

4.2 Farming

There are more than 83,000 farms in Oman. The national average farming scale is low (about 1 ha -- average area under cultivation is 0.6 ha), although it is rather higher in the region along the Batinah coast (approximately 1.6 ha), but much lower in the Salalah region (around 0.15 ha).

Farm types are generally classified into three types: new farms, traditional farms, and commercial farms. The term "new farm" refers to farms exclusively devoted to agriculture that have been settled on previously uncultivated land within about the last ten years. "Traditional farm" refers to farms run by families that have been living on the same land for a very long time, that use water from aflaj or hand-dug wells, and that do agriculture using mainly traditional flood irrigation for date palms, coconuts, etc.

Commercial farms consider agricultural production as a profit-making enterprise, and operate on a large commercial scale with their main purpose being the pursuit of profit. In Oman, there are over 2,500 new farms, at least 80,000 traditional farms, and more than 100 commercial farms.

In the first phase, the JICA team selected representative examples totaling eight new farms, four traditional farms, and one commercial farm from the five main agricultural regions, and studied current conditions of agriculture in Oman. The results of this study on crop cultivation area, proportions of area under cultivation for the different crops, and income production are shown in Tables 4.3 to 4.7.

In order to estimate a realistic farming index at the end of the 10-year Agricultural Development Plan the knowledge and information gained from this study and results of analysis of the information available before the study were used to draw up farming improvement models, which were then utilized to estimate projected farmers' income.

Table 4.3 Planted Area, Rate of Cropped Area and Production of New Farms in North Batinah Region

Crops		Farms	Planted area (ha)				Rate of cropped area (%)			
			1	2	3	Average	1	2	3	Average
Fruit	Date palm		1.00	0.22	0.53	0.58	2.44	5.4	1.29	1.42
	Orange etc		0.10	0.53	0	0.21	2.4	12.9	0	5.1
	Mango		0.05	0.21	0.02	0.09	1.2	5.1	0.5	2.3
	Banana		0.05	0	0	0.02	1.2	0	0	0.4
	Total		1.2	0.96	0.55	0.9	29.2	23.4	13.4	22.0
Fodder	Alfalfa		0.42	0	0.84	0.42	10.2	0	20.5	10.2
(Semi-perennial)	Total		0.42	0	0.84	0.42	10.2	0	20.5	10.2
Vegetable	Wheat		0.21	0	0	0.07	5.1	0	0	1.7
&	Barley		0.21	0	0	0.07	5.1	0	0	1.7
Field crop	Sorghum		0.21	0	0	0.07	5.1	0	0	1.7
	Cowpea		0	0	0.08	0.03	0	0	2.0	0.7
	Water melon		0.50	1.05	0	0.52	12.2	25.5	0	12.6
	Sweet-melon		0	1.00	0	0.33	0	24.3	0	8.1
	Tomato		0.50	1.05	0.84	0.80	12.2	25.5	20.5	19.4
	Cabbage		0.43	0	0	0.14	10.5	0	0	3.5
	Onion		0.42	0.05	0.40	0.29	10.2	1.2	9.8	7.1
	Cucumber		0	0	0.84	0.28	0	0	20.5	6.8
	Chilli pepper		0	0	0.42	0.14	0	0	10.2	3.4
	Eggplant		0	0	0.11	0.04	0	0	2.7	0.9
	Raddish		0	0	0.02	0.01	0	0	0.5	0.2
	Total		2.48	3.15	2.71	2.78	60.4	76.5	66.2	67.7
Total			4.10	4.11	4.10	4.10	99.8	99.9	100.1	99.9
Net production profit* (R0/FARM)			2938	4671.4	3199.3	2721.5	-	-	-	-
			(per 4.1 ha: 2,721.5R0)							
do (R.O./ha)			71.7	1136.6	780.3	663.8	-	-	-	-

Note: *Depreciation cost is not included in production cost.

Table 4.4 Planted Area, Rate of Cropped Area and Production Profit of New Farms in the Interior Region

Crops		Farms	Planted area (ha)					Rate of cropped area (%)				
			1	2	3	4	Average	1	2	3	4	Average
Fruit	Date Palm		0.42	0.42	2.70	0.05	0.90	3.7	10.5	19.0	1.0	8.55
	Lime & other Citrus		0.21	0.10	--	0.75	0.27	1.9	2.6	--	15.2	4.93
	Mango		--	0.05	--	0.10	0.04	--	1.3	--	2.0	0.83
	Banana		--	--	--	0.05	0.01	--	--	--	1.0	0.25
	Guava		--	0.05	--	--	0.01	--	1.3	--	--	0.33
	Total		0.63	0.62	2.70	0.95	1.23	5.6	15.7	19.0	19.2	14.88
Fodder (Semi-Perennial)	Alfalfa Rhodes grass		1.26	0.42	4.20	1.68	1.89	11.1	10.5	29.6	34.0	21.30
	Total		1.68	0.42	4.62	2.52	2.31	14.8	10.5	32.6	51.0	27.23
Vegetable & Field crop	Wheat		--	0.42	--	--	0.11	--	10.5	--	--	2.63
	Barley		--	0.21	--	0.42	0.16	--	5.3	--	8.5	3.45
	Sorghum		--	0.21	0.42	--	0.16	--	5.3	3.0	--	2.08
	Cowpea		--	--	0.26	--	0.07	--	--	1.8	--	0.45
	Sugar cane		0.84	--	--	--	0.21	7.4	--	--	--	1.85
	Maize		0.21	--	--	--	0.05	1.9	--	--	--	0.48
	Water-melon		1.26	0.42	2.52	--	1.05	11.1	10.5	17.7	--	9.83
	Sweet-melon		1.26	0.42	--	--	0.42	11.1	10.5	--	--	5.40
	Tomato		0.42	0.42	2.10	0.84	0.95	3.7	10.5	14.8	17.0	11.50
	Chilli pepper		0.84	--	--	--	0.21	7.4	--	--	--	1.85
	Potato		0.42	0.21	--	--	0.16	3.7	5.3	--	--	2.25
	Cucumber		0.42	--	0.42	--	0.21	3.7	--	3.0	--	1.68
	Onion		1.26	0.21	0.42	--	0.47	11.1	5.3	3.0	--	4.85
	Garlic		0.84	0.21	--	0.21	0.32	7.4	5.3	--	4.3	4.25
	Cabbage		0.42	--	0.42	--	0.21	3.7	--	3.0	--	1.68
	Carrot		0.82	0.21	--	--	0.26	7.2	5.3	--	--	3.13
	Beet		--	0.02	--	--	0.01	--	0.5	--	--	0.13
Couflower		--	--	0.21	--	0.05	--	--	1.5	--	0.38	
Lettuce		--	--	0.11	--	0.33	--	--	0.8	--	0.20	
Total		9.01	2.96	6.88	1.47	5.08	79.4	74.3	48.6	29.8	58.03	
Total			11.32	4.00	14.20	4.94	8.62	99.8	100.5	100.2	100.0	100.14
Net production profit* (RO/FARM)			17529.8	3552.5	6039.1	3556.0	7669.4	--	--	--	--	--
do (R.O./ha)			1548.6	888.1	425.3	719.8	889.7	--	--	--	--	--
			(per 4.1 ha: 3,647.8RO)									

Note: *Depreciation cost is not included in production cost.

Table 4.5 Planted Area, Rate of Cropped Area and Production Profit of New Farm and Traditional Farm in Salalah Region

Crops	Farmers		New farm		Traditional farm	
	Planted area (ha)	Rate of cropped area (%)	Planted area (ha)	Rate of cropped area (%)	Planted area (ha)	Rate of cropped area (%)
Fruit	Coconut	0.18	7.8	0.18	8.9	
	Banana	1.05	45.3	1.05	51.7	
	Lime	0.02	0.9	0.02	1.0	
	Papaya	0.06	2.6	0.08	3.9	
	Total	1.31	56.6	1.33	65.5	
Vegetable	Chilli pepper	0.59	25.4	0.59	29.1	
	Eggplant	0.21	9.1	—	—	
	Cauliflower	0.21	9.1	—	—	
	Sweet potato	—	—	0.11	5.4	
	Total	1.01	43.6	0.70	34.5	
Total	2.32 (Net area 1.84)	100.2	2.03 (Net area 1.84)	100.0		
Net production profit* (RO/FARM)	1,220,370 (per 2.0 ha: 1,326.5 RO)	—	1,679,600 (per 0.5 ha: 456.4 RO)	—		
do (R.O./ha)	663,245	—	912,826	—		

Note: Depreciation cost is not included in production cost.

Table 4.6 Planted Area, Rate of Cropping Area and Production Profit of Traditional Farms in South Batinah Region

Crops	Farms	Crops Farms Planted area (ha)		Rate of cropped area (%)		
		1	2	1	2	Average
Fruit	Date palm	0.42	0.17	67.7	32.7	50.2
	Total	0.42	0.17	67.7	32.7	50.2
Fodder (Semi-perennial)	Alfalfa	0.10	0.18	16.1	34.6	25.4
	Total	0.10	0.18	16.1	34.6	25.4
Vegetable & Field crop	Barley	-	0.17	-	32.7	16.4
	Water melon	0.02	-	3.2	-	1.6
	Sweet-melon	0.06	-	9.7	-	4.9
	Onion	0.01	-	1.6	-	0.8
	Leek	0.01	-	1.6	-	0.8
	Total	0.10	0.17	16.1	32.7	24.5
Total		0.62	0.52	100	100	100.1
Net production profit* (RO/farm)		-384.960	-165.510	-	-	-
do (RO/ha)		-620.903	-318.288	-	-	-
				(per 0.5ha : -234.8 RO)		

Note: *Depreciation cost is not included in production cost.

Table 4.7 Planted Area, Rate of Cropped Area and Production Profit of a Commercial Farm (Oman Modern Farm)

Category	Crops	Planted area (ha)	Percentage (%)	2) Production amount (RO)	3) Production cost	Net production profit ⁴⁾
Fruit	Date palm	1.0	1.8	615.000	2.033.000	-1.418.000
	Lime	3.0	5.5	3.888.000	4.827.000	- 939.000
	Lemon	5.0	9.1	11.250.000	8.045.000	3.205.000
	Orange	5.0	9.1	9.625.000	8.050.000	1.575.000
	Mango	1.0	1.8	500.000	1.642.000	-1.142.000
	Total	15.0	27.3	25,878.000	24,597.000	1,281.000
Vegetable	Tomato	2.4	4.4	5,126.400		
	Water melon	2.0	3.7	2,640.000		
	Sweet-melon	11.0	20.0	61,600.000		
	Squash	6.3	11.5	11,781.000		
	Cabbage	10.0	18.2	39,600.000		
	Cauliflower	1.5	2.7	2,415.000		
	Sweet potato	2.7	4.9	8,100.000		
	Sweet corn	1.5	2.7	2,315.250		
Total	37.4 ¹⁾	68.1	133,577.650	52,700.000	80,877.650	
Green house (Pad & Fan system)	Cucumber, Sweet pepper, Tomato, etc	1.5	2.7	64,332.000	26,700.000 ⁵⁾	
					138,076.000 ⁶⁾	-100,444.000
Hydroponic facilities (circulation System)	Lettuce & others	1.0	1.8	30,246.000	18,700.000 ⁵⁾	
					53,576.000 ⁶⁾	-42,030.000
Total (Net production area 42.5 ha)		5.49	100.0	254,033.650	314,349.000	-60,315.350

Notes:

1) Net production area 25 ha. annual land utilization rate
 $R = 37.4 / 25.0 \times 100 = 149.6\%$.

2), 3) and 4) Fruit values are calculated based on average yield (ton/ha), unit sale price (RO/ton) and production cost (RO/ha: depreciation cost not included) which are indicated in the "Annual Update of Important Statistical Series" by the DAS, of MAF.
 Depreciation cost is not taken into consideration in net production profit.

2), 3) and 4) Vegetables, green house, hydroponic facilities
 production amount is based on the actual result of Oman Modern Farm production cost includes depreciation cost.
 Net production profit is considered with depreciation cost.

5) Production cost including personnel expenses

6) Operation cost + depreciation cost

(1) Formation of Farming Improvement Models

Improved present farming models are firstly formulated on the assumption of the introduction of modern irrigation methods and major crops (Table 4.2), and modification of the ratio of areas under cultivation between the different crops. The present unit yield which is shown in Table 4.15 is used for the calculation in these improved models. Taking into account the potential for technological improvements in the future, final farming improvement models are worked out on the basis of the improved present models. The details of those preconditions and the values for increases in production they are expected to result in are given below.

Technological Improvement Methods
and Expected Increases of Production
in Farming Improvement Models

Parameter	Technological Improvement Methods	Expected production increase
Improvement of crop selection and ratio of area under cultivation between crops	Following the govt's agriculture policy selecting comparatively profitable crops, and increasing their proportion of area under cultivation	At least several % (there are examples of improvements from about -300RO to about 500 RO on 0.5 ha)
Introduction of superior varieties	Introduction of good quality varieties that can be easily cultivated for high yield and to promote replacement of low yield varieties	several %
Introduction of modern irrigation methods	Fruit trees: bubbler method; semiperennial feed crops: sprinkler method. veget. and field crops: drip method. The fertilizer is dissolved in the irrigation water for application	several %

Technological Improvement Methods
and Expected Increases of Production
in Farming Improvement Models

(Continued)

Parameter	Technological Improvement Methods	Expected production increase
Improvement of cropping pattern	New farms: improving annual cropping rates. Traditional farms: in addition to the above, introducing as much inter-cropping and mixed cropping as possible	13% on traditional farms to 19% on new farms in Northern Oman several %
Introduction of crop-rotation system	The same family of crop is to be cultivated more than two years apart on the same land.	Avoiding increase of pest and soil exhaustion.
Fertilization improvement	Complete compliance with fertilization standards prepared by MAF. The current fertilization rate is 50% or less and it should be increased 100%	Depending on the kind of crops, about 30% increase in yield can be expected for feed crops, field crops and vegetables.
Thorough pest control	Appropriate selection and application of agricultural chemicals and increase of expenditure on chemicals by 50%	The reduction of income and the quality deterioration rates will be improved, at least several percent.
Increasing of unit yield (ton/ha.)	To target overall increases in income from the above improvements in technology	See Table 4.16

(a) Farming Improvement Models of New Farms

The farm management scale of the new farms in the Batinah Region and Interior Region (in a broad sense), that is including Dhahira, Dakhliya, and Sharqiya, is generally about 4.2 ha, and around 2 ha in the Salalah region. Besides mechanically drilled wells and storage pumps, large farms generally possess tractors and other planting and soil-preparation machinery, high pressure atomizers and other equipment for dealing with insect pests, threshers, and farm vehicles. They are very actively pursuing specialized agriculture in a serious, business-minded way.

(i) Batinah Region New Farms' Farming Improvement Model

As Table 4.3 shows, at the three farms studied, the average area of land under cultivation was 4.1 ha. The proportions of area under cultivation for principle crop groups were approximately 22 % for fruit trees, approximately 10 % for semiperennial feed crops. These findings showed that there was a strong tendency for farms in the study to devote high proportions of land area to vegetables. The average net income for crop production (note that depreciation is not included in costs) for the three farms was approximately R.O. 2,700 (664 R.O./ha). These farms also keep about 40 head of goats (some in this figure are sheep), generating a net income of more than R.O. 300.

The hypothetical model of current conditions with slight improvements in the kinds of major crops and proportions of area under cultivation for the different crops was produced using the above findings of the study on actual current conditions in farming. The Batinah Region new farms' improvement model was then produced by adding the technical improvements required as preconditions (those given above and those below) for increasing profitability.

Preconditions for Batinah
Region New Farms'
Farming Improvement Model

Target area	South and North Batinah
Farming scale	4.2 ha, area under cultivation: 4.1 ha, total annual cultivation area : 4.9 ha
Cropping pattern	Multiple farming; Vegetables as a main crop, combined feed crops and fruit trees. 4 vegeta- bles and 3 feed crops grown in rotation.
Field conditions	Vegetables and feed crops: 0.4 to 0.8 ha, total cultivation rate: 87.8% Fruit trees: 0.2 to 0.3 ha, total cultivation rate:12.2%
Labor capacity	Basic labor capacity: 3 workers. Machines are owned by individuals, or exten- sion center machinery is used.
Main technology, other	Improving cropping area rates: making best use of advantages of site conditions like being close to large markets of consumption, increa- se of cultivation of sweet-melons, other vegetables, and Rhodesgrass, which yield good income. Reduction of date palms, and introduc- tion of grapes which bring good profit.

Table 4.8 shows the farming indices for the Batinah Region new farms' farming improvement model. This model makes the best use of the advantages of being close to large centers of consumption and is based on multiple farming which combines vegetables (main crop) with feed crops and fruit trees, and proposes a rotation system with a cycle of six years and a cultivation interval of at least two years for the four vegetables (mainly tomatoes) and sorghum grown on the same land. Also, the feed crops are principally semiperennial Rhodes grass and alfalfa grown in rotation. Date palms -- the main kind of fruit tree in Oman, but which unfortunately do not have a good income yield -- are slightly reduced, and grapes, which do have good income yield, introduced instead.

Table 4.8 Management Index in Proposed Farming Improvement Model
for New Farms in the Batinah Region

Category	Crops	Planted area (ha/year)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase (%)	Production cost* (RO/ha)
Fruit	Date palm	0.3	7.3	6.0	46	742.2
	Grape	0.2	4.9	19.0	27	413.3
	Total (Average)	0.5	12.2	(12.5)	(36.5)	1,155.5
Fodder (Semi- perennial)	Alfalfa	0.4	9.8	7.20	88	949.4
	Rhodes grass	0.8	19.5	120.0	33	2,161.6
	Total (Average)	1.2	29.3	(96.0)	(26.5)	3,111.0
Vegetable & Field crop	Sorghum	0.4	9.8	125.0	50	905.6
	Tomato	0.8	19.5	40.0	80	1,897.4
	Sweet melon	0.8	19.5	23.0	76	1,877.8
	Potato	0.8	19.5	30.0	20	1,724.0
	Carrot	0.4	9.8	30.0	27	901.2
	Total (Average)	3.2	78.0	(49.6)	(50.6)	7,306.0
Total (Net area: 4.1 ha)		4.9	119.5	465.0	37.9	11,572.5

Note: Depreciation cost is limited to irrigation facilities, and does not include equipment and storage.

Working hours will increase at a rate of 19.5% of the increase in annual land utilization rate. However, the number of workers remains the same, because a reduction in labor for irrigation and fertilization could be possible, by the introduction of modern irrigation system.

Figure 4.6 shows the cropping pattern and rotation systems applied on this farming improvement model, and it shows that the mode suggests eight crops in six-year cycles for vegetables and field crops, setting the land utilization rate at 119.5%, which means a 19.5% increase over the current land utilization rate of 100%. Introducing modern irrigation makes the ridges used for furrow irrigation or border irrigation unnecessary, offering the possibility of increased area for cultivation.

(ii) Batinah Region New Farm's Crop and Livestock Production Combined Farming Improvement Model

Many of the new farms cultivate crops for sale and grow feed crops which constitute an important part of fodder for goats, sheep, poultry and other domestic animals (cows in rare cases). Table 4.8 shows the new management improvement model developed for the Batinah Region, while Table 4.9 lists the combined farming indices for crop production and goat farming for the region. A total of forty head of goats can be raised on the Rhodes grass crop grown on 0.47 ha together with concentrates, yielding 28 head of baby goats and 1,270 l of milk, although the milk is consumed by the farm family. Other feed crops like alfalfa, sorghum, and the Rhodes grass grown on 0.33 ha can be sold.

(iii) Interior Region (in a broad sense) New Farm's Farming Improvement Model

As Table 4.4 shows, at the four farms studied, the average area of land under crop cultivation was 8.6 ha, but this is thought to be significantly larger than the average land area under cultivation for new farms in this region.

The proportions of land area under cultivation for the major crop groups were approximately 15% for fruit trees, approximately 27% for semiperennial feed crops, and approximately 58% for vegetables and field crops. These findings

Area (ha)	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year	The 6th year
Area of land Unit No of % Total area fields						
12.2 0.5 0.3 1	Date palm					
0.2 1	Grape					
20.3 1.2 0.4 1	Rhodes grass	Alfalfa (5 years - 1 field)				
0.4 2	alfalfa	Rhodes grass(4 years - 2 fields)			Alfalfa	
51.5 2.4 0.4 2	S-melon	Potato	Carrot	S-melon	Potato	Sorghum
0.4 2	Potato	S-melon	Potato	Carrot	S-melon	Potato
0.4 2	Tomato	Potato	S-melon	Tomato	Carrot	S-melon
100.0 4.1						

Note : Alfalfa is rotationally cropped with Rhodes grass.

Figure 4.6 Proposed Crop Rotation Pattern for New Settlement Farm in the Batinah Region

Table 4.9 Management Index in Farming Improvement Model for Managing Crop and Livestock Production for New Farms in the Batinah Region

Category	Crops	Planted area (ha/year)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase (%)	Production cost ¹⁾ (RO/ha)	
Fruit	Date palm	0.3	7.3	5.0	46	742.2	
	Grape	0.2	4.9	19.0	27	413.3	
	Total (Average)	0.5	12.2	(12.5)	(36.5)	1,155.5	
Fodder (Semi-perennial)	Alfalfa	0.4	9.8	7.20	20	949.4	
	Rhodes grass	0.47	11.5	120.0	33	0 ²⁾	
	"	0.3	8.0	120.0	33	891.7	
	Total (Average)	1.2	29.3	(96.0)	(26.5)	1,841.1	
Vegetable &	Sorghum	0.4	9.8	125.0	50	905.6	
	Tomato	0.8	19.5	40.0	80	1,897.4	
Field crop	Sweet melon	0.8	19.5	23.0	76	1,877.8	
	Potato	0.8	19.5	30.0	20	1,724.0	
	Carrot	0.4	9.8	30.0	27	901.2	
	Total (Average)	3.2	78.0	(49.6)	(50.6)	7,306.0	
	Total (Net area: 4.1 ha)	4.9	119.5	465.0	—	10,302.6	
Goat	40 female goats	20 for sale 1,270 l of milk for self-consumption					971.0
	Grand total						11,273.6

Notes:

1) Depreciation costs for irrigation facilities are included in production cost, but those for equipment and storage are not taken into consideration. The annual land utilization rate will increase by 19.5%, but the number of workers will remain unchanged because less manpower will be required for irrigation and fertilization due to introduction of modern irrigation system.

According to the Table 4.3.11 for the model for breeding 40 goats, the total Rhodes grass produced from 0.47 ha, is used for self-use and the remaining fodder will be for sale.

2) Production cost is included in the breeding cost of goats.

show that there was a strong tendency for farms in the study to devote a low proportion of land area to fruit trees, and a high proportion to field crops. The average net income for crop production (note that depreciation is not included in costs) for the four farms was approximately R.O. 7,700 (890 R.O./ha). Even in farms of a smaller farming scale of 4.0 ha, this was R.O. 3,600 which is sufficient to support a family and to maintain the farm.

The hypothetical, improved farming model of current conditions with slight improvements in the kinds of major crop and proportion of area under cultivation for the different crops was produced using the above findings of the study on current conditions of farming agriculture. The Batinah Region new farms' improvement model was then produced by adding the technological improvements required as preconditions (those given above and those below) for increased profitability.

Preconditions for Interior Region (in a broad sense)
New farms' Agriculture Model

Target area	Interior region (in a broad sense) (including Dakhliya, Dhahira, Sharqiya)
Farming scale	4.2 ha; area under cultivation, 4.1 ha. Total annual cultivation area, 4.9 ha
Cropping pattern	Vegetables, field and feed crops, and fruit trees combined cultivation with increased proportion of land devoted to field crops. All crops other than fruit trees cultivated in rotation
Field conditions	Field and feed crops: 0.4 to 0.8 ha, total cultivation rate: 58.5% Fruit trees: 0.4 ha, total cultivation rate: 48.8%
Labor capacity	Basic labor capacity: 3 workers. Machines are owned by individuals, or extension center machinery is used.
Main technology, other:	Improving cropping area rates: considering location factors like being far from main centers of consumption and climate factors like the dry atmosphere, proportion of land devoted to field crops (mainly wheat) should be increased. Proportion of land for growing vegetables with good storage tolerance and which travel well like potatoes, garlic, and carrots, should also be increased. Cultivation of fruit trees cannot be significantly reduced, and so high income yield grapes should be introduced.

Table 4.10 shows the farming indices for the Interior Region (in a broad sense) new farms' farming improvement model. This model takes into account factors like farms being far from large centers of consumption and climate factors like the dry atmosphere, and the fact that it is not easy for farmers in this area to generate a high income. It proposes increasing the proportion of land under cultivation devoted to field crops, principally wheat - recommended by the government to improve self-sufficiency - as well as the proportion of land devoted to growing vegetables with good storage tolerance and that travel well like potatoes and garlic. It requires multiple farming that combines field crops and feed crops (main crops) with vegetables and fruit trees. In principle, it is considered that vegetables of the same family should be planted at the interval of more than two years. However, when potatoes are to follow tomatoes, it is extremely difficult to allow more than one year between the two crops, so it was decided to insert cultivation of wheat between these two crops to avoid damage from continuous cropping. For fruit trees, just as in the Batinah Region, the proportion of land used for growing date palms is slightly reduced to make room for introducing of grapes, which are profitable.

Figure 4.7 shows the cropping pattern and rotation systems applied by this farming improvement model, and the model suggests eight crops in six-year cycles for vegetables and field crops, setting the land utilization rate at 119.5%, which means a 19.5% increase over the current land utilization rate of 100%.

(iv) Salalah Region New Farms' Agriculture Improvements Model

As Table 4.5 shows, the one farm studied in this region had a farming scale of 1.84 ha, with a total annual area of land under cultivation of 2.32 ha. The proportions of areas under cultivation for major crop groups were approximately 57% for fruit trees and approximately 43% for vegetables. It was found that a high proportion of land under cultivation was devoted to

Table 4.10 Management Index in Proposed Farming Improvement Model
for New Farms in the Interior Region

Category	Crops	Planted area (ha/year)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase (%)	Production cost* (RO/ha)	
Fruit	Date palm	0.3	7.3	6.0	46	742.2	
	Grape	0.2	4.9	19.0	27	413.3	
	Total(Average)	0.5	1.22	(12.5)	(36.5)	1,155.5	
Fodder (Semi- perennial)	Alfalfa	0.4	9.8	7.20	20	949.4	
	Rhodes grass	0.8	19.5	120.0	33	2,161.6	
	Total(Average)	1.2	29.3	(96.0)	(26.5)	3,111.0	
Field crop & Vegetable	Wheat	0.8	19.5	2.4	60	1,088.6	
	Sorghum	0.4	9.8	125.0	50	905.6	
	Tomato	0.4	9.8	40.0	80	1,897.4	
	Sweet melon	0.4	9.8	23.0	76	1,877.8	
	Potato	0.4	9.8	30.0	20	1,724.0	
	Garlic	0.4	9.8	14.0	75	2,208.6	
	Carrot	0.4	9.8	30.0	27	901.2	
	Total (Average)	3.2	78.0	(37.8)	(55.4)	10,603.2	
	Total(Net area: 4.1 ha)		4.9	119.5	-	(39.5)	14,869.7

Note: *Depreciation cost is limited to irrigation facilities, and does not include cost for equipment and storage. For others, see

Table 4.8.

Area (ha)	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year	The 6th year
Unit No of field						
% Total area						
12.2 0.5 0.3 1	Date palm					
0.2 1	Grape					
20.3 1.2 0.4 1	Rhodes grass	Alfalfa (5 years, 1 field)				Rhodes
0.4 2	Alfalfa	Rhodes grass (4 years, 2 fields)				Alfalfa (5 years)
58.5 2.4 0.4 2	Tomato	Wheat	Potato	Carrot	Wheat	Garlic
0.4 2	Garlic	Sorghum	Wheat	Carrot	Carrot	Sorghum
0.4 2	Wheat	Garlic	Tomato	Potato	Wheat	Carrot
		Sorghum	Tomato	Wheat	Carrot	Sorghum
		Garlic	Tomato	Wheat	Carrot	Sorghum
100.0 4.1						

Figure 4.7 Proposed Crop Rotation Pattern for New Settlement Farm in the Interior Region

Note : Alfalfa is rotationally cropped with rhodesgrass.

fruit trees, mainly bananas, and that papayas were being grown amongst the bananas palms. Net income on crop production (note that depreciation is not included in costs) was approximately R.O. 1,200, which is not sufficient, but in fact the owner of this farm was also in the construction business, and was generating enough income to support his family and keep the farm going as well.

The hypothetical, improved farming model of current conditions with slight improvements in the kind of major crops and proportions of areas under cultivation for the different crops was produced using the above findings of the study on current conditions of farming. The Salalah region new farms' improvement model was then produced by adding the technological improvements required as preconditions (those given above and those below) for increasing profitability.

Preconditions for Salalah Region
New Farms' Farming Improvement-Model

Target area	Salalah plain in Janobia
Farming scale	2.0 ha; total cultivation area: 3.10 ha
Cropping pattern	Fruit trees, feed crops and vegetables in well-balanced combined cultivation. All crops other than fruit trees cultivated in rotation.
Field conditions	Fruit trees: 0.2 ha, total cultivation rate: 20%. Feed crops: 0.1 to 0.4 ha, total cultivation rate: 25%. Vegetables: 0.22 to 0.44 ha, total cultivation rate: 55%
Labor capacity	Basic labor capacity: 2 workers, extension center machinery used.
Main technology, others	Improving cropping area rates, because of the large number of livestock, deficiencies in feed resulted. Therefore, the proportion of land being cultivated for feed crops should be increased. The number of fruit trees should be somewhat decreased to make more room for growing relatively profitable vegetables. The planting period for vegetables should be adjusted to conform with the lean time between harvest in Northern Oman. Good use could be made of the comparatively mild climate in this region to establish a system of rotating crop cultivation combining vegetables and feed crops, with cultivation continuing throughout the year, and not allowing the land to lie fallow. Inter-cropping and mixed cropping can be done in the orchards to maximize land surface utilization.

Table 4.11 shows the farming indices for the Salalah region new farms' agriculture improvement model. This model seeks to overcome disadvantageous factors like the narrow range of the Salalah region and is based on ideas for maximizing the land utilization rate while maintaining its fertility. In the main area of this region, there is a large number of livestock resulting in deficiencies in feed, and therefore the proportion of land under feed-crop cultivation is increased in the model. The number of fruit trees should be somewhat decreased to make room for growing more profitable vegetables. The planting period for vegetables should be adjusted to allow for transporting to conform with the lean time between harvests in northern Oman with its large number of consumers. The plan behind the model is to make good use of the comparatively mild climate in this region by establishing a system of rotating crop cultivation combining vegetables and field crops, with cowpeas grown before potatoes among the vegetables to increase fertility, and cultivation throughout the year, not allowing the land to lie fallow. Intercropping and mixed cropping can be done in the orchards to maximize land utilization.

Figure 4.8 shows the cropping pattern and rotation systems -- with alfalfa planted for one year and Rhodes grass for four years, both cultivated in rotation -- applied by this farming improvement model. It also shows that the model suggests ten crops in five-year cycles for vegetables and field crops, setting the land utilization rate at 155.0%, which means a 22.9% ($155.0\%/126.15$) increase over the current land utilization rate of 126.1% (2.32 ha/1.84 ha). Intercropping and mixed cropping of coconuts and/or grapes and/or bananas, as well as of bananas and papaya, can be done to encourage an increase in the land utilization rates. Unfortunately, because the relationship between the rate of introduction of intercropping and mixed cropping, increasing the rate of utilization of water resources, and increasing income, is unclear, it is not possible to give concrete numerical values for the rate of introduction of these two methods (this is also true in what follows).

Table 4.11 Management Index in Proposed Farming Improvement Model
for New Farms in Salalah

Category	Crops	Planted area (ha)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase in yield (%)	Production cost* (RO/area)
Fruit	Banana	0.2	100	200	47	439.9
	Grape	0.2	100	190	27	413.3
	Total(Average)	0.4	200	(195)	(37.0)	853.2
Fodder (Semi- perennial)	Alfalfa	0.1	50	720	20	237.4
	Rhodes grass	0.4	200	1200	33	1,080.8
	Total(Average)	0.5	250	(960)	(265)	1,318.2
Vegetable & Field crop	Wheat	0.22	110	2.4	60	299.4
	Sorghum	0.22	110	1250	50	498.1
	Tomato	0.44	220	400	80	1,043.6
	Sweet melon	0.22	110	230	76	516.4
	Potato	0.44	220	300	20	948.2
	Garlic	0.22	110	140	75	479.3
	Okra	0.22	110	220	67	512.8
	Cabbage	0.22	110	350	51	460.1
	Total(Average)	2.20	1100	(364)	(599)	4,757.9
	Total (Net area: 2.0 ha)	3.10	1550	-	(411)	6,929.3

Note: Depreciation cost is limited to irrigation facilities, and does not include cost for equipment and storage. For others, see Table 4.8.

Area (ha)	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
20.0	Banana				
0.4	1				
0.2	Grape				
0.2	1				
25.0	Alfalfa	Rhodes grass			Alfalfa
0.5	1				
0.1	Rhodes	Alfalfa	Rhodes grass		
0.1	1				
0.1	Rhodes grass	Alfalfa	Rhodes grass		
0.1	1				
0.1	Rhodes grass		Alfalfa	Rhodes grass	
0.1	1				
0.1	Rhodes grass			Alfalfa	Rhodes
0.1	1				
55.0	Potato	Wheat	Potato	Tomato	Sorghum
1.1	0.367	0.367	0.367	0.367	0.367
0.367	1	1	1	1	1
0.367	Cabbage	Potato	Wheat	Potato	Garlic
0.367	1	1	1	1	1
0.367	Garlic	Tomato	S-melon	Wheat	Potato
0.367	1	1	1	1	1
100	2.0	2.0	2.0	2.0	2.0
2.0	10	10	10	10	10

Figure 4.8 Proposed Crop Rotation Pattern for New Settlement Farm in Salalah

Note : Alfalfa is rotationally cropped with rhodesgrass.

(b) Traditional Farms' Farming Improvement Models

The scale of traditional farms which have been operating for a long time along the Batinah coast is rather high (about 1.5 ha), but extremely low in the Salalah region (0.15 ha). Traditional farms in or near mountainous areas use traditional water sources like the falaj, hand-dug wells along the Batinah coast and in the Salalah region. Traditional subsistence farming is practiced in northern Oman, mainly for the cultivation of date palms, around Salalah mainly for the cultivation of coconuts and bananas. In general, these farms do not possess heavy machinery like tractors or high-pressure atomizers, and supporting the family often involves serious dependence on sources of income other than agriculture.

(i) Northern Oman Traditional Farms' Farming Improvement Model

The JICA team investigated three traditional farms in the South Batinah Region. One of these was in the area near the Barka coast where salt damage to date palms occurs. Its farming scale was high (14.7 ha) and had many of the characteristics of the new farms. For these reasons it was decided that this farm would be excluded from analysis in this section. As Table 4.6 shows, the average land area under cultivation of the farm at the foot of the Oman mountain range on the east side and the farm near the Barka coast was 0.59 ha, while the land devoted to cultivation of major crop groups was approximately 50% for fruit trees, 25% for semi-perennial feed crops, and 25% for field crops, and vegetable. The portion of land devoted to growing date palms and alfalfa was high. The farm at the foot of the mountains has put a concrete water reservoir in its date palm farm in which water from the falaj is temporarily accumulated. A pump is then used to supply water to vegetable and feed crop fields outside the orchard in a traditional furrow and border irrigation system. The average net income of crop production (note that depreciation is not included in costs) for the two farms was approximately R.O. -280 (-470 R.O./ha). These farms

both rely on income from work other than agriculture to support their families. The family of the farm on the coast was involved in fishing.

The hypothetical farming model of current conditions with slightly better kinds of major crops and a modification of the proportions of the area under cultivation for different crops was produced using the above findings from the study on current conditions of farming. The northern Oman traditional farms' farming improvement model was then produced by adding the technological improvements required as prerequisites (given above and those below) for increasing profitability.

**Prerequisites for Northern Oman
Traditional Farm's
Farming Improvement Model**

Target area	Northern Oman (including the Batinah, the Interior, the Dahira, and the Sharqiya region)
Farming scale	0.5 ha, total cultivation area: 0.57 ha
Cropping pattern	Mainly fruit trees combined with feed crops and vegetables; All crops other than fruit trees are cultivated in rotation.
Field conditions	Fruit trees: 0.1 to 0.2 ha, total cultivation rate: 60%. Feed crops: 0.05 ha, total cultivation rate: 20%. Vegetable and field crops: 0.02 to 0.03 ha, total cultivation rate: 20%
Labor capacity	Basic labor capacity: 1 worker, extension center machinery is used for ploughing. Pest control is accomplished with manually operated atomizers.
Main technology, others	Improving cropping area ratios. The land devoted to cultivation of date palms is slightly reduced to allow for introduction of highly profitable grapes. The proportion of land devoted to vegetables in the Batinah region, and for field crops in the Interior Region, are increased. Land time and space utilization rates are also increased. Inter-cropping and mixed cropping are also to be conducted as much as possible within the orchards

Table 4.12 shows the farming indices for the Northern Oman traditional farms' farming improvement model. This model shows that in order to improve the operation of traditional farms which mainly cultivate date palms it is necessary to reduce the proportion of land devoted to this crop and to increase the proportion of land used for cultivating profitable crops. However, it is very difficult to get the people of Oman, for whom the date palm is a very important crop, to reduce cultivation of it quickly. For this reason the model proposes replacing a part of the land devoted to date palms with more profitable grapes. To enable cultivation of profitable vegetables, irrigation intervals cannot be far apart, and consequently, the installation of a reservoir, wherever possible, for each farm in an Oasis might be useful. While the model increases the land utilization rate for the fields, it also proposes increasing land surface utilization rate by inter-cropping and mixed cropping underneath and between the trees.

The cropping pattern and rotation systems in this farming improvement model are shown in Figure 4.9 The model calls for ten crops of vegetables and field crops in six-year cycles, and sets the land utilization rate at 113.0%. This represents an increase of 9.6% ($113.0\%/103.1\%$) over the current land utilization rate of 103.1% (0.516 ha/0.5 ha).

(ii) Northern Oman Traditional Farms' Crop and Livestock
Production Combined Farming Improvement Model

Table 4.12 shows the traditional farm management improvement model developed for northern Oman, while Table 4.13 lists the combined farming indices for producing goats and egg-laying poultry for the region. This model suggests that 3.6 tons of alfalfa, 6.0 tons of Rhodes grass, and 2.06 tons of sorghum can be produced on 0.1165 ha of fields, which can be used with purchased concentrates to raise eight goats. The income from this is still insufficient, so it is necessary to plan raising 750 poultry for egg with purchased fodder.

Table 4.12 Management Index in Proposed Farming Improvement Model
for Traditional Farms in Northern Oman

Category	Crops	Planted area (ha.)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase in yield (%)	Production cost* (RO/area)
Fruit	Date palm	0.2	40.0	6.0	46	494.8
	Grape	0.1	20.0	1.90	27	206.7
	Total(Average)	0.3	60.0	(1.25)	(36.5)	701.5
Fodder (Semi-perennial)	Alfalfa	0.05	10.0	7.20	20	118.7
	Rhodes grass	0.05	10.0	12.00	33	135.1
	Total(Average)	0.1	20.0	(9.60)	(26.5)	253.8
Vegetable & Field crop	Sorghum	0.0165	3.3	125.0	50	37.4
	Cowpea	0.0165	3.3	25.0	67	34.8
	Tomato	0.033	6.6	40.0	80	78.3
	Sweet-melon	0.033	6.6	23.0	76	77.5
	Potato	0.0165	3.3	30.0	20	35.6
	Carrot	0.0165	3.3	30.0	27	37.2
	Garlic	0.0165	3.3	14.0	75	35.9
	Okra	0.0165	3.3	22.0	67	38.5
	Total(Average)	0.165	33.0	(38.6)	(57.8)	375.2
	Total (Net area: 0.5 ha)	0.565	113.0	-	(40.3)	1,330.5

Note: Depreciation cost is limited to irrigation facilities, and does not include cost for equipment and storage. For others, see Table 4.8.

Area (ha)	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year	The 6th year
Unit No of field						
% Total area						
0.0 0.3 0.2 1	Date Palm					
0.1 1	Grape					
20.0 0.1 0.05 1	Rhodes grass	Alfalfa (5years, 1 field)				Rhodes
0.05 1	Alfalfa	Rhodes grass (1 field)				Alfalfa
20.0 0.1 0.033 1	S-melon	Tomato	Okra	Garlic	Tomato	Cowpea
0.033 1	Potato	Sorghum	S-melon	Tomato	Okra	Garlic
0.033 1	Tomato	Cowpea	Potato	Sorghum	Tomato	Okra
100.0 0.5						

Figure 4.9 Proposed Crop Rotation Pattern for Traditional Farm in Northern Oman

Note : Alfalfa is rotationally cropped with rhodesgrass.

Table 4.13 Management Index in Farming Improvement Model for
Managing Crop and Livestock Production for
Traditional Farms in Northern Oman

Category	Crops	Planted area (ha/year)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase (%)	Production 1) cost (RO/area)
Fruit	Date palm	0.2	40.0	6.0	46	49.48
	Grape	0.1	20.0	19.0	27	206.7
	Total(Average)	0.3	60.0	(12.5)	(36.5)	701.5
Fodder (Semi-perennial)	Alfalfa	0.05	10.0	70.0	20	0 ²⁾
	Rhodes grass	0.05	10.0	120.0	33	0 ²⁾
	Total(Average)	0.1	20.0	(96.0)	(26.5)	0 ²⁾
Vegetable & Field crop	Sorghum	0.0165	3.3	125.0	50	0 ²⁾
	Cowpea	0.0165	3.3	25.0	67	34.8
	Tomato	0.033	6.6	40.0	80	78.3
	Sweet-melon	0.033	6.6	23.0	76	77.5
	Potato	0.0165	3.3	30.0	20	35.6
	Carrot	0.0165	3.3	30.0	27	37.2
	Garlic	0.0165	3.3	14.0	75	35.9
	Okra	0.0165	3.3	2.0	67	38.5
	Total(Average)	0.165	33.0	(38.6)	(57.8)	337.8
	Total (Net area 0.5 ha)	0.565	113.0	-	(40.3)	1,039.3
Goats 8 female goats	5-6 for sale, 254 l of milk for self-consumption.					203.9
Poultry for egg 750	112,500 eggs for sale 675 culled chickens for sale					3,852.0
Total						5,095.2

Notes: 1) Depreciation costs for irrigation facilities are included in production cost, but those for equipment and storage are not taken into consideration. For others, refer to table 4.8.

2) These are included in the production costs for goat and chicken. The gross production of fodder will be 11.66 tons, which consists of 3.6 tons of alfalfa, 6 tons of rhodes grass, and 2.06 tons of sorghum. Its dry weight will be 2.33 tons, which is estimated to be 20% of its gross weight. With this amount of fodder, 8 goats can be raised. The production cost is calculated as follows: 971.0RO x 0.21 = 203.9RO. Concentrates for poultry will be provided for poultry breeding and its production cost is calculated as follows: 2,568RO x 1.5 = 3,852RO.

(iii) Salalah Traditional Farm's Farming Improvement Model

As Table 4.5 shows, the farm studied in this region was 1.84 ha and its annual total land area under cultivation was 2.03 ha. The proportions of land devoted to cultivation of major crop groups was 66% for fruit trees, 34% for vegetables. The proportion of land devoted to fruit trees here (mainly banana palms) is high. Bananas, limes and papayas are grown separately from and underneath coconut palms. The average net income from the crop production (note that depreciation is not included in costs) was approximately R.O. 1,700 which is not sufficient, but it is supplemented with income from six head of milk cows.

The hypothetical farming model of current conditions with slightly better kinds of major crops, and a change of the proportions of area under cultivation for different crops was produced using the above findings of the study on actual current conditions of farming. The Salalah region traditional farm's improvement model was then produced by adding the technological improvements required as preconditions (given above and below) for increasing profitability.

Preconditions for Salalah Region
Traditional Farms' Farming
Improvement Model

Target area	Salalah Plain in the Southern region												
Farming scale	0.5 ha, total cultivation area: 0.57 ha												
Cropping pattern	Mainly fruit trees combined with feed crops and vegetables, all crops other than fruit trees are cultivated in rotation.												
Field conditions	<table> <tr> <td>Fruit trees:</td> <td>0.06 to 0.2 ha,</td> </tr> <tr> <td>total cultivation rate:</td> <td>52%</td> </tr> <tr> <td>Feed crops:</td> <td>0.06 ha,</td> </tr> <tr> <td>total cultivation rate:</td> <td>12%</td> </tr> <tr> <td>Vegetables and field crops:</td> <td>0.04 to 0.07ha</td> </tr> <tr> <td>total cultivation rate:</td> <td>36%</td> </tr> </table>	Fruit trees:	0.06 to 0.2 ha,	total cultivation rate:	52%	Feed crops:	0.06 ha,	total cultivation rate:	12%	Vegetables and field crops:	0.04 to 0.07ha	total cultivation rate:	36%
Fruit trees:	0.06 to 0.2 ha,												
total cultivation rate:	52%												
Feed crops:	0.06 ha,												
total cultivation rate:	12%												
Vegetables and field crops:	0.04 to 0.07ha												
total cultivation rate:	36%												
Labor capacity	<p>Basic labor capacity: 1 worker. The extension center machinery is used for ploughing. Pest control is done with manually operated atomizers.</p>												

Preconditions for Salalah Region
Traditional Farms' Farming
Improvement Model

(continued)

<p>Main technology, others</p>	<p>Improving cropping area ratios: The land devoted to the cultivation of banana is slightly reduced, and highly profitable grapes is introduced. Many heads of livestock are kept, and because it causes deficiencies in feed, profitable rhodes grass is introduced. Coconuts, bananas and papayas are planted separately and mixed to increase land utilization. Vegetables and field crops are inter-cropped inside the grape orchard, which should also increase land utilization. The cropping period for vegetables needs to be adjusted to enable shipment in the lean time between harvests in North Oman. The comparatively mild climatic conditions need to be taken advantage of to develop a cropping pattern and rotation system of vegetables and field crops for continuous cultivation throughout the year without allowing the land to lie fallow.</p>
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Table 4.14 shows the farming indices for the Salalah region traditional farm's farming improvement model. The easily cultivated and profitable Rhodes grass is introduced in order to deal with the shortage of feed for livestock in this region. Grapes, which are also profitable, are introduced for the first time in this model, and the proportions of land devoted to cultivating bananas, which are currently self-sufficient, is slightly reduced. Coconuts, bananas and papayas are inter-cropped or mix-cropped while vegetables and field crops are intercropped inside the grape orchard to increase the land surface utilization. The cropping period for vegetables is adjusted to enable shipping in the lean time between harvests in northern Oman. The model is also designed to take advantage of the comparatively mild climatic conditions to develop a cropping pattern and rotation system of vegetables and field crops for continuous cultivation throughout the year without allowing the land to lie fallow.

The cropping pattern and rotation systems in this farming

Table 4.14 Management Index in Proposed Farming Improvement Model
for Traditional Farms in Salalah

Category	Crops	Planted area (ha/year)	Rate of cropped area (%)	Unit yield (Ton/ha)	Rate of increase in yield (%)	Production cost* (RO/area)
Fruit	Banana	0.2	40.0	20.0	47	439.9
	Coconut	0.02	4.0	25.0	49	36.1
	Papaya	0.02	4.0	19.0	58	37.2
	Grape	0.02	4.0	19.0	27	41.3
	Total(Average)	0.26	52.0	(20.8)	(45.3)	554.5
Fodder (Semi-perennial)	Rhodes grass	0.06	12.0	120.0	33	162.1
	Total(Average)	0.06	12.0	(120.0)	(33)	162.1
Vegetable & Field crop	Wheat	0.036	7.2	2.4	60	49.0
	Sorghum	0.036	7.2	125.0	50	81.5
	Tomato	0.072	14.4	40.0	80	171.0
	Sweet melon	0.036	7.2	23.0	76	84.5
	Potato	0.072	14.4	30.0	20	155.2
	Garlic	0.036	7.2	14.0	75	78.4
	Okra	0.036	7.2	22.0	67	74.6
	Cabbage	0.036	7.2	35.0	51	75.3
	Total(Average)	0.36	72.0	(364)	(599)	769.5
Total (Net area 0.5 ha)		0.68	136.0	--	(46.0)	1,486.1

Notes: * Depreciation costs for irrigation facilities are included in production cost, but those for equipment and storage are not taken into consideration. For others, refer to Table 4.8.

Area (ha)	Unit No of field	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
52	0.26	Banana				
	0.06	Coconut, Papaya, Grape				
12	0.06	Garlic	Rhodes grass			Tomato
36	0.18	Potato	Wheat	Potato	Garlic	Cabbage
	0.06	Sorghum	Potato	Wheat	Potato	Okra
	0.06	Cabbage	Sorghum	Tomato	Garlic	Tomato
	0.06	Garlic	Cabbage	Potato	Wheat	Potato
	0.06	Tomato	Sorghum	S.melon	Okra	Okra
100	0.50	6				

Figure 4.10 Proposed Crop Rotation Pattern for Traditional Farm in Salalah

Note : Alfalfa is rotationally cropped with rhodesgrass.

improvement model are shown in Figure 4.10. The model calls for planting Rhodes grass for four years, and conducting a rotation system of Rhodes grass, vegetables, and field crops. It also calls for ten crops of vegetable and field crops in five-year cycles. Traditional farms in the Salalah region are generally between 0.1 and 0.5 ha, which is small, but this does seem to indicate that land utilization has reached its limit. For this reasons the land utilization rate in this model is set at the same level as the current rate 136%.

(c) Improving Farming in Commercial Farms

There are more than 100 large-scale agricultural production companies, principally in the Batinah Region along the national highway Route 1 and in Salalah. They generally use modern irrigation methods, heavy machinery, and cultivate feed crops, vegetables, fruit trees and other crops very efficiently.

In the first phase, the JICA team investigated the actual conditions of farming in the Oman Modern Farm. As Table 4.7 shows, this farm has a total of 42.5 ha under cultivation, with 15 ha devoted to fruit trees, 25 ha for vegetables, with cucumbers and other vegetables grown in 1.5 ha of greenhouses, and lettuce grown in 1.0 ha of hydroponic facilities. Bubbler irrigation is used in both the field and greenhouses. Large tractors are used for ploughing and soil preparation as well as intertillage and weeding. High-pressure atomizers mounted on the tractors are used to apply agricultural chemicals for pest control. However, weeding between plants, harvesting, and other work are still done manually.

In the case of vegetable cultivation, the land utilization rate has been increased to 150%, with a net profit rate per hectare of approximately R.O. 3,200, which is double the average profitability of approximately R.O. 1,650 per hectare, found by the JICA team, for vegetable production in the new farms. Even in the orchards, the cultivation rate for date palms and mangoes, which are not very

profitable, is kept low, while cultivation rates for lemons and oranges, which are highly profitable, are high, and they do seem to be generating good income. Although vegetables grown in glasshouses and hydroponic installations are of high quality, they are not priced significantly higher than field vegetables. However, because the cost for running the facilities, and the initial investment depreciation costs are very high, these operations are deeply in the red.

The Al Raja Farm has 300 ha of fields divided into 12.6 ha for fruit trees, mainly lemons, only 2.1 ha devoted to cultivation of Rhodes grass, and the remaining approximately 280 ha devoted to highly profitable sweet-melons as well as the cultivation of watermelons and tomatoes. Modern facilities like glasshouses and hydroponic facilities are not used. At this farm they have chosen superior varieties of vegetables, taken cropping periods at different intervals for each land division, applied sufficient fertilizer and chemicals to deal with insects and crop diseases. All of this has been done under strict and scrupulous supervision. The result is a very high yield per hectare: approximately 28 tons, 31 tons, and 48 tons, respectively. All estimates suggest that this farm is generating a considerable income.

The big commercial enterprises adopt independent management policies, with many of them employing specialist managers. For these reasons, the JICA team decided not to propose a farming improvement model for these farms, confining itself to pointing out that while open-field cultivation is generating high profits, investment in modern agricultural technology does not seem to be effective, principally because significant sale price differences in the market are not established according to the quality of produce.

(2) Estimates of Farming Profit of Farming Improvement Models

The "Annual Updates of Important Statistics Series" from the Department of Agricultural Statistics of MAF contains data collected from

studies which have been conducted since 1982. It includes selling prices and other data on products from more than four farms every year for each on the five major extension centers, data on more than 100 samples of approximately 20 principal crops such as yields and production costs per hectare (not including depreciation costs on initial investment and machines, etc.). Table 4.15 lists national averages for these production-related parameters.

Table 4.16 lists crops used in the farming improvement model for the new farms and traditional farms described above, with details on national average production costs revised by adding depreciation cost of wells and pumps, yield and sale prices, to unit production net profit of each individual crop. It also contains quantities of specific materials and equipment as well as their unit prices, increases in these parameters recorded over the last ten years of the agricultural development plan, and finally projections of unit yield, its rate of increase, and net profit in 2000 when the 10-year Master Plan for Agricultural Development ends. Quantitative increases over the ten years of this plan are as follows: seed costs, 5%; fertilizer costs, 100%; agricultural chemical costs, 50%; cost of introducing modern irrigation systems; the cost of the depreciation of initial investment plus running costs, which for a bubbler system for fruit ranges from R.O. 254 for date palms to R.O. 314 for bananas; for a sprinkler system for semiperennial feed crops it is R.O. 241, and for a drip system for field crops and vegetables R.O. 590.

Table 4.16 shows the rate of increase in unit yield projected for the completion of this 10-year Master Plan in the year 2000, with targets ranging from 20% for potatoes to 80% for tomatoes.

Production net profit (R.O./ha) of each crop at the completion of the agricultural development plan is calculated by multiplying present sale prices (R.O./ton) by improved unit yield (ton/ha), and subtracting the revised production cost (R.O./ha). The following formulas are used to estimate operating profit increases and rates of increase in the farming improvement models described above.

Table 4.15 Average Production Cost, Yield, Sale Price and Net Production Profit of Major Crops in Oman

Crops	Production ¹⁾ cost(RO/ha)	Yield (Ton/ha)	Price (RO/Ton)	Balance (RO/ha)	Note	Crops	Production ¹⁾ cost(RO/ha)	Yield (Ton/ha)	Price (RO/Ton)	Balance (RO/ha)	Note
Water melon	1,583	190	125	792		Wheat	536	1.5	256	-152	
Sweet melon	1,528	131	290	2,271		Barley	560	1.9	250	-85	
Cucumber	1,147	149	202	1,862.8		Maize	1,500	43.0	4200	4,900	Seed
Squash	1,100	158	140	1,112		Sorghum	1,250	42.8	50	640	Fodder
Tomato	1,537	222	146	1,704.2				53.3	50	1,415	Fodder
Chilli pepper	1,559	90	325	1,366				42.0	4200	4,850	Seed
Egg plant	1,600	190	61	-141		Alfalfa	1,804	384.3	60	500	
Potato	1,272	250	117	1,653		Rhodes grass	1,800	57.6 ³⁾	50	1,080	
Sweet potato	1,400	238	150	2,170		Sugarcane	1,600	40.0	175	5,400	
Sweet pepper	1,280	232	65	228		Tobacco	651	4.9	2,500	11,599	
Cabbage	1,280	91	80	-552		Average	1,212.6	37.9	423.9	1,864.7	
Cauliflower	1,050	230	100	1,250		Dates	2,033	4.1	150	-1,418	
Radish	1,050	143	150	1,095		Lime	1,609	1.08	120	-313	
Beet	1,400	238	200	3,360		Sweet lime	1,610	1.10	150	40	
Carrot	1,500	170	200	1,900		Lemon	1,609	1.50	150	641	
Lettuce	1,404	137	90	-171		Orange	1,610	1.10	175	315	
Onion	1,270	170	175	1,705		Mango	1,642	2.0	250	-1,142	
Leek	1,302	80	550	3,098		Guava	1,600	8.3	140	-438	
Garlic	(1,350)	(100)	(147)	(120)		Banana	1,730	1.36	160	386	
Sweet corn	1,499	132	255	1,867		Coconut	1,476	1.68	150	1,044	
Okra	1,350	170	230	2,560		Papaya	1,500	1.20	175	600	
Beans	1,305	150	150	945		Grape	1,700	15.0	300	2,800	
Cowpea	1,350	140	150	750		Average	1,632.6	10.9	174.5	2,286	
Chick pea	1,250	143	150	895							
Fababean	1,348.5	163	178.3	1,366.1							

Notes: 1) Depreciation cost is not included in production cost.

2) Average Selling price of farmers during production season of each crop in 1988. () These are figures in the Omnn Modern Farm.

3) Semi-dried weight.

Table 4.16 Current Unit Values Concerned with the Production of Major Crops for Farming Improvement Model and Prospective Output in the Master Plan for Agricultural Development

Crops	Average in Oman*					Present situation							Master Plan for Agricultural Development									
	Producer cost (RO/ha)	Unit yield (Ton/ha)	Sale price (RO/ton)	Net production profit (RO/ha)	1)	Seeding & Seeds		Fertilizer/quantity			Pesticides		Increased cost			Total		Year 2000				
						Quantity	Unit cost	Organic	Chemical	Organic	Chemical	Total	Quantity	Cost	Seeds Fertilizer	Pesticides	Irrigation	production cost	Target yield	Net production profit		
Date palm	2158	41	150	-1543	124	20	2480	2.5	1.3	0.609	9.42	61.2	(1.0)	(1.3)	0	61.2	0.7	254	2473.9	6.0	45	-1573.9
Grape	1825	150	300	2675	(300)	(4)	1200	1.0	1.5	"	"	7.07	(3.0)	(3.9)	0	7.07	2.0	294	2066.7	19.0	27	3508.3
Banana	1915	136	160	261	2500	(10)	25000	1.5	2.0	"	"	9.42	(2.0)	(2.6)	0	9.42	1.3	314	2193.5	20.0	47	875.5
Coconut	1601	168	150	919	156	(2)	312	2.3	1.6	"	"	7.54	(1.0)	(1.3)	0	7.54	0.7	254	1806.1	25.0	49	1818.9
Papaya	1625	120	175	475	(2500)	(1)	2500	1.0	1.0	"	"	4.71	(2.0)	(2.6)	0	4.71	1.3	314	1862.4	19.0	58	1337.5
Alfalfa	1929	38.4 ²³⁾	60	375	43	20	860	5.0	2.0	2.436	9.452	155.4	(8)	(10.3)	4.3	155.4	5.2	241	2373.6	72.0 ²⁴⁾	20	391.2
Rhodes grass	1925	57.6 ²³⁾	50	955	10	5	50	5.0	10.0	"	"	53.95	0	0	2.5	53.95	0	241	2702.0	120.0 ²⁴⁾	33	1138.0
Wheat	661	1.5	256	-277	107	(0.3)	321	5.0	1.0	"	"	108.2	0	0	1.6	108.2	0	590	1360.8	2.4	60	-746.4
Sorghum	1375	53.3 ²³⁾	50	790	55	(0.2)	11	5.0	5.0	"	"	297.2	2.0	2.6	0.6	297.2	1.3	590	2264.1	125.0 ²⁴⁾	50	1735.0
Cowpea	1430	15.0	150	820	(80)	(0.9)	72	5.0	0.5	"	"	84.5	1.0	1.3	3.6	84.5	0.7	590	2108.8	25.0	67	1641.2
Tomato	1622	222	146	1579.2	0.8	9.465	7572	5.0	1.1	"	"	112.9	10.2	12.9	0.4	112.9	6.5	590	2371.8	4.00	80	3468.2
Sweet-melon	1653	131	290	2146	3.5	5608	10628	5.0	0.76	"	"	96.3	10.2	12.9	1.0	96.3	6.5	590	2347.3	23.0	76	4322.7
Potato	1397	250	117	1528	2400	0.246	5904	5.0	1.6	"	"	136.5	3.0	3.9	29.5	136.5	2.0	590	2155.0	30.0	20	1355.0
Carrot	1525	238	200	3235	(0.6)	4800	2.9	(5.0)	1.6	"	"	136.5	2.0	2.6	0.1	136.5	1.3	590	2252.9	3.00	27	3747.1
Garlic	1427	80	550	2973	540	0.550	297	5.0	1.8	"	"	146.0	1.0	1.3	1.49	146.0	0.7	590	2178.6	14.0	75	5521.4
Cabbage	1405	232	65	103	1.0	3833	3.8	5.0	0.7	"	"	94.0	3.0	3.9	0.2	94.0	2.0	590	2091.2	35.0	51	1828.8
Okra	1624	132	255	1742	(20)	2078	416	(5.0)	1.1	"	"	112.9	3.0	3.9	2.1	112.9	2.0	590	2331.0	22.0	67	3279.0

Notes: *Values were obtained in 1989 from the D.A.S. of MAF which has been preparing "Annual Update of Improvement Statistical Series" since 1982. (): estimated value

1) Depreciation cost $(\frac{6000RO + 2000RO}{10 \text{ year}}) \frac{1}{4} \text{ ha} = 125 RO$ for wells (6000RO) and pumps (2000RO) are included, but the initial costs for equipment and storage are not, 3) Average sale prices by farmers during a production period. 4) = 3) x 2) - 1). 7) = 6) x 5). 11) = Fruit AS+TS+PS = 83.6 x 1.5 + 106.5 x 0.6 + 103.5 x 0.9 = 942.90. Field crop & Vegetables: TSP+Urea+PS+AS+NPK comp. = $\frac{106.5+63.0+103.5+83.6+116.0}{5} = 94.52$. 12) = Fruit: 11) x 0.5 (Current application rate). Field crop & Vegetables: (10) x 8) - 11) x 0.5

(Current application rate). 13), 14) Values were obtained from both the price list issued by the MAF, and a record book (Farmer Book) of new farmers in the North Batinah Region. 15) = 7) + 0.05 (increase of land utilization rate). 16) = 12) x 1 (100% implementation of the fertilizer application standard of MAF). 17) = 14) x 0.5 (50% increase to the current utilization quantity). 18) Fruit: Subbler; Fodder: Sprinkler, Vegetable & Field crop: Drip system (Depreciation cost + operation cost). 19) = 1) + 15) + 16) + 17) + 18). 21) = $\frac{20 - 2}{2} \times 100$. 22) = 3) x 20) - 19). 23) Semi-dried weight. 24) Fresh weight.

Farming profit increase (R.O.) A1

= Total production net income of each crop in the hypothetical current situation in the improvement model (total of each of 'parameter 4 in Table 4.16) x hypothetical current cultivation area in the model')

- Total of current production net income of each crop as obtained by the JICA team (production net income is given in Tables 4.3 to 4.6).

Farming profit increase (R.O.) A2

= Total of production net income of each crop in the year 2000 (total of each of 'parameter 22 in Table 4.16) x cultivation area in the improvement model')

- Total production net income of each crop in the hypothetical current situation in the improvement model (total of each of 'parameter 4 x hypothetical current cultivation area in the model').

Rate of increase in farming profit (%) R1

= (Farming profit increase A1)
/ (total of current production net income of each crop obtained by the JICA team) x 100.

Rate of increase in farming profit (%) R2

= (Farming profit increase A2)
/ (Total production net income of each crop in the hypothetical current situation of improvement model) x 100.

(a) Estimated Calculations of Net Profit of the New Farms' Farming Improvement Model

(i) Batinah Region New Farms' Farming Improvement Model

Estimates of increases in farming profits in the Farming Improvement model (farming scale: 4.1 ha) for the new farms in the Batinah Region can be calculated using the total values for production net income in Table 4.3, 16 and 17 in the following

Table 4.17 Trial Balance for Farming Improvement Model for New Farm
in the Batinah Region

Crops	Estimated present situation			Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Date palm	0.3	-1,543	-462.9	0.3	-1,573.9	-472.2
Grape	0.2	2,675	535.0	0.2	3,508.3	701.7
Alfalfa	0.4	375	150.0	0.4	391.2	156.5
Rhodes grass	0.8	955	764.0	0.8	1,138.0	910.4
Sorghum	0.4	790	316.0	0.4	1,735.0	694.0
Tomato	0.8	1,579.2	1,263.4	0.8	3,468.2	2,774.6
Sweet-melon	0.4	2,146	858.4	0.8	4,322.7	3,458.2
Potato	0.4	1,528	611.2	0.8	1,355.0	1,084.0
Carrot	0.4	3,235	1,294.0	0.4	3,747.1	1,498.8
Total	4.1		5,329.1	4.9		10,806.0

Note: Annual cropping rate of farm for 4.1 ha.

Annual land utilization rate : $4.9 / 4.1 = 119.5\%$.

way:

Increase in profit from actual figures found by the JICA team [1] to model hypothetical current level [2]

$$A1 = 5,329,1 - 2,721,5 = \text{R.O. } 2,607.6$$

Increase profit from model hypothetical current level [2] to 2000 [3]

$$A2 = 10,806.0 - 5,329.1 = \text{R.O. } 5,476.9$$

Increase in profit from actual figures obtained by the JICA team [1] to 2000 [3]

$$A3 = 10,806.0 - 2,721.5 = \text{R.O. } 8,084,5$$

Rate of increase in profit from [1] to [2]

$$R1 = (2,607.6 / 2,721.5) \times 100 = 95.8\%$$

Rate of increase in profit from [2] to [3]

$$R2 = (5,476.9 / 5,329.1) \times 100 = 102.8\%$$

Rate of increase in profit from [1] to [3]

$$R3 = (8,084.5 / 2,721.5) \times 100 = 297.1\%$$

The calculation estimate examples given above show that it would only require slight improvements in crop kinds and cropping rates to achieve the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2] -- an approximately R.O. 2,600 net income increase, an increase of approximately 95%. The improvements in cultivation technology described above as preconditions would result in an increase in net income of approximately R.O. 5,500, or about 100%. Also, the projected rate of net income increase from the current levels obtained by the JICA team to the date of completion of this agriculture development plan is approximately

300%.

If the sum required for one farming family to support itself and to continue agricultural production is assumed to be R.O. 2,500 per annum, then this model suggests that there is ample margin for healthy operation, and so it can provisionally be accepted as an effective model.

(ii) Batinah Region New Farms' Crop and Livestock Production
Combined Farming Improvement Model

The estimates of increases in farming profits from the combined improvement model (farming scale: 4.1 ha, 40 goats) for the new farms in the Batinah Region devoted to crop production, but to which livestock farming has been added can be calculated using the total values for production net income given in Tables 4.3, 4.16 and 4.18 in the following:

Increase in profit from actual figures obtained by the JICA team [1] to hypothetical model current level [2]

$$A1 = 5,329.1 - 2,721.5 = \text{R.O. } 2,607.6$$

Increase in profit from hypothetical model current level [2] to 2000 [3]

$$A2 = 11,273.6 - 5,329.1 = \text{R.O. } 5,944.5$$

Increase in profit from actual figures obtained by the JICA team [1] to 2000 [3]

$$A3 = 11,273.6 - 2,721.5 = \text{R.O. } 8,552.1$$

Rate of increase in profit from [1] to [2]

$$R1 = (2,607.6 / 2,721.5) \times 100 = 95.8 \%$$

Rate of increase in profit from [2] to [3]

Table 4.18 Trial Balance of Farming Improvement Model for Managing
Crop and Livestock Production for New Farms
in the Batinah Region

Crops	Estimated present situation			Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Date palm	0.3	-1,543	-462.9	0.3	-1,573.9	-472.2
Grape	0.2	2,675	535.0	0.2	3,508.3	701.7
Alfalfa	0.4	375	150.0	0.4	391.2	156.5
Rhodes grass	0.8	955	764.0	0.47	1,138.0	0
"	-	-	-	0.33	1,138.0	375.5
Sorghum	0.4	790	316.0	0.4	1,735.0	694.0
Tomato	0.8	1,579.2	1,263.4	0.8	3,468.2	2,774.6
Sweet-melon	0.4	2,146	858.4	0.8	4,322.7	3,458.2
Potato	0.4	1,528	611.2	0.8	1,355.0	1,084.0
Carrot	0.4	3,235	1,294.0	0.4	3,747.1	1,498.8
Total	4.1	-	5,329.1	4.9	-	10,271.1
Goat 40 female goats	Number of raised goats:0			Selling price of goats: 1819RO Milk: 508RO (for self-consumption)		
Total				11,119.1		

Note: Farm size: 4.1 ha. Annual cropping ratio of farm: 4.9/4.1=119.5%

Livestock is introduced to full-time crop production farmers for
their farm management.

$$R2 = (5,944.5 / 5,329.1) \times 100 = 111.5\%$$

Rate of increase in profit from [1] to [3]

$$R3 = (8,552.1 / 2,721.5) \times 100 = 314.2\%$$

The calculation estimate examples given above show that the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2] represent a net income increase of R.O. 2,600, which is an increase of approximately 95%. Net income increase from the hypothesized current conditions to the year 2000 according to this model would be R.O. 6,000, or 110%. The projected rate of net income increase from the current levels obtained by the JICA team to the completion date of the agricultural development plan in the year 2000 is approximately R.O. 8,500, which represents an increase of about 310%.

The total income after the proposed improvements for the farms dedicated to crop production is about R.O. 10,800. Combined farming by adding 40 heads of goats generates a further R.O. 500 net income increase, an increase of 15%. Apart from these improvements in income, goat milk can be consumed by the family, as can the meat when necessary. Thus, combined farming would help improve the family's diet and nutrition, and generate good quality organic fertilizer.

This model of improvements in combining livestock farming with crop production was developed for the Batinah Region but the basic features of livestock farming are such that it could be applied in other regions indicating the same levels of increase in income.

(iii) Interior Region (in a broad sense) New Farms' Farming Improvement Model

Estimates of increases in farming profits from the farming improvement model (farming scale: 4.1 ha) for the new farms in

Table 4.19 Trial Balance for Farming Improvement Model for New Farms
in the Interior Region

Crops	Estimated present situation		Year 2000	
	Planted area (ha)	Net unit profit (RO/ha)	Planted area (ha)	Net unit profit (RO/ha)
Date palm	0.3	-1,543	0.3	-1,573.9
Grape	0.2	2,675	0.2	3,508.3
Alfalfa	0.4	375	0.4	391.2
Rhodes grass	0.8	955	0.8	1,138.0
Wheat	0.4	-277	0.8	-746.4
Sorghum	-	-	0.4	1,735.0
Tomato	0.4	1,579.2	0.4	3,468.2
Sweet-melon	0.4	2,146	0.4	4,322.7
Potato	0.4	1,528	0.4	1,355.0
Garlic	0.4	2,973	0.4	5,521.4
Carrot	0.4	3,235	0.4	3,747.1
Total	4.1		4.9	
		5,459.8		8,759.1

Note: Farm size 4.1 ha. Annual cropping rate of farm for 4.1 ha : 4.9 / 4.1 = 119.5 %.

the extended Interior Region (in a broad sense) can be calculated using the total values for production net income given in Tables 4.4, 4.16 and 4.19.

Increases in profit from actual figures obtained by the JICA team (using net income per 4.1 ha)[1] to hypothetical model current level[2]

$$A1 = 5,459.8 - 3,647.8 = \text{R.O. } 1,812.0$$

Increase in profit from hypothetical model current level[2] to 2000[3]

$$A2 = 8,759.1 - 5,459.8 = \text{R.O. } 3,299.3$$

Increase in profit from actual figures obtained by the JICA team[1] to 2000[3]

$$A3 = 8,759.1 - 3,647.8 = \text{R.O. } 5,111.3$$

Rate of increase in profit from [1] to [2]

$$R1 = (1,812.0 / 3,647.8) \times 100 = 49.7\%$$

Rate of increase in profit from [2] to [3]

$$R2 = (3,299.3 / 5,459.8) \times 100 = 60.4\%$$

Rate of increase in profit from [1] to [3]

$$R3 = (5,111.3 / 3,647.8) \times 100 = 140.1\%$$

The estimates given above show that it would only require slight improvements in crop kinds and cropping rates to achieve the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2] of an approximately R.O. 1,800 net income increase, an increase of approximately 50%. Increases in income arising from improvements in cultivation techniques given in the preconditions stated above would be about R.O. 3,300, or 60%.

Also, the projected rate of net income increase from the current levels obtained by the JICA team to the date of completion of this agriculture development plan is approximately 140%.

The figures for production income given above demonstrate that this model provides ample margin for healthy operation, and so it can be accepted as an effective model.

(iv) Salalah Region New Farms' Farming Improvement Model

Estimates of increases in farming profits from the farming improvement model (farming scale: 2.0 ha) for new farms in the Salalah region can be calculated using the total values for production net income given in Table 4.5, 4.16 and 4.20.

Increase in profit from the actual figures obtained by the JICA team (using net income per 2.0 ha) [1] to hypothetical model current level[2]

$$A1 = 3,335.3 - 1,326.5 = \text{R.O. } 2,008.8$$

Increase in profit from the hypothetical model current level[2] to 2000[3]

$$A2 = 6,638.3 - 3,335.3 = \text{R.O. } 3,303.0$$

Increase in profit from the actual figures obtained by the JICA team[1] to 2000[3]

$$A3 = 6,638.3 - 1,326.5 = \text{R.O. } 5,311.8$$

Rate of increase in profit from [1] to [2]

$$R1 = (2,008.8 / 1,326.5) \times 100 = 151.4\%$$

Rate of increase in profit from [2] to [3]

$$R2 = (3,303.0 / 3,335.3) \times 100 = 99.0\%$$

Table 4.20 Trial Balance for Farming Improvement Model for New Farms
in Salalah

Crops	Estimated present situation			Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Banana	0.20	261	52.2	0.20	875.5	175.1
Grape	0.20	2,675	535.0	0.20	3,508.3	701.7
Alfalfa	0.10	375	37.5	0.10	391.2	39.1
Rhodes grass	0.40	955	382.0	0.40	1,138.0	455.2
Wheat	0.22	-277	-60.9	0.22	-746.4	-164.2
Sorghum	0.22	790	173.8	0.22	1,735.0	381.7
Tomato	0.22	1,579.2	347.4	0.44	3,468.2	1,526.0
Sweet-melon	0.22	2,146	472.1	0.22	4,322.7	951.0
Potato	0.22	1,528	336.2	0.44	1,355.0	596.2
Garlic	0.22	2,973	654.1	0.22	5,521.4	1,214.7
Okra	0.22	1,742	383.2	0.22	3,279.0	721.4
Cabbage	0.22	103	22.7	0.22	183.8	40.4
Total	2.66		3,335.3	3.10		6,638.3

Note: Farm size 2.0 ha. Annual cropping rate of farm for 2.0 ha=3.1/2.0=155.0%.

Rate of increase in profit from [1] to [3]

$$R3 = (5,311.8 / 1,326.5) \times 100 = 400.4\%$$

The examples given above show that it would only require slight improvements in crop kinds and cropping rates to achieve the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2] of approximately R.O. 2,000 net income increase, that is an increase of approximately 150%. The increase in income arising from improvements in cultivation techniques, given in the preconditions above, would be about R.O. 3,300, or 100%. Also, the projected rate of net income increase from the current levels obtained by the JICA team to the date of completion of this agriculture development plan, is approximately 400%.

The figures for the income on production given above demonstrate that this model provides ample margin for healthy operation, and so it can be accepted as an effective model.

(b) Estimate Calculations of Net Profit of the Traditional Farm's Farming Improvement Model

(i) Northern Oman Traditional Farms' Farming Improvement Model

Estimates of increases in farming profits from the farming improvement model (farming scale: 0.5 ha) for the traditional farms in the northern Oman can be calculated using the total values for production net income given in Tables 4.6, 4.16 and 4.21 in the following way:

Increase in profit from the actual figures obtained by the JICA team (using net income per 0,5 ha)[1] to the model hypothetical current level[2]

$$A1 = 276.1 - (-234.8) = R.O. 510.9$$

Table 4.21 Trial Balance for Farming Improvement Model for New Farms
in Northern Oman

Crops	Estimated present situation			Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Date palm	0.2	-1,543	-3086	0.2	-1,573.9	-314.8
Grape	0.1	2,675	2675	0.1	3,508.3	350.8
Alfalfa	0.05	375	188	0.05	391.2	19.6
Rhodes grass	0.05	955	478	0.05	1,138.0	56.9
Sorghum	-	-	-	0.0165	1,735.0	28.6
Cowpea	-	-	-	0.0165	1,641.2	27.1
Tomato	0.033	1,579.2	52.1	0.033	3,468.2	114.5
Sweet-melon	0.033	2,146	70.8	0.033	4,322.7	142.6
Potato	0.0165	1,528	25.2	0.0165	1,355.0	22.4
Carrot	0.0165	3,235	53.4	0.0165	3,747.1	61.8
Garlic	0.0165	2,973	49.1	0.0165	5,521.4	91.1
Okra	-	-	-	0.0165	3,279.0	54.1
Total	0.52		276.1	0.565		654.7

Note: Farm size 0.5 ha. Annual cropping ratio of farm: 0.565/0.5=113.0%

Increase in profit from the hypothetical model current level[2] to 2000[3]

$$A2 = 654.7 - 276.1 = \text{R.O. } 378.6$$

Increase in profit from the actual figures obtained by the JICA team[1] to 2000[3]

$$A3 = 654.7 - (-234.8) = \text{R.O. } 889.5$$

In the improvement of farming profit from [1] to [2], it is improved from a deficit to a benefit of R.O. 510.

Rate of increase in profit from [2] to [3]

$$R2 = (378.6 / 276.1) \times 100 = 137.1\%$$

In the improvement of profit from [1] to [3], it is improved from a deficit to a benefit of R.O. 890.

The calculations above show that it would only require slight improvements in crop kinds and cropping rates to achieve the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2], an approximately R.O. 500 net income increase. The improvements in cultivation technology described above as preconditions would result in a net income increase of approximately R.O. 400, or about 140%. Also, the net income increase from the current levels obtained by the JICA team to the date of completion of this agriculture development plan is approximately R.O. 900. Thus, while the improvement in operation that would result from this model is high, the total income on production that would be reached by the year 2000 is no more than about R.O. 650. It seems clear that it would be very difficult for a family to support itself and continue with agriculture with only this income. Therefore, if we assume that the minimum amount required to support a family is R.O. 2,500, this can be achieved by increasing farming scale above 2.0 ha, or if farming scale is

kept at current levels, farming families will have to rely on income from raising livestock or from sources other than agriculture.

(ii) Northern Oman Traditional Farms' Crop and Livestock Production Combined Farming Improvement Model

The estimates of increases in farming profits from the combined improvement model (farming scales: 0.5 ha, eight goats, and egg-laying poultry) for the traditional farm in the northern Oman devoted to crop production, but to which livestock farming has been added can be calculated using the total values for production net income given in Table 4.6, 16 and 22 in the following way.

Increase in profit from actual figures obtained by the JICA team (using net income per 0.5 ha)[1] to hypothetical model current level [2]

$$A1 = 276.1 - (-234.8) = \text{R.O. } 510.9$$

Increase in profit from model hypothetical current level [2] to 2000 [3]

$$A2 = 2,610.1 - 276.1 = \text{R.O. } 2,334.0$$

Increase in profit from actual figures obtained by the JICA team [1] to 2000[3]

$$A3 = 2,610.1 - (-234.8) = \text{R.O. } 2,844.9$$

In the improvement of farming profit from [1] to [2], it is improved from a deficit to a benefit of R.O. 276.

Rate of increase in profit from [2] to [3]

$$R2 = (2,334.0 / 276.1) \times 100 = 845.3 \%$$

Table 4.22 Trial Balance of Farming Improvement Model for Managing
Crop Production and Livestock for Traditional Farms
in Northern Oman

Crops	Estimated present situation			Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Date palm	0.2	-1,543	-308.6	0.2	-1,573.9	-314.8
Grape	0.1	2,675	267.5	0.1	3,508.3	350.8
Alfalfa	0.05	375	1.88	0.05	391.2	0
Rhodes grass	0.05	955	47.8	0.05	1,138.0	0
Sorghum	—	—	—	0.0165	1,735.0	0
Cowpea	—	—	—	0.0165	1,641.2	27.1
Tomato	0.033	1,579.2	52.1	0.033	3,468.2	114.5
Sweet-melon	0.033	2,146	70.8	0.033	4,322.7	142.6
Potato	0.0165	1,528	25.2	0.0165	1,355.0	22.4
Carrot	0.0165	3,235	53.4	0.0165	3,747.1	61.8
Garlic	0.0165	2,973	49.1	0.0165	5,521.4	91.1
Okra	—	—	—	0.0165	3,279.0	54.1
Total	0.52	—	276.1	0.565	—	549.6
Goats 8 female goats	Number of raised goats:0			Selling price of goats: 364RO		
Poultry for egg 750	Number of raised Poultry:0			Milk 101.6RO(for self- consumption) Selling price of eggs: 506.5RO Selling price of chicken: 675RO		
Total				2,610.1		

Note: Farm size: 0.5 ha. Annual cropping ratio of farm: 0.565/0.5=113.0% Livestock is introduced to full-time crop production farmers for their farm management. Gross net profit will be 1,984.6RO based on the fact that the net profit for breeding 500 chickens is 1,772.4RO.

In the improvement of farming profit from [1] to [3], it is improved from deficit to a benefit of R.O. 2,610.

The calculation estimate examples given above show that the increase from the current levels obtained by the JICA team [1] to the levels hypothesized in the improvement model [2] can be achieved by only slight improvement in kinds of crops and rates of land under cultivation to approximately R.O. 500 net income increase. The net income increase from the hypothesized current conditions to the year 2000 according to this model would be about R.O. 2,300 or 850% which is extremely high. The projected rate of net income increase from the current levels obtained by the JICA team to the completion date of the agricultural development plan is approximately R.O. 2,800.

The total income after the proposed improvements for farms dedicated to crop production is about R.O. 650. But initiating combined farming by adding 8 goats and 750 egg-laying poultry generates a R.O. 1,950 net income increase, which raises the total to R.O. 2,600. This meets the minimum income considered necessary to support a family and continue with agriculture, which is R.O. 2,500.

This model of improvement in combined farming was developed for the northern Oman, but the basic features of livestock farming are such that it could also be applied to farms in the southern Oman indicating the same levels of increase in income.

The milk can be consumed by the family, as can the eggs and the chickens when necessary. Another advantage is that combined farming would also generate good-quality organic fertilizer. These advantages show that this model is effective in improving small-scale crop and livestock combined farming.

However, it is estimated that more than 500 chickens could be bred by model farms which rely only on occasional supplementary help and do not increase their basic labor

capacity from the current level of one person. That is one problem this model cannot deal with. Net income from breeding 500 egg-laying poultry is R.O. 1,257, which in this case would mean a total net income of R.O. 1,985, R.O. 515 less than the minimum requirement of R.O. 2,500 mentioned above. For this reason, small farms for which this improvement model was designed need to increase their farming scale to support their families and continue with agriculture. Otherwise they will have to supplement their incomes from sources other than agriculture.

(iii) Salalah Region Traditional Farms' Farming Improvement Model

Estimates of increases in farming profits from the farming improvement model (farming scale: 0.5 ha) for the traditional farms in the extended Interior Region can be calculated using the total values for production net income given in Tables 4.5, 4.16 and 4.23 in the following way:

Increased farming profit from the actual figures obtained by the JICA team (using net income per 0.5 ha)[1] to hypothetical model current level[2]

$$A1 = 683.7 - 456.4 = \text{R.O. } 227.3$$

Increase in profit from hypothetical model current level [2] to 2000 [3]

$$A2 = 1,238.6 - 683.7 = \text{R.O. } 554.9$$

Increase in profit from actual figures obtained by the JICA team [1] to 2000[3]

$$A3 = 1,238.6 - 456.4 = \text{R.O. } 782.2$$

Rate of increase in profit from [1] to [2]

$$R1 = (227.3 / 456.4) \times 100 = 49.8\%$$

Table 4.23 Trial Balance for Farming Improvement Model
for Traditional Farms in Salalah

Crops	Estimated present situation		Year 2000		
	Planted area (ha)	Net unit profit (RO/ha)	Planted area (ha)	Net unit profit (RO/ha)	Net production profit (RO/area)
Banana	0.2	261	0.2	875.5	175.1
Coconut	0.02	1,356.3*	0.02	2,221.6*	1,333*
Papaya	0.02		0.02		
Grape	0.02		0.02		
Rhodes grass	0.06		0.06		
Wheat	0.036	-277	0.036	-746.4	-26.9
Sorghum	0.036	790	0.036	1,735.0	62.5
Tomato	0.072	1,579.2	0.072	3,468.2	249.7
Sweet-melon	0.036	2,146	0.036	4,322.7	155.6
Potato	0.072	1,528	0.072	1,355.0	97.6
Garlic	0.036	2,973	0.036	5,521.4	198.8
Okra	0.036	1,742	0.036	3,279.0	118.0
Cabbage	0.036	103	0.036	1,838	6.6
Total	0.68		0.68		1,238.6

Note: * Average of 3 crops. Farm size: 0.5 ha. Annual cropping ratio of farm: 0.68 / 0.5 = 136.0 %.

Rate of increase in profit from [2] to [3]

$$R2 = (554.9 / 861.9) \times 100 = 64.4\%$$

Rate of increase in profit from [1] to [3]

$$R3 = (782.2 / 456.4) \times 100 = 171.4\%$$

The calculation estimate examples given above show that it would only require slight improvements in crop kinds and cropping rates to achieve the increase from the current levels obtained by the JICA team[1] to the levels hypothesized in the improvement model [2] of approximately R.O. 230, that is an increase of approximately 50%. The increase in income arising from improvements in cultivation technologies given in the preconditions stated above would be about R.O. 550, or approximately 65%. Also, the projected rate of net income increase from current levels obtained by the JICA team to the date of completion of this agriculture development plan is approximately 170%, with total increased net income reaching no more than about R.O. 1,250.

The current level of land utilization in the traditional farms of Salalah is already sufficiently high, and consequently there is not much chance of increasing it in the future. Even when it comes to attempts to increase the proportion of land devoted to cultivation of highly profitable crops, there are practical limits to rational implementation of a rotation cropping pattern. There are also limits on increasing unit income. At the low levels of the farming scale, traditional farms in the area of 0.5 ha or less find it very difficult to increase their income beyond that required to support the family and continue agriculture with only the production of the usual crops. If we therefore assume that the minimum amount required to support a family in Salalah is R.O. 2,500, this can only be achieved by increasing the farming scale above 1.0 ha, or if the farming scale is to be kept at current levels, farming families will have to rely on income from raising livestock or

from sources other than agriculture. It also seems necessary to take advantage of the climatic conditions, which are better in Salalah than in other regions, and to sufficiently develop effective new cultivation methods.

(3) Conclusion

Table 2.24 summarizes the farming profit calculation estimate examples using the farming improvement models described above. It shows that in general new farms in northern Oman have a farming scale of more than about 4 ha and in Salalah of more than about 2 ha. Production net income of agricultural crops (note that depreciation is not taken into consideration in calculating costs) is usually higher than the minimum level of R.O. 2,500 required to support a family and continue reproduction of agriculture, but is sometimes less than this. The development plan calls for increasing net income to about R.O. 10,200 in northern Oman and to about R.O. 6,600 in Salalah. For these reasons, it is considered that this farming improvement model would make it possible for new farms to establish a secure operating system.

In the case of traditional farms, in general they operate on farms smaller than 1 ha, which is very low. In addition, the rate of cultivation for relatively unprofitable fruit trees like date palms is high, and the current levels of net income from agricultural crops is extremely low about R.O. -470 to about R.O. 900 (per ha). Even after it is improved, as called for in the 10-year Master Plan, it would only rise to between R.O. 660 to R.O. 1,200. For these reasons, income from livestock farming or work outside agriculture, at a level of between about R.O. 1,300 and R.O. 1,800 per year, or significant increases in farming scale, would be necessary to secure healthy operations here.

Many traditional farms keep goats, sheep, poultry and other domestic animals, though only rarely do they have cows. They often use home-produced fodder and the waste and leftovers of agricultural produce to feed their animals. According to the calculation estimate examples for farming operations, net income on production for keeping 40 head of goats

Table 4.24 Summary of Trial Balance for Present Farming Management and Improvement Model

Region	Farming type	Sample data collected by the JICA Study Team			Farming improvement model					
		Present situation			Estimated present situation			Improvement model Year 2000		
		ha	RO	RO/ha	ha	RO	RO/ha	ha	RO	RO/ha
1. Batinah Region	Full-time crop production of new farm	4.1	2,722	664	4.1	5,329	1,300	4.1	10,806	2,636
2. do	Crop production with livestock in new farm	—	—	—	4.1	—	—	4.1	11,119	2,712
3. Interior Region	Full-time crop production of new farm	8.6	7,669	892	4.1	5,460	1,332	4.1	8,759	2,136
4. Salalah Region	Full-time crop production of new farm	1.8	1,220	663	2.0	3,335	1,668	2.0	6,638	3,319
5. do	Full-time crop production of traditional farm	1.8	1,680	913	0.5	684	1,368	0.5	1,239	2,478
6. Northern Oman	Full-time crop production of traditional farm	0.6	-275	-470	0.5	276	552	0.5	655	1,310
7. do	do	—	—	—	(2.0	1,104	552)	(2.0	2,620	1,310
8. do	Crop production with livestock of traditional farm	—	—	—	0.5	—	—	0.5	2,610	5,220

Note: () Estimated value

is R.O. 848, R.O. 1,772 for raising 500 egg-laying poultry and R.O. 57 for keeping 10 cows.

This is why the combined farming model of eight goats and 750 egg-laying poultry added to crop production in the model farms of farm management scale 0.5 ha was produced. The estimates calculated from this model indicate a total income of R.O. 2,610, which is above the minimum income of R.O. 2,500. Breeding 750 egg-laying poultry with only a little supplementary labor to help the basic manpower of one person seems to present serious problems, but estimates for breeding 500 hens, which could be manageable by one person indicate a total income of R.O. 1,985, which does not meet the minimum.

According to Table 4.24, net income per hectare for farms dedicated to crop cultivation is about R.O. 2,400 for new farms in northern Oman and about R.O. 3,300 for new farms in Salalah. Therefore, with the characteristic cultivating system of the new farms (low proportion of land area devoted to fruit trees, high proportion to vegetables), a farming scale of at least about 1 ha should be enough to provide almost all of the minimum requirement of R.O. 2,500. For traditional farms the net income per hectare is about R.O. 1,300 in Northern Oman and approximately R.O. 2,500 in Salalah. This means that with the characteristic cropping pattern of traditional farms (high proportion of land devoted to fruit trees, low proportion to vegetables) the minimum required income can be generated by farms with a farming scale of 1 ha in Salalah, but a farm management scale of about 2 ha would be necessary to do the same in northern Oman. On the other hand, combined operations including livestock farming open up a wide range of possibilities for combinations. To a great extent, the relationship between farming scale and income is determined by proportions involved in these combinations. Although no examples are given here, combinations are possible that would generate the required minimum income on less than the scales given above of 1 ha for Salalah and 2 ha for northern Oman.

Table 4.25 gives the number of farms by owned land area in Oman taken from the agricultural census of 1978/9. Group A in this Table may be mainly the small-scale traditional farms; Group B may be mostly the larger

scale traditional, new, and other farms; while group C consists of the very large farms including commercial farms.

There are about 56,000 farms 2 ha or less throughout the country, which is about 85% of the total number. There are about 46,000 farms less than 1 ha, which is about 70% of the total. It is therefore felt that an agricultural policy should strive to expand farm-management scale gradually, and to ensure that these small-scale farm families can be led to healthy and culturally rich lives.

Table 4.25 Number of Farms and Its Percentage in Each Farm-size Class

Category	Farm size (ha)	Number of farms	do (%)
Group A	0.01 - 0.49	3 546 4	5 4.4
	0.05 - 0.99	1 047 2	1 6.1
Sub-total		4 593 6	7 0.5
Group B	1.0 - 1.99	9 87 8	1 5.2
	2.0 - 4.99	6 38 0	9.8
	5.0 - 9.99	1 84 8	2.8
	10.0 - 24.99	8 5 8	1.3
Sub-total		1 89 6 4	2 9.1
Group C	25.0 - 49.99	1 7 6	0.3
	50.0 - 99.99	4 4	0.1
	100.0 - 199.99	2 2	0.0
Sub-total		2 4 2	0.4
Group D	0	1 80 6 2	0
Grand Total		8 32 0 4	1 00.0

ANNEX

*LINKAGE BETWEEN PROJECTS IN REGIONAL
DEVELOPMENT PLAN REPORTS AND
JICA MASTER PLAN STUDY REPORTS*

Annex Table 1 Linkage between Projects in Regional Development
Plan Reports and JICA Master Plan Study Report

1. Regional Development Plan for the Southern Region

Regional Plan Report		JICA Report	
Project Ref. No.	Name	Project Ref. No.	Name
(1) AGRICULTURE			
	[Salalah Plain]		
HPAGRC01	Technical Support	⊙ NAE-1	Improvement and development of Extension Centers and Facilities
		⊙ NAE-3	Training of Researchers, Extension Staff and Statistic Staff
HPAGRC02	Irrigation Water Distribution System	⊙ NW-1	Improvement of Irrigation System and Centrally-Controlled Water Distribution System
HPAGRC03	Trickle Irrigation & Vegetables	⊙ NW-2	Subsidy for New Irrigation System Project for 30,000 ha
HPAGRC04	Amenity/Production Trees	⊙ NAR-2-9	Salt-Tolerant Plants and Halophytes Research Units (pilot project areas)
		⊙ NAR-4	Forestry-Improvement Program
HPAGRC05	Papaya Export	○ NAR-1-3	Agricultural Research Facilities at Salalah
		⊙ NAR-3-5	Development of Nurseries in Southern Region
	[Jabals (An Integrated Package)]		
HPAGRC06	Tree Planting	⊙ NAR-4	Forestry-Improvement Program
HPAGRC07	Enhanced Fog-Water Collection	nil	
HPAGRC08	Phosphate Fertilizer	○ NLL-1-2	Grazing Control
HPAGRC09	Wall Building	○ NLL-1-2	Grazing Control
	[Nejd]		
HPAGRC10	Soil Survey	⊙ NAR-6	Soil Surveys
HPAGRC11	New Irrigated Area Development	⊙ NI-1	Integrated Agricultural Development Project in Nejd 2) Main Development Project (450 ha)
HPAGRC12	Pilot Production Training Farm	⊙ NI-1	Integrated Agricultural Development Project in Nejd 1) Pilot Farm (50 ha)
HPAGRC13	Date Production Improvement	○ DI-2	Master Plan for Development of Date Palm Cultivation
		○ NAE-4-2	Date Palm Rehabilitation & Improvement Program
HPAGRC14	Sub-regional Administration	○ NI-1	Integrated Agricultural Development Project in Nejd 1) Pilot Farm (50 ha)
HPAGRC15	Grass Pelleting	nil	
	[General]		
HPAGRC16	Groundwater Control and Monitoring		
HPAGRC17	Research Review	⊙ NAR-1-3	Agricultural Research Facilities at Salalah
HPAGRC18	Enhanced Technical Support	⊙ NAE-1-2	Improvement of Extension Center Facilities
		○ NAE-1-3	Development of Agricultural Technology Information Units
		○ NAE-2	Establishment of Development Support communication Center
		○ NAE-3	Training of Researchers, Extension Staff and Statistic Staff
		○ NI-1	Integrated Agricultural Development Project in Nejd 1) Pilot Farm (50 ha)
HPAGRC19	Sanitation		
HPAGRC20	Crop Survey	⊙ NAA-1	Collection and Organization of Agricultural Statistics
HPAGRC21	Crash Research Programme	⊙ NAR-1-3	Agricultural Research Facilities at Salalah
		⊙ NAR-2-4	Central Soil, Plant and Water Analysis Laboratory
		⊙ NAR-2-6	Plant Water Requirement Determination Unit (Salalah)
		⊙ NAR-2-7	Medical and Perfume Plant Research Unit (Salalah)
		⊙ NAR-2-9	Salt-Tolerant Plants and Halophytes Research Units (pilot project areas)
		○ NAR-2-11	Honey Bee Research Unit (Salalah)
(2) LIVESTOCK			
	[General]		
HLIVE01	Marketing Organization	⊙ NLM-1-1	Company for Livestock Products
		○ NLM-1-2	Cattle Fattening
		○ NLM-1-3	Cut Meat Processing
		○ NLM-1-4	Milk Collecting and Processing
		○ NLM-1-5	Hides and Skins Development
		○ NLM-1-6	Cattle De-stocking Subsidy
		○ NLM-1-7	Marketing Promotion

Annex Table 1 (Continued)

Regional Plan Report		JICA Report	
Project Ref. No.	Name	Project Ref. No.	Name
APLIVE02	Staff/Producer Training	⊗ NLE-1-2	Training Centers Management Consultancy
		○ NLL-1-1	Establishment of Rangeland Management
		○ NLL-1-2	Grazing Control
		○ NLL-2-4	National Vaccination
		○ NLM-1-2	Cattle Fattening
		○ NLM-1-3	Cut Meat Processing
		○ NLM-1-4	Milk Collecting and Processing
		○ NLM-1-5	Hides and Skins Development
		○ NLL-4-1	Smallholder Poultry Production
		○ NLL-4-3	A.I. Services for Dairy Cows
APLIVE03	Improved Veterinary Facilities	⊗ NLL-2-1	Animal Clinics Improvement
APLIVE04	Livestock Census	⊗ NAA-1-1	Livestock Census
APLIVE05	Grazing Pressure Control	⊗ NLL-1-1	Establishment of Rangeland Management
		⊗ NLL-1-2	Grazing Control
APLIVE06	Abattoirs	⊗ NLM-1-3	Cut Meat Processing
		○ NLM-1-7	Marketing Promotion
APLIVE07	Credit Supply Facilities	○ NLM-1-1	Company for Livestock Products
		○ NLL-4-1	Smallholder Poultry Production
APLIVE08	Promotion of Local Produce	⊗ NLM-1-7	Marketing Promotion
APLIVE09	Genetic Material Supply Units	⊗ NLL-4-3	A.I. Services for Dairy Cows
APLIVE10	Video Material [Salalah]	⊗ NLE-1-1	Extension Method Improvement
APLIVE11	Diagnostic Laboratory	⊗ NLL-2-2	Laboratory Development
APLIVE12	Credit Packages-Goats	○ NLL-4-2	Intensive Livestock Production
APLIVE13	Diversity Milk Product Processing	○ NLM-1-4	Milk Collecting and Processing
APLIVE14	Feedlot Facilities at Quarantine	⊗ NLM-1-2	Cattle Fattening
APLIVE15	Yarding on Jerbeeb	○ NLL-1	Rangeland Revegetation Project in Southern Region
APLIVE16	Egg Laying Units [Jabals]	○ NLM-4-2	Intensive Livestock Production
APLIVE17	Demonstration Units	⊗ NLE-1-1	Extension Method Improvement
		○ NLL-4-1	Smallholder Poultry Production
		○ NLL-4-2	Intensive Livestock Production
		○ NLM-1-2	Cattle Fattening
APLIVE20	Grazier Control Schemes	⊗ NLL-1-1	Establishment of Rangeland Management
		⊗ NLL-1-2	Grazing Control
APLIVE21	Establishment of Grazier Organizations	⊗ NLL-1-2	Grazing Control
APLIVE22	Calf Purchase Schemes	⊗ NLM-1-6	Cattle Destocking Subsidy
APLIVE25	Applied Research Programme	○ NLR-1-1	Development of Livestock Research Centers
APLIVE26	Demonstration Veal Calf, Broiler and Bee Units	⊗ NLE-1-1	Extension Method Improvement
		○ NLL-4-1	Smallholder Poultry Production
		○ NLL-4-2	Intensive Livestock Production
		○ NLM-1-2	Cattle Fattening
APLIVE27	Broiler Enterprise Scheme	○ NLM-4-2	Intensive Livestock Production
APLIVE28	Milk Collection and Processing Units [Hejd]	⊗ NLM-1-4	Milk Collecting and Processing
APLIVE29	Video Unit	⊗ NLE-1-1	Extension Method Improvement
APLIVE31	Pilot Sheep/Goats Production Units	⊗ NLE-1-1	Extension Method Improvement
		○ NLL-4-2	Intensive Livestock Production
APLIVE32	Bedouin Livestock Production Units	⊗ NLE-1-1	Extension Method Improvement
APLIVE35	Pilot Camel Scheme Facilities	⊗ NLE-1-1	Extension Method Improvement
(3) WATER RESOURCES			
APWRES1	Reticulation for Agricultural Water Supply - Salalah		The JICA team has not received the description of the projects classified in water resources sector. The report related to the agriculture sector was provided through MAF by D.C.
APWRES11	Recharge Dams	⊗ NW-4	Recharge Dams

The marks in the ⊗ column have following meaning:

⊗: This project has strong connection with the project in the regional plan report.

○: This project has connection with the project in the regional plan report.

Annex Table 1 (Continued)

2. Regional Development Plan for the Muscat Region*

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(1) AGRICULTURE			
PHASE I			
1	Feasibility Study for Afforestation Wilayat Quriyat (5-Year Pilot Programme)	NAR-4	Forestry-Improvement Program
2	Intensification and Improvement of Agriculture + Feasibility Study + 1 Pilot Project		Details of the project in the regional plan are not provided.
3	Establishment of an Agriculture Department	NI-2	MAF Facilities Improvement and Maintenance
PHASE II			
4	Afforestation Wilayat Quriyat (3 Pilot Project)	NAR-4	Forestry-Improvement Program
5	Intensification of Agriculture		Details of the project in the regional plan are not provided.
6	Extension of Veterinary Services		Details of the project in the regional plan are not provided.
PHASE III			
7	Afforestation (3 Pilot Projects Continuation)	NAR-4	Forestry-Improvement Program
(2) ANIMAL HUSBANDRY			
PHASE I			
1	Rangeland Management Plan + Survey, Analysis, Plan + Feasibility Study and Partial Implementation		Details of the project in the regional plan are not provided.
2	Pilot Project for Corral Husbandry + Feasibility Study 2 Pilot Farms of 2-3 ha. each	NLL-5	Livestock Specialized Services
3	Introduction of Corral Husbandry	NLL-5	Livestock Specialized Services
4	Assessment of Potential for Poultry Production and Bee Keeping		Details of the project in the regional plan are not provided.
PHASE II			
5	Rangeland Management Plan Implementation (5-Year Programme)		Details of the project in the regional plan are not provided.
6	Introduction of Corral Husbandry		Details of the project in the regional plan are not provided.
PHASE III			
7	Central Animal Market		Details of the project in the regional plan are not provided.

3. Regional Development Plan for the Batinah Region**

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(1) AGRICULTURE			
PHASE I			
1	Pilot Irrigation + Feasibility Study + Implementation of Pilot Projects	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
2	Implementation of Central Agricultural Research Institute + Study / Site Selection	NAR-1	Support for Agricultural Research Station
		NAR-2	Establishment of New Research Units and Laboratories
		NAR-3	Development and Establishment of Experimental Farms and Nurseries
3	Afforestation + Feasibility Study + Startup of Pilot Phase	NAR-4	Forestry-Improvement Program
PHASE II			
4	Public Irrigation Wells on the Coast + Survey & Drilling + Implementation	NW-1	Improvement fo Irrigation System and Centrally-Controlled Water-Distribution System
5	Implementation of Central Agricultural Research Institution + Construction	NAR-1	Support for Agricultural Research Station
		NAR-2	Establishment of New Research Units and Laboratories
		NAR-3	Development and Establishment of Experimental Farm and Nurseries
6	Agricultural Extension Center + Implementation	NAE-1	Improvement and Development of Extension Centers and Facilities
7	Agricultural Warehouse + Implementation		Details of the project in the regional plan are not provided.
8	Afforestation + Continuation of Programme	NAR-4	Forestry-Improvement Program
PHASE III			
9	Public Irrigation Wells on the Coast + Survey & Drilling + Implementation	NW-1	Improvement fo Irrigation System and Centrally-Controlled Water-Distribution System
10	Agricultural Extension Center + Implementation	NAE-1	Improvement and Development of Extension Centers and Facilities
11	Agricultural Warehouse + Implementation		Details of the project in the regional plan are not provided.
12	Afforestation + Continuation of Programme	NAR-4	Forestry-Improvement Program

Annex Table 1 (Continued)

3. Regional Development Plan for the Batinah Region**

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(2) WATER RESOURCES			
PHASE I			
1	2nd Batinah Highway + Construction as Recharge Dam	NW-4-1	Groundwater Recharge Scheme
2	Construction of Water Recharge Dams + Feasibility Studies + Implementation	NW-4-1	Groundwater Recharge Scheme
PHASE II			
3	Construction of Water Recharge Dams + Feasibility Studies + Implementation	NW-4-1	Groundwater Recharge Scheme
PHASE III			
4	Construction of Water Recharge Dams + Feasibility Studies + Implementation	NW-4-1	Groundwater Recharge Scheme
(3) ANIMAL HUSBANDRY			
PHASE I			
1	Rangeland Management Plan + Survey, Analysis, Plan + Implementation		Details of the project in the regional plan are not provided.
2	Pilot Project for Corral Husbandry + Feasibility Studies Pilot Farms (3-5 ha)	NLL-5	Livestock Specialized Services
3	Broad Introduction of Corral Husbandry	NLL-5	Livestock Specialized Services
4	Rehabilitation Programme of Natural Vegetation (Feasibility Study)		Details of the project in the regional plan are not provided.
PHASE II			
5	Rangeland Management Plan + Survey, Analysis, Plan + Implementation		Details of the project in the regional plan are not provided.
6	Broad Introduction of Corral Husbandry	NLL-5	Livestock Specialized Services
PHASE III			
7	Rangeland Management Plan + Survey, Analysis, Plan + Implementation		Details of the project in the regional plan are not provided.
8	Broad Introduction of Corral Husbandry	NLL-5	Livestock Specialized Services
9	Animal Markets + Implementation		Details of the project in the regional plan are not provided.

4. Regional Development Plan for the Bakhliya Region***

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(1) ENVIRONMENT/AGRICULTURE/LIVESTOCK			
1991-1995			
1	Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
2	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
1996-2010			
3	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
(2) WATER RESOURCES			
1991-1995			
1	Water Allocation Management Plan		Details of the project in the regional plan are not provided.
2	Study for Agricultural Water Demand	NW-3	Legal Framework for Agricultural Water Use
3	Metering of Groundwater Extraction	NAR-1-2	Agricultural Research Facilities at Jemmah
		NW-2	Subsidy for New Irrigation System Project for 30,000 ha
4	Recharge Scheme	NW-3	Legal Framework for Agricultural Water Use
5	Rehabilitation of Existing Falages	NW-4-1	Groundwater Recharge Scheme
		NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
1996-2010			
6	Water Resources Development Plan - Implementation		Details of the project in the regional plan are not provided.
7	Metering of Groundwater Extraction	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
		NW-3	Legal Framework for Agricultural Water Use
8	Recharge Scheme	NW-4-1	Groundwater Recharge Scheme
9	Rehabilitation of Existing Falages	NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
10	Water Resources Awareness Campaign		Details of the project in the regional plan are not provided.

Annex Table 1 (Continued)

5. Regional Development Plan for the Sharqiya Region****

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(1) ENVIRONMENT/AGRICULTURE/LIVESTOCK			
1991-1995			
1	Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
2	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
1996-2010			
3	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
(2) WATER RESOURCES			
1991-1995			
1	Water Allocation Management Plan		Details of the project in the regional plan are not provided.
2	Study for Agricultural Water Demand	NW-3	Legal Framework for Agricultural Water Use
		NAR-1-5	Agricultural Research Facilities at Sharqiya
3	Metering of Groundwater Extraction	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
		NW-3	Legal Framework for Agricultural Water Use
4	Recharge Schemes	NW-4-1	Groundwater Recharge Scheme
5	Rehabilitation of Existing Falages	NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
1996-2010			
6	Water Resources Development Plan		Details of the project in the regional plan are not provided.
7	Metering of Groundwater Extraction	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
		NW-3	Legal Framework for Agricultural Water Use
8	Recharge Schemes	NW-4-1	Groundwater Recharge Scheme
9	Rehabilitation of Existing Falages	NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
10	Awareness Campaign		Details of the project in the regional plan are not provided.

6. Regional Development Plan for the Dhahira Region****

Regional Plan Report		JICA Report	
Number	Name	Project Ref. No.	Name
(1) ENVIRONMENT/AGRICULTURE/LIVESTOCK			
1991-1995			
1	Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
2	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
1996-2010			
3	Implementation of Livestock Rangeland Management Study		Details of the project in the regional plan are not provided.
(2) WATER RESOURCES			
1991-1995			
1	Water Allocation Management Plan		Details of the project in the regional plan are not provided.
2	Study for Agricultural Water Demand	NW-3	Legal Framework for Agricultural Water Use
		NAR-1-6	Agricultural Research Facilities at Dhahira
3	Metering of Groundwater Extraction	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
		NW-3	Legal Framework for Agricultural Water Use
4	Recharge Schemes	NW-4-1	Groundwater Recharge Scheme
5	Rehabilitation of Existing Falages	NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
1996-2010			
6	Water Resources Management Plan - Implementation		Details of the project in the regional plan are not provided.
7	Metering of Groundwater Extraction	NW-2	Subsidy for New Irrigation System Project for 30,000 ha
		NW-3	Legal Framework for Agricultural Water Use
8	Recharge Schemes	NW-4-1	Groundwater Recharge Scheme
9	Rehabilitation of Existing Falages	NW-6-1	Repair and Maintenance of Aflaj
		NW-6-3	Improvement and Maintenance of Major Aflaj
10	Awareness Campaign		Details of the project in the regional plan are not provided.

Explanatory Note:

Details of the agricultural projects tabulated in the regional development plan for Muscat*, Batinah**, Dakhliya***, Sharqiya**** and Dhahira***** Region are not clearly described. Therefore, it should be noted that the linkage between these regional projects and national projects is formulated on the basis of limited information.

