,163	16,586
Buri Ram	14,437	19,708	17,585
Nong Khai	16,637	19,411	30,769
Si Sa Ket	20,211	7,021	18,856
Kalasin	19,100	11,841	17,581
Nakhon Phanom	13,423	21,215	22,415
Sakon Nakhon	12,784	29,031	13,768
Loei	10,445	13,284	12,138
Udon Thani	23,489	26,279	24,311
Phitsanulok	26,937	17,594	17,756
Urraradit	15,752	18,047	-3,412
Sukhothai	21,775	19,444	21,786
Kamphaeng phet	36,687	25,206	32,333
Phetchabun	26,853	16,570	24,541
Nakhon Sawan	25,732	21,849	27,425
Uthai Thani	26,689	20,118	17,373
Lop Buri	27,395	36,545	41,480
Kanchanaburi	13,795	50,786	36,091
Chai Nat	16,262	20,556	23,884
Ratchaburi	26,661	26,866	43,706
Phetchaburi	27,993	12,340	8,389
Prachuap Khiri Khan	25,458	37,315	19,312

Source: Office of Agricultural Economics, Provincial Average Data: Farm Households Income and Expenditure Surveys" 1982/83 and 1986/87"

In order to formulate policy recommendations for (1) increasing the income levels of households living in forest reserves, and (2) stemming further encroachment and deforestation, it is important to first understand the sources of these income variations. For this purpose we have formulated a number of hypotheses pertaining to the three main sources of income of households in forest reserves.

Farmers in the forest derive their cash income from five sources: crop farming (54%), fruits and livestock (15%), wage labor (13%), remittance (16%), and sale of forest products (2%). The last figure underestimates the farmers' dependence on the forest. Farmers derive many of their basic necessities from the forest: construction poles, fuelwood fodder for livestock, fruits, vegetables (especially bamboo shoots and mushrooms), animals for meat, medicinal plants and herbs, and condiments. Thus, while forest products contribute only 2 percent to the family's cash income, they may contribute closer to 50 percent of its noncash income.

There is considerable variation in family cash income among provinces/forest sites, ranging from a low of 7,600 baht in Nakhon Phanom to a high of 30,400 baht in Kamphaeng Phet. To explain this variation, three production functions are specified; one production function for each component of cash income other than remittances. Income from agriculture (crop farming plus fruits and livestock) is hypothesized to depend on three inputs: land, family labor, and expenses for agricultural inputs (working capital). Normally, one would expect these inputs to explain most of the variation in incomes among farmers who use no irrigation or modern agricultural technology. In the case of farmers in the forest, several additional factors were hypothesized to be important including (1) time since first clearing of the land, (2) size of forest, (3) distance from market, (4) security of land ownership, and (5) level of education. A strong negative relationship between time, encroachment, and agricultural income is expected. This is because, with the passage of time the fertility of the land declines as original nutrients are used up or leached from the soil in the absence of water and soil conservation and fertilizer use. The size of the forest is likely to be positively related to the income from forest products and negatively related to the income from agriculture because it presents an alternative source of activity and income. The more remote the site is from markets (especially Bangkok), the lower the farmers' income is likely to be.

The settlements in national forest reserves are illegal and are not entitled to infrastructure or government services. However, older settlements such as Pak Chong

have grown into functioning towns and sites of Amphoes (districts) with considerable infrastructure. The villages which have been more recently settled tend to be in more remote areas with less infrastructure than the older settlements.

As one would expect, secure land titles are less prevalent inside the forest reserve than outside. It is, in fact, surprising that any titles exist at all over land that is acquired through encroachment. The National Rural Development village surveys show that 48 percent of villages in forest reserves had a part of their land under some form of land title, mostly NS3 and NS3K (see Table 4). In the OAE sample, however, the most prevalent type of title was a *Sor Tor Kor* (STK) (a STK is a usufruct certificate issued to an encroacher by the RFD) since the survey was carried out in the area under a STK. It is hypothesized that, in provinces where farmers have a larger percentage of their land under a STK, farm income will be higher because the presumed increased security of ownership and settlement encourage farm investments. In addition, educational attainment probably contributes to higher incomes, both on-farm and off-farm. With regard to wage income, the average wage rate in the province and the level of family education are expected to be the main determinants. The family cash income from the sale of forest products is expected to vary positively with the size of the forest and negatively with the distance from markets and from income from other sources. One important hypothesis in this context is that the dependence on income from forest products increases with the passage of time since the initial encroachment. This is attributable to falling productivity and income from farming due to the exhaustion of soil nutrients.

Table 4 Land Titles Inside and Outside the Forest Reserve

Type of Title	Inside		Outside	
	No. of Villages	Percent	No. of Villages	Percent
Chanode	211	1.7	10,267	24.2
NS 3	1,331	10.8	7,811	18.4
NS 3 K	2,577	21.0	19,054	45.0
Bai Jong	840	6.8	840	2.0
STK	879	7.2	1,379	3.2
None	6,434	52.3	3,126	7.4
Total	12,272	100	42,477	100

Source: TDRI, NRE-GIS Data Files

To test these hypotheses, income production functions were estimated using the OAE survey data for 24 forest sites/provinces. The estimated models explain up to 89 percent of the variation in farm income, 77 percent of wage income, and 65 percent of income from forest products. All hypotheses, except one, were accepted at a 10 percent level or higher (see Appendix Table 7). The nine main findings are summarized in terms of elasticities in Table 5 and explained in detail below:

Table 5 Sources of Agricultural Income of Farmers in the Forest (Elasticities)

One percent increase in:	Percent increase in Agricultural income	
	Model 1	Model 2
Land holding	0.403	0.235
Land document		0.096
Cash expenditure in agriculture	0.559	0.671
Family labor	0.037	0.094
Education		1.169
Size of forest	-0.137	
Distance	-0.105	
Years since first encroachment	-0.75	-0.871
R square adjusted	0.915	0.889

Source: Appendix Table 7

1. **The clearing of an additional rai of land for farming generates an average increase in farm cash income of 307 baht.** This is comparable to other estimates of the return from cassava. After deduction of farm expenses, adjustment for inflation, and capitalization at 12 percent real interest, the net return to encroachment, 3,500 baht per rai, is obtained which is about the price at which encroached land sells today.

2. **Although the labor supply is abundant for most of the year, it is binding during the planting and harvesting season,** but its marginal contribution to farm income is minimal. A 10 percent increase in farm family labor would result in less than 1 percent increase in farm income. Hired farm labor is included in farm expenditures (see below).

3. **The return to farm expenditure is 35 percent which is 2.3 times the interest rate charged by formal financial institutions.** This implies that farmers under-invest in their farms (using little fertilizer and no soil conservation). However, since farmers in the forest do not have access to institutional credit (due to lack of collateral) any credit they obtain is from informal rural credit markets that charge an average of 3 percent in interest rate per month or 36 percent per year. Compared to this rate of interest farm expenditures are privately "optimal". To induce farmers to invest more in sustaining and raising land productivity, it is necessary to make (low-cost) institutional credit accessible through land titling and elimination of interest rate ceilings that constrain formal rural credit.

4. The fact that farmers do not spend enough on fertilizer and soil and water conservation to maintain their yields is evidenced by the finding that in **every passing year from the time of land clearing, farm income drops by 830 baht per family or 57 baht per rai.** Thus, it takes less than a decade for farm income at the margin to drop to zero. Of course farming stops long before that, and farmers temporarily increase their dependence on forest products and wage labor (if available). Eventually, they encroach further into the forest opening new, ultimately more marginal land in a vicious circle of encroachment, yield decline, and further encroachment: an obviously unsustainable process. Even with continued encroachment income cannot be sustained because of increased remoteness: a 10 percent increase in the distance from Bangkok results in 1.0 percent decline in farm income, or 7.7 baht for every 10 kilometers of distance (see Table 5).

5. Since very few farmers have any secure land titles (Chanod, NS3, NS3K), the only test is for a STK (usufruct rights). STKs, which are not legally transferable, were found to have some impact on agricultural income. A 10 percent increase in such titles results in a 1.0 percent increase in farm income. The value of a STK to farmers was confirmed for the province of Roi Et with a sample of 180 farmers. However, when the sample was divided into farmers living both inside and outside of the forest area the **STK's were found to be significant only to farmers living outside the forest and claiming land in the forest.** One possible explanation is that for farmers living outside the forest, STKs increase the security of possession which cannot be ensured through their physical presence. The farmers living in the forest tend to regard STKs as limiting their land "holding" to 15 rai and state ownership over land which they already possess (Feder et al.).

6. The macro level findings were reaffirmed: education contributes significantly to farm income. **A 10 percent increase in the working members with education at or above the compulsory level increases farm income proportionately.** Alternatively, the attainment of compulsory or higher education by an additional working member of the household increases farm income by 4,560 baht per year (or 318 baht per rai) without a change in landholding and other inputs.
7. Education was also by far the most significant contributor to off-farm (wage) employment. Even without a change in the wage rate, **the attainment of compulsory level of education, or higher, by an additional member of the household increases wage income by 610 baht per annum by making more employment opportunities available to the household during the dry season.** The lower a household's farm income, the greater the pressure to seek off-farm wage employment.
8. An increase in the average wage rate in the province by 1 baht increases the wage income of the household in the forest by only 45 baht per year. Since the average household supplies about 260 days of labor for wage (a backward supply curve is unlikely at such a low income level), **less than 20 percent of a wage increase in the provincial center is transmitted to the farmers in the forest.** The limited accessibility and scarcity of off-farm employment opportunities in the forest reserves are thought to be responsible (see Appendix Table 8).
9. **In every passing year from the initial encroachment (year of land clearing) the average household seeks 28 baht more from the sale of forest products as a partial compensation for falling land productivity.** While this amount seems small, the 1.7 million households in forest reserves earn 48 million baht per year in cash income from selling forest products. Presumably, there is increased dependence on the forest for noncash income as well, but detailed data are not available (see Appendix Table 9).

RURAL POVERTY AND THE CAUSES OF DEFORESTATION

Poverty and deforestation are locked in a vicious circle of mutual reinforcement. Landless and small-scale farmers, among others, encroach on forest reserves in search for a better livelihood. Either they clear the land themselves, usually following loggers (legal or illegal), or they purchase the land from influential persons who claim control over large areas of forest reserves. In the first few years after encroachment, crop yields are relatively high because of the nutrients in the slash-and-burn forest. Once these nutrients are exhausted, yields begin to drop.

In response to falling agricultural income, farmers increase their dependence on forest products from nearby forests and on off-farm employment. Further encroachment is also likely if unencroached forestland is available nearby. Except in areas where off-farm employment is abundant, farmers sooner or later are forced by declining

productivity to move deeper into the forest in search of new, more productive land. **The unsustainability of farming on fragile, marginal land without adequate investment in soil and water conservation and without use of fertilizers ensures the perpetuation of both poverty and deforestation.**

To test the hypothesis that poverty, the demand for agricultural land, and the harvest of forest products are major causes of deforestation, we have specified a deforestation function for Northeast Thailand, a region where both poverty and deforestation have been most prevalent. We hypothesize that the area of deforestation (the area of forest loss in a province between LANDSAT Surveys) is determined by the following factors:

- Population growth
- Income level
- Size of forest
- Price of cassava
- Road network
- Harvest of forest products

All of the above factors, except income level, are expected to contribute positively to deforestation. By pooling cross-sectional data for the 17 Northeastern provinces with a time-series for five Landsats and related socioeconomic variables, a sample of 79 observations was generated. This sample is employed to estimate deforestation functions. The objective is to explain (1) changes in forest area (forest loss) between LANDSAT surveys and (2) variations across provinces.

The hypothesized causes of deforestation have been found to explain over 75 percent of the deforestation that took place between 1973 and 1988 in Northeast Thailand. The detailed results are reported Appendix Table 10, summarized in the form of elasticities in Table 6 and explained below:

1. **The addition of 1,000 kilometers of rural roads results in a loss of 179,000 rai of forest per year.** In other words, a 10 percent increase in the rural road network results in a 2.8 percent increase in forest loss.
2. **The harvest of forest products valued at 10,000 baht results in the loss of 44 rai of forest or 1 rai for every 227 baht.** Alternatively, a 10 percent increase in the harvested forest products results in a 1.4 percent increase in forest loss.

Table 6 Causes of Deforestation (Elasticities)

One percent increase in:	Percent increase in deforestation	
	Model 1	Model 2
Income per capital	-0.982	-0.833
Price of cassava	1.600	1.533
Harvest of forest products	0.140	
Size of forest	0.692	0.691
Rural road network	0.280	
Population growth		0.331

Source: Appendix Table 10

3. **An increase in the (real) price of cassava root by one stang per kilogram results in the loss of 18 thousand rai of forest.** In terms of percentage, a 10 percent increase in the price of cassava brings about a 16 percent increase in forest loss. This is a very powerful response to economic incentives that goes a long way towards explaining deforestation in Northeast Thailand over the past 15 years to 20 years.
4. **An increase in the real income per capita by 1,000 baht (in 1972 prices) results in a reduction of deforestation by 100,000 rai.** Thus, the forest loss could be cut in half by simply raising the provincial income per capita by 50 percent, this is not a difficult task in a country with a 10 percent real growth rate.
5. The forest loss is greater, where the forest is larger, primarily because there is a larger perimeter to encroach upon. **Of every additional 1,000 rai of forest, 133 rai are deforested.** In other words, provinces with 10 percent larger forests have a 7 percent higher rate of deforestation, all other factors being constant. This should be a sobering finding for those who simply advocate faster reforestation as a means for attaining the desired area of forest cover.
6. **The population growth** was tested in a separate model because it was strongly correlated with the rural road network and the harvesting of forest products. The provinces with a one percent higher population growth than the average have an additional 5,700 rai of forest loss, all other things being equal. This corresponds to an elasticity of 0.33, that is a 10 percent

higher population growth, resulting in a 3.3 percent increase in deforestation.

7. Several provinces in the Northeast experienced exceptionally high rates of deforestation (over 800,000 rai each) during 1973 to 1976 including Chaiyaphum, Nakhon Phanom, Maha Sarakham, Surin, and Sisaket; and two other provinces, Chaiyaphun and Sakhon Nakhon experienced the problem during 1976 to 1978 These high rates were specific to these provinces during these specific years.
8. On the positive side, autonomous deforestation (that is unrelated to the above factors) was found to be on the decline since 1976. All other things being equal, the deforestation in the Northeast decline by an average of 75,000 rai per year during 1973 to 1976. Autonomous deforestation was highest during the early 1970s, and it slowed by 40,000 rai per year during 1976-1978, by 38,000 rai per year during 1978-1982, by 70,000 rai per year during 1982 to 1983, and by 95,000 rai per year during 1985 to 1988. Thus, we observe a deceleration of deforestation not attributable to any particular cause. Therefore, policy changes that aim to contain the causes of deforestation identified would be reinforcing underlying trends.

In summary, **the main, historical causes of deforestation in order of priority have been (1) poverty, (2) population growth, and (3) the price of cassava.**[1] The population growth has contributed to deforestation primarily through harvesting of forest products and through agricultural forestland clearing, both of which have been made easier by the expansion of the road network. These results corroborate an earlier study (Panayotou and Sungsuwan 1989) which identified population, price of forest products, poverty, rural roads, irrigation infrastructure, and crop price as the main causes of deforestation in Northeast Thailand. Remote locations and high rice yields help to contain deforestation. Northeast Thailand is the poorest, most populous, and most deforested region of Thailand. The resource base is too weak and degraded to supply the inhabitants with the means for escaping poverty. A rehabilitation of the resource base is possible, but this requires halting deforestation and accelerating reforestation. These actions, however, mean preventing farmers from further encroaching on the remaining forests for land and forest products and from replacing their declining production on their current farm holdings. It also means taking some land out of crop production before it is fully degraded and reverting it to forests. This is a luxury that poor farmers cannot afford, and any attempts to halt deforestation and to accelerate reforestation must deal with poverty first, or at least concurrently. Otherwise, the plan is bound to fail.

In the past, the activities of rural development, forest protection, and reforestation have been carried out with little recognition of their inherent interdependence. As a result, they achieved only limited success, although some notable exceptions did

recognize the inseparable nature of the two problems. In recent years, however, the interdependence between rural poverty and deforestation is increasingly being recognized, and policies and projects are being formulated to deal with these two problems integrally and holistically. Two of the instruments being advocated and experimented with are commercial plantations of fast-growing trees and community, or social forestry.

The premise of commercial plantations is that the energies and resources of the private sector can be mobilized to reforest large areas of encroached and degraded forestland with fast-growing species. In this manner, it is hoped, the national forest policy target of 40 percent forest cover could be attained in a few years. Under this scenario poor farmers would obtain employment in industrial plantations, and some may even plant their own lands with fast-growing species for which a ready market would exist. The domestic processing of logs into woodchips for export and pulp and paper for domestic use would increase value added, earn foreign exchange, and ultimately create benefits for the country, including the rural poor.

The premise of community forestry is that local people know best how to protect and manage the resources around them and will provide the optimal forestry management when their rights to these resources are fully recognized and not infringed upon by outsiders. Local participation in resource management, and even local control of resources, is deemed critical to the success of social forestry. Advocates including environmental groups, nongovernmental organizations (NGOs), and rural communities point to traditional communities that have conserved their resources in the past and to a few cases of community forestry in operation today. They advocate the rejuvenation of traditional management systems throughout Thailand and the reliance on community forestry for forest protection and reforestation. The rural poor would benefit by retaining access to forest products while excluding outsiders; by managing these resources for sustainable yields; by enhancing these resources through replanting; and by protecting the environment around the community, and other forest-related resources such as soil and water.

In what follows Thailand's commercial and social forestry practices are assessed in order to answer the following questions: Can commercial forestry help break the vicious circle of deforestation and rural poverty? What are the financial, economic, and social profitability and distributional implications of commercial plantations? Is

community forestry a realistic alternative? What types of social forestry have been successful in Thailand, and under what conditions? What is the scope for expansion of community forestry beyond the few existing cases today?

COMMERCIAL PLANTATIONS: FOR WHOM AND FOR WHAT

The national forest policy introduced in 1985 aims to raise the country's area under forest cover from 28 percent (1988) to 40 percent: 15 percent for protection forests and 25 percent for economic forests. The Royal Forestry Department (RFD), recognizing the difficulty of accomplishing this target on its own, has been promoting the involvement of the private (mostly corporate) sector in reforestation. The encroached land in forest reserves is leased at a nominal rent of 10 baht per rai to large companies for eucalyptus plantations to produce industrial wood for pulp and paper and woodchip for export. The companies also receive generous promotional privileges from The Board of Investment (BOI) for both planting and processing. While the companies find it necessary to pay farmers to vacate the encroached land, the private reforestation policy has been controversial.

Most small-scale farmers, including small-scale eucalyptus planters, complain about the negative environmental impacts of eucalyptus—such as damage to their crops and a reduction in soil moisture and the water supply in the vicinity of eucalyptus plantations. However, they think that the land used for planting eucalyptus can still be used for other crops after the stumps have been removed. (see Table 7) Farmers do not think that eucalyptus will help to improve soil, climate and water conditions. So far, they can only see the adverse effects of eucalyptus. Most of the farmers in the study area want the government to promote tree species other than eucalyptus in reforestation projects.

The main conclusions of scientific research, both Thai and international, is that eucalyptus, like acacia and a number of other tree crops, reduces the water table and affects neighboring crops, where moisture and nutrients are in short supply. eucalyptus is not recommended for protection of watersheds, for regulation of water flows, or as a crop for good soil. Eucalyptus is suitable for degraded areas; it should be planted in small plots, blocked by other species. When planted on a large scale, agroforestry practices should be used, and the environmental and social impacts should be assessed.

Table 7 Local People's Perception of Eucalyptus Plantations, Chachoengsao Province, 1990

	Eucalyptus planters		Non-planters	
	Number	%	Number	%
1. Do eucalyptus lower other crops' yield nearby?				
Yes.	34	85.0	53	84.1
No.	4	10.0	6	9.5
Don't know	2	5.0	4	6.4
Reason for answer Yes.				
They compete for water	20	58.8	35	66.0
They compete for nutrient.	4	11.8	6	11.3
Don't know	10	29.4	12	22.6
2. Do you think that eucalyptus use much more water than other crops do?				
Yes.	39	97.5	58	92.1
No.	1	2.5	1	1.6
Don't know			4	6.3
3. Do you think that land will be usable for planting other crops after eucalyptus are removed?				
Yes.	28	70.0	37	60.7
No.	4	10.0	10	16.4
Don't know	8	20.0	14	23.0

Source: TDRI Survey Data.

Local people perceive eucalyptus as having economic rather than ecological benefits, and they complain that such economic benefits go to the companies and to the wealthier farmers.

Although the evidence is less than conclusive, it is possible to assess the likely impact of the private reforestation policy on farmers' incomes given the previously discussed findings. The RFD policy does little to improve the productivity of farmers' land in terms of the traditional crops; to the extent that nearby crops are damaged or the water table is reduced, crop yields are adversely affected. While new possibilities are opened to farmers by a new tree crop with an expanding market, a financial and economic analysis of private eucalyptus plantations indicates the following:

1. The high initial investment and the long gestation period (4 years to 5 years) of **eucalyptus plantation is ill-suited to the conditions of the cash-starved small-scale farmer** who has no access to institutional credit.
2. With an average landholding of 14 rai (adjusted for quality) **small-scale farmers in the forest reserves can hardly spare land for eucalyptus plantations**. The adopters of Eucalyptus are usually younger farmers with larger holdings and substantial farm assets who have access to credit and experience in tree planting and multiple cropping (see Tables 8 and 9).
3. **There are economies of scale in plantations that are not available to farmers with small holdings;** even better-off farmers who experimented with eucalyptus plantations on a small scale have incurred losses unless they were in the land reform area and received low-interest loans from the Agricultural Land Reform Office.
4. **Contract farming holds some promise for small-scale eucalyptus planters, but it has not been promoted yet at a significant scale.**
5. **The large-scale or corporate (over 1,000 rai) plantations are quite profitable generating a net financial flow of 1,400 baht per rai per year** under current yields and prices, over 1,800 baht per rai under 33 percent higher yields; and over 2,000 baht per rai with the same yield but 28 percent higher prices, which are achievable in the near future. In contrast, **small-scale planters (less than 100 rai) earn only 204 baht per rai compared to 500 baht from cassava** under present conditions, 405 baht under 50 percent higher yields, and 526 baht under 43 percent higher yields, which is about the most that can be expected in the foreseeable future. Small farmers, who do not have access to institutional credit and borrow in informal markets at an average 36 percent (31 percent real) interest rate, would incur a financial loss of 517 baht per rai per year if they adopted eucalyptus planting. Medium-scale planters (100-1,000 rai) earn approximately one-half the income of corporate planters per rai per year. (see Tables 10 and 11)

Table 8 Socioeconomic Characteristics of Eucalyptus Planters Compared to Non-Planters, Chachoengsao Province, 1990

	Unit	Eucalyptus planters	Non-planters
No. of cases		37	66
Background information			
-Age of hh's head	year	48.0	53.0
-Education level	level	3.1	2.7
-Exp.in tree crops	%	59.5	37.9
Off-farm income		7,855.5	5,702.3
-Ag.activities	baht	2,408.0	2,503.3
-Non-ag. activities	baht	2,998.5	2,119.0
-Remittance	baht	2,449.0	1,080.0
Land holding			
-Size of land holdings	rai	107.2	62.3
-Eucalyptus	rai	14.6	-
Land use pattern			
-less than two crops	%	35.1	80.3
-more than two crops	%	64.9	19.7
Value of farm assets	baht	144,074.0	59,761.0
Average of loan/hh.	baht	61,135.0	16,455.0
Loan with interest rate less than or equal 13%	%	73.0	44.7
Loan with interest rate more than 13%	%	27.0	55.3

Source: TDRI Survey Data

Table 9 Explaining Adoption of Eucalyptus in Chachoengsao Province, 1990

Determinants of adoption	Model 1	Model 2
Age	-0.3104 (3.41)	-0.293 (2.92)
Experience in tree planting	3.005 (5.00)	3.346 (4.60)
Labor per land holding	-4.949 (1.97)	-4.672 (1.79)
Farm assets per land holding	0.002 (1.78)	0.003 (2.57)
Number of crops	0.321 (1.93)	0.750 (2.49)
Education	-	-0.445 (1.91)
R square adjusted	0.660	0.662
Number of observations	101	101

Source: Estimated using probit analysis of survey data on 101 households in Chachoengsao Province sampled by TDRI in 1990

6. Private economic analysis that has netted out the opportunity costs of land and of family labor found that small-scale planters are losing 188 baht per rai. Even with a concessionary interest of 13 percent (8 percent real) from the Agricultural Land Reform Office (ALRO), losses persist. At either 50 percent higher yields or 20 percent higher price, small-scale planters barely reach the break-even point. Therefore, **even under optimistic conditions about yields and prices, small farmers are no better off with eucalyptus than they are with cassava at the current yield and price.** In private economic terms, medium-and large-scale planters (over 11,000 rai) continue to be equally profitable. The reasons for the increasing profitability with larger scale farming are (1) economies of scale, (2) higher yields because of higher expenditures superior technology and better production organization, and (3) higher farmgate prices because of scale economies, better market information, and own means of transport. (see Tables 10 and 11)
7. In terms of social profitability (for which taxes, subsidies, and other distortions are netted out and inputs and outputs are shadow-priced at their social opportunity costs), we found that **small-scale eucalyptus plantations are socially unprofitable unless the price of eucalyptus logs is increased by 40 percent, or yield increases by 100 percent.** Medium- and large-scale plantations are socially profitable, however, environmental costs have not been taken into account. Even if we deduct 100 baht per rai of eucalyptus for environmental damage, both medium- and large-scale plantations remain profitable, even without subsidies. (see Tables 10 and 11)
8. **Direct and indirect subsidies for industrial plantations, whether duty exceptions on equipment and tax holidays from the BOI, or leasing out public land at token rates from the RFD, are unnecessary and distortional** since the private return from eucalyptus plantations exceeds the social return.
9. **An environmental charge of about 25 baht per rai to account for environmental cost and certain restrictions on proximity to neighboring crops and sources of water supply are socially warranted and affordable.**

Commercial plantations are clearly not profitable to the small-scale planter (under 100 rai of plantation), and much less so to the small farmer (under 26 rai of farm holding), who can hardly spare any land for a perennial crop, other than a few fruit trees. However, small farmers may benefit indirectly from larger-scale commercial plantations by (1) receiving a higher price for their land than they would otherwise, and (2) obtaining more off-farm employment at a higher wage. The effect on land prices is ambiguous; a higher demand for land results in higher prices, but the threat of eviction or of siege by eucalyptus plantations may lower the price of land. Some farmers do receive higher prices, while others complain of having been forced out. This problem arises mainly with regard to encroached land in forest reserves. The farmers hold on to land in anticipation of receiving a secure title one day, which could double the price of the land.

(see Table 12) When they are offered a somewhat higher price than they would receive otherwise for untitled land, they are tempted to sell and move to obtain land elsewhere. They may regret the sale later when they realize that new land is hard to find or more costly to purchase, while they see their previous land improved by commercial interests.

Table 10 Cost-Benefit Analysis of Eucalyptus Plantations in Chachoengsao Province, 1990

Net Present Value (baht/rai)

Scale of operation: cost and benefits	Financial cash-flow	Private profitability	Social profitability
Small-scale planter (<100 rai)			
Costs (12 Years)	6,583	11,281	12,003
Benefits (12 years)	9,028	9,028	9,028
Net benefits (12 years) or NPV (12)	2,445	-2,253	-2,975
Net benefits (1 year) or NPV (1)	204	-188	-248
Medium-scale planter (100-1,000 rai)			
Costs (12 Years)	6,331	9,463	9,748
Benefits (12years)	15,154	15,154	15,154
Net benefit (12 years) or NPV (12)	8,823	5,691	5,406
Net benefits (1 year) or NPV (1)	735	474	451
Corporate planters (>1,000 rai) (with subsidy)			
Costs (12 Years)	8,736	11,868	12,858
Benefits (12 years)	25,702	25,702	25,737
Net benefits (12 years) or NPV (12)	16,966	16,966	12,879
Net benefits (1 year) or NPV (1)	1,414	1,414	1,073
Corporate planters (>1,000 rai) (without subsidy)			
Costs (12 Years)	9,285	12,417	-
Benefits (12 years)	25,702	25,702	-
Net benefits (12 years) or NPV (12)	16,417	13,285	-
Net benefits (1 year) or NPV (1)	1,368	1,107	-

Table 11 Financial, Private Economic, and Social Profitability of Eucalyptus Plantations under Alternative Price, Yield, Land Cost and Interest Rate Scenarios

Alternative scenarios	Financial cash flow	Private profitability	Social profitability
Base (price 470 baht/ton)			
Small-scale (y=10,10,10)	204	-188	-248
Medium-scale (y=15,15,15)	735	474	451
Corporate (y=20,30,30)	1,414	1,153	1,073
Price (600 baht/ton)			
Small-scale	526	135	75
Medium-scale	1,085	824	800
Corporate	2,004	1,743	1,664
Yield (price 470 baht/ton)			
Small-scale (y=10,15,15)	405	13	-47
Medium-scale (y=15,20,20)	960	699	676
Corporate (y=20,40,40)	1,864	1,603	1,162
Real interest rate			
Small-scale (31%)	-517	-932	-917
Small-scale (8%)	292	-107	-102
Small-scale (15%)	11	-373	-366
Medium-scale (15%)	483	227	206
Corporate (15%)	1,248	832	743
Land cost			
Small-scale (OC=200 baht/rai)	204	-101	-139
Large-scale (OC=200 baht/rai)	735	561	550
Corporate (LP=4,000 baht/rai)	1,081	1,081	924

Note: Y = Yield
OC = Opportunity cost of land
LP = Land Price of encroached forest land

Source: Analysis of TDRI Survey Data, Chachoengsao Province 1990

Table 12 Land Price Index

Land title	Province			
	Buriram	Roiet	Chaingmai	Lampang
Chanod	170	-	346	176
NS3 K	113	111	292	133
No title	100	100	100	100
Forest reserve	18	62	99	83

Source: Yongyuth Chalamwong and Gershon Feder, "The Economic Implications of Land Documents in Thailand" Agrcultural Administration and Extension (1988), page 132

Off-farm employment is one of the supposed benefits from large-scale eucalyptus plantations. While plantation companies do pay a somewhat higher wage than the prevailing rural wage (60 baht per day compared to 40 baht per day), the employment generated (61 man-days per rai) is less than the employment displaced (75 man-days per rai) for cassava (see Table 13).

Table 13 Labour Requirement Per Rai

	Cassava (5 years)	Eucalyptus (5 years)
Labour requirement (man-days)	75 a	61 b
Wage (baht/man-day)	40 c	60 c
Earnings	3000	3660

Source: a Office of Agricultural Economics 1988 figure
b Tingsabat (1989)
c TDRI survey

In conclusion, the **private reforestation policy (in pursuit of the 40 percent forest cover target) does not appear to be an effective means for alleviating poverty, improving income distribution, or halting forest encroachment.** The reason is the failure to address the root cause of rural poverty: the lack of secure resource entitlements. Insecure land ownership, declining yields, limited off-farm employment opportunities, no access to institutional credit, and poor education do not add up to a sustainable livelihood. To the extent that large-scale eucalyptus plantations further undermine the resource endowment of farmers in the forest reserves either through displacement, or through perceived negative environmental impacts, rural poverty and encroachment might worsen. This is not to imply that eucalyptus plantations on private land are not economically viable or beneficial to the country. **Commercial plantations could be beneficial to farmers through a system of contract farming, provided that farmers have secure ownership over their lands, and commercial companies provide them with improved technology, credit, and guaranteed prices.**

Indeed, the problem lies less in the private reforestation policy than in the forest policy itself. The target of 40 percent forest cover includes some 38.4 million rai which have been encroached and are currently farmed by 1.7 million households. The private reforestation effort was conceived as a compromise, but with the emphasis placed on reforestation rather than on poverty and income distribution. As it stands, large-scale commercial forestry does not alleviate poverty since it fails to distribute the benefits of the enterprise to the local population. Nor does it recognize traditional rights or any interest or capability on the part of local communities to manage resources around them. An alternative approach advocated by environmental groups and rural communities, and currently being considered by the government as a supplement to the private reforestation policy, is social or community forestry.

THE PROMISE OF COMMUNITY FORESTRY

Community forestry is a set of forestry activities in which the members of a given community are involved in the decision-making process and the benefits accrue to the community as a whole. The concept is in contrast to commercial forestry where the decisions are made by, and the benefits accrue to, a private enterprise. While conventional forestry is usually practiced on state-owned-and-managed forests under a concession granted by the state forest service to a private company subject to specified terms and conditions, community forestry is usually found in communal property with or

without the government's awareness and consent. The essential elements of social forestry, in addition to local participation and control, may include (according to the United Nations Food and Agriculture Organization (FAO)):

(a) Generation of income and stable employment for the local people

(b) Production on a sustained basis of forest products such as wood for fuel and construction, fodder, and food for the community

(c) Control of local ecological degradation and maintenance of land productivity

(d) Strengthening of rural community institutions

Community forestry is viewed as a means to contain forest encroachment, promote afforestation, reduce rural poverty through forestry, and promote sustainable agricultural and forestry production though environmentally sound land use.

Community or social forestry has been practiced in Thailand for many years. The community-initiated *Muang Fai* system of protecting local watersheds by the community is one of the earlier forms of social forestry which survives today in Northern Thailand. Another early form of social forestry was the introduction in 1906 of the *taungya* forestry system from Myanmar (Burma), by the RFD in a forest plantation in Phrae Province. In 1967, the Forest Industry Organization (FIO) expanded the taungya system with the creation of forest villagers in its teak plantations. More recent forms of social forestry initiated by the government include village woodlots, the STK land usufruct certificate program, forestry extension projects, and the *Isan Khiaw* (Green Northeast) Project coordinated by the military. In addition, the Agricultural Land Reform Office (ALRO) is expected to set aside 20 percent of all the degazetted reserve forest lands as community forests , but little progress has been made.

The involvement of non-governmental organization (NGOs) is a recent phenomenon that gathered momentum in the late 1980s. Yet, the total area of coverage both in number of villages and areas planted may already exceed the combined area of government programs (RFD and FIO) that date back many decades. It is estimated that 200 NGOs work at present on forestry-related issues that involve local communities. The best known NGOs in this area are the Population and Community Development Association (PDA), the Project for Ecological Recovery, the Thai Farmers' Association of Thailand, the Catholic Relief Services, and the Save the Children Fund.

The primary purpose of social forestry programs is to resolve the conflict between national policy on the use of land and forests, on the one hand, and the needs of the local population for land, forests, and tree products, on the other. The true measure of success or failure of social forestry in Thailand is in how well it resolves the conflict and meets both the national and local needs. If successful, it can contribute significantly to curing the ills of poverty, deforestation, and environmental degradation. Otherwise, no matter how successful individual projects or programs may be, social forestry activities would be little more than a palliative, giving an illusion of solving the problems while having no real impact on them.

While it is beyond the scope of the study to assess in detail the various government and NGO social forestry projects, the conclusions that emerge from their review that have a bearing on the projects of social forestry as an instrument to curb deforestation and alleviate poverty are as follows:

1. The main purpose of the **FIO forest villages** is to ensure a steady, low-cost supply of labor for its forest plantations. The FIO provides villagers with a combination of (1) wage employment on the plantations, and (2) opportunity to plant crops on small agricultural plots of 5 rai per household. Since employment is irregular and the plots too small to earn a livelihood, sometimes villages engage in illegal logging of the very trees they planted thus generating both additional income and additional employment. The FIO forest village hardly qualifies as community forestry since the local people are neither involved in the decision making nor are they sharing in the profits of the plantation.
2. Poverty alleviation and reforestation are the dual objectives of the **RFD's forest villages**. There have been good results in a few locations where manpower and resources were concentrated and coordination among agencies was achieved. However, the operating costs and staff requirements for each village are too high to spread the program beyond its current 90 locations. Only 44,342 hectares have been covered thus far, a miniscule 0.2 percent of the total forest area. Moreover, while the villagers enjoy most of the benefits of the forest village, they are rarely involve in the decision making.
3. The **village woodlot** program was established under the RFD's forestry extension services to supply villages with wood for fuel and timber products for both cash and home consumption. (see Table 14) The RFD regulations, however, stipulate that only RFD personnel are entitled to cut the trees in the woodlot even though the woodlots were established to benefit the rural communities. The energy orientation of the woodlots program is another drawback, since fuelwood production is rarely the primary reason why farmers grow trees. **While the village woodlots do not qualify as community forestry under RFD regulations, they have the potential to develop into a successful community forest program**

only if the project recipients are given more management rights including more flexibility in the choice and the use of the trees.

Table 14 Royal Forestry Department's Village Woodlot Project, Number of Target Villages, 1987-1990

Region	1987	1988	1989	1990	Total
North	148	80	85	76	38
Northeast	200	238	238	231	907
Center	37	57	63	71	228
South	-	16	6	14	36
Total	385	391	392	392	1,560

Source: National Forest Land Management Division, RFD

4. While the **STK land certificates** issued by the RFD to forest encroachers are successful as a census activity, they provide little security of ownership to the holders because they are temporary by regulation, permanent by practice, and nontransferable except by inheritance. A World Bank study (Feder et. al.) found that the supply of institutional credit to STK holders was not different than the supply to squatters without a STK. As the land remains a property of the state while restrictions are imposed on the size of holdings and on the use of the land, many farmers perceive greater risk of eviction with STKs than without them. Otherwise, farmers continue to rent and sell their STK holdings regardless of the law. The ALRO usufruct certificates are clearly superior because they allow larger holdings and indefinite tenure and provide credit and infrastructure. The ALRO requires that 20 percent of the total holdings be used in community forestry but, as yet, there is little evidence of this happening. While neither of these programs strictly qualifies as social forestry, the objective is clearly to address poverty and deforestation with a common forestry-related instrument.

5. The **PDA's forestry projects** are focused on rural development in Northeast Thailand; social forestry is used as an instrument to improve the living standards of villages. The PDA's philosophy is that rural development efforts will work if there is social cohesion in the community and if the community gains enough experience to manage communal projects on its own. The PDA's community forestry projects take the form of 30 rai woodlots of fast-growing trees which are harvested and sold and the revenues deposited in the village revolving funds. Soon, villagers enticed by the quick return adopt tree-planting activity and form a committee to manage the project. Thus, the communal forest serves as a means to build social cohesion and cooperation. In this sense, the PDA projects qualify as community forestry, as do the projects of several other NGOs, but on a smaller scale. **The great advantage of the NGOs is their**

flexibility to meet local needs unrestricted by government regulations which constrain the RFD. There is a considerable area for collaboration between NGOs and the RFD forestry extension through which NGOs could act as community organizers and facilitators while the RFD plays a supportive role in terms of material, training, and expertise.

6. **The community forestry projects that are initiated by the communities themselves are among the most successful.** There are five basic types of **traditional community forestry:** (1) watershed forest, (2) wildlife sanctuary, (3) recreation area, (4) sacred forest, and (5) communal woodland. In Northern Thailand, the communal forest has a long tradition, and it is an integral part of the daily life of the community. In the Northeast, locally initiated community forests are a recent development (since 1985) in reaction to the National Forest Policy's promotion of eucalyptus in degraded areas and forest reserves. It is, therefore, premature to assess their performance.

COMMUNITY PROTECTED FOREST: AN EXAMPLE FROM THE NORTH

Since the controversy over community forestry centers on the rural community's role in forest management, particular attention was paid to locally initiated community forestry projects in Northern Thailand because they have a long history. TDRI carried out a field study and analysis of communities in Northern Thailand with locally initiated community forestry projects and of several neighboring villages without such initiatives. The survey has focused on **community protected forests**, which do not involve any replanting. However, the findings regarding the factors contributing on the establishment and success of community forestry have wider relevance and applicability to other forms of community forestry, including those initiated by the government and NGOs and involving reforestation activities and are as follows:

1. **Community-protected forests are established when a resource that is vital to the community (land, forest, or water) is being threatened.** In Northern Thailand the entire Muang Fai system of irrigation and protected communal watershed forests was established in response to threats from deforestation which was threatening the water supply which is vital to paddy cultivation. However, **communities do not conserve the forest until the resource decline actually threatens their survival.**

2. **There must be a direct link between the threatened resource and the forest and between the forest and the actions of the community.** Of the three neighboring villages studied in the San Kamphaeng District in Chiang Mai, only Ban Don Sai has a community-protected forest and that is only because the forest is situated next to its main water supply. The other two villages, which depend on the same source, are too far from the watershed forest to initiate and implement a community-protected forest. Even Ban Don Sai has chosen to conserve only that part of the watershed forest that has the greatest bearing on its water supply. In other parts of the watershed forest, there are no community regulations governing use.

3. **The threat to the water resource must be either internal to the community or if external, manageable by the community.** Internal threats are generally easier to handle since the community is dealing with its own members who operate within the recognized norms and understand and obey its rules. Traditional community institutions such as the Muang Fai and the village elders are sufficient agents of enforcement and the rules governing the use of communal forest evolve in response to the ever-changing nature of threats. For example, when Ban Tung Yao first established the Pa Nam Cham Protected Forest in the mid 1920s, the head of the Muang Fai and the village headman were managing the forest. By the mid- 1940s when extensive deforestation was threatening the communal forest, fines were introduced and subsequently increased and the villages had to endorse written rules.

4. **As external threats replace internal threats, traditional community institutions alone do not have the power to enforce forest conservation measures, particularly without government recognition and support.** When traditional community institutions resist outsiders claims, their powers of enforcement are often discredited and challenged since they are not legally recognized by the government. For example, as long as Ban Pong Tham was isolated, an implicit agreement among the villagers was sufficient to conserve the communal forest. Once the Payao-Lampang Road was built in 1986, the outside threat of encroachment induced the formal establishment of a community-protected forest managed by the village committee which is a legally recognized political structure established by the government. **When the government itself asserts state ownership over forests, grants concessions to outsiders, or fails to protect them from outside threats, the villages feel that their land has been usurped. Being helpless, they join in the race for a quick profit by liquidating the very forest they have traditionally conserved.**

5. While any forest clearance is strictly prohibited in the community-protected forest, there are usually no regulations governing the use of forests outside the community-protected forest. These "outside" forests serve as a source of fuelwood, construction poles, cash income from charcoal, and land for cultivation. **The availability of other forests for exploitation has enabled many communities to initiate and implement their own community-protected forests.**

6. **Today, when few forests are left to be exploited, the major factor enabling communities to protect the forest is the availability and access to off-farm employment opportunities in nearby towns.** With more cash income available, villagers can purchase charcoal from the market, gas stoves, bricks and cement which are substitutes for products previously extracted from the forest.

7. **The protection of the communal forest ultimately depends on the balanced interdependency of the community and the forest.** The communities that protect their forest are sufficiently dependent on the forest to conserve it, but not to the point of threatening its survival (see Figure 4). A heavy dependence on land and forest by poverty-stricken villagers actually threatens the forest because of the heavy discounting of future benefits from conservation when survival is at stake. At the other extreme, insufficient dependency on land and forest can similarly threaten the forest for lack of motivation to conserve it. When villages are no

longer dependent on the land, they will likely sell it, along with the communal forest land. The three villages studied, which had community-protected forests, were all relatively financially stable with sufficient purchasing power to buy goods that they previously obtained freely from the forest. Yet, they continue to plant rice for home consumption and food security which has maintained their dependence on the watershed forest as an indispensable source of water supply. By comparison, **many, if not most, rural communities in Thailand are either too dependent or not dependent enough on the forest to preserve it.**

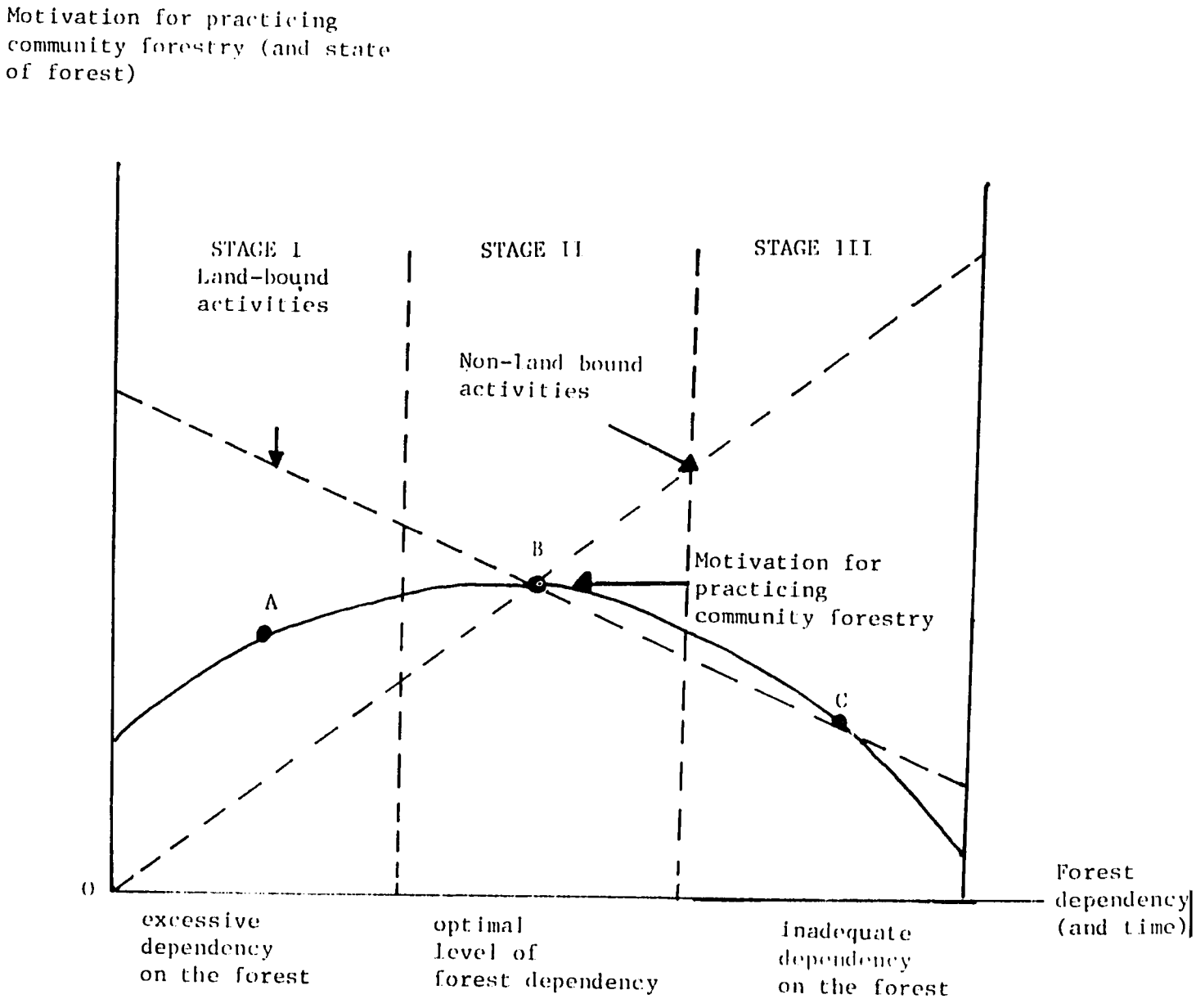


Figure 4 Motivation for Practicing Community Forestry: a Function of the Community's Dependence on the Forest

Off-farm employment, industrialization, and urbanization reduce the dependence on land, water, and forest. For some communities this means increased ability to practice community forestry, while for others it means reduced interest in conservation.

IMPLICATIONS OF FINDINGS

These findings can help address the questions often asked about community forestry that include the following: Can the villages be trusted to conserve the forest? Is community forestry an effective tool in curbing deforestation and alleviating poverty? Does community forestry have a future ten years to twenty years from now?

Much of the controversy surrounding community forestry arises from the failure to understand the heterogeneity and special circumstances of each community and to recognize that the relationship of the community to the forest is not static, but rather dynamic, and it is determined by the community's changing dependence on the forest.

To answer the above questions, the following community-specific questions must be answered first: What are the community's basic means of livelihood? How do the community's current land-use patterns fit within this scenario? How will the community's livelihood pattern evolve and how will its evolution affect land-use patterns, particularly forest conservation? What is the community's current level of forest dependency? Given the community's profile, what appropriate measures can be introduced to achieve optimum level of forest dependency (conducive to forest conservation)?

The underlying premise is that rural communities are not in a purely subsistence economy but in a combination of a cash and a subsistence economy. As the rural communities are developed, they are increasingly incorporated into the cash economy until they are fully submerged in it. A community's forest utilization pattern is a function of its level of dependency on the forest, which ranges from total to nonexistent. The level of forest dependency is determined by the types of income-generating activities open to the community of which there are two types: land-bound activities and nonland-bound activities. Land-bound activities are agricultural and forestry activities, and nonland-bound activities are off-farm, nonagricultural employment. There are three stages of forest dependency determined by the relative importance of land-bound and nonland-bound income-generating activities. Stage I is maximum forest dependency and

is dictated by the community's maximum dependency on land-bound income-generating activities for their livelihood. At this stage nonland-bound activities are insignificant. There is a wide gap between the level of land-bound and nonland-bound activities (see Figure 4 point A.), and this is detrimental to the forest. The farmers in search of land will clear the forest for farmland and supplement their income through other forest-based and land-based activities such as logging, making charcoal, cultivating cash crops, etc. Forest clearance is abundant and the existence of the forest is due to the low population.

As rural development in the community increases, there will be more job opportunities in nonland-bound income-generating activities as level of nonland-bound activities rises and the significance of land-bound activities declines. The community becomes increasingly dependent on nonland-bound activities and less dependent on land-bound activities (Stage II). This is the of status the community-protected forests of northern Thailand.

As industrialization in rural areas continues, nonland-bound income-generating activities will eventually eclipse land-bound activities. The gap between the two types of income-generating activities widens again and the importance of the forest as the natural resource base of the community declines. The rising opportunity costs of forest protection discourage it (both in terms of the foregone profit from selling the land and of the labor and time costs of forest protection, which could be spent in other lucrative activities), and the forest area around the community declines. Two scenarios are likely in this stage.

In the first scenario greater industrialization brings forth more land speculation. With the substantial profit to be made from the sale of land, agricultural land and illegally claimed forest land, that is, field plots without title deeds, will be sold, thereby increasing the pressure on the forest. The farmers who have sold their land but have not yet been absorbed by the job market will encroach further into the forest. Also, as the urban population becomes more affluent, it will seek luxury goods including resorts many of which are found in forest reserves.

In the second scenario, as certain rural populations become less dependent on the forest and more engaged in off-farm employment, they become less vigilant of their communal forest. This loop-hole enables other rural groups who are in search of land to encroach into the communal forest.

Communities with community-protected forest are not poverty-stricken, but are fairly operative with a wide array of income generating activities (many of them non-land-bound) to choose from. In these communities there is a balance between forest-dependent and nonforest-dependent activities.

Given the above observation on the relationship between the forest and communities, recommendations are made as follow:

1. To facilitate communities' progression from Stage I to Stage II, (Figure 4), off-farm employment opportunities should be promoted to alleviate the pressure on the land. This alone will not immediately lead to the establishment of communal forests, Other ingredients include an adequate dependency on the forest, a proximity to the forest, and the existence of an informal village organization. Special emphasis should be given to achieving and maintaining the equilibrium of forest dependency. Land-based and forest-based means of production should be promoted in combination with nonforest/nonland-based activities, that is, greater off-farm employment opportunities.
2. Once a community reaches Stage II, it is unlikely it will remain there forever. It will probably graduate to Stage III where the importance of the forest to the community declines as a result of industrialization, and there will be less forest protection. In anticipation of this, there should be mechanisms to promote forest conservation, that is, make the benefits from forest conservation greater than not conserving the forest. The government could consider subsidizing rural communities which practice community forestry projects. In doing so, the state should examine the local social organization to determine which organization would be the best manager of the community protected forest.

The forest may directly serve the surrounding communities, but Thai society as a whole claims that it attaches a value to the forest and to the benefits indirectly stemming from it, for example, the water supply environmental amenities. If the Thai society, indeed believes that the forests are vital to its well-being, it should be willing to pay for the cost of forest conservation, at least by subsidizing communities that make genuine efforts to conserve the forest.

Endnote

1 The ranking is based on the beta coefficients.

Chapter 4

Water Resources: Managing Demand and Expanding Supply

THE SUPPLY AND DEMAND OF WATER

Water, like land and forests, is a critical resource of great importance to the rural poor and, at the same time, of growing importance to the rapidly growing urban centers, the industrial sector, and the tourist industry. Poor farmers are in need of increased quantities of reliable water supply for irrigating their crops, if they are to raise their productivity and escape poverty in the face of the disappearing land frontier. In Chapter 2, it was found that a 10 percent increase in irrigation raises agricultural productivity by 3.3 percent, despite the fact that water is used inefficiently and wastefully in many areas. Water, like any other scarce resource, ought to flow to the use with the highest return and, hence, the highest willingness to pay. The highest-value use of water is not by agriculture, but rather by urban consumers, industrial firm and tourist resorts. The pricing of water at its true opportunity cost or full scarcity value (see the next section) would divert water from agricultural to nonagricultural users, which would be efficient, but also would be patently inequitable and socially and politically unacceptable.

The improvement of income distribution is as much of an objective of the Seventh Plan (1991-1996) and government policy as is growth and environmental improvement. Water and land are the only resources available to rural people, in the absence of adequate education, skills, and nonagricultural employment. Pricing water out of the reach of small farmers and the rural poor would certainly widen the rural-urban income gap even as it improves rural-rural income distribution since the major beneficiaries of irrigation water are better-off farmers, especially in the Central Plains. The diversion of water from rural to urban areas without full compensation to farmers is no different than the allocation of farmers' untitled land in forest reserves to industrial plantations without due compensation. Due compensation, however, presupposes secure

property rights over the resource, whether land or water. In this section we focus on the emerging water resource conflicts that will intensify over the next 10 years to 20 years as nonagricultural water demands quadruple while planned supplies lag behind due to inadequate raw water allocation and the high cost of interbasin transfers (see Figure 5).

Our analysis of nonagricultural sector demands, projections, and planned supplies provides the following results:

1. **Out of an estimated 199 billion cubic meters per year of renewable water resources, 40 billion cubic meters are withdrawn annually for agriculture, 2 billion cubic meters for domestic use, and 2 billion cubic meters for industry. Given the current trends, by the year 2010 the corresponding figures will be 144, 15, and 8 billion cubic meters per year, respectively.** Thus, domestic and industrial water use will increase eightfold while agricultural use will increase fourfold. This increase in the withdrawal-to-resource ratio from 1:4.6 to 1:1.2 will be made with increasing difficulty, at higher costs and environmental impacts, and at the expense of other intangible benefits such as aesthetic values and recreation. These projections also imply corresponding increases in the quantity of wastewater pollution generated which, without costly treatment and control, would reduce the quality of available water resources. A caveat here is that the macro water picture ignores the regional and seasonal variations in both supply and demand which require large storage requirements. The Northeast is considerably dryer and the South is wetter than the rest of the country, but even the Northeast suffers from excessive water and floods during part of the year. These macro projections also ignore yearly variations including the global climatic change due to man-made environmental degradation and the greenhouse effect.

2. Based on an estimated water demand function (see Appendix Table 11) and conservative assumptions about price, per capita income growth (5 percent per annum), and increase in the number of water users (7 percent), **the demand for water for the Bangkok Metropolitan Region (BMR) is projected to grow from 700 million cubic meters today to 1,566 million cubic meters by the year 2000 and to 3,526 million cubic meters by the year 2010.** Assuming that leakage stabilizes at 30 percent of the Metropolitan Waterworks Authority's (MWA) water production, Bangkok's demand for water is projected to reach 2,237 million cubic meters by the year 2000 and 5,037 million cubic meters by 2010. The Royal Irrigation Department (RID) has set a limit for the MWA of 1,891 million cubic meters per year from the Chao Phraya irrigation system, which is expected to be reached by the mid-1990s. To meet the projected, long-term excess demand, the MWA is planning the transfer of 949 million cubic meters of water from the Mae Klong River Basin through a 100-kilometer-long canal. The MWA estimates that the scheme will cost 1,500 million baht in capital investment and 35 million baht per year for operations and maintenance. The additional water supplies will barely suffice to meet the projected demand in the year 2000. Longer-term plans include MWA surface water storage in the North and the West.

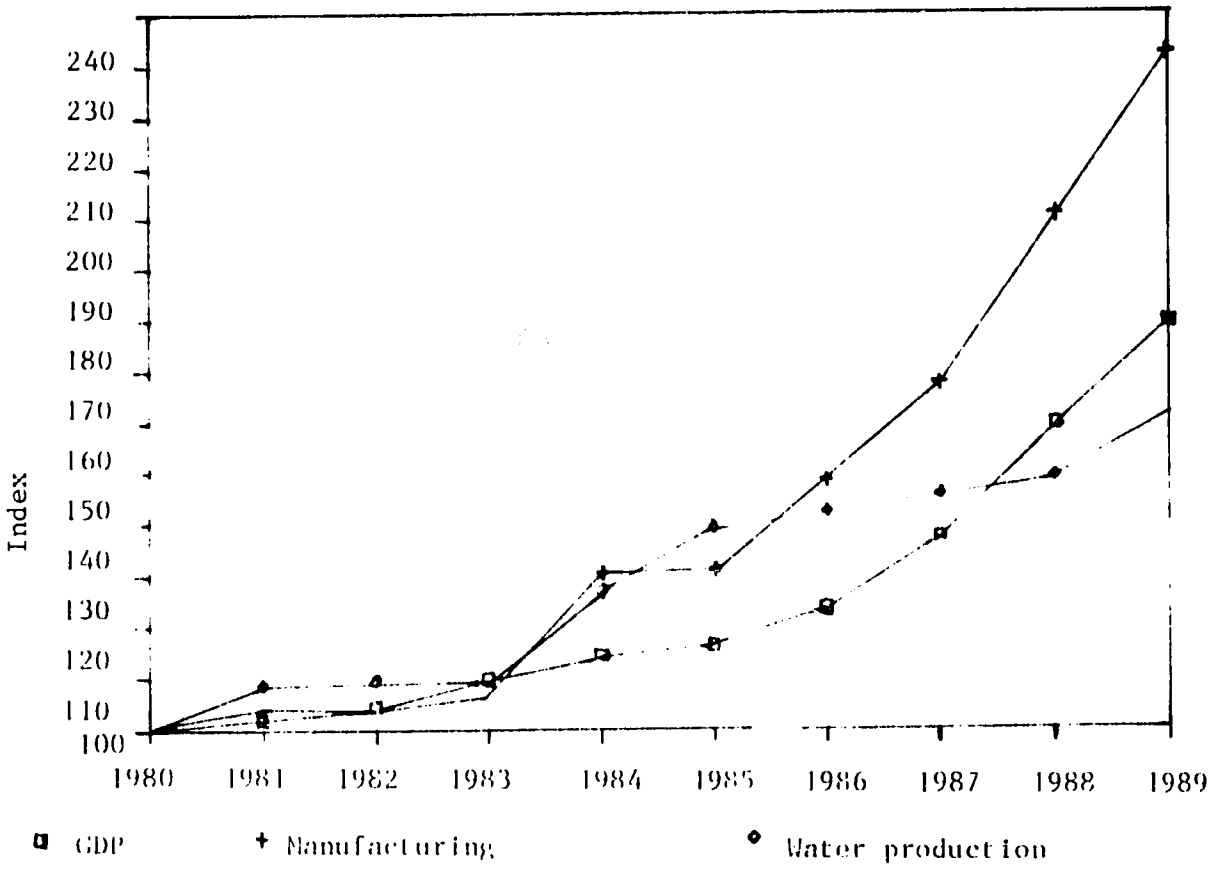


Figure 5 Trends in Total GDP, Manufacturing GDP, and Water Consumption

3. Based on the estimated industrial output elasticity of water demand of 0.61 (see Table 15) and a 9 percent per annum industrial growth projection, the demand for pipe water by industrial users in the BMR over the next 20 years is projected to grow at more than 5 percent per annum. (assuming a constant real price for water). This less-than-proportional growth of water demand in response to industrial output growth is explained by the structural change away from the water-intensive food-processing industries towards less water-intensive industries such as electronics and petrochemicals. Also, the increasing spread of industry into the outlying provinces of the BMR which are less well served by the MWA system results in increased use of groundwater. However, even in areas served by the MWA, 9 out of 10 industries prefer groundwater to pipe water because it costs them only one to two baht per cubic meter compared to five to seven baht per cubic meter for pipe water. **It is estimated that 2,869 thousand cubic meters of groundwater were pumped per day in 1989 by the industrial sector in the BMR.** These estimates are almost three times the official Department of Mineral Resources (DMR) figures, and they are corroborated by estimates of industrial groundwater net of pipe water and surface water use. In terms of social costs, groundwater is no less costly than pipe water because of the considerable damage to property from land subsidence and flooding. (In 1983 about 6.6 billion baht of property and land damage was recorded from flooding alone). Assuming a slightly higher growth rate (6%) for the demand for groundwater, we expect **industrial demand for groundwater to more than triple by 2010, reaching 3,400 million cubic meters.** However, the groundwater aquifers cannot last forever. Even if the current official figure of 415 million cubic meters of groundwater pumping was sustainable (which it is not, given land subsidence) and various industrial water users continued to draw 5 percent of their water supply from surface water bodies, by 2010, over 80 percent of all industrial water use will have to come from the pipe water supply. **By combining industrial and urban demand, it is conservatively concluded that the demand for pipe water in the BMR will reach 6,500 million cubic meters, or 9,286 million cubic meters of raw water by the year 2010.**

4. **The tourism sector is the fastest-growing water-user. In Pattaya, for example, water demand is projected to rise from 7.2 million cubic meters today to 40 million cubic meters by the year 2010.** The greatest increase is expected to take place during the 1990s. The number of hotel rooms and tourists in Pattaya are projected to increase by 2.4 times and 2.7 times, respectively, between 1990 and 2000. With an elasticity of tourist water demand, with respect to the number of hotel rooms, of 0.88 (representing fixed water use) and a 0.54 elasticity with respect to the number of tourists (representing variables water use), water demand is expected to reach 27 million cubic meters in the year 2000 and 40 million cubic meters in 2010. (see Table 15) However, the water supply is lagging. The Provincial Waterworks Authority (PWA) has recorded a water shortage of 3.3 million cubic meters in 1989 despite the over-capacity operation of its plants. The shortage, which is met through private water sales at 20 baht to 40 baht per cubic meter, is attributed by the PWA to the scarcity of raw water. A joint plan by the PWA, the RID and the Public Works Department (PWD) provides for the construction of a number of reservoirs to convey water to Pattaya and its adjacent areas

including Chon Buri. But a water resource conflict with the Eastern Seaboard's industrial development is likely since the very same reservoirs are expected to primarily serve the rapidly growing Eastern Seaboard economy.

Table 15 Water Demand Elasticities for Urban, Tourist and Industrial Centers.

Water demand elasticity with respect to:	Urban (Bangkok)		Tourist (Pattaya)	Industry (Bangkok)
	Residential	Services		
Price	-0.28	-0.31	-0.41	-0.52
Income per capita	0.48		-	-
Number of hotel rooms	-		0.88	-
Number of tourists	-		0.54	-
Sectoral output (GDP)	-	0.45	-	0.61
Number of water uses	0.79	0.98	-	-

Source: Derived from Appendix Table 11

In summary, under the forces of growth, urbanization, and industrialization, the demand for water by the nonagricultural sectors is growing at unprecedented rates and far beyond the planned capacities to respond. **Unless additional raw water is made available in increasing quantities, water use would have to be either rationed through shortages and government controls or met through further mining of the groundwater aquifer with the associated environmental costs of land subsidence.** This would amount to allowing an unsustainable activity to impose an irreversible cost on society. Since parts of the BMR already lie below sea level, submersion may not have to wait for global warming if groundwater mining continues unabated. Since agriculture is by far the largest user of water, structural changes that reduce the share of agricultural water use should theoretically save much larger quantities of water than those needed to supply the growing urban centers and nonagricultural sectors. Unfortunately, this is not the case, because migration tends to originate in rainfed rather than irrigated areas. Farmers continue to use water wastefully regardless of its growing scarcity since it is provided free of charge. Therefore, **the nonagricultural demand for water will rise without a corresponding decline in agricultural water use.**

In fact, the demand for irrigation water is likely to increase in the foreseeable future, as farmers seek to substitute agricultural intensification for land expansion and shift to higher-value crops such as fruits, fish, and vegetables, all of which are water intensive. Only a reduction in rice cultivation due to low rice prices might substantially reduce the quantities of water used by the agricultural sector. The flood irrigation of paddies at zero cost to the farmer is at the margin the lowest-value use of water in the country. Even if more raw water were to be made available for urban and industrial use, there are substantial costs involved in the conveyance, treatment and distribution, which translate into a rising supply curve for pipe water to urban and industrial centers.

WATER PRICING: MANAGING DEMAND TO EXPAND SUPPLY

The response to emerging water shortages has always been via efforts to increase the supply by developing untapped water resources through new water resource development. However, the most suitable sites for reservoirs have already been used, and further expansion faces a steeply rising supply curve in terms of both construction and environmental costs. (see Appendix, Figures 1 and 2) The most cost-effective approach for dealing with the current shortages of raw water is undoubtedly improved maintenance and efficient management of existing systems through rehabilitation and

protection of watersheds, dredging of sedimented reservoirs, and efficient allocation of water among competing users. The latter requires raw water pricing according to its scarcity value and the supply cost to each user including agriculture, electricity generation, and the public water supply to limit waste and induce efficient use and conservation.

Demand management has not been practiced in Thailand despite the tremendous growth in demand in recent years and the apparent wasteful use of water. **The real price of pipe water in Bangkok is lower today than it was in 1986** (see Appendix, Table 12), **even though the marginal cost of supply has increased in light of the need for interbasin transfer. Raw water continues to be a free good, both to the farmer and to the public utilities** (the MWA, the PWA, and the Electricity Generating Authority of Thailand (EGAT)). This is due to many reasons including the perception that water is still an abundant, virtually inexhaustible resource, a perception which is reinforced by the annual flooding; the perception that water is a "gift of nature" which should not be priced and a basic need from which no one should be deprived; and the belief that the demand for water is not responsive to price, even if the price is allowed to increase substantially. These perceptions and beliefs find their expression in the supply of raw water to farmers and utilities free of charge and in the supply of water to domestic, commercial, and industrial users at "low" prices fixed in nominal terms by the cabinet, and hence declining in real terms. Ostensibly, the objective in granting free water is to help poor farmers, to protect poor urban consumers, and to promote industrialization. The result is that large farmers, wealthy urban consumers, large industrial establishments, luxury hotels, and foreign tourists enjoy a generous water subsidy which lies at the root of the emerging water shortages. **The social concerns, can easily be met by controlling the lowest block of the water tariff and by leaving the rest to the forces of supply and demand.**

Water pricing is critical for meeting water shortages and managing growing demands for several reasons as follows:

- It helps determine the optimal sectoral allocation of water (for example among agricultural, industrial, and domestic users).
- It encourages reduction of waste and promotes efficient water use, thereby limiting demand.
- It recovers the costs of supply, thereby making funds available for expanding the supply.

- It shields users from the rising price of water guarantees either growing water shortages, growing water subsidies, or a combination of the two (see (see Appendix Figure 2).

The most critical parameter for water demand management is the price elasticity of the demand for water, which reflects the scope for controlling demand through pricing.

Econometric estimates of water demand function suggest the following price elasticities:

- Urban centers (BMR): -0.28
- Service sector (BMR): -0.31
- Tourist resorts (Pattaya): -0.41
- Industrial sector (BMR): -0.52

Thus, a 10 percent increase in the price of water would result in a reduction of demand in the range of 2.8 percent to 5.2 percent depending on the type of user. Industrial users are found to be more responsive to price changes because they have more opportunity to recover and reuse water than urban users. In the industrial province of Samut Prakan, despite the low cost of groundwater, industries recover and reuse, on the average, 77 percent of the water flow through their plants (Japan International Cooperation Agency 1989). Tourist resorts are less flexible than industries, but are more responsive than domestic users. A greater proportion of their consumption is for less essential uses, such as watering of gardens, for which there are more opportunities to economize. For example, higher water prices may induce hotels to install sprinkler systems. Even urban consumers appear to have considerable flexibility in economizing on water.

It is reassuring to note that these elasticity estimates, which refer to the short run, are comparable to those of other countries. The short-term elasticities for municipal water demand in the United States range between -0.27 and -0.63. The long-term elasticities estimated using cross-sectional data are considerably higher, ranging between -0.40 and -1.24 (Gibbons 1986). Long-run elasticities are not estimated here because of lack of data, but any such estimates would reinforce the case for demand management.

Using a weighted average price elasticity of 0.32 for BMR it is estimated that an increase of water rates by 1 baht per cubic meter (from the current 6.12 baht per cubic

meter) would reduce demand by 33 million cubic meters a year, sufficient to supply 48,000 customers at the 1989 level of water use. It would also generate 393 million baht of revenues sufficient to finance the supply of an additional 44 million cubic meters at the cost of 9 baht per cubic meter (including capital costs and opportunity or scarcity costs.) This is sufficient to supply another 64,000 customers. Thus, **a one baht increase in water rates (15%) can save enough water and generate sufficient revenues to supply an additional 112,000 users (a 13 percent increase) by inducing consumers to use 7 cubic meters less per capita per year (a 5 percent reduction in water use).** The average user's water bill would go up only by 10 percent, or 45[illegible] baht per year, while **the average household's water bill would go up only by 307 baht per year.** For social reasons, the lowest block of the water tariff could remain unchanged to ease the impact on low-income consumers.

In the case of industry and tourism, a significant reduction in demand and generation of revenues would result from full-cost pricing because they are large users with considerable scope for efficiency improvement and conservation. The concerns that increasing water rates to cover the marginal cost of supply would affect the competitiveness of the Thai industry and tourism are unfounded because their expenditure on water is less than 1 percent of their total operating costs. **A one baht increase in water rates would increase the production cost of the average firm by less than one-tenth of 1 percent. Water shortages are by far a more serious threat to industrial growth than higher water charges.**

There is a great potential for water saving in the following five major groups of industries: food, paper, textiles, metals, and chemicals. Improving the effective use of industrial water can be achieved by several means including a thorough control of the use of water, recycling, multistaging or cascading, the reclamation of wastewater, the application of water-saving apparatus, the control of domestic water use, etc. The Japan International Cooperation Agency (1989) estimates that by using fairly simple methods, these **five groups of industries could save one-fourth of their water use at an average cost of two baht per cubic meter.**(see Table 16) While the average cost of improving water-use efficiency is substantially lower than the rate charged by the MWA for pipe water, it is about equal to the cost of groundwater pumping (including the one baht fee charged by the DMR). Therefore, as long as the groundwater option remains open to industries, there would be no incentive for them to improve their water-use efficiency, no matter what the social costs. The action of raising the price of pipe water may induce

more groundwater pumping than improving efficiency. Yet raising the groundwater fee to achieve cost parity with pipe water and to foreclose substitution of pipe water by groundwater is likely to lead to increased illegal groundwater pumping. The answer to this dilemma lies in the introduction of presumptive groundwater charge for factories not connected to pipe water, or connected but consuming less than the average for the type and size of industry. (for details see chapter below on policy recommendations).

Table 16 Estimated Water-saving Rate and Average Cost of Improvement

Type of Industry	Water Consumed (cu.m./day)	% Saving	Per Unit Cost (baht/cu.m.)
Food	7,025	14.9	3.4
Paper	18,845	31.0	3.3
Textile	13,632	19.4	10.1
Metal	8,594	18.8	1.4
Chemical	4,799	14.8	1.3
Total	52,895	22.2	4.7

Note: This includes water reclamation for certain industries. If water reclamation is excluded, the saving rate is reduced to 10.8 percent at a cost of 1.4 baht per cubic meter.

Source: Japan International Cooperation Agency (1989).

Optimum water pricing involves consideration of all the available alternatives and their relative marginal costs and potential leakages. The MWA, for example, faces the following options: an additional supply from the Chao Phraya River; diversion from the Mae Klong River; a reduction of water leakage; groundwater pumping; and a reduction in demand through higher water rates, which would increase both water-use efficiency and water recycling. (see Appendix Figure 1). Each of these alternative supply sources involves different scarcity, production, and environmental costs, which vary with the level of supply. For example, while the production cost of groundwater is relatively low (one baht to two baht per cubic meter), its environmental cost is very high due to the land subsidence resulting from overpumping. In contrast, beyond a certain level reduction of leakage is costly, but has minimal or no environmental impacts. The average (operating) cost of the MWA water supply reached 5.35 baht per cubic meter in 1989. The marginal cost is probably higher because of the need for inter basin diversion to expand supply. The marginal cost of leakage reduction increased from less than one baht per cubic meter to more than three baht over the last four years. **The cost of improving industrial water-use efficiency is as low as two baht per cubic meter, while water diverted from the Mae Klong River might cost three to four times that amount.**

Chapter 5

Summary and Policy Recommendations

SUMMARY

Thailand's development experience has been remarkably successful: the national wealth has quadrupled in the last 20 years; poverty has been cut by half; and the economy has become broad-based and has diversified into the industry and services. The coveted newly industrialized country (NIC) status is just around the corner.

However, four clouds loom in the horizon. The first problem is the continuing depletion and degradation of the country's vital natural resources. The second problem is the persistence of poverty among one-third of the rural population and the growing rural-urban income gap despite (or because of) rapid economic growth and structural change. The third problem is that resource conflicts are on the rise because of growing demands for land, water, and forests by the nonagricultural sectors and by a growing, and increasingly affluent, urban population. These are the very resources the rural poor also depend upon to alleviate their poverty and to close the income gap. Finally, a fourth cloud on the horizon is the deteriorating environmental quality due to unregulated industrial and urban growth, a subject addressed by a synthesis of a second set of papers titled "Industrialization and Environmental Quality: Paying the Price."

The sustainability of growth could be undermined if resource degradation, poverty, and resource conflicts persist for long. Sustainability calls for the maintenance of the productive base and for the enhancement of both society's and nature's resilience. Yet the advancing deforestation, a growing income gap, and the proliferating resource conflicts serve to undermine this necessary social and natural resilience and stability. The Seventh National Economic and Social Development Plan (1991-1996), in recognition of the problem, focuses on the triad of growth, income distribution, and environmental quality (including natural resources).

The objective of this study has been to formulate policy options that would promote the sustainable use of resources, recognizing that sustainability is unattainable in the midst of poverty and unresolved conflicts. The background research papers for this study have carried out new analyses of a wide range of data to arrive at a new package of policy recommendations. The following five sets of **data** have been used: (1) national data relating to the growth and structure of the economy, to forest resources, and to land use; (2) provincial and village data relating to incomes, crop production, employment, and the living conditions of farmers in forest reserves based on Kor Chor Chor - 2 Khor surveys and the surveys by the OAE under the Land Reclassification Program; (3) field survey data in commercial eucalyptus plantations from Chachengsao Province; (4) field study data from Northern villages practicing community forestry; and (5) water demand and supply data from the MWA and the PWA.

The following new **analyses** have been carried out under the study:

1. The demand for agricultural land has been specified and estimated as a function of crop prices, productivity, agricultural population, and differential return within agriculture and between agriculture and other sectors. Through these estimates the relationship between structural change and the demand for agricultural land has been established and projections of future demand made.
2. The cumulative (negative) effect of deforestation on agricultural production has been empirically established and quantified.
3. An empirical relationship has been established between the area of unused farmland and the average size of holding, and the relative return to labor from nonagricultural activities.
4. The cash incomes of farmers living in national forest reserves have been comparatively and quantitatively analyzed.
5. The unsustainability of farming encroached land in national forest reserves without farm investment and fertilizer use has been quantitatively established.
6. A vicious circle between rural poverty and deforestation has been hypothesized and empirically tested and verified. The role of population growth and of the profitability of cassava have also been assessed.
7. The financial, economic, and social profitability of commercial eucalyptus plantations have been appraised and their potential for breaking the vicious circle of poverty and deforestation evaluated.
8. The experience with community forestry in Thailand has been critically reviewed, and the conditions under which community forestry can succeed have been identified.

9. The demand elasticities for urban, industrial, and tourist use for water were estimated to explore the potential of demand management as a means of meeting water shortages and easing resource conflicts.
10. The future demand and supply for water by nonagricultural sectors has been projected to the year 2010 as an indicator of emerging water resource conflicts with the rural sector and of potential solutions.

The main **findings** of the analysis may be summarized as follows:

1. **The demand for cultivated farmland**, which is currently 109 million rai, grew at the rate of 3 percent over the past 30 years, is levelling off, **and will soon begin to fall, reaching 87 million rai by the year 2010.**
2. Under the prevailing policies, much of the **land taken off agriculture will remain unused while the encroachment of marginal forestland continues.** This is due to the low opportunity (private) cost of unused land and the even lower (private) cost of encroachment, despite the fact that both may have high social opportunity cost.
3. While **the social benefits from the conversion of forestland into agricultural land** in the 1960s and the 1970s were positive (counting only the impact on agriculture), they **have now become negative.** The total agricultural output could increase, considering all other factors, by shifting marginal land from forestry to agriculture, that is, the social returns to forest encroachment are negative, even in terms of agriculture.
4. **Poverty, population growth, and the price of cassava are the main causes of deforestation.** The associated causes are road construction through forest reserves, which make the forests more accessible to encroachment, and the (excessive) harvest of forest products.
5. **Poverty is not only a cause of deforestation; it is also a consequence.** In every succeeding year from the initial encroachment, crop yields have dropped at such a rate that farming becomes unprofitable in less than 10 years, necessitating the clearing of additional land. This is primarily due to several factors including the fact that the land is marginal to start with and that farmers lack the cash and credit to invest in land improvement and the use of fertilizer and other yield-sustaining inputs. Insecure land ownership, remoteness, and infrastructure inadequacy are serious constraints; even STK unusufruct certificates, which are neither permanent nor transferable, make any difference. This is especially true for farmers with other secure land (and access to credit) outside the forest, who tend to regard STK as a recognition of their claim to additional land. For farmers who depend exclusively on encroached land and protect it by their physical presence, STKs do little to increase their security of ownership or access to credit.
6. **Education is a significant factor in both agricultural and wage incomes;** it enables better management decisions in farming and more access to off-farm employment which is a limiting factor, especially in remote areas.
7. **Settlers' dependence on dwindling forests as a source of cash and noncash income increases** rather than declines over time, a sign of their inadequate and deteriorating resource base.

8. **Commercial eucalyptus plantations,** one of the government's major instruments of reforestation, have been found by the study to be financially and economically **profitable when carried out (1) on a large scale, (2) with modern technology, and (3) with specialized management.** Small farmers have neither the land necessary to attain economies of scale nor the capital that would allow them to wait for 8 years to 12 years to receive a return (the first harvest incurs losses). They also lack access to markets, technology, and information. Large-scale plantations generate less employment than crops such as cassava, but pay somewhat higher wages. Farmers perceive eucalyptus plantations as detrimental to their crops and water supply, but scientific evidence is still inadequate. On balance, **the distributional effects of eucalyptus plantations are regressive, especially when farmers are displaced from encroached lands.** They are, however, a promising agroindustry that could also benefit farmers through contract farming, provided that they own their land securely and are provided with credit, technology, and a guaranteed market by the industry.

9. Social or community forestry is often advocated as an effective means to break the vicious circle of rural poverty and deforestation. Our analysis concluded that social forestry, when it meets certain conditions, can play an important role in managing forest resources for the benefit of the community. It is not, however, a panacea for what are massive market and policy failures. Nor can community forestry be fossilized in an intrinsically dynamic and ever-changing society and economy. **Community forestry is most successful when it is initiated by the community itself in response to threats to the well-being of its members, and it is sustained by a balanced dependency on the forest.** Ironically, extreme poverty is not conducive to conserving community forests because day-to-day survival takes a precedence. The availability of nonland-based activities helps conserve a communal forest until such activities largely replace land-based activities and the *raison d'etre* of community forestry disappears. The government can help communities protect communal and nearby forests by (1) recognizing community rights, (2) protecting them from outside threats, and (3) providing them with financial and technical resources and alternative employment. NGOs can be instrumental as advocates, facilitators, and organizers of community forestry, especially in reforestation activities. But even under the best conditions, community forestry will remain a space-and-time-bound institution, with most communities being either too dependent or not dependent enough on the forest to sustain it. Yet, **if society does want forest conservation and reforestation and is willing to pay for it, local communities are, by their very presence and intimate knowledge of the forest, likely to be the best forest protectors and managers, if adequately compensated.**

10. The growing resource conflicts are exemplified by (1) the conversion of prime agricultural land to urban and industrial use or to simply unused land for speculation, and (2) the increasing need for diversion of irrigation water to supply the needs of expanding urban centers and the rapidly growing industrial and tourist sectors. Focusing on water, in particular, we project the demand for nonagricultural uses to quadruple over the next 15 years to 20 years. **Since nonagricultural users are already experiencing shortages, and conflicts over water resources are**

widespread, a quadrupling of water demand would result either in growth-limiting water shortages or in burdensome government subsidies. We found that water demand is moderately responsive to price and, therefore, pricing can be used to increase water-use efficiency and to induce conservation as well as to raise revenues to finance additional higher-cost supplies. Full-cost water pricing (with due allowance for low-income consumers) would avert water shortages and obviate government subsidies. However, **unless the rural poor also benefit from the increasing urban and industrial use of water resource, its diversion to higher-value uses without due compensation for farmers would exacerbate the rural-urban income gap.** The allocation of water rights to farmers and rural poor could be a potent instrument for both improving efficiency in water use and spreading the benefits of growth and industrialization to Thailand's countryside.

POLICY RECOMMENDATIONS

Based on the previously discussed analyses and findings, some concrete policy recommendations are as follows:

1. The remaining natural forests, estimated to cover 28 percent of the country's land area, must be clearly demarcated (using remote sensing, geographic information systems and global positioning system). The 28 percent remaining natural forest figure is based on the best estimates of the Royal Forestry Department. Although it is well accepted that even in national parks, wildlife sanctuaries and watershed class 1A there are people residing in these forests, both hilltribesmen and farmers, the 28 percent figure has already excluded areas occupied by human habitats, and only represents the natural state of the remaining forests.

Our finding that deforestation reduces agricultural production leaves little doubt that **Thailand cannot afford to lose any more of its natural forest. The emphasis on economic forests in recent years has diverted attention from the need to save the remaining natural forest which is essentially a nonrenewable resource and a national heritage.** The natural forest's ecological function and immense biological diversity cannot be recreated by man; once it is gone, it is gone forever; its destruction is irreversible. Economic or production forests produce an economic commodity, wood, which is not absolutely vital to the country and is always obtainable from imports or from substitution. If, on the other hand, wood was in great demand and was not easily obtainable from imports, its price would rise sufficiently to make commercial plantations on private land profitable. It is, therefore, prudent to expand the total area of "preservation forest" to cover most of the remaining natural forests. With this approach,

at least 25 percent of the total land area of the country should be set aside as *protected* or *conservation* forest.

In demarcating the protected forests, consideration should be given to alternative uses such as mining provided that: (1) the area does not include endangered or endemic species of flora and fauna; (2) it is not part of a critical watershed (1A), wildlife sanctuary or national park; (3) valuable reserves are known to exist in the area; and (4) the industry is committed, through an appropriate bond, to minimize and compensate for environmental impacts and to restore the land to its original use after mining is completed (for further details see the paper entitled "Mining, Environment and Sustainable Land Use"). Based on the current understanding of the potential of mineral reserves in forest land, the affected area should be limited, not exceeding one percent of the total land area of the country. It should be made explicit that areas to be designated for mineral resource development should not coincide with national parks, wildlife sanctuaries or watershed class 1A.

2. The demarcation and declaration of the remaining natural forest as protected or conservation forest is an important first step, but not sufficient to halt the continuing forest loss. The root causes of encroachment and deforestation must also be dealt with effectively. Our findings suggest that a large and growing rural population depending on land for livelihood, insecure land ownership, sagging agricultural productivity and rural poverty are major causes of encroachment and deforestation. The clouded property right regime over vast areas of encroached forest lands and the dependence of some 10 million people on forest encroachment for survival provides the smoke screen for forest encroachment by others such as illegal loggers and land speculators. **There can be simply no successful forest policy unless the issue of land ownership over encroached forest lands is clarified and settled.** The land and forest policies, are opposite sides of the same coin and must be addressed integrally and concurrently. Similarly, the alleviation of poverty of farmers in the forest and hence rural development is key to the success of forest protection from further encroachment and plundering.

Therefore, land reform programs that improve the security of land ownership as well as provide infrastructure and development assistance are of critical importance to halting deforestation and protecting the remaining natural forests. It is encouraging that the Government is doubling its land reform effort to cover as much as 4 million rai of mostly degraded forest reserves annually throughout the 7th

Plan. Presently two forms of land titles are most prevalent in encroached forest lands. The usufruct certificate (Sor Tor Kor) issued by the Royal Forestry Department (RFD) and the partial land title (Sor Por Kor 4-01) issued by the Agricultural Land Reform Office. However, neither is acceptable as collateral for long-term credit. To be acceptable as collateral for long-term credit, and to encourage farm investment, land documents must be secure, indefinite and transferable. It is, therefore, recommended that **the issuing of land titles to farmers over land they occupy be accelerated and such titles be as secure and unconstrained (un-attenuated) as possible.**

3. The findings of the present study suggest that the area of unused land would increase over the next 10-20 years as better off-farmers take up other more lucrative occupations. At the same time other studies found that "land speculation is the most important factor contributing to the reduction of cultivated areas. Many farmers have sold their lands. Most of these land were left idle until they were resold". (Chalamwong 1990 p.38) To discourage people from holding large, unused tracts of agricultural land either for speculation or because of low opportunity cost, **it is recommended that land taxes be raised from the current nominal rate of under 10 baht per rai to a substantial and progressive percentage of the assessed market value of the land.** The tax rate should progressively increase with the size of land ownership.

To further discourage the holding of unused land for purely speculative purposes and to increase the supply of land for cultivation **unused land could be taxed on a higher rate.** This differentiation between used and unused land for tax purposes is already in effect in urban areas but the tax rates are negligible. It is recommended that the land tax rates increase and the same differentiation is made with regard to rural land.

The proposed land tax reform would induce landowners to either cultivate the land, rent it to other farmers, or put it under some form of tree cover. The progressive land tax would have three beneficial effects on the forest:

- The tax would help reduce encroachment by increasing the supply (and lowering the cost) of farmland for cultivation. This effect, coupled with the increased cost of encroachment, would help satisfy the bulk of new demand for agricultural land from unused land rather than from forest encroachment.
- The tax would encourage farmers to put more land under tree cover which might include both fast-growing forest plantations and fruit trees,

especially if the tax reform provides for tax rebates for land put under *permanent* tree cover.

- The land distribution would improve and substantial revenues would be raised that could be used for forest protection and reforestation.

4. The reforestation policy is urgently in need of revision. The policy of granting public forestland for commercial plantations should be discontinued because it leads to conflicts with the farmers already occupying this land. Once the remaining natural forest is adequately protected and the issue of land rights is settled, commercial forestry should be set on an equal footing with other land uses that involve tree cover.

Large-scale commercial plantations are privately and socially profitable as long as they are planted on private land and measures are taken to mitigate possible negative environmental impacts of extensive monocultures. Cheap public land, capital subsidies, and tax holidays are neither necessary nor warranted. A modest environmental charge of 25 baht to 50 baht per rai per year would internalize the impact on the water table made by large-scale plantations (over 1,000 rai) and would create a fund for helping affected communities with their water supply. Other impacts, such as those on neighboring crops, could be dealt with by placing restrictions on proximity to crops and sources of water supply. An environmental impact assessment (EIA) should also be required of large-scale plantations.

To increase the area under tree cover additional incentives could be provided to individual farmers and other landowners, such as land tax rebates, long-term credit, free seedlings and crop price guarantee for a variety of species.

5. **Local communities should be given more role and responsibility in managing communal forests, reforesting local watersheds, and protecting conservation forests. Rural people, by their very presence and intimate knowledge of the forest, are in the best possible position to protect forests in their vicinity.** They should not, however, be expected to do this at their own expense. In some cases, most notably in Northern Thailand, where people are sufficiently (but not overwhelmingly) dependent on a communal forest or a local watershed, communities undertake, on their own initiative, to protect communal forests. In other cases, especially in the Northeast, a scarcity of fuelwood, an outside threat, or a catalytic input from an NGO or the government are sometimes sufficient to induce local communities to engage in forest

protection and reforestation. In many cases, however, local communities are either too dependent or not dependent enough on the forest to conserve it or recreate it. In other cases, communities may have the right interest and motivation, but outside threats are overwhelming for traditional community institutions that are not legally recognized and backed by the powers of the state. Therefore, **community forestry cannot be a blanket prescription for all communities.** It depends on the area and even on the individual community. As such, it requires enormous amount of information at the local level—hence the critical importance of the NGOs. **The government can help by** instituting the following measures:

- **Recognizing and protecting traditional community rights against outside threats**
- **Helping to improve local incomes and reduce the excess dependence on the forest by poor communities**
- **Working closely with NGOs** to identify communities suitable for social forestry activities and to provide material, training, and expertise where needed.

Community forestry cannot solve all communities' problems. Many communities, especially those in close proximity to urban or industrial centers, have little direct dependence on nearby forests to practice community forestry, even with outside input. These cases will multiply as nonland-based activities are spread in the rural area as part of the development process. In these cases, either the Royal Forestry Department (RFD) would have to be directly responsible for their protection and management, or communities and individuals would have to be paid to protect forests in their proximity on behalf of society at large.

To **minimize protection costs and maximize effectiveness, the concept of buffer zones around protected forests should be introduced.** The responsibility in the buffer zone should be divided and clearly delineated between individual communities, the RFD, and other units entrusted with forest protection. The preliminary of estimates suggest that the recommended 80 million rai of conservation forest (25 percent forest cover) could be effectively protected at a small fraction of the forest's social value.

6. Land titling would go a long way toward improving both incentives and access to credit for both the small farmers and squatters in forest reserves. According to a World Bank study (Feder et al.1989), land titling, if secure and transferable, would increase agricultural productivity between 10 percent and 30 percent. But this is hardly

sufficient to alleviate poverty let alone to narrow the rural-urban income gap. Land titling is a necessary, not a sufficient condition for addressing poverty and deforestation. To prevent deforestation, additional measures are needed to protect the remaining forests. **To alleviate poverty and improve income distribution, additional measures are needed to raise agricultural productivity.**

Agricultural production is found to be quite responsive to increases in agricultural investment at the macro level and more so at the micro level (for farmers in forest reserves). **A doubling of the current low levels of farm investments and purchases of farm inputs would increase farm income by as much as 60 percent.** However, farmers face a formidable capital constraint which land titling would only partially help alleviate. As long as interest rate ceilings are in effect, small farmers in remote areas would face a scarcity of institutional credit for the simple reason that they are relatively "costly" borrowers. Either the interest rate ceilings must be removed, or the government should provide loan guarantees to financial institutions on behalf of small farmers. The recent increase in the interest rate ceiling is a move in the right direction. Assess to long-term credit is particularly important if the farmers are to undertake tree planting and soil conservation investments. **But credit can only help if it is "guided by the criterion of economic viability for ultimately the poor can benefit only if the projects are viable"** (Siamwalla 1990).

7. The most potent measure for raising both farm and wage income was found to be the level of education of household members. Better educated farmers make better farming decisions which raise farm incomes. Education enhances (1) access to off-farm employment, possibly at a higher wage rate, and (2) occupational and geographical mobility which improves access to employment opportunities outside the area.

At the macro level, analysis suggests that a 10 percent increase in educational attainment increases real agricultural income by 6.4 percent, a very potent response. The micro-level, data analysis indicates an even greater response of 9.5 percent. **Given the very low secondary school enrollment in rural areas, there is considerable scope for improving educational attainment, thereby raising farm and nonfarm income.** According to Myers (1989) policy options for upgrading rural education and increasingly enrollment include the following:

- Reducing the opportunity costs of secondary school attendance by altering the academic calendar and/or school hours to free students for periods of peak demand
- Subsidizing direct costs to the poorer households by providing an allowance per child attending
- Providing "opportunity vouchers" for gifted, talented rural children backed by government, communities, and the private sector
- Providing incentive pay for high-performing teachers
- Improving the quality of rural schools and of secondary school curricula to emphasize cognitive skills which according to empirical evidence (Knight and Sabot 1990) are what employers seek and what enhances productivity and income (for more details see Myers and Sussangkarn, 1989).

Given the potentially powerful contribution of education to rural incomes and the equally powerful contribution of higher incomes to the reduction of deforestation, **expenditures to improve the rural educational system could be treated as forest protection investments** as well as investments in human capital and poverty alleviation. Since deforestation itself affects agricultural productivity, education also has further positive effects on agricultural incomes.

8. Public investments in agriculture are also significant factors in productivity growth. Among the three main areas of such investment—irrigation, agricultural research, and extension—agricultural research was found to be the most significant factor in terms of its contribution to agricultural production and farm incomes followed by irrigation. This agrees with the findings of other studies such as Siamwalla et al. (1990).

- **Increase agricultural research expenditures, especially on high-value crops suitable for the lower-quality soils and higher water stress conditions** that characterize the Northeast and other resource-poor areas
- **Improve management and efficiency of irrigation systems to increase the irrigated area.** Irrigation efficiency, currently below 30 percent, is among the lowest in Asia and can be easily doubled through combination of water pricing and water rights if the experience of Taiwan, Malaysia and China is relevant to Thailand.
- Provide temporary assistance for land and soil improvement in areas of reversible soil deterioration.

9. **A limited resource base, especially one that suffers from past abuse, cannot unendingly accommodate increasing numbers of people with rising aspirations for a higher standard of living.** For example, the forest, land, and water resources of Northeast Thailand, already under intense pressure, cannot be reasonably expected to

provide the means for raising the living standards of approximately one-third of the Thai population to the level enjoyed by other regions, much less to that of Bangkok. The combination of nonresource-related off-farm employment and seasonal and permanent migration to other regions helps relieve some of the pressure on the resource base. However, much more needs to be done to encourage and increase the inflow of industry and the outflow of people to restore a sustainable equilibrium between supply of and demand for rural natural resources.

The pressure on the rural resource base can be reduced through a three-pronged strategy incorporating elements as follows:

- **Educational and land reforms** (described above): These reforms encourage geographical and occupational mobility. Low educational attainment and lack of secure land ownership or restrictions on the transferability of land titles are major obstacles to mobility to occupations and areas of greater economic opportunity.
- **Continued efforts to control population growth:** A combination of family planning and economic incentives such as increased education and employment opportunities for women will help bring about a better balance between people and resources in densely-populated, resource-poor regions such as the Northeast.
- **Expansion of employment opportunities**: Employment opportunities can be expanded by promoting the development of labor-intensive, nonresource-based industries and by increasing the labor intensity of the industrial and service sectors. Towards this objective, the government should **reduce the promotional privileges and hidden subsidies for capital-intensive sectors, and provide stronger incentives for labor-intensive, non-resource-using sectors,** and by promoting the regional dispersion of industry, with due consideration for competitiveness, market potential, and economies of scale in the provision of public infrastructure. **Expanded non-resource based employment opportunities combined with increased occupational and spatial mobility would help attract increasing numbers of people out of the natural resource-intensive sectors.** This would be another potent force helping to contain forest encroachment.

10. **Full-cost pricing of water**, which is an important resource for both agricultural and nonagricultural uses, **is an indispensable component of the policy package for resolving resource conflicts, averting growth-constraining shortages, and improving efficiency and income distribution.** Currently, most farmers don't have to pay for irrigation water and, thus, have little incentive to conserve water or use it efficiently on high-value crops. As a result, irrigation efficiency is under 30 percent. Urban consumers and commercial and industrial users pay only nominal water fees that

do not reflect the marginal cost of supply. Without adequate cost recovery, the development of additional supplies to meet mounting water demands face tight financial constraints. Without full-cost pricing, supplies and demands cannot be balanced, and shortages and conflicts can only grow more severe over time as unchecked demand forges ahead of supply. It is through proper pricing that scarce resources are put to their best possible use.

However, water pricing faces serious problems. The government, concerned that low-income users will be adversely affected, is reluctant to raise urban water rates. The act of raising industrial water prices may simply lead to increased groundwater pumping and further exacerbate the problems of land subsidence and flooding. Finally, charging farmers for irrigation water has been considered but never introduced because farmers might oppose it. Moreover, since agriculture is the lowest-value use of water, farmers would lose in the competition for limited supplies, especially during the dry season and in drought years. Such an outcome will be distributionally regressive. **The critical question at hand is how to improve the efficiency of water use of all sectors and to induce water conservation without adversely affecting farmers and low-income consumers.**

The price of pipe water produced by both the MWA and the PWA should be increased to reflect the marginal cost of supply, except for the first block which could be frozen (in real terms) at the current minimal rate to cushion the effect of the price rise on low-income users. To prevent increased groundwater pumping, we recommend the introduction of presumptive use rates for industry based on the type of industry and level of production: the industries within the public water network which are not connected to pipe water or use less than the average use for the industry (presumptive rate), would be presumed to be using groundwater and would be charged for the balance at the pipe water price, unless they can prove otherwise. This is a critical component because, without it, raising the price of pipe water would be self-defeating. Industrial competitiveness would not be affected because the cost of water is a very small fraction of the industry's total operating cost (less than 1 percent).

While the price of water for non-agricultural users should be set at a level that fully reflects the marginal cost of supply, the latter should be kept at the minimum possible level, as not to become a constraint on economic growth. Once leakage and wasteful water use are contained, additional raw water supplies may come from two

sources: (1) diversion of water from agricultural to non-agricultural uses or (2) interbasin transfers and conveyance over long distances. The first option, violates the minimum cost principle. The second option, would have negative distributional effects and would intensify water resource conflicts, even if the water utilities (MWA and PWA) pay the Royal Irrigation Department (RID) for the additional allocations of raw water. **A mechanism must be found whereby the urban areas and industry and service sectors receive water at the minimum cost possible (without subsidies) through diversion of water from low-value agricultural uses in a way that benefits rather than harms the rural population.**

A promising mechanism for converting water shortages and conflicts into beneficial exchanges that improve both efficiency and income distribution is the allocation of transferable water rights or capacity shares to the rural pupulation. Under this system people residing outside urban areas and municipalities are given water rights in the form of (equal) capacity shares in public irrigation systems and reservoirs regardless of whether they own irrigated land or any land at all. The system can be applied by basin or catchment area, although interbasin water transfers should not be precluded where higher-value uses justify such transfers.

The absolute amount of water that each farmer is entitled per unit of time would, of course, depend on how much water is in storage which varies with season and year. At the end of the rainy season, the RID would announce the amount of water in storage. Each farmer automatically knows the quantity of water he is entitled to (share times water in storage). What he does with it would be his own business: he might use part of it in his own farm, sell it to other farmers or sell it to the water utilities. Farmers outside the irrigation command area can sell their share for each season to farmers in command areas or to municipalities. The scarcer the water and the higher the demand from urban centers, industry, tourism, and high-value crops, the higher the price that the farmer would command for his share of water. Neither the MWA nor the PWA would have continued access to scarce raw water free of charge, and the RID would not need to impose a limit on these utilities' access to raw water. The water utilities acting on behalf of the urban and industrial consumer would purchase water from farmers through the RID which would act as the intermediary between farmers and potential water buyers.

In this way, the benefits of rapid industrialization and the growth of the tourism and services sectors will be spread to the rural areas without having to physically move to

the urban areas. **Water shortages and conflicts would be replaced by beneficial exchanges, and the desirable aspects of rural life would be preserved without costly farm subsidies that lead to over-production and costly surpluses. An increasingly scarce and valuable resource would be put to its highest-value use in a way that benefits rather than deprives the farmers and the rural poor.** A variant of this system of transferable water rights is currently in operation in India, Australia and California. The implementation of this system in Thailand would require additional investments to properly control and meter water, but the potential benefits are large enough for the scheme to warrant a serious consideration and study. Bulk water allocation to water-user associations, farmers groups, and communities could help reduce metering and collection costs by leaving water distribution to local organizations which can best monitor water use and prevent meter manipulation or damage. **The system of transferable capacity shares could be tried on an experimental basis in one river basin such as the Mae Klang Subbasin in the North or the Lam Ta Khong Subbasin in the Northeast.** (Details on resource conflicts in these two subbasins are given in the research report "Water-Shortages: Managing Demand to Expand Supply").

ISSUES FOR CONSIDERATION

1. We have projected that cultivated farmland, which is currently 109 million rai will begin to level off in the early 1990s and decline to 87 million rai by the year 2010. At the same time we project continued dependence of the majority of the population on land and forests and further widening of rural-urban income inequality. The implication is that unused agricultural land would increase in the near future, yet the pressure on the remaining natural forest from illegal encroachment would persist.

2. We have found that the clearing of new forest land for cultivation no longer increases total agricultural production. In fact, since the early 1980's the adverse effects of deforestation on agriculture have become so strong as to diminish total agricultural production by some 150 baht for every additional rai of forest land cleared and added to cultivated land. This figure does not include the loss of biological diversity or the loss of environmental emenities. Thus, we call for an "offensive" strategy to preserve the remaining natural forests. As a first step, the *protected* or *conservation* forest should be raised from 15 percent to at least 25 of the total land area of the country to cover all the remaining natural forests with minor exceptions for highly valuable mineral sites.

3. We fully understand the plight of the Thai farmers in the forest who lack both the means to improve their productivity on their farm and the mobility to seek better opportunities elsewhere. Unless their standard of living can be meaningfully raised, they will continue to rely on the dwindling natural resources - land, water and forest. We thus fully support the policy of the Government to expedite its land reform program at the rate of 4 million rai per year. However, the basic issue is to offer land security to the farmer. We thus propose that land reform in

any specified area must fulfill its major objective of granting full ownership to the tillers. A transfer tax would help alley fears of land sale and further encroachment.

4. To help farmers increase their productivity on the land and their mobility and access to higher-income opportunities elsewhere we recommend, in addition to land titling, public investments in research on rainfed agriculture, in rural education and in promotion of non-resource based, labor-intensive industries and services.

5. To discourage the holding of large areas of agricultural and suburban land unused for speculation we recommend the introduction of a progressive land tax. Tax rates would be set higher for unused land, to further discourage large holdings for unproductive uses Higher tax rates should also be imposed on short-term land transactions to prevent excessive windfall profit.

6. From our study, we believe that the goal of "economic forest" is not achievable. In reality economic forest does not exist. Furthermore, the practice of relying on the private sector to take the lead in securing large plots of land in forest reserves for commercial plantations has led to confrontation, confusion and chaos. We also found that farmers with less than 100 rai of land are not likely to benefit from investing in fast-growing tree plantations. Nor are the employment benefits superior to those of cassava cultivation. Large scale plantations are profitable on their own and no subsidies are warranted; a modest environmental charge and detailed environmental impact assessment are recommended. Fast-growing tree plantations can benefit the farmers through contract farming provided they own their land securely and are provided with credit, technology and a guaranteed market.

7. As for community forestry, our study reveals that there are pre-conditions crucial to its success or failure. Community forests can not be replicated at will. We, however, do believe in the potent force of people's participation and call for a gradual expansion program to promote community forest, relying both on local communities and the role of non-governmental organizations (NGOs). Rural communities by their very presence and intimate knowledge of the forest are in the best possible position to protect forests in their vicinity. Buffer zones around protected forest could be demarcated and communities within those zones given incentives to help protect the forest perimeter.

8. Finally, to address emerging water shortages facing non-agricultural users, and growing resource conflicts and inequalities between rural and urban areas we recommend full-cost pricing of water for non-agricultural uses and a serious study of the concept of transferable water rights for the rural population. In this way, water shortages would not become a constraint on economic growth and the rural people would share in the benefits of industrialization and growth. Spreading the benefits of economic development is key to conserving natural resources and preserving national stability for a sustainable future.

Appendices

Appendix

Table 1 Land Utilization in Thailand 1961-1988

Million Rai

YEAR	TOTAL	FOREST	Cultivated Land	Other Agri. Land	Unused Agri. Land	TOTAL FARM HOLDIN	UNCLAS
1961	320.70	175.19	48.55	0.00	17.34	65.88	79.63
1962	320.70	172.31	53.68	0.00	15.18	68.86	79.52
1963	320.70	169.60	55.23	0.00	14.20	69.43	81.67
1964	320.70	166.70	56.57	0.00	19.48	76.06	77.94
1965	320.70	163.93	58.37	0.00	21.36	79.73	77.04
1966	320.70	160.23	66.59	0.00	15.43	82.01	78.45
1967	320.70	156.48	63.22	0.00	21.20	84.42	79.80
1968	320.70	152.80	66.43	0.00	20.80	87.23	80.67
1969	320.70	149.10	70.38	0.00	20.03	90.41	81.19
1970	320.70	145.42	71.68	0.00	22.33	94.01	81.27
1971	320.70	141.88	72.44	0.00	26.78	99.22	79.60
1972	320.70	138.32	73.53	0.00	29.85	103.37	79.00
1973	320.70	134.71	80.13	0.00	29.04	109.17	76.82
1974	320.70	134.56	81.54	0.00	28.72	110.26	75.88
1975	320.70	130.76	86.48	0.49	25.24	112.21	77.72
1976	320.70	124.01	84.44	0.49	28.18	113.11	83.57
1977	320.70	116.57	91.01	0.40	22.38	113.80	90.33
1978	320.70	109.52	98.94	0.50	17.01	116.44	94.74
1979	320.70	106.39	95.64	0.67	21.29	117.60	96.70
1980	320.70	103.42	98.14	0.68	20.17	119.00	98.28
1981	320.70	100.58	100.78	0.93	19.59	121.29	98.82
1982	320.70	97.86	100.70	0.96	21.93	123.59	99.24
1983	320.70	96.27	104.08	0.99	19.17	124.23	100.20
1984	320.70	94.70	105.15	0.98	19.18	125.31	100.69
1985	320.70	93.16	109.24	1.10	18.26	128.60	98.94
1986	320.70	91.65	104.99	1.19	23.67	129.85	99.20
1987	320.70	90.73	101.42	3.12	34.29	138.82	91.11
1988	320.70	89.88	108.98	5.09	33.73	147.80	83.02

Note: (1) Cultivated land is calculated from the planted areas of 22 major crops.

(2) Other Agricultural land uses include grassland, housing area, shrimp farming, etc.

(3) Unused Agricultural land is total farm holding less cultivated and other agricultural land uses.

(4) Unclassified land includes public land, royal estate, water bodies, urban areas, etc.

Source: Office of Agricultural Economics

Appendix

Table 2 The Demand for Agricultural Land (Cultivated), 1962-1989

Explanatony Variables	Coefficients and T-Statistics
Real price of agriculture crops (lagged one year)	0.081 (2.00)
Agricultural population	1.337 (12.82)
Agricultural productivity (lagged one year)	-0.280 (2.43)
Relative return to land from land-saving crops to land using crops	-0.155 (3.95)
Relative return to labor from non-agriculture	-0.308 (3.37)
Time dummy	-0.352 (4.12)
AR(2)	0.437 (2.27)
R square adjusted	0.987
Durbin-Watson	2.00
F-Statistic	330.00
Degrees of freedom	19.00

Appendix

Table 3 Explaining Unused Agricultural Land (1962-1988)

Explanatory Variables	Coefficients and T-Statistics
Real crops price	-0.383 (2.57)
Land productivity	-0.627 (1.97)
Agricultural population	-0.957 (2.26)
Agricultutal holding per farmer	3.872 (7.08)
Differential return between nonagriculture and agriculture	0.993 (3.36)
Dummy (1979-1985)	-0.201 (5.00)
R square adjusted	0.889
Durbin-Watson statistic	2.32
F-Statistic	43.00
Degrees of freedom	19.00

Figures in Parenthesis are t-statistics

Appendix

Table 4 Sources of Changes in Cultivated Land, 1962-1968

Million Rai

YEAR	CHANGE IN CULTIVAT. LAND	CHANGE IN FOREST AREA	CHANGE IN UNUTIL. LAND	CHANGE IN OTHERS	CHANGE IN UNCLASSIF. LAND
1962	5.13	-2.87	-2.16	0.00	-0.10
1963	1.55	-2.71	-0.98	0.00	2.14
1964	1.34	-2.90	5.28	0.00	-3.72
1965	1.80	-2.77	1.88	0.00	-0.91
1966	8.22	-3.70	-5.94	0.00	1.42
1967	-3.36	-3.75	5.77	0.00	1.34
1968	3.21	-3.68	-0.40	0.00	0.87
1969	3.95	-3.71	-0.77	0.00	0.52
1970	1.30	-3.68	2.30	0.00	0.08
1971	0.76	-3.54	4.45	0.00	-1.67
1972	1.09	-3.55	3.06	0.00	-0.60
1973	6.60	-3.61	-0.81	0.00	-2.18
1974	1.41	-0.15	-0.32	0.00	-0.94
1975	4.95	-3.80	-3.48	0.49	1.84
1976	-2.05	-6.75	2.94	0.00	5.85
1977	6.57	-7.44	-5.80	-0.09	6.75
1978	7.92	-7.06	-5.37	0.10	4.41
1979	-3.29	-3.12	4.29	0.17	1.96
1980	2.50	-2.97	-1.12	0.02	1.58
1981	2.63	-2.84	-0.59	0.25	0.54
1982	-0.07	-2.71	2.34	0.03	0.41
1983	3.38	-1.61	-2.76	0.03	0.96
1984	1.08	-1.57	0.01	-0.00	0.49
1985	4.09	-1.54	-0.91	0.11	-1.75
1986	-4.25	-1.50	5.41	0.09	0.26
1987	-3.57	-0.89	10.62	1.93	-8.09
1988	7.56	-0.89	-0.56	1.97	-8.09
AVERAGE	2.24	-3.16	0.61	0.19	0.13
PER RAI	1.00	-1.41	0.27	0.08	0.06

Note: Calculated from Table 1

Appendix

Table 5 Explaining Agricultural Production : The Role of Deforestation 1961-1988

Explanatony Variables	Coefficients and T-Statistics
Cultivated land	0.477 (3.29)
Agricultural labour	0.107 (1.48)
Capital	0.415 (4.11)
Research	0.072 (2.30)
Education	0.637 (3.46)
Cumulative forest loss	-0.442 (2.32)
R square adjusted	0.996
Durbin-Watson statistic	1.83
F-Statistic	1319
Degrees of freedom	19

Appendix

Table 6 Explaining Agricultural Land Productivity 1961-1988

Explanatony Variables	Coefficients and T-statistics
Education	0.218 (1.98)
Capital per a unit of cultivated land	0.113 (0.44)
Irrigation per a unit of cultivated land	0.330 (2.45)
Rainfall	0.099 (1.16)
Forest area	0.186 (2.56)
R square adjusted	0.548
Durbin-Watson statistic	1.43
F-Statistic	9
Degrees of freedom	20

Appendix

Table 7 Regression Coefficients and Related Statistics for Explaining Variations in Cash Income from Agriculture

	Model 1	Model 2	Model 3
Constant	2.883*** (6.002)		
Year	-0.750*** (3.145)	-0.871** (2.887)	-0.970*** (3.276)
Land Holding	0.403*** (3.081)	0.235* (1.743)	0.215 (1.588)
Land Document		0.096 (1.300)	
Cash Expenses on Agr.	0.559*** (6.342)	0.671*** (9.992)	0.659*** (9.770)
Size of Forest	-0.137*** (3.132)		
Education		1.169*** (5.342)	1.269*** (6.107)
Family Labor	0.037 (0.371)	0.094 (0.811)	0.125 (1.083)
Distance	-0.105 (1.167)		
Dummy	-0.305*** (4.245)	-0.434*** (5.176)	0.083*** (4.941)
R2 Adjusted	0.915	0.889	0.886
DW	1.892	1.535	1.716

*** Significant at 1 percent,
** at 5 percent, and
* at 10 percent respectively

Appendix

Table 8 Regression Coefficients and Related Statistics for Explaining Variations in Wage Income

Equation	1	2
Education	15.524*** (4.271)	15.524*** (4.204)
Wage Rate	45.060** (2.635)	46.148** (2.557)
Income from Crop	-0.032* (1.808)	
Income from Agr.		-0.027* (1.630)
Dummy	1,684.439*** (5.395)	1,719.359*** (5.497)
R2 Adjsuted	0.769	0.763
F-Ratio	26.507	25.633

*** Significant at 1 percent,
** Significant 5 percent and
* For 10 percent respectively

Appendix

Table 9 Regression Coefficients and Related Statistics for Explaining Variations in Cash Income from Selling Forest Products

Equation No.	1	2	3
Year	28.483*** (7.116)	40.043*** (5.921)	37.737*** (6.203)
Size of Forest	0.443** (2.904)	0.393** (2.600)	0.390** (2.632)
Income from Crops	-13.000** (2.822)		
Family Cash Income		-9.134** (2.331)	
Agricultural Income			-10.000** (2.516)
Distance		-0.295* (1.906)	-0.298* (1.962)
Dummy	553.272*** (3.373)	540.708*** (3.261)	502.926*** (3.112)
R2 adjusted	0.619	0.635	0.648
F-ratio	12.936	10.572	11.149

Values in parenthesis are t-ratio
*** Significant at 1 percent level
** Significant at 5 percent level
* Significant at 10 percent level

Appendix

Table 10 Regression Coefficients and Related Statistics Explaning Variations of Deforestation in Northeastern Provinces

Variables	Model 1	Model 2	Model 3
Constant	-222.500	-228.700	--
	(-1.38)	(-1.50)	--
Income per capita	-0.099	-0.084	-0.056
(baht)	(-3.28)***	(-2.88)***	(1.26)
Price of cassava	17.83	17.247	9.055
(satang/kg)	(2.99)***	(3.02)***	(2.81)***
Value of forest products	0.44	--	0.43
(1,000 baht)	(1.83)*		(1.74)
Size of forest	0.133	0.13	0.124
(1,000 rai)	(5.56)***	(5.65)***	(5.56)***
Rural road network	178.5	--	163.6
(1,000 km in last 5 years)	(2.12)**	--	(1.81)*
Population growth	--	5.694	--
(%during last 3 years)		(3.47)***	
Dummy	379.5***	486.5	--
(for DEFORE>800,000 rai)	(3.95)	(5.32)***.	
1976-78	--	--	-81.7
			(-1.35)
1978-82	--	--	-151.0
			(-2.09)**
1982-85	--	--	-211.5
			(-2.28)
1985-88	--	--	-189.9
			(-1.91)
R^2 adjusted	0.751	0.767	0.75
Durbin Watson	2.217	2.029	2.21
Degrees of freedom	70	71	69

Appendix

Table 11 Explaining Water Demand

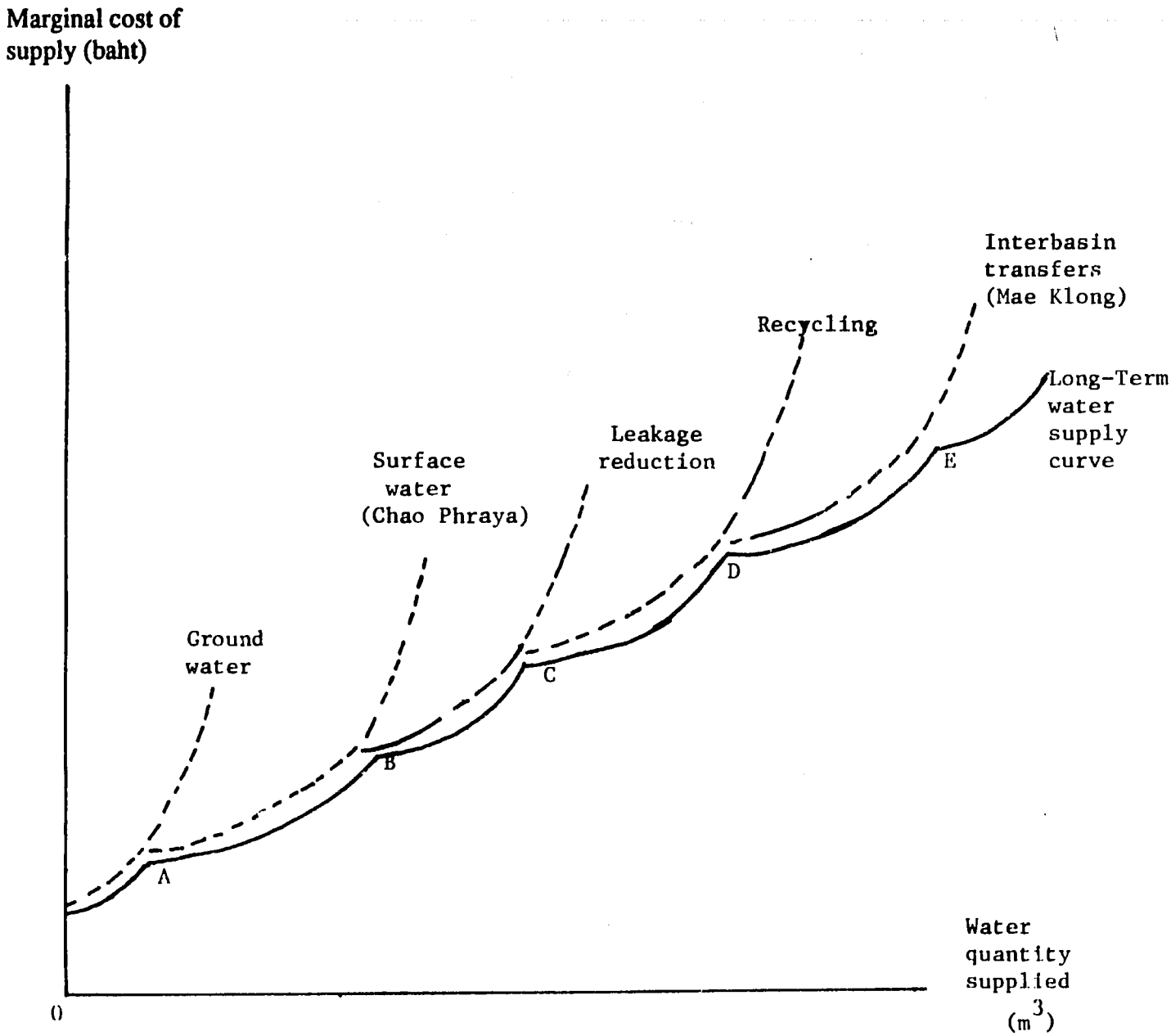
Explanatony variables	Urban (BMR)		Tourist (Pattaya)	Industry (BMR)
	Residentia	Service		
Functional form	Translog	Translog	Linear	Translog
Constant	-	-	-	3.743 (8.72)
Real price of water (p)	-2.547 (2.64)	-4.47 (2.63)	-0.767 (2.35)	-2.363 (3.10)
Per capita income (y)	0.806 (2.53)	-	-	-
Number of users (u), square	0.070 (2.00)	-	-	-
Interaction between p & y	0.688 (2.46)	-	-	-
Interaction between y & u	-	-	-	-
Number of hotel rooms	-	-	0.541 (2.51)	-
Number of tourists	-	-	3.55 (1.71)	-
Manufacturing output (m)	-	-	-	0.451 (2.93)
Interaction between p & m	-	-	-	0.484 (2.68)
Service sector output (o)	-	-0.204 (2.00)	-	-
Interaction between u & p	-	0.873 (2.58)	-	-
Interaction between u & o	-	0.142 (6.82)	-	-
Price square	-	-0.135 (1.45)	-	-
R square adjusted	0.961	0.976	0.892	0.984

Appendix

Table 12 Water Pricing and Number of Water Users in Metropolitan Waterworks Authority (MWA) Area

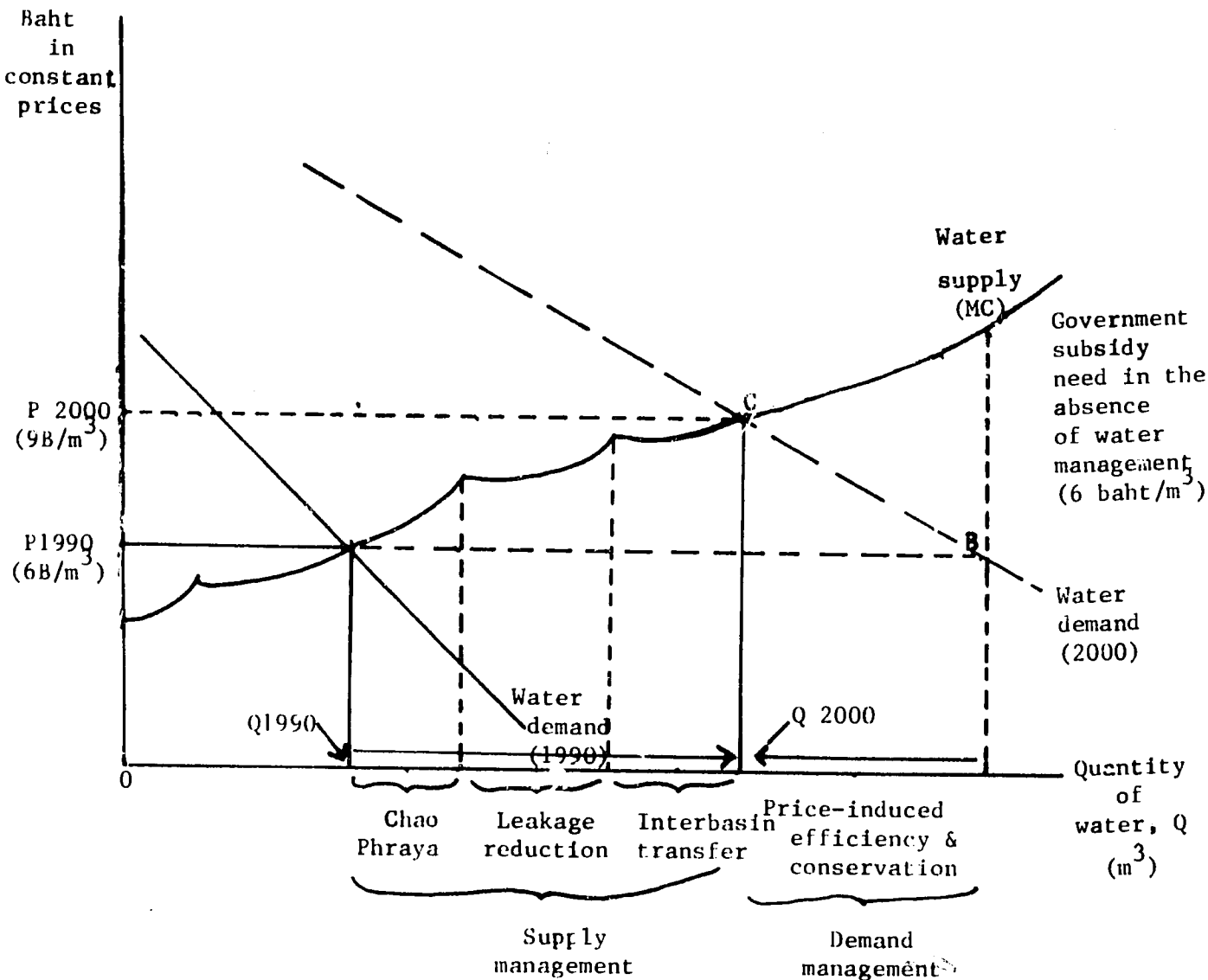
Year	Nominal effective rate (B/m)	Real effective rate (B/m)	Minimu rate (B/m)	Maximu rate (B/m)	Nominal prod.cost Baht/Cu.m	Users	
						Number (Thousand	Growth (Percent)
1976	1.449	3.295	0.50	2.50	-	317	-
1977	1.487	3.223	0.50	2.50	-	329	3.7
1978	1.494	2.987	0.50	2.50	-	341	3.7
1979	1.534	2.819	0.50	2.50	2.29	356	4.3
1980	1.597	2.661	0.50	2.50	4.56	387	8.9
1981	2.198	3.055	0.50	2.50	5.01	423	9.2
1982	3.029	3.712	1.50	5.50	4.40	445	5.2
1983	3.059	3.557	1.50	5.50	4.97	468	5.1
1984	3.190	3.587	1.50	5.50	4.63	519	11.1
1985	4.926	5.501	4.10	8.75	5.64	602	15.9
1986	6.142	6.646	4.10	8.75	5.63	660	9.5
1987	6.092	6.482	4.05	8.70	5.64	721	9.4
1988	6.102	6.328	4.00	8.70	5.65	790	9.5
1989	6.118	6.118	4.00	8.70	5.35	867	9.7

Source: MWA, Annual Report various issues



Appendix

Figure 1 Rising Marginal Costs of Water Supply from Alternative Sources and Long-Term Water Supply Curve. (A, B, C, D, E: water source switching points).



Appendix

Figure 2 Meeting Future Water Shortages Through a Combination of Supply and Demand Management

Q : water quantity
P : water price
A : Demand and supply balance 1990 (P + 6.12 baht/m^3)
B : Demand and supply balance 2000 (P + 6.12 baht/m^3)
C : Demand and supply balance 2000 (P + 9.00 baht/m^3)

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