Appendix I

THE CULTIVATION OF THE FIVE CROPS IN THE AMPAEM DRAWDOWN AREA

Crop	Varieties	Conditions for growth	Soils	Land preparation	Method of propagation	Spacing
MAIZE	La Posta (popular) Composite IV	Can be grown both in dry and rainy seasons. Requires a minimum, well-distributed rainfall of about 1016 mm	It does best in well-drained sandy loams.	Hoeing-to clear weed in the path of the the rising water or ploughing.	Sow directly; 1-2 seeds per hole.	60 cm x 30 cm
TOMATOES	Roma V.F. (popular) "Worso-Worso" "Owusu-bio"	Can be grown both in dry and rainy seasons. Optimal temperatures for growth are 29°C during the day and 18°C at Night. Requires medium but well-distributed rainfall, with irrigation in the dry period.	Requires a rich well-drained sandy loam or clay loam. Gentle slope soils are the best.	Hoeing-to clear weed in the path of the rising water or ploughing.	Sow in seed beds. Transplant some 4-5 weeks later.	60 cm x 30 cm
OKRO	"Nkruma Asutem" (popular) "Nkruma Afuogya" "Putsele"	Can be grown both in dry and rainy seasons. Where rainfall is limiting it may be irrigated.	Grows in a wide variety of soils throughout the year. Best is well-drained sandy loams.	Hoeing-to clear weeds in the path of rising water or ploughing.	Sow directly; 2-3 seeds per hole, and 1-2 cm deep.	70 cm x 30 cm
GROUNDNUTS	Mani Pinta	Can be grown both in dry and rainy seasons. Requires steady high temperatures of some 20-30°C. A moderate but well distributed rainfall, with irrigation during dry periods.	Coarse or fine textured light sandy loams.	Hoeing-to clear weed in the path of the rising water or ploughing.	Sow directly; 1-2 seeds per hole.	60 cm x 15 cm
COWPEAS	"Adua fitaa" (popular) "Adua asontem"	Requires warm climatic conditions. It benefits from extra water/irrigation during the dry months. Can be grown both in dry and rainy season.	Prefers loamy soils.	Hoeing-to clear weeds in the path of the rising water or ploughing.	Sow directly; 2-3 cm deep.	60 cm x 7 cm

Appendix I (contd.)

THE CULTIVATION OF THE FIVE CROPS IN THE AMPAEM DRAWDOWN AREA

Crop	Seed rate	Time to reach (maturity wks)	Time of planting	Fertiliser application	Irrigation/Watering		Weeding
					Level of moisture	Irrigation frequency interval	
MAIZE	45 kg/ha	9-16 after planting	At any time; but preferably after the first rains of the season	Basal dressing/ha = 4 bags of N.P.K. Top dressing/ha = 4 bags of NH_4SO_4 30 days after germination = 4 bags of NH_4SO_4 60 days after germination.	50-70 mm	9-10 days	At least twice
TOMATOES	0.5 kg/ha	10-14 after planting	At any time	Basal dressing/ha = 4 bags of N.P.K. on transplanting. Top dressing/ha = 10 bags 4 weeks after transplanting.	50-70 mm	7-9 days	At least twice
OKRO	9 kg/ha	8-12 from planting	At any time	Basal dressing/ha = 6 bags of N.P.K. Top dressing/ha (when in bearing) = 4 bags of NH_4SO_4.	50-70 mm	9-10 days	At least twice
GROUNDNUTS	50 kg/ha	12-16 from planting	At any time	Basal dressing/ha = 4 bags of single superphosphate before seeding.	50-70 mm	12-14 days	At least twice.
COWPEAS	65 kg/ha	10-14 from sowing	At any time	Basal dressing/ha = 10 bags of N.P.K. before planting.	50-70 mm	9-10 days	At least twice.

Appendix I (contd.)

THE CULTIVATION OF THE FIVE CROPS IN THE AMPAEM DRAWDOWN AREA

Crop	Pest control	Harvesting and marketing	Storage
MAIZE	Aldrex T or Dieldrex A for seed dressing. Aldrex 40 for spraying	In wet season, crop can be harvested green and sold to the roasting and boiling markets. In the dry season, harvested crop is usually-husked and shelled (by hand).	Some means of drying are used to provide storage conditions. The use of "Edib" grain preservative is recommended for protection.
TOMATOES	Aldrex T or Dieldrex B for seed dressing. Aldrex 40 for spraying.	If fruits are to be transported for a long distance, they are harvested when still yellow.	Can be canned in its puree form. The "Roma" variety can keep for about 2 weeks if picked yellow-green.
OKRO	Aldrex T or Dieldrex B for seed dressing. Aldrex 40 for spraying.	Harvesting is done as soon as fruits mature to avoid over-grown fruits except when harvesting for seed, in which case the fruits can be allowed to mature and dry before harvesting.	Can be refrigerated.
GROUNDNUTS	Alrex T or Dieldrex A for seed dressing. Aldrex 40 for spraying.	After harvesting, nuts are dried, and then shelled.	Can be stored shelled as well as unshelled. Pest can be controlled with Gammalin A dust. Can be processed into vegetable oil.
COWPEAS	Aldrex T or Dieldrex A for seed dressing. Aldrex 40 for spraying.	Usually pods are allowed to dry before beans are harvested. However pods may be harvested green.	The well dried beans/seeds store well. Otherwise fumigate with Ethylene Dibromide (Edib.).

Sources:
1. Agronomy Section, VLR & DP, Akosombo.
2. Irrigation Development Authority, Accra.
3. Ministries of Agriculture.
4. Interviews with farmers.

Appendix II

GROSS MARGIN BUDGETS FOR THE FIVE CROPS

In computing the gross margins for the five crops the following limitation which is based on a certain assumption needs mentioning. Gross value of output which is made up of expected yield x expected price, is subject to year-to-year variation. The present study has been designed to reflect the farmers actual situation in 1982/83 cropping year, and average yields and farm gate prices were used in the analysis. Therefore there is likely to be a loss in value by using data based on a single year as it may be atypical, particularly in the case of crops. However, it was observed that the data did not deviate much from those of the two previous seasons (see Table below). Thus is was assumed that the data represent an average of three years.

Crops	Yields (kg/ha)			Farm gate prices (¢/kg)		
	1980/81	1981/82	1982/83	1980/81	1981/82	1982/83
MAIZE						
Irrigated	3500	3570	3550	8.90	8.80	9.00
Non-irrigated	1100	1050	1000	8.90	8.80	9.00
TOMATOES						
Irrigated	9900	9900	9900	3.60	4.20	4.00
Non-irrigated	3200	3050	3000	3.60	3.90	4.00
OKRO						
Irrigated	4650	4600	4630	6.80	7.00	7.00
Non-irrigated	2400	1200	1300	6.80	7.00	7.00
GROUNDNUTS						
Irrigated	2400	2500	2470	15.00	14.80	15.00
Non-irrigated	1000	1000	900	15.00	14.80	15.00
COWPEAS						
Irrigated	2555	2600	2550	12.90	13.00	13.00
Non-irrigated	1100	1020	1050	12.90	13.00	13.00

Source: Agronomy Section, VLR & DP, Akosombo; Interview with Farmers at the Ampaem area.

(a) GM for maize:

Irrigated maize (¢):

Gross value of output per ha:-		
3500 kg @ ¢9.00 per kg		= 31 500
Less variable costs per ha:-		
Seeds, 45 kg @ ¢10.00/kg	= 450	
Fertiliser, 200 kg N.P.K. @ ¢3.6/kg	= 720	
400 kg NH_4SO_4 @ ¢2.9/kg	= 1 160	
Sprays	= 432	
Fuel, 72.7L of diesel @ ¢22/L .	= 1 600	
2.27L engine oil @ ¢ 88/L	= 200	
Repairs and maintenance	= 260	
Transport	= 2 500	
	= 7 322	
		¢24 178

Non-irrigated maize (¢):

Gross value of output per ha:-		
100 kg @ ¢9.00 per kg		= 900
Less variable costs per ha:-		
Seeds, 45 kg @ ¢10.00/kg	= 450	
Transport	= 800	
	= 1 250	
		7 750

(b) GM for tomatoes:

Irrigated tomatoes (¢):

Gross value of output per ha:-		
9900 kg @ ¢4.00 per kg		= 39 600
Less variable costs per ha:-		
Seeds, 0.5 kg @ ¢1056/kg	= 528	
Fertiliser, 200 kg N.P.K. @ ¢3.6/kg	= 720	
500 kg NH_4SO_4 @ ¢2.9/kg	= 1 450	
Sprays	= 432	
Fuel, 90.8L of diesel @ ¢22/L	= 2 000	
2.27L engine oil @ ¢88/L	= 200	
Repairs and maintenance	= 260	
Transport	= 2 500	
	= 8 090	
		31 510

Non-irrigated tomatoes (¢):

Gross value of output per ha:-		
3000 kg @ ¢4.00 per kg		= 12 000
Less variable costs per ha:-		
Seeds, 0.5 kg @ 1056/kg	= 528	
Transport	= 800	
		= 1 328
		¢10 672

(c) GM for okro:

Irrigated okro (¢):

Gross value of output per ha:-		
4630 kg @ ¢7.00 per kg		= 32 410
Less variable costs per ha:-		
Seeds, 9 kg @ ¢7/kg	= 63	
Fertiliser, 300 kg N.P.K. @ ¢3.6/kg	= 1 080	
200 kg NH_4SO_4 @ ¢2.9/kg	= 580	
Sprays	= 432	
Fuel, 90.8L of diesel @ ¢ 22/L	= 2 000	
2.27L of engine oil @ ¢ 88/L	= 200	
Repairs and maintenance	= 260	
Transport	= 2 500	
		= 7 115
		¢25 295

Non-irrigated okro (¢):

Gross value of output per ha:-		
1300 kg @ ¢7.00 per kg		9 100
Less variable costs per ha:-		
Seeds, 9 kg @ ¢7/kg	= 63	
Transport	= 800	
		= 863
		¢8 237

(d) GM for groundnuts:

Irrigated groundnuts (¢):

Gross value of output per ha:-		
2470 kg @ ¢15.00 per kg		= 37 050
Less variable costs per ha:-		
Seeds, 50 kg @ ¢15/kg	= 750	
Fertiliser, 400 kg S.S.P. @ ¢3/kg	= 1 200	
Sprays	= 432	
Fuel, 72.7L of diesel @ ¢ 22/L	= 1 600	
2.27L engine oil @ ¢88/L	= 200	

Repairs and maintenance	=	260	
Transport	=	2 500	
			= 6 942
			¢30 108

Non-irrigated groundnuts (¢):

Gross value of output per ha:-			
900 kg @ ¢15.00 per kg			= 13 500
Less variable costs per ha:-			
Seeds, 50 kg @ ¢15/kg	=	750	
Transport	=	800	
			= 1 550
			¢ 11 950

(e) GM for cowpeas:

Irrigated cowpeas (¢):

Gross value of output per ha:-			
2550 kg @ ¢13.00 per kg			= 33 150
Less variable costs per ha:-			
Seeds, 65 kg @ ¢ 13/kg	=	845	
Fertiliser, 500 kg N.P.K. @ ¢3.6/kg	=	1 800	
Sprays	=	432	
Fuel, 72.7L of diesel @ ¢ 22/L	=	1 600	
2.27L engine oil @ ¢ 88/L	=	200	
Repairs and maintenance		260	
Transport	=	2 500	
			= 7 637
			¢25 513

Non-irrigated cowpeas (¢):

Gross value of output per ha:-			
1050 kg @ ¢13.00 per kg			= 13 650
Less variable costs per ha:-			
Seeds, 65 kg @ ¢13/kg	=	845	
Transport	=	800	
			= 1 645
			12 005

Appendix III

HIRED LABOUR SCHEDULES FOR THE FIVE CROPS (man-hours per ha)

(Wage rate of labour = ¢7.5/m-hr)

Crops	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
MAIZE:										
Irrigated	41.6	118.4	144.0	160.0	128.0	144.0	6.4	112.0	185.6	80.0
Non-irrigated	41.6	54.4	64.0	80.0	70.4	153.6	6.4	64.0	144.0	41.6
TOMATOES:										
Irrigated	89.6	102.4	144.0	224.0	64.0	176.0	54.4	112.0	281.6	64.0
Non-irrigated	89.6	54.4	64.0	128.0	32.0	169.6	38.4	64.0	208.0	32.0
OKRO:										
Irrigated	41.6	112.0	134.4	176.0	112.0	144.0	6.4	102.4	211.2	80
Non-irrigated	41.6	74.4	64.0	73.6	80.0	137.6	6.4	57.6	156.8	48
GROUNDNUTS:										
Irrigated	41.6	112.0	112.0	176.0	96.0	144.0	6.4	99.2	188.8	80
Non-irrigated	41.6	70.4	57.6	73.6	80.0	137.6	6.4	57.6	80.0	32
COWPEAS:										
Irrigated	41.6	112.0	112.0	176.0	96.0	144.0	6.4	99.2	188.8	80
Non-irrigated	41.6	70.4	57.6	73.6	80.0	137.6	6.4	57.6	80.0	32

Source: Interview with Farmers.

[1] Hired labour is usually employed in harvesting, crop management (especially control), planting, and land preparation in that order of importance.

Appendix IV

QUESTIONNAIRE FOR DRAWDOWN FARMERS

A. GENERAL INFORMATION

Name of Farmer _____

Address _____

Type of Farm (output pattern) _____

Type of Business: (one owner/partnership/private company etc.) _____

Ownership of Land:

Area owned (ha) _____

Area rented (ha) _____

Other areas (specify) (ha) _____

Outline of Management Problems _____

Notes on Farmer's Objectives and General Preferences _____

B. RESOURCES AVAILABLE

B1. LAND

Total Farm Area (ha) _____

Area of Ploughable Land (ha) _____; Soil Type _____

Area of Non-ploughable Land (ha) _____; Soil Type _____

Area Not Suitable for Specificy Purposes _____

Area suitable for Specific Purposes _____

B2. LABOUR

Regular Labour (Including Members of Family):

No. available _____ Full-time/Part-time _____

Type of manual work _____

Machine operator(s):

Full-time; No. _____ Annual cost/man (¢) _____

Part-time; No. _____ Annual cost/man (¢) _____

Other field workers:

Full-time; No. _____ Annual cost/man (¢) _____

Part-time; No. _____ Annual cost/man (¢) _____

Casual Labour:

Task _____

Period covered _____

Number available _____

Rate of work _____

Transport arrangements _____

Remuneration _____

Contract Work:

Task _____

Period covered _____

Numbers available _____

Rate of work _____

Remuneration _____

Notes _____

B3. CAPITAL

Current Liabilities:

Items _____

Sum outstanding _____

Rate of interest _____

Repayment terms _____

Credit:

Sources _____

Sum available _____

Rate of interest _____

Repayment terms _____

Possible investments being considered _____

Buildings:

Type _____

Capacity _____

Purposes _____

Alternative uses _____

Machinery:

Types _____ Cost _____ Age _____ Approx. Capacities _____

C. PLANNING RESTRICTIONS

Cropping Restrictions:

Crop type ____ Max. ha ____ Min. ha ____ Reasons _____

Rotation Limits _____

Personal Restrictions _____

Marketing Restrictions _____

Labour and Equipment Restrictions _____

D. SERVICES

Availability of Electricity _____

Piped water _____

Health posts _____

Schools _____

Roads _____

E. ACTIVITY DATA

Output/ha:

Crop type ____ Anticipated yield ____ Price ____ Subsidy ____

____ ____ ____ ____

Home consumption _____

Variable Costs/ha:

Seeds _____

Fertilisers _____

Sprays _____

Other materials _____

Casual labour _____

Contract labour _____

Transport _____

F. OTHER NOTES/COMMENTS

REFERENCES

Ahn, P. (1970), 'Brief progress report on work carried out on the Lake drawdown area, July 1968 - February 1970', VBRP Technical Report 34, University of Ghana, Legon.

Amaugo, G.P. (1979), Agricultural utilization of reservoir drawdown areas - the Kainji Lake drawdown, Unpublished paper, 1-8.

Amametekpor, J.K. (1970), 'Some investigations on soils, agricultural land use, insect pests and plant diseases in the drawdown area of the Volta Lake', VBRP Technical Report 36, University of Ghana, Legon.

Atubra, F.K. (1977), Economic Studies of agriculture in the Volta basin: pre-irrigation studies, B.Sc. dissertation, University of Ghana, Legon.

Barnard, C.S. and Nix, J.S. (1979), Farm Planning and Control 2nd Edition, Cambridge University Press.

Baumol, W.J. (1963), 'An expected grain confidence limit criterion for portfolio selection', Management Science 10 (October), 174-82.

Camm, B.M. (1962), 'Risk in vegetable production on a fen farm', Farm Economist 10(2), 89-98.

Castle, E.N., Becker, M.H., and Smith, F.J. (1972), Farm Business Management 2nd edition, Macmillan, New York, ch 1-2.

Cocks, K.D. (1968), 'Discrete stochastic programming', Management Science 15, 72-79.

Core, P. (1973), Retraining and off-farm migration rates, M.Ec. dissertation, University of New England, Armidale.

Desai, D.K. (1963), 'Increasing income and production in Indian farming', Indian Society of Agricultural Economics, Bombay.

Dillon, J.L. and Hardaker, J.B. (1980), Farm Management Research for Small Farmer Development, Agricultural Services Bulletin 41, FAO, Rome, 21-22.

Duloy, J.H. and Norton, R.D. (1975), 'Prices and incomes in linear programming models', American Journal of Agricultural Economics (Nov.), 591-600.

Eicher, C.K. (1983), West Arica's agrarian crisis, Paper prepared for the fifth bi-annual conference of the West African Association of Agricultural Economists, Abidjan, December 1983, 7-11.

Ewusi, K. (1981), The Economy of Ghana: Recent Trends and Prospects for the Future, University of Ghana, Legon, 6-8.

Freund, R.J. (1956), 'The introduction of risk into a programming model', Econometrica 24 (July), 253-63.

Ghana (1977), Ghana 1977: An Official Handbook, Information Services Department, New Times Corporation, Accra.

_____ (1980), Food for the People: Two-year (1980-81) Crash Programme, Ministry of Agriculture, Accra.

_____ (1981), Economic Survey: 1977-80, C.B.S., Statistical Service Board, December, Accra.

_____ (1982), Quarterly Digest of Statistics 1(6), C.B.S. Statistical Service Board, September, Accra.

_____ (1983), Economic Survey: 1980-82, C.B.S., Statistical Service Board, December, Accra.

Hardaker, J.B. (1971), Farm Planning by Computer, Technical Bulletin No. 19, Ministry of Agriculture, Fisheries and Food, H.M.S.O., London.

_____ (1978), Farm Planning by Computer, Technical Bulletin No. 19, revised edition, Ministry of Agriculture, Fisheries and Food, H.M.S.O., London.

Hardaker, J.B. and Pearse, R.A. (1980), BGPP: A programme for solving linear programming methods, University of New England, Armidale.

Hazell, P.B.R. (1971), 'A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning under Uncertainty', American Journal of Agricultural Economics 53, 53-62.

Heady, E.O. and Candler, W.V. (1958), Linear Programming Methods, Ames, Iowa State University Press.

Holmes, W.E. and Buffier, B.D. (1975), Gross Margin Budgeting - Survey and Commentary, N.S.W. Department of Agriculture, North West Region, Bulletin No. 8.

Huddleston, B. (1983), Closing the cereal gap with trade and food aid, IFPRI, Washington.

Ilaco, B.V. (ed.) (1981), Agricultural Compendium for Rural Development in the Tropics and Subtropics, Elsevier, N.Y., 476-96.

Kaul, S.N. and Rao, V.M. (1960), 'Deep water paddy cultivation in multi-purpose reservoirs', Journal of Soil and Water Conservation in India 8(2 & 3), 47-511.

Kaul, S.N. (1973), Conservation, agronomy in man-made lakeshore lands, Regional seminar on shifting cultivation and soil conservation in Africa, 2nd-21st July, Ibadan.

Kearl, B. (ed.) (1976), Field Data Collection in Social Sciences, Agricultural Development Council, Inc., New York.

Killick, T. (1978), Development Economics in Action: A Study of Economic Policies in Ghana, Studies in the Economics of Africa, H.E.B., 261-3.

Laryea, K.B. (1973), Work programme for the evaluation of the irrigation potential of the drawdown and the immediately adjacent areas of the Volta Lake, VLR & DP, Akosombo, Unpublished paper.

Lawson, R.M. (1968), 'An interim economic appraisal of the Volta resettlement scheme', Nigerian Journal of Economic and Social Studies 10(1), March, 100-104.

Lee, S.M., Moore, L.J. and Taylor, B.W. (1981), Management Science, Wcb, U.S.A.

Makeham, J.P. and Malcolm, L.R. (1981), The Farming Game, Gill Publications, Armidale, 250-317.

Malassis, L. (1975), Agriculture and the Development Process, UNESCO Press.

Markowitz, H.M. (1959), Portfolio Selection: Efficient Diversification of Investments, John Wiley and Sons, New York.

Nuamah, G.E.A. (1976), 'Screening of tomato varieties (Lycopersicon esculentum Mill.) for suitability on the drawdown areas of the Volta Lake of Ghana', Ghana Journal of Agricultural Science 9, Ghana University Press, Accra, 143-44.

Ofei-Mensah, A. (1981), End of season report (tomatoes): Ampaem pilot irrigation scheme, VLR & DP, Akosombo, Unpublished paper.

Oyedipe, F.P.A. (1974), The relative success of the Kainji resettlement scheme as compared with that of Volta, KLRI, Kwara State, Unpublished paper.

Paulino, L. (1983), The evolving food situation in Sub-Sahara Africa, Paper presented at IFPRI/Univ. Zimbabwe conference, Victoria Falls.

Richardson, L.F. (1956), 'Mathematics of war and foreign politics', I J.R. Newman (ed.), The World of Mathematics, Vol. 2, Simon and Schuster, New York, 1240-63.

Schluter, M.G.G. and Mount, T.D. (1976), 'Some management objectives of the peasant farmer: an analysis of risk aversion in the choice of cropping pattern in Surat District of India', Journal of Development Studies 12, 246-61.

Sinderus, W. (1974), Kainji Lake drawdown area, Report prepared for the Kainji Lake Research Project, FAO, Rome, 1-32.

Szerezewski, R. (1965), Structural Change in the Economy of Ghana, Weidenfeld and Nicolson, London, 189-191.

Tamakloe, M. (1970), 'A case study of a resettlement town: new Mpamu', In R. Chambers (ed.), The Volta Resettlement Experience, Pall Mall Press, London, 193-4.

Trebeck, D.B. and Hardaker, J.B. (1972), 'The integrated use of simulation and stochastic programming for whole farm planning under risk', Australian Journal of Agricultural Economics 16(2), 115-126.

Upton, M. (1973), Farm Management in Africa, Oxford University Press.

Young, D.F. and Rickards, P.A. (1978), AGRIPLAN: A User's Manual for Small Farm Analysis, Farm Management Unit, FAO, Rome.