

APPENDIX B

SENSITIVITY ANNALYSIS FOR OPTIMAL SOLUTION

Table B1 Allowable increases and decreases in crop activity for the small farm using chemicals and bioextract

| Land unit (rai) | Activity | Optimal value | Reduced cost | Objective coefficient | Allowable increase | Allowable decrease |
|--------------------------|-----------------------------|---------------|--------------|-----------------------|--------------------|--------------------|
| Irrigated upland | Coffee | 1.12 | 0.00 | 0.00 | 0.00 | 3.54 |
| | Sweet corn-sweet corn | 3.06 | 0.00 | 0.00 | 3.54 | 0.00 |
| Rainfed upland | Coffee | 1.91 | 0.00 | 0.00 | 0.00 | unlimited |
| Irrigated lowland | Citrus | 1.50 | 0.00 | 0.00 | 0.00 | 3.62 |
| | Longan | 1.13 | 0.00 | 0.00 | 0.00 | 32.79 |
| | Rice-sweet corn- sweet corn | 3.83 | 0.00 | 0.00 | 2.26 | 0.00 |
| Rainfed lowland | Lychee | 1.25 | 0.00 | 0.00 | 9.37 | unlimited |
| Total area | | 13.80 | - | - | - | - |
| Off-farm work (man-days) | | 62.83 | 0.00 | 0.00 | 0.00 | 0.46 |

Table B2 Allowable increases and decreases in land units
for the small farm using chemicals and bioextract

| Land unit (rai) | Optimal land use | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|-------------------|---------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Irrigated upland | 4.18 | - 45,598.56 | 4.18 | 0.41 | 1.10 |
| Rainfed upland | 1.91 | - 48,646.40 | 1.91 | 0.57 | 0.87 |
| Irrigated lowland | 6.46 | - 28,229.61 | 6.46 | 0.10 | 0.29 |
| Rainfed lowland | 1.25 | - 23,446.92 | 1.25 | 0.09 | 0.28 |
| Total | 13.80 | - | - | - | - |

Table B3 Allowable increases and decreases for household and hired labor
for the small farm using chemicals and bioextract

| Activities | Household labor /hired labor (man-days) | | | | |
|-----------------|---|-----------------|--------------------------|-----------------------|-----------------------|
| | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
| Household labor | | | | | |
| January | 51.00 | 0.00 | 51.00 | 34.23 | 15.77 |
| February | 51.00 | 0.00 | 51.00 | 30.79 | 19.21 |
| March | 51.00 | -534.02 | 51.00 | 0.88 | 1.88 |
| April | 51.00 | 0.00 | 51.00 | 26.90 | 23.10 |
| May | 51.00 | -271.76 | 51.00 | 0.29 | 0.89 |
| June | 50.55 | 0.00 | 51.00 | unlimited | 0.45 |
| July | 51.00 | 0.00 | 51.00 | 2.87 | 7.31 |
| August | 33.19 | 0.00 | 51.00 | unlimited | 17.81 |
| September | 42.30 | 0.00 | 51.00 | unlimited | 8.70 |
| October | 51.00 | -293.41 | 51.00 | 0.33 | 1.21 |
| November | 30.88 | 0.00 | 51.00 | unlimited | 20.12 |
| December | 51.00 | -452.29 | 51.00 | 0.37 | 0.13 |
| Hired labor | | | | | |
| January | 34.23 | 0.00 | 50.00 | unlimited | 15.77 |
| February | 30.79 | 0.00 | 50.00 | unlimited | 19.21 |
| March | 50.00 | -534.02 | 50.00 | 0.88 | 1.88 |
| April | 26.90 | 0.00 | 50.00 | unlimited | 23.10 |
| May | 50.00 | -271.76 | 50.00 | 0.33 | 0.99 |
| June | 49.55 | 0.00 | 50.00 | 8.70 | 0.45 |
| July | 50.00 | 0.00 | 50.00 | unlimited | 7.31 |
| August | 50.00 | 0.00 | 50.00 | 8.70 | 2.87 |
| September | 38.43 | 0.00 | 50.00 | unlimited | 2.87 |
| October | 50.00 | -293.41 | 50.00 | 0.33 | 1.21 |
| November | 29.88 | 0.00 | 50.00 | 335.51 | 20.12 |
| December | 50.00 | -452.29 | 50.00 | 0.37 | 0.13 |

Table B4 Allowable increases and decreases for investments and loans
for the small farm using chemicals and bioextract

| Source of investment (baht) | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|--------------------------------|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Owner investment | 44,934.21 | 0.00 | 44,934.21 | unlimited | 139,343.62 |
| BAAC | 124,869.70 | 0.00 | 200,000.00 | unlimited | 137,580.27 |
| Agricultural co-operative | 0.00 | 0.00 | 20,000.00 | 61,844.43 | 20,000.00 |
| Village fund | 0.00 | 0.00 | 30,000.00 | 59,911.79 | 30,000.00 |

Table B5 Allowable increases and decreases for the goal constraints for the small farm using chemicals and bioextract

| Goal | Explanation | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|------|--|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| GA | Annual equivalent value (baht) | 206,880.93 | 0.00 | 206,880.93 | unlimited | 49,413.44 |
| GH | Hired labor (man–days) | 150.39 | 0.00 | 361.57 | unlimited | 211.19 |
| GI | Independence from external inputs (baht) | 126,938.01 | 0.00 | 368,573.00 | unlimited | 241,634.99 |
| GL | Loan investment (baht) | 49,517.68 | 0.00 | 239,019.70 | unlimited | 189,502.02 |
| GY | Yield variance (kg) | 7,103.63 | 0.00 | 16,098.18 | unlimited | 8,994.54 |
| GR | Revenue variance (baht) | 107,913.88 | 0.00 | 426,809.09 | unlimited | 318,895.21 |
| GS | Off-farm work (baht) | 18,415.52 | 0.00 | 18,415.52 | unlimited | 5,849.09 |

Table B6 Allowable increases and decreases in crop activity for the large farm using chemicals

| Land unit (rai) | Activity | Optimal value | Reduced cost | Objective coefficient | Allowable increase | Allowable decrease |
|--------------------------|-----------------------|---------------|--------------|-----------------------|--------------------|--------------------|
| Irrigated upland | Citrus | 85.21 | 0.00 | 0.00 | 0.54 | unlimited |
| Rainfed upland | Coffee | 0.48 | 0.00 | 0.00 | 0.10 | 0.16 |
| | Sweet corn-sweet corn | 7.48 | 0.00 | 0.00 | 0.16 | 0.10 |
| Irrigated lowland | Citrus | 43.55 | 0.00 | 0.00 | 2.06 | 0.76 |
| | Rice-sweet corn | 2.26 | 0.00 | 0.00 | 0.16 | 0.21 |
| Rainfed lowland | Rice | 3.52 | 0.00 | 0.00 | 0.63 | unlimited |
| Total area | | 142.50 | - | - | - | - |
| Off-farm work (man-days) | | 347.10 | 0.00 | 0.00 | 0.00 | 0.00 |

Table B7 Allowable increases and decreases in land units
for the large farm using chemicals

| Land unit (rai) | Optimal land use | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|-------------------|---------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Irrigated upland | 85.21 | -26,415.40 | 85.21 | 10.60 | 14.50 |
| Rainfed upland | 7.96 | -21,007.96 | 7.96 | 9.94 | 1.30 |
| Irrigated lowland | 45.81 | -17,843.87 | 45.81 | 8.79 | 15.03 |
| Rainfed lowland | 3.52 | -21,570.88 | 3.52 | 17.10 | 3.52 |
| Total | 142.50 | - | - | - | - |

Table B8 Allowable increases and decreases for household and hired labor
for the large farm using chemicals

| Activities | Household labor /hired labor (man-days) | | | | |
|-----------------|---|-----------------|--------------------------|-----------------------|-----------------------|
| | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
| Household labor | | | | | |
| January | 11.41 | 0.00 | 52 | 722.96 | 27.04 |
| February | 16.41 | - 203.00 | 52 | 4.61 | 2.91 |
| March | 27.45 | - 364.14 | 52 | 63.67 | 5.84 |
| April | 17.77 | 0.00 | 52 | 674.60 | 75.40 |
| May | 16.69 | 0.00 | 52 | unlimited | 148.69 |
| June | 13.03 | 0.00 | 52 | unlimited | 155.03 |
| July | 17.45 | 0.00 | 52 | 618.37 | 131.63 |
| August | 25.41 | 0.00 | 52 | 645.25 | 104.75 |
| September | 35.45 | 0.00 | 52 | 640.84 | 109.16 |
| October | 31.45 | 0.00 | 52 | unlimited | 77.41 |
| November | 28.93 | 0.00 | 52 | 667.29 | 82.71 |
| December | 35.45 | - 728.33 | 52 | 2.86 | 15.46 |
| Hired labor | | | | | |
| January | 721.21 | 0.00 | 750 | unlimited | 27.04 |
| February | 750.00 | - 203.00 | 750 | 4.61 | 2.91 |
| March | 750.00 | - 364.14 | 750 | 63.67 | 5.84 |
| April | 664.28 | 0.00 | 750 | unlimited | 75.40 |
| May | 578.28 | 0.00 | 750 | 22,284.58 | 148.69 |
| June | 567.93 | 0.00 | 750 | 22,284.58 | 155.03 |
| July | 588.51 | 0.00 | 750 | unlimited | 131.63 |
| August | 568.54 | 0.00 | 750 | unlimited | 104.75 |
| September | 555.40 | 0.00 | 750 | unlimited | 109.16 |
| October | 600.65 | 0.00 | 750 | 22,284.58 | 77.41 |
| November | 631.84 | 0.00 | 750 | unlimited | 82.71 |
| December | 750.00 | - 728.33 | 750 | 2.85 | 15.45 |

Table B9 Allowable increases and decreases for investments and loans for the large farm using chemicals

| Source of investment (baht) | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|-----------------------------|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Owner investment | 2,503,925.33 | 0.00 | 2,503,925.33 | unlimited | 4,456,916.52 |
| BAAC | 0.00 | 0.00 | 200,000.00 | 216,456.52 | 200,000.00 |
| Agricultural co-cooperative | 0.00 | 0.00 | 20,000.00 | 214,461.53 | 20,000.00 |
| Commercial banks | 984,907.90 | 0.00 | 5,000,000.00 | 207,759.61 | 719,079.79 |

Table B10 Allowable increases and decreases for the goal constraints for the large farm using chemicals

| Goal | Explanation | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|------|--|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| GA | Annual equivalent value (baht) | 3,390,848.45 | 0.00 | 3,390,848.45 | unlimited | 354,951.14 |
| GH | Hired labor (man–days) | 3,965.93 | 0.00 | 4,065.70 | unlimited | 99.77 |
| GI | Independence from external inputs (baht) | 3,436,327.24 | 0.00 | 3,801,763.74 | unlimited | 365,436.50 |
| GL | Loan investment (baht) | 2,221,617.69 | 0.00 | 2,560,455.62 | unlimited | 338,837.93 |
| GY | Yield variance (kg) | 156,417.63 | 0.00 | 193,667.33 | unlimited | 37,249.70 |
| GR | Revenue variance (baht) | 3,287,862.50 | 0.00 | 3,424,563.89 | unlimited | 136,701.39 |
| GS | Off-farm work (baht) | 160,400.00 | 0.00 | 160,400.00 | unlimited | 81,962.43 |

Table B11 Allowable increases and decreases in crop activity for the large farm using chemicals and bioextract

| Land unit (rai) | Activity Crop | Optimal value | Reduced cost | Objective coefficient | Allowable increase | Allowable decrease |
|--------------------------|-----------------------|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Irrigated upland | Coffee | 7.58 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Sweet corn-sweet corn | 9.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rainfed upland | Coffee | 2.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigated lowland | Citrus | 15.99 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rice-sweet corn | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rainfed lowland | Rice | 5.46 | 0.00 | 0.00 | 0.00 | unlimited |
| Total area | | 40.63 | | | | |
| Off-farm work (man-days) | | 92.85 | 0.00 | 0.00 | 0.00 | 0.00 |

Table B12 Allowable increases and decreases in for the large farm using chemicals and bioextract

| Land unit (rai) | Optimal land use | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|-------------------|---------------------|-----------------|--------------------------|-----------------------|-----------------------|
| Irrigated upland | 16.75 | - 49,101.09 | 16.75 | 0.00 | 0.60 |
| Rainfed upland | 2.32 | - 49,820.77 | 2.32 | 6.37 | 0.00 |
| Irrigated lowland | 16.10 | - 37,100.93 | 16.10 | 0.00 | 4.17 |
| Rainfed lowland | 5.46 | - 27,119.78 | 5.46 | 0.00 | 3.03 |
| Total | 40.63 | - | - | - | - |

Table B13 Allowable increases and decreases in household labor and hired labor constraints for the large farm using chemicals and bioextract

| Activities | Household labor /hired labor (man-days) | | | | |
|-----------------|---|--------------|-----------------------|--------------------|--------------------|
| | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
| Household labor | | | | | |
| January | 43.75 | - 92.21 | 43.75 | 0.00 | 0.34 |
| February | 43.75 | 0.00 | 43.75 | 147.56 | 0.00 |
| March | 43.75 | 0.00 | 43.75 | 140.77 | 0.00 |
| April | 43.75 | 0.00 | 43.75 | 0.00 | 15.92 |
| May | 43.75 | - 43.92 | 43.75 | 7.92 | 0.00 |
| June | 43.75 | 0.00 | 43.75 | 0.00 | 17.89 |
| July | 21.39 | 0.00 | 43.75 | unlimited | 22.36 |
| August | 43.75 | 0.00 | 43.75 | 0.00 | 32.58 |
| September | 43.75 | 0.00 | 43.75 | 0.00 | 20.13 |
| October | 43.75 | - 301.20 | 43.75 | 90.49 | 0.00 |
| November | 13.69 | 0.00 | 43.75 | unlimited | 30.06 |
| December | 43.75 | - 392.21 | 43.75 | 0.20 | 0.00 |
| Hired labor | | | | | |
| January | 150.00 | - 92.21 | 150 | 0.00 | 0.34 |
| February | 147.56 | 0.00 | 150 | unlimited | 2.44 |
| March | 140.77 | 0.00 | 150 | unlimited | 9.23 |
| April | 134.08 | 0.00 | 150 | unlimited | 15.92 |
| May | 150.00 | - 43.92 | 150 | 7.92 | 0.00 |
| June | 132.11 | 0.00 | 150 | unlimited | 17.89 |
| July | 127.64 | 0.00 | 150 | 83.19 | 0.00 |
| August | 117.42 | 0.00 | 150 | unlimited | 32.58 |
| September | 129.87 | 0.00 | 150 | unlimited | 20.13 |
| October | 150.00 | - 301.20 | 150 | unlimited | 14.03 |
| November | 119.94 | 0.00 | 150 | 223.65 | 0.00 |
| December | 150.00 | - 392.21 | 150 | 0.20 | 0.00 |

Table B14 Allowable increases and decreases in owner and loan investment
constraints for the large farm using chemicals and bioextract

| Source of investment | Optimal Value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|---------------------------|---------------|--------------|-----------------------|--------------------|--------------------|
| Owner investment | 480,800.54 | 0.00 | 480,800.54 | unlimited | 956,637.46 |
| BAAC | 0.00 | 0.00 | 200,000.00 | unlimited | 200,000.00 |
| Agricultural co-operative | 0.00 | 0.00 | 20,000.00 | unlimited | 20,000.00 |
| Commercial bank | 152,580.17 | 0.00 | 5,000,000.00 | unlimited | 3,889,116.19 |

Table B15 Allowable increases and decreases for the goal constraints from equal weight
for the large farm using chemicals and bioextract

| Goal | Explanation | Optimal value | Shadow price | Constraints R.H. side | Allowable increase | Allowable decrease |
|------|--|------------------|-----------------|--------------------------|-----------------------|-----------------------|
| GA | Annual equivalent value (baht) | 869,429.70 | 0.00 | 869,429.70 | unlimited | 142,229.90 |
| GH | Hired labor (man–days) | 894.51 | 0.00 | 1,176.85 | unlimited | 282.35 |
| GI | Independence from external inputs (baht) | 729,039.93 | 0.00 | 1,058,377.15 | unlimited | 329,337.22 |
| GL | Loan investment (baht) | 440,845.55 | 0.00 | 708,672.57 | unlimited | 267,827.02 |
| GY | Yield variance (kg) | 35,476.12 | 0.00 | 46,218.06 | unlimited | 10,741.94 |
| GR | Revenue variance (baht) | 723,841.50 | 0.00 | 998,378.34 | unlimited | 274,536.84 |
| GS | Off-farm work (baht) | 38,750.00 | 0.00 | 38,750.00 | unlimited | 20,179.31 |

CURRICULUM VITAE

Name Miss Panitpim Sittisak
Date of birth January 02, 1973
Place of birth Chiang Rai Province, Thailand

Education background:

1991 – 1995 B.Sc. Agricultural Science
Chiangmai Rajabhat Institution, Chiang Mai, Thailand

2009 – 2015 B.Sc. Economics
Sukhothai Thammathirat University, Bangkok, Thailand

1998 – 2001 M.Sc. Agricultural Economics
Maejo University, Chiang Mai, Thailand

2010 – 2015 Ph.D. Agricultural Systems
Center for Agricultural Resource Systems Research, Faculty of
Agricultural, Chiang Mai University, Chiang Mai, Thailand

Work experience:

1995 – 1996 Know You Seed Co., LTD.
43 Ratchpurk Road, Chang Phurk, Muang, Chiang Mai, Thailand

1997 – 1998 Berli Jucker Co., LTD.
99 Ruber street, Sukhumvit Road 42, Phrakanong, Khlongtoei,
Bangkok, Thailand

- 1998 – 2001 Research Assistant
The Royal Project, Chiang Mai, Thailand
- 2001- 2006 Research Assistant
Multiple Cropping Center, Faculty of Agricultural, Chiang Mai
University, Chiang Mai, Thailand
- 2007 – 2008 Research Assistant
Faculty of Economic, Chiang Mai University, Chiang Mai,
Thailand
- 2009 – Present Freelance Researcher

