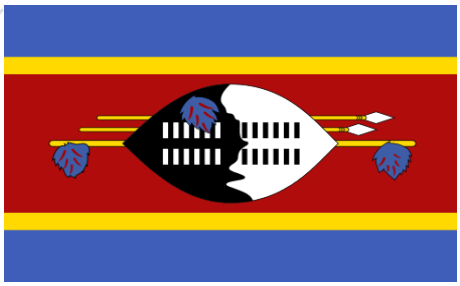
MALKERNS AGRICULTURE PLANNING GUIDELINES

MINISTRY OF AGRICULTURE



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1.0 INTRODUCTION

The objectives of these guidelines is to ensure that:

- Agriculture remains the principal use in prime agricultural areas
- Prime agricultural areas are protected from development for future generations and continual productivity
- Land taken out of agricultural production, if any, is minimal
- Regard is given to the long-term (multi-generational) impact on prime agricultural areas
- Normal farm practices and activities are able to continue unhindered
- Agricultural heritage is maintained as much as possible
- Landuse is compatible with agricultural uses
- Agricultural uses make a positive contribution to the agricultural industry, either directly or indirectly
- Servicing requirements (e.g., water and wastewater, road access, fire services, policing) fit within the agricultural context.

2.0 DEFINITIONS

Prime Agricultural Soil — A classification given to soil groups that produce the highest yields with minimal inputs of energy and economic resources, and farming them results in the least damage to the environment. Such soils within Malkerns is referred to as *M series* and the soils map show them as class A and B [Murdoch].

Protection — The preservation, conservation, management and improvement of lands which are part of viable farming operations, for the purpose of encouraging such lands to remain in agricultural production.

Agriculture and Agricultural Use — The employment of land, including for the primary purpose of obtaining a profit in money, for raising, harvesting, and selling crops, or feeding, including but not limited to grazing, breeding, managing, selling or producing livestock, poultry, fur-bearing animals or honeybees, or dairying and the sale of dairy products, or any other horticulture,

floriculture or viticulture, aquaculture, animal husbandry, or a combination thereof.

3.0 THE FARMING OPERATIONS

3.1 Livestock Operations

Livestock operations raise and keep cattle (beef and /or dairy), sheep, or goats. Operations can be described as cow and calf operations, cattle stocker and feeder operations, sheep operations for meat or wool production, or goat operations for meat or mohair production.

Livestock operations will be guided by stocking rates and requirements for sheds indicated in the attached tables Annex 1. This type of operation, depending on the species of animal, requires an “adequate” fence for animal containment. All livestock operations will be required to have “adequate” fencing to control the livestock in order to qualify for this category.

3.2 Non Ruminant Operations

This type of operation includes pigs, rabbits, and poultry. This operation require built structures and shall **NOT** be placed on prime agricultural land. Annex 1 indicate requirements for such operation.

ANNEXURE 1

4.0 LIVESTOCK AND NON RUMINANT PRODUCTION COMMODITY SIZE CATEGORISATION

Agriculture sector policies utilized in the country include (but not limited to): The Comprehensive Agriculture Sector Policy (2005); The National Food Security Policy for Swaziland (2005); The Animal Disease Act, 1965; The Veterinary Public Health Act 2017; The Cattle Routes Act; Reviewed and Updated (December, 2016); The Livestock Development Policy of 1995; The Swazialnd Environment Management Act, 200; The Waste Regulations 2000.

Besides these policies, there are other animal husbandry practices used for animal welfare regulations that are yet to be adopted by the Kingdom of Eswatini. These preactises provide for the Five Freedoms of Animal Welfare. These freedoms form the cornerstone of modern animal welfare. These are:

1. **Freedom from hunger and thirst:** By ready access to fresh water and a diet to maintain full health;
2. **Freedom from discomfort:** By providing an appropriate environment including shelter and a comfort;

3. **Freedom from pain, injury or disease:** By prevention or rapid diagnosis and treatment;
4. **Freedom to express normal behaviour:** By providing sufficient space, proper facilities and company; and
5. **Freedom from fear and distress:** By ensuring conditions and treatment which avoids mental suffering.

4.1 Commodity: Beef Cattle (Rangeland)

SCALE	RANGE (NUMBER)	MINIMUM SPACE/BEAST/HA
Small	1-10	2.3-2.9ha/Livestock Unit (LSU)
Medium	11-49	
Large	50 and above	

Classification: UM4, Upper Middleveld Basin Grassland.

Description: Inherently a grassland or open savanna with a vigorous grass component, but now largely cleared for cultivation and settlement due to the deep red soils (Sweet and Khumalo 1994). *Tithoniadiversifoliar* (Mexican Sunflower)?

Note: A detailed range survey needs to be conducted on land parcels designated for grazing as the carrying capacity and the above recommended stocking rates may not reflect the current status (outdated) of the rangeland condition.

PRODUCTION REQUIREMENT	***REQUIRED STANDARD***
Water	65L/LSU/day but ensure unlimited supply of water to animals
Waste Management	Land application
Odor Management	Burial and landfill
Health Management	Devise a Herd Health Programme. Practice disease diagnosis and early treatment of infections. Otherwise, periodically vaccinate

	relevant animals against Anthrax, Botulism, Black quarter and Lumpy skin. Deworm animals.
Storage/Handling Facility	Average size of corrals should be 30m by 40m with 4 holding pens (4.5 cubic ft per 100 square ft of lot). Provide 1.5m^2 per LSU for each holding pen, 0.8m^2 per LSU for crowding pen. Working chute should be 6m long, 0.8m wide and 1.6m in height. Appropriate storage for animal feeds should be ensured (sheltered, well ventilated and feeds should be raised from the ground). Hay barn structures should be well roofed and open at one end for good air circulation. Hay barn size also depends on the number hay bales to be stored. 1.6m^3 per normal sized round bale is recommended. Otherwise a 30m by 20m (600m^2) hay barn structure is ideal.
Based on Beef production, 30 animals requiring 2.9 ha/cow need 87 Ha ~ 90 ha	

4.2 ***Commodity: Beef Cattle (Feedloting)***

SCALE	***RANGE (NUMBER)***	***MINIMUM SPACE/BEAST/ M²***
Small	1-10	14m²
Medium	11-30	
Large	30 and above	
PRODUCTION REQUIREMENT	***REQUIRED STANDARD***	
Water	70L/LSU/day. Water requirements are dependent solely on weather conditions and nature of the feed.	
Waste Management	Lagoons, land application, septic tanks, bury carcass, incinerate	
Odor Management	**Use of chemicals** – Masking and counteractants chemicals.	

	Other techniques: Burial, dust suppressant, incineration and landfill.
Health Management	On arrival, deworm animals and vaccinate against Botulism, Bovine respiratory disease (BRD) and provide multivitamin shots. Otherwise ensure appropriate transportation measures and good animal husbandry practices.
Storage/Handling Facility	Establish appropriate working and loading chutes. Working chute should be 6m long, 0.8m wide and 1.6m in height Appropriate storage for animal feeds should be ensured (sheltered, well ventilated and feeds should be raised from the ground). A 30m by 20m sized structure is ideal or use the Bulk Feed Bins.

4.3 Gross Margin For Beef (Feedlot)

GROSS MARGIN FOR BEEF (FEEDLOT)					
				20 animals	**10 animals**
Item	**Unit**	**Quantity**	**Cost/Unit E**	**Total Value (E)**	**Total Value E**
Income					
Revenue	E	20	7,280.00	145,600.00	72,800.00
Empty bags	g	288	2.00	576.00	288.00
Manure	50 Kg	100	50.00	5,000.00	2,500.00
Head and trotters		20	100.00	2,000.00	1,000.00
Hide		20	150.00	3,000.00	1,500.00
offals	5 Kg	20	600.00	12,000.00	6,000.00
Total income				**168,176.00**	84,088.00
		Quantity	**Cos/Unit**	**Total Value**	**Total Value**
Variable costs					
feeder cattle		20	3,500.00	70,000.00	35,000.00
Feed					
Fattening ration/Beef pro	50 Kg	90	215.00	19,350.00	9,675.00
Drugs& tools					
Vaccine black qt + botulism	20 D	1	210	210.00	210.00
Deworm	Litre	1	527.90	527.90	527.90
Ectoban	200 ml	1	470	470	470.00
eartag marker		1	66	66	66.00
Yellow eartags		20	55.00	1,100.00	550.00
Supona aerosol	200ml	1	171.00	171	171.00
Cattle weigh belt		1	210.00	210.00	210.00
Eartag applicator		1	407.00	407.00	407.00
Syringe		1	89	89	89.00
Needle		1	32	32	32.00
abbattoir costs		20	150.00	3,000.00	1,500.00
Labour		2	1,200.00	2,400.00	1,200.00
Transport		3	500.00	1,500.00	1,500.00
Total costs				**99,532.90**	**49,766.45**
Gross Margin				**68,643.10**	**34,321.55**
BEP/ animal				**4,976.65**	**2,488.32**
BEY (no. of animals)				**13.67**	**6.84**

Assumptions

Dressing percentage 52%

Live weight after feedlotting 400 Kg

Price/Kg Grade A – E35/Kg

4.4 Commodity: Dairy Cattle

SCALE	***RANGE (NUMBERS)***	***MINIMUM SPACE/BEAST/HA***
Small	1-10	1beasts/0.75ha
Medium	11-49	
Large	50 and above	
PRODUCTION REQUIREMENT	***REQUIRED STANDARD***	
Water	115L/LSU/day	
Waste Management	Lagoons, land application, septic tanks, burry carcass, Incinerate	
Odor Management	**Use of chemicals** – Masking and counteractants chemicals. **Other techniques:** Burial, dust suppressant, incineration and landfill.	
Health Management	Devise a Biosecurity and Herd Health Programme**.** Vaccinate animals against common diseases e.g. Brucellosis, salmonellosis. Practice disease diagnosis and early treatment of infectionse Mastitis.	
Storage/Handling Facility	Use an appropriate milking parlor design and proper cattle handling facilities. Feeds should be kept dry and free from insects and rodents	

4.5 Gross Margin Dairy Cows

GROSS MARGIN FOR 5- DAIRY COWS			**(Small Scale)**	
Item	**Unit**	**Quantity**	**Value E**	**Total Cost E**
Sales	Litre	18000	10.00	180,000.00
Male calf sales	Units(s)	2	300.00	600.00
Total income	E			**180,600.00**
		Quantity	**Value E**	**Total Cost E**
Variable Costs				
Dairy cows	Unit(s)	5	15,000.00	75,000.00
Dairy meal	50Kg	155	265.00	41,075.00
Calf Starter	50Kg	15	315.00	4,725.00
Calf Grower	50Kg	8	206.00	1,648.00
Drugs	Unit(s)	1	1,604.00	1,604.00
Dipping Chemicals	Litre	1	2,436.00	2,436.00
Pasture Manageme	50Kg	7.5	255.00	1,912.50
Milking Cream	500g	4	82.00	328.00
Detergent Chemica	Unit(s)	1	142.00	142.00
Milk Filters	Unit(s)	8	44.31	354.48
Agita (Fly traps)	1Kg	1	34.80	34.80
Mineral Licks	25Kg	1	197.00	197.00
Milk Replacer	50Kg	1	155.00	155.00
Hay	350 Kg	4	300.00	1,200.00
Labour	Md	1	1,200.00	1,200.00
Transport	Trip	3	500.00	1,500.00
Calf Starter	Kg	10	247.95	2,479.50
Water	Litre	3.6	200.00	720.00
Total Variable Costs				**136,711.28**
Gross margin				**43,888.72**
BEP (E/L)				**7.60**
BEY (L)				**13,671.13**

GROSS MARGIN FOR 20- DAIRY COWS			(Large Scale)	
Item	**Unit**	**Quantity**	**Value E**	**Total Cost E**
Sales	Litre	90000	7.65	688,500.00
Male calf sales	Units(s)	9	300.00	2,700.00
Total income	E			**691,200.00**
		Quantity	**Value E**	**Total Cost E**
Variable Costs				
Dairy cows	Unit(s)	20	15,000.00	300,000.00
Dairy meal	50 Kg	600	265.00	159,000.00
Calf Starter	50 Kg	25	315.00	7,875.00
Calf Grower	50 Kg	25	206.00	5,150.00
Drugs	Unit(s)	2	1,604.00	3,208.00
Dipping Chemicals	Litre	1	2,436.00	2,436.00
Milking Machine va	Litre	1	200.00	200.00
Pasture Manageme	50 Kg	30	255.00	7,650.00
Detergent Chemica	Unit(s)	2	142.00	284.00
Milk Filters	Unit(s)	8	44.31	354.48
Agita (Fly traps)	1Kg	1	34.80	34.80
Mineral Licks	25 Kg	1	197.00	197.00
Milk Replacer	50 Kg	4	155.00	620.00
Hay	350 Kg	12	300.00	3,600.00
Labour	Months	2	1,200.00	2,400.00
Transport	Trip	4	1,500.00	6,000.00
Calf Starter	50 Kg	2	247.95	495.90
Water	Litre	15	200.00	3,000.00
Total Variable Costs				**502,505.18**
Gross margin				**188,694.82**
BEP (SZL/L)				**5.58**
BEY (L)				**65,686.95**

Assumptions

- Cows will be in milk (Lactating Period) for 300 days
- Each cow is assumed to produce 15L/day
- Milk is sold E7.65/L (Average price formal and informal)
- Cows require 15.0ha of land on irrigated pasture
- Each lactating cow will be fed 5kg of Dairy Meal per day
- Calf Mortality rate is at 10%
- 50% chance that a calf will be male

4.6 Commodity: Broilers

SCALE	***RANGE (NUMBERS)***	***MINIMUMSPACE/BIRD/M²***
Small	0-3000	10-12 birds/m²
Medium	3001-9999	
Large	10000 and above	

Small Scale: A farmer in this category will normally have 3 poultry houses each with a capacity of 1000 birds making a total of 3000 birds when all three houses are full. Each house needs an area of 125 m² taking into consideration that each house has a storeroom. Spacing between the houses is 20m for biosecurity reasons. Therefore, an area needed by a small scale farmer is 28m² by 71m² which is 1,988m².

Medium Scale: Farmers under this category usually have 5 houses each with a capacity of 2,000 birds. Each house needs area of 230 m² taking into consideration that each house has a storeroom and the spacing between the houses is 20m for biosecurity reasons. Therefore, each house needs an area of 48m by 118 m making 5,664 m².

Large Scale: Under this category usually there are 5 houses each house have a capacity of 20,000 birds. However, there is no storeroom. There are silos for feed storage and usually there are showers and office at the gate under this category. Area needed under this category is 182 m by 138 m making 25,116m².

PRODUCTION REQUIREMENT	***REQUIRED STANDARD***
Water	370L/1000 birds/day (0.37L/bird/day).
Waste Management	Composting, land application, septic tanks, bury carcass, incinerate
Odor Management	Composting, burial, incineration and landfill
Health Management	Ensure good hygiene, prevention of diseases, early diagnosis and treatment of diseases. Otherwise vaccinate birds against Infectious Bursal and Newcastle diseases.

Storage/Handling Facility	Feeds should be kept dry and free from insects and rodents

GROSS MARGIN FOR 1000 BROILERS				
Item	**Unit**	**Number o**	**Price/unit**	**Total Value**
Sales	E	950	38	36,100.00
Manure	50kg	100	10	1,000.00
Empty bags		70	2	140.00
Total income	E			37,240.00
Less Total Variable Costs				
Items	**Units**	**Unit**	**Unit/ Cost E**	**Total Cost E**
Day Old Chicks	Chick	1000	6.91	6,910.00
Broiler starter	50kg	20	290	5,800.00
Broiler grower	50kg	30	285	8,550.00
Broiler Finisher	50kg	20	289	5,780.00
Vitamins Stress Pac	100g	4	48	192.00
Lasota Vaccine	1000 D	1	53.86	53.86
Gumboro Vaccine	1000 D	1	68	68.00
Fowl pox vaccine	1000 D	1	75	75.00
Virukill Disinfectant	Litre	1	195	195.00
Wood Shavings	Bales	4	160	640.00
Transport		3	500	1,500.00
Wages	Week	6	280	1,680.00
Gas Refill	Month	2	410	820.00
Total Variable Costs				**32,263.86**
Gross Margin				**4,976.14**
BEP (E/bird)				**33.96**
BEY (birds)				**849.05**

Assumptions

5 % mortality

4.7 Commodity: Layers

SCALE	RANGE	MINIMUM SPACE/BIRD/M²
Small	Less than 800	
Medium	800-1999	6-7birds/m²

Large	Above 2000	

Note: Numbers depends on the battery cage system used.

Small Scale; Area need for this enterprise is 170 m² for the house which include the storeroom and the land area needed is 525 m² assuming that there is one house. The land area can increase if the farmer chooses to have multiple houses which can add up to a maximum of 800 birds. This is based on deep litter system.

Medium Scale: Assuming that the farmer will have two houses each with a capacity of 1000 birds on a deep litter system. The area needed for the houses, pack house and a storeroom is 1,872 m².

Large Scale: Under this category it depends on the types of battery cages that the farmer will use and the number of houses that will be constructed. It is worth noting that a farmer can have houses with a total on 20,000 birds and packing house. Land area of 20,000 m² would be suitable for this category.

PRODUCTION REQUIREMENT	***REQUIRED STANDARD***
Water	270L/1000 birds/day (0.27L/ bird/day)
Waste Management	Composting, land application, septic tanks, bury carcass, incinerate
Odor Management	Composting, burial, incineration and landfill
Health Management	Ensure good hygiene, prevention of diseases, early diagnosis and treatment of diseases. Vaccinate against Newcastle, Infectious bronchitis, Egg Drop Syndrome etc.
Storage/Handling Facility	Feeds should be kept dry and free from insects and rodents

GROSS MARGIN FOR 500 LAYERS				
Item	**Unit**	**Number of**	**Price E**	**Value E**
Eggs	30s	4,333	35	151,655.00
Empty bags	1	345	2	690.00
Spent layers	1	500	35	17,500.00
Manure	50	80	10	800.00
Total income				170,645.00
Less Total Variable Costs				
Items		**Quantity**	**Cost/Unit**	**Total cost**
Layers		500	85.50	42,750.00
Laying mash	50 kg	345	255.00	87,975.00
Egg trays		400	2.11	844.00
Electricity	Months	12	300	3,600.00
Labour	Months	12	1200	14,400.00
Water	Months	12	200.00	2,400.00
Transport	Trips	4	500.00	2,000.00
Virukill	Litre	1	195.00	195.00
Lasota (booster dose)	1000 D	1	53.86	53.86
Vitamin stresspack	ml	1	48.00	48.00
TVC				**154,265.86**
Gross Margin				**16,379.14**
BEP (E/tray)				35.60
BEY (trays)				4,407.60

4.8 Commodity: Indigenous Chickens

SCALE	RANGE	MINIMUM SPACE/BIRD/M²
Small	Less than 20 hens and 3 cocks (breeding stock)	5-6 birds/m² housing and 4 m²/bird in fowl run
Medium	More than 20 hens (breeding stock)	5-6 birds/m² and 4 m²/bird in fowl run

Small Scale: Under this category the land is for the structure and grazing land for the chickens. The structure needs land of 40 m² and the grazing land of approximately 250 chickens including the growers is 1,000 m². Total land area required is 1,040 m².

Medium Scale: Most farmers in this category have 50 hens and 6 cocks (breeding stock). The land area for the poultry house of 56 chickens breeding stock and 500 growers with chicks is 95 m² and the grazing land is 2,200 m² which makes a total of 2,295 m².

PRODUCTION REQUIREMENT	***REQUIRED STANDARD***
Water	270L/1000 birds/day (0.27L/ bird/day)
Waste Management	Composting, land application, septic tanks, burry carcass, incinerate
Odor Management	Composting, burial, incineration and landfill
Health Management	Ensure good hygiene, prevention of diseases, early diagnosis and treatment of diseases. Vaccinate against Newcastle, Infectious bronchitis, Egg Drop Syndrome etc.
Storage/Handling Facility	Feeds should be kept dry and free from insects and rodents

INDIGENOUS CHICKEN GROSS MARGIN				
HENS	**20**	**COCKS**	**3**	
Item/Description	**Unit**	**Quantity**	**Price/Unit**	**Total Income (E)**
Income				
Growers		1008	80	80,640.00
Empty bags		179	2	358.00
Manure	Kg	10	10	100.00
Total Income				**81,098.00**
Breeding stock	**Unit**	**Quantity**	**Price/Unit (E)**	**Total Income (E)**
Hens		20	100	2,000.00
Cocks		3	150	450.00
Total				**2,450.00**
VARIABLE COSTS				
FEED				
Broiler Starter Crumbles	50 Kg	24	290	6,960.00
Mixed Fowl	50 Kg	155	247	38,285.00
Medication				
Newcastle vaccine	1000 D	4	53.86	215.44
Fowl pox vaccine	1000 D	5	75	375.00
Gumboro vaccine	1000 D	4	68	272.00
Paparizine	g	3	45	135.00
Virukill	Litre	1	195	195.00
Karbadust	g	2	88	176.00
Labour	Month	12	1200	14,400.00
Transport		4	500	2,000.00
Total Variable Costs				**63,013.44**
Total Costs				**65,463.44**
Gross Margin				**18,084.56**
Break Even Price				**62.51**
Break Even Yield				**787.67**

4.9 Commodity: Pig

SCALE	***RANGE***	***MINIMUM SPACE/PIG/M²***
Small	1-29	Boar pen 9m^2 Farrowing pen 6.2m^2 Breeding pens 4m^2 Pregnant sow pen 3m^2 Porkers pen 7.3m^2 (10 porkers)
Medium	30-49	
Large	Above 50	
PRODUCTION REQUIREMENT	**REQUIRED STANDARD**	
Water	20L/animal/day	
Waste Management	Composting, land application, septic tanks, bury carcasses, Incinerate	
Odor Management	Composting, feeding to a fish pond	
Health Management	Establish a Herd Health Programme and practice good hygiene (Biosecurity). Vaccinate pigs against Leptospirosis, Parvovirus Erysipelas, Atrophic rhinitis etc.	
Storage/Handling Facility	Proper handling chutes should be established. Feeds should be kept dry and free from insects and rodents	

Note: Effluent Disposal

A 100-sow herd produces 1600 tons effluent per annum, consisting of 9.75 tons N, 3.7 tons P, 5.7 tons K. one hectare of pasture could dispose of 60 tons of effluent, i.e. about thirty hectares would be required for a 100-sow herd.

PIG GROSS MARGIN FOR 10 SOWS AND 1 BOAR				
Gross Income				
Item	**Unit**	**Quantity**	**Price (E/KG)**	**Total Value E**
Growers	55	228	32	401,280.00
head and trotters	1	228	80	18,240.00
Empty bags	1	852	2	1704
Total income				**421,224.00**
Less Total costs				
Breeding stock	**Units**	**Qty**	**Cost/Unit**	**Total Cost**
Boar		1	3200	3,200.00
Gilts		10	2500	25,000.00
				28,200.00
Feeds				
Sow and boar meal	50 Kg	90	248	22,320.00
Lactating Sow meal	50 Kg	10	267.5	2,675.00
Creep Feed	50 Kg	48	400	19,200.00
Pig weaner	50 Kg	48	339.9	16,315.20
Pig grower	50 Kg	478	265	126,670.00
Pig finisher	50 Kg	178	245	43,610.00
Labour	months	12	1200	14,400.00
Drugs and tools				-
Farrowsure B	10 doses	2	180	360.00
Litterguard	10 doses	2	156.95	313.90
Paperizine	100g	2	52	104.00
Pig Pour On	250ml	4	45	180.00
Iron injection	100ml	1	250	250.00
Eartags	10/packet	24	73	1,752.00
Eartag applicator		1	460	460.00
Teeth clipper		1	165	165.00
Supona	385ml	1	170	170.00
Pessaries	Tablet	20	45	900.00
Water	E/month	12	300	3,600.00
virukill	L	5	195	975.00
Transport		6	500	3,000.00
Abattoir		240	100	24,000.00
TVC				**281,420.10**
Total Cost				**309,620.10**
Gross Margin				**111,603.90**
BEY (kgs)				8,794.38
Gross Margin				**111,603.90**
BEP (E/poker)				1,234.30
Break even price E/Kg				22.44
Break even yield (number of pigs)				159.90

Assumptions:

12 piglets (average) / sow/cycle

2 cycles per year

5% mortality

4.10 Commodity: Goat

SCALE	***RANGE***	***MINIMUM SPACE/GOATS/HA***
Small	1-20	6 goats/ha when fed on range. Housing requirements are 1-2m^2 for adult goats.
Medium	21-40	
Large	Above 41	
PRODUCTION REQUIREMENT	**REQUIRED STANDARD**	
Water	8L/animal/day	
Waste management	Composting, land application, septic tanks, bury carcass, Incinerate	
Odor management	Landfill, burial, incineration	
Disease control	Devise a herd health programme. Practice disease diagnosis and early treatment of infections. Vaccinate animals against tetanus, contagious pluero pneumonia anthrax and manage foot rot.	
Storage/Handling facility	Establish proper animal handling chutes.	

Due consideration should be given to the following points in site selection for a goat house.

- **Drainage:** The area should be slightly sloped for effective drainage.
- **Wind Direction:** Goat houses should be partially or totally protected from the direction of strong wind depending on the wind intensity of the area.
- **Environmental Factors:** The house should not be placed within 10 meters of springs, rivers/streams or other water bodies.
- **Bio-security**: Goat house should be at least 10 meters away from other animal structures to avoid spreading of diseases between farm animals.

GROSS MARGIN FOR 30 GOATS				
Item	**Unit**	**Quantity**	**Price (E/kg)**	**Value E**
Growers	20	41	55	45,100.00
Empty bags		40	3	120.00
Skins	1	41	5	205.00
Insides	5	41	28	5,740.00
manure	30	20	10	200.00
Total income				**51,365.00**
Breeding Stock	**Units**	**Quantity**	**Cost/unit**	**Total cost**
Buck		1	3500	**3,500.00**
Less Total variable cost				
Mineral block	25 Kg	2	164.00	328.00
Sheep and goat meal	50 Kg	4	182.00	728.00
Sheep and goat pellets	50 Kg	43	182.00	7,826.00
Labour	Months	12	1,200.00	14,400.00
Tick greese	500g	2	84.00	168.00
Panacure	Litre	1	527.90	527.90
HI-TET 120	100ml	1	108.00	108.00
Black quarter/Botulism	20 D	2	210.00	420.00
Pulpy kidney vaccine	100ml	1	85.00	85.00
Rubber rings and scissor	1set	1	100.00	100.00
Hoof trimmer	1	1	80.00	80.00
Tetunus vaccine	100ml	1	68.95	68.95
Water	Months	12	100.00	1,200.00
Transport	Trips	4	500.00	2,000.00
Abattoir		41	100.00	4,100.00
TVC				**31,083.85**
Total Cost				**34,583.85**
Gross Margin				**20,281.15**
BEP (E/goat)				758.14
BEY (kgs)				565.16
Break even price (E/KG)				37.91
Break even yield (number of goats)				13.78

Assumptions:

50 % twinning

45 kids

5 % mortality

41 growers for sale

Innovative farmer has 30
breeding does

Average price per kg= E55.00

5.0 GENERAL ANIMAL WASTE MANAGEMENT (VETERINARY WASTE)

Animals that die from one of the following diseases have separate disposal requirements. This can be death due to tuberculosis, anthrax, haemorrhagicsepticaemia, glanders, infections abortion, hog cholera, Malta fever, foot and mouth disease, rabies in animals other than canines, bacillary white diarrhoea among fowl, equine infectious anaemia, other disease recognised as communicable by the veterinary profession. Consult the Vet offices for advice, for approval of low capacity carcase incinerators, and to report suspected notifiable disease.

The carcasses must be disposed of within 24 hours by:

- Digging a five foot (1.5 metre) deep grave and covering the carcass with lime and filling with dirt or
- Setting fire to the carcass and burning until it is thoroughly consumed.

Careless handling of animal carcasses can create potentially harmful exposure to serious diseases such as rabies and lyme disease, and infections from salmonella, e-coli and other pathogens. Improper disposal of carcasses and failure to properly disinfect tools, vehicles, and equipment may also infect co-workers, as well as potentially spread disease to the general public and wildlife population.

The Regulations referred to in this Code of Practice are the Waste Disposal (Livestock Waste) Regulations made under section 33(1) of the Waste Disposal Ordinance (Cap. 354).

5.1 Pollution And Nuisance Problem

Indiscriminate discharge of livestock waste causes severe pollution in the watercourses. The decomposition of the organic component of livestock waste leads to rapid deoxygenation of water and results in the blackening of water, unpleasant odours, death of aquatic life and the formation of scum on water surface. Uncontrolled discharge of livestock waste should be prevented.

5.2 Livestock Waste Handling

Livestock waste may be divided into two main categories, namely solid and liquid livestock waste. Solid livestock waste is mainly collected by means of dry muck-out of livestock manure. Liquid livestock waste is mainly derived from hosing out by water (or treated effluent) of livestock excreta (wet muck-out), or from washing livestock and livestock premises with water after dry muck-out.

A livestock keeper should ensure that all livestock waste handling facilities and equipment including channels, drains, storage facilities, tanks, storage containers, storage bags, enclosures, soakaway-pits, etc. used, or intended for use, in or on his livestock premises are properly constructed, and maintained in a manner such that there is no risk of pollution arising from the livestock waste handling operations. A livestock waste handling facility or equipment is considered properly constructed, within the meaning of good code of practice, when:

i) The livestock waste handling facility or equipment has been designed and constructed solely for its intended use;
ii) It is designed to prevent, so far as is practicable, any nuisance or annoyance to any person whether arising from odours, insects, vermin or from any other cause in connection with that livestock waste;
iii) It is constructed of material(s) of physical and chemical properties commonly known suitable for the intended use in the handling of livestock waste; and
iv) Good engineering practice is adopted wherever appropriate during fabrication, construction and installation;

v) Under normal use, the facility or equipment will not in anyway endanger life, or give rise to health hazard or risk of pollution.

vi) A properly constructed storage container, storage bag or other storage facility should also have been designed to prevent so far as is practicable the spillage, leakage or escape of any livestock waste contained therein.

vii) All livestock waste handling facilities and equipment, including channels, drains, tanks and pits, etc., should be covered to prevent ingress of rain, surface runoff and breeding of flies and mosquitoes.

Should there be any risk of overflow or spillage from any of his livestock waste handling facilities or equipment, a livestock keeper should take all reasonable precaution and exercise all due diligence to avoid any overflow, spillage or pollution.

5.3 Temporary Storage Of Solid Livestock Waste

i. Solid livestock waste, typically collected through practising the dry muck-out method, should be treated or taken off the livestock premises in accordance with the Regulations.

ii. Raw waste may be stored on the livestock premises prior to any treatment or disposal; depending on the manure collection technique adopted, the desired storage capacity should take into account the worst combination of expected conditions.

iii. However, unless on-farm treatment provisions such as on-farm composting are made, raw pig manure should be stored in storage containers and removed to and disposed of at a designated place of collection at least twice during any period of 7 days.

iv. In case of poultry manure, it should also be stored in storage containers and disposed of preferably once a week, except when the litter bedding method has consistently been adopted. With the litter bedding method, the frequency of manure removal would depend on the type of poultry and individual operation, but not less than once every two months for poultry kept in battery cages is recommended.

v. Any solid livestock waste generated or produced from the *in-situ* composting operation should be stored by the livestock keeper in or on those properly constructed parts of the livestock premises in which that waste is composted and

in such a manner as not to cause any nuisance or annoyance to any person until such time as that waste is removed from those premises for its intended use or disposal. In any case, good management should be exercised at all times such that no nuisance or pollution is caused to the environment or to livestock premises or dwellings nearby.

5.4 Collection And Disposal Of Solid Livestock Waste

Solid livestock waste for collection or treatment should be separated from liquid livestock waste on the livestock premises in the following ways:

i. The solid livestock waste (mostly manure) should be collected by means of a shovel, a scraper or specially designed dung channels and placed in a properly constructed storage container.
ii. The solid livestock waste including any contaminated bedding material should either be composted on the livestock premises or be taken to a designated place of collection.
iii. During such operations, the livestock keeper should make suitable arrangement and take all necessary precautions to avoid any spillage or pollution.
iv. The livestock and livestock premises, which are still contaminated with livestock waste, should then be washed or hosed down, with a controlled use of water, to a properly constructed channel leading to a soakaway-pit for disposal or to a liquid livestock waste treatment plant for treatment to at least the minimum standard specified in the Regulations before discharging into any nearby watercourse or receiving waters.
v. All liquid livestock waste treatment plants should be designed to achieve at least the minimum standard of a biochemical oxygen demand (BOD) and a suspended solids(SS) content, according to the Schedule in the Regulations.
vi. It is recommended that water usage should be controlled at no more than 15 litres per pig per day and 0.4 litres per chicken per wash.
vii. Solid livestock waste collected from livestock premises and not intended for on-farm treatment or reuse should be sent to a designated place of collection at intervals and emptied into the collection containers provided at the designated place of collection.

viii. It is advisable to give at least 24 hours' notice to the Authority if disposal of a large quantity of solid livestock waste is necessary.

5.5 Collection And Disposal Of Liquid Livestock Waste

a. Liquid livestock waste is derived mainly from hosing out by water of livestock excreta or from washing with water after dry muck-out from the livestock premises.
b. It is necessary to control the usage of water for washing to avoid giving rise to an unnecessarily large volume of liquid livestock waste subsequently requiring treatment and disposal.
c. Livestock premises should provide sufficient capacity of pits or tanks for storage of liquid livestock waste prior to treatment or disposal, and such storage pits or tanks should not cause nuisance or pollution of the environment.
d. When a soak-away-pit is used, an excessive use of water will require the soak-away-pit to be made much larger or otherwise result in overflow by overloading the soak-away-pit.
e. When a wastewater treatment plant is used, an excessive use of water will require a larger plant and consequently increase both capital and running costs very substantially.

A livestock keeper shall dispose of any liquid livestock waste generated or produced in or on his livestock premises:

i) By discharging into a properly constructed soak-away-pit, after the solid livestock waste has been removed; or
ii) By discharging along or through properly constructed channels to a designated place of disposal; or
iii) By discharging into a collection vehicle which is designed or adapted for the purpose of transporting liquid livestock waste to a designated place of disposal for liquid livestock waste, taking all necessary precautions to prevent the spillage, leakage or escape of such waste during that operation; or
iv) By discharging along or through properly constructed channels into a soak-away-pit, a communal sewer, saline waters or a watercourse, after such waste has been treated

in a liquid livestock waste treatment plant to at least the minimum standard required in the Regulations.

- All liquid livestock waste treatment plants should be designed to achieve at least the minimum standard of a biochemical oxygen demand(BOD) and a suspended solids(SS) content, according to the Schedule in the Regulations.
- It is recommended that water usage should be controlled at not more than 15 litres per pig per day and 0.4 litres per chicken per wash.

5.6 Control Requirement For Livestock Waste Treatment Plant

i. In general terms, treatment of livestock waste can be described as any process which uses one or more stages of biological, chemical or physical changes to stabilize the raw waste or to reduce its polluting effect.

ii. Essentially, livestock waste after proper treatment can be disposed of in accordance with the Regulations without endangering the receiving environment.

iii. All livestock waste treatment plants, whether or not mentioned in this Code of Practice, should be properly designed, constructed, operated and maintained so as not to cause pollution to the environment.

iv. All channels along or through which liquid livestock waste is discharged, after being treated to at least the minimum standard required in the Regulations, should be properly provided and maintained by the livestock keeper to ensure that these channels are kept in good order and free from breaks, cracks, holes or any other defects.

5.6.1 Soak-Away-Pit

i. A suitably designed and properly constructed soak-away-pit may be used for treating small volume of dilute liquid livestock waste, such as the liquid livestock waste generated from washing livestock or livestock premises (contaminated with livestock waste) after dry muck-out operations, or leachate from the composting of solid livestock waste.

ii. The soak-away-pit relies on the percolation of liquid livestock waste into the subsoil and it is, therefore, important not to exceed its design capacity.

iii. Liquid livestock waste should be allowed to percolate into the ground or subsoil without any overloading or overflow occurring.

iv. The effectiveness of the soak-away-pit will be prolonged by prior removal of solids, and in the case of a pig farm, a septic tank is invariably required to precede the soak-away-pit.

v. As a general guide, it is a requirement that a soak-away-pit must not be situated less than 30 metres (or such other distance in substitution for 30 metres, and subject to such conditions, as may be specified in writing by the Authority by reference to any particular livestock premises) from any reservoir, saline waters, spring, watercourse or well for potable use.

5.6.2 Composting

i. Composting is a natural biological degradation process whereby heterogeneous organic matter, including solid livestock waste, is decomposed into simple or stable compounds by the action of micro-organisms and it should be carried out in a properly constructed enclosure.

ii. Raw waste, with or without the addition of bedding material or spent litter resulting from litter bedding method e.g. Pig-on-Litter, should be prepared and placed inside the enclosure where it is allowed to undergo composting and to reduce the moisture content. Such enclosure should be constructed with a permanent roof and three surrounding walls to prevent ingress of rain. Properly constructed channels with covers should be provided along the periphery of the enclosure to prevent any ingress of surface runoff, and to intercept and collect any effluent generated during composting.

iii. Leachate and drainage from composting facilities should be either properly disposed of to a soak away-pit or collected for treatment in a liquid livestock waste treatment plant.

5.6.3 Lagooning

This is a biological livestock waste treatment plant which provides storage and treatment at the same time. Livestock keepers with sufficiently large space available within their livestock premises may handle their liquid livestock waste, especially wet muck-out slurry, by this means.

5.6.4 Aerobic Lagoon

Aerobic lagoon or oxidation pond is characterised by its relatively shallow depth which usually does not exceed 1.5 metres. The treated effluent may be applied onto cultivated land or open fields where it could be completely assimilated. Any treated effluent can only be discharged to a watercourse, a communal sewer or saline waters if it has been treated to at least the minimum standard required by the Regulations and is discharged along or through properly constructed channels.

5.6.5 Anaerobic Lagoon

i. This type of system does not require dissolved oxygen to break down the organic livestock waste matter and has no restriction on its depth.
ii. The lagoon should be constructed with an impervious lining and be located far from any residential areas (a minimum distance of 300 metres is recommended), such that it does not cause any nuisance or endanger nearby farming activities, underground water, watercourse or saline waters.
iii. Never overload the lagoon.
iv. For sufficient degradation and stabilization of livestock waste, the liquid slurry should, in general, be retained in the lagoon for over 200 days.
v. The sludge accumulated in the lagoon should be removed regularly and, in any case, should not take up more than half of the lagoon volume.
vi. The sludge so removed should be properly disposed of.
vii. In general, anaerobic lagoon can provide some 80 to 90 per cent reduction in biochemical oxygen demand, but it cannot treat liquid livestock waste fully to render it suitable for discharge into watercourses, communal sewers or saline waters, and hence a second stage of treatment is required.

5.7 Disposal Of Livestock Waste Treatment Sludge

i. Sludge is a residual livestock waste generated from liquid livestock waste treatment plants including septic tank and soakaway systems.

ii. Such sludge may be dewatered on-farm either by drying, composting or mechanical means to reduce its moisture content and make it easier to handle prior to final disposal.

iii. Sludge should be properly dried before it may be disposed of as solid livestock waste to a designated place of collection.

iv. “Properly dried” means dried to a moisture content not exceeding 85 per cent by weight, such that it can be readily picked up by means of a shovel or similar tools; and that no water droplet can be squeezed out of such sludge upon pressing by hand.

v. Alternatively, such sludge may be delivered in liquid form, by means of a purpose-built sludge tanker, to a designated place of disposal for liquid livestock waste.

5.8 Additional Pollution Preventive Measures For Free Range Livestock Keeping

i. Where free range livestock keeping is practiced, the livestock keeper shall cause to be constructed permanent and impermeable barriers to prevent the escape of liquid livestock waste from the livestock premises, in accordance with the standards as specified in this Code of Practice.

ii. The land area itself should not be impermeable, so that any residual waste may be assimilated.

iii. All free-range livestock keeping areas shall be provided with an impermeable barrier or bund to prevent the direct runoff of the polluted first flush of rainwater.

iv. The barrier or bund shall be capable of retaining all rainwater that falls onto these areas during the first 15 minutes of an average rainstorm with a return period of two years.

v. In general, the provision of a bund wall along the downslope perimeter of the livestock premises should be sufficient.

vi. The minimum height requirement of this bund wall is 50cm.

5.9 Handling Of Livestock Waste For Reuse

Any solid livestock waste generated or produced in or on any livestock premises in a livestock waste control area or a livestock waste restriction area shall, in the case of livestock waste intended for use as fertilizer or soil conditioner in landscaping schemes, agriculture,

horticulture, forestry or for the production of animal feedstuffs or fishmeal, be stored by the livestock keeper in or on those premises:

i) In properly constructed enclosures used solely for composting or drying that waste and designed to prevent so far as is practicable the spillage, leakage or escape of that waste; or

ii) Where such waste is the subject of *in situ* composting, in or on those properly constructed parts of the livestock premises in which that waste is composted; and

iii) In such a manner as not to cause any nuisance or annoyance to any person whether arising from odours, insects, vermin or from any other cause in connection with that waste, until such time as that waste is removed from the premises whether by the livestock keeper or otherwise for such use of production. Any raw manure or manure compost that is not utilised must be properly disposed of as solid livestock waste.

5.9.1 Livestock Waste In Land Application

The practice of land application can be considered as a proper means of treatment and disposal of livestock waste, but this requires good planning and management. Livestock waste is rich in plant nutrients (Nitrogen, Phosphorus and Potassium). Raw or treated waste may be applied onto agricultural farmland to help maintain the soil fertility, provided that adequate precautions are taken to prevent causing any nuisance or pollution.

i. Diluted livestock excreta may be applied onto crop land, vegetated land or half-grown crops as top dressing.

ii. Spreading of manure and waste onto agricultural land must not exceed the uptake capacity of the crop.

iii. Where large quantity of manure is produced, exceeding that required for on-farm land application, arrangement could be made, if possible and agreeable with the neighbours concerned, to spread it onto neighbouring crop growing land as a crop fertilizer.

iv. It is advisable to secure the agreement of the neighbours concerned well in advance to enable the amount of land available for such application and the amount of livestock excreta that could be utilised to be correctly estimated.

v. Livestock waste for land application should be handled in such a manner so as not to cause any risks of water pollution.

vi. The maximum amount and rate of application of livestock waste as a fertiliser is strictly governed by plant nutrient requirement, soil conditions, location of site, and quality of the given waste.

vii. Good management must be exercised and care must be taken to avoid over-application in any case.

viii. Excessive application of livestock waste on land would result in the need to collect the livestock waste that is not assimilated for alternative treatment and disposal.

5.9.2 Livestock Waste In Red Worm Breeding

Any wastewater arising from red worm breeding using livestock waste as feedstuff is a liquid livestock waste, and it should not be discharged into any watercourse, communal sewer or saline waters unless it has been treated to the minimum standard required and is discharged along or through properly constructed channels.

5.9.3 Livestock Waste In Pond Fish Culture

Any water arising from fish ponds cultivated with livestock waste is a liquid livestock waste and it should not be discharged into any watercourse, communal sewer or saline waters unless it has been treated to the minimum standard required and is discharged along or through properly constructed channels.

5.10 Collection And Transportation

Good livestock waste control practices make the final disposal operation an easier task. Irrespective of the dry muck-out or wet muck-out methods used, livestock waste, treated or untreated, requires collection and transportation for final disposal. Storage, collection and transportation of livestock waste should be well planned and coordinated to avoid causing any nuisance or pollution to the environment.

5.10.1 Storage Containers And Bags

i. A livestock keeper should ensure that the storage containers used, or intended for use, in or on his livestock premises are kept in good order and repair and free from breaks, cracks, holes or any other defects.

ii. All storage containers should be leakage proof, properly designed to prevent ingress of rainwater, and constructed of robust and corrosion resistant material such as hot dip galvanized steel or hard-wearing plastic.

iii. Such storage containers should have a cover that would effectively minimize odour emission and intrusion of insects and rodents.

iv. Have handles such that it can be readily moved or manipulated or lifted by a normal adult during normal use, even when the container is fully loaded.

v. For easy handling, the capacity of storage containers should be in the region of 20 to 50 litres each as per the number of storage containers required for storage and delivery of dry muck-out manure from the livestock premises to the designated place of collection.

vi. Livestock keepers should ensure that they are adequately equipped to take necessary precautions against any unforeseen circumstances, and that there is always enough storage containers to hold all the solid livestock waste that may be generated or produced in or on the livestock premises and required storage.

vii. Livestock keepers who make their own arrangement for collection and transportation of solid livestock waste may use larger containers such as skips, provided that the total capacity is not less than the minimum requirement.

viii. Poultry waste collected from dry muck-out operations and placed in storage bags for recycling or selling purposes should be properly covered with tarpaulin during storage and transportation to avoid causing any nuisance.

ix. Poultry waste stored in storage bags should be sent to the designated place of collection.

x. Livestock keepers should ensure that the storage containers and storage bags are used for the storage of livestock waste and for no other purpose, and that no spillage or leakage occurs during storage and transportation.

5.10.2 Storage Of Liquid Sludge

i. Pits or tanks for handling livestock waste treatment sludge in liquid form should be sized according to the waste output for which they must provide total containment and should be properly designed for the resultant hydraulic load.

ii. Local soil condition should be checked prior to installation of any storage pits or tanks, and in case of doubt, suitable expert advice should be sought.

iii. These storage pits or tanks should be accessible to a purpose-built sludge tanker and should have a suitable opening located within reach for the removal and emptying operations, unless such operations are to be performed by other environmentally acceptable means.

5.11 Livestock Keeper's Obligation To Report Plant Failure

i. All livestock waste treatment plants shall be operated and maintained in good running order.

ii. In the event of a breakdown of a livestock waste treatment plant, or any failure of any component of the treatment plant which may cause the plant to fail to meet the minimum standard required in the Regulations, the following action should be taken:

- The livestock keeper should report the breakdown, irrespective of its cause, to the Local Authority as soon as practicable, but in all cases within a period of 48 hours.
- At the same time, the livestock keeper should take all reasonable measures and exercise all due diligence to repair the plant and bring it back to normal operation.

5.12 Burial

Burial is a very common method of disposing of carcasses, however it is not allowed in all jurisdictions. Burial is safe if proper procedures are used, but may result in long decomposition times, especially in anaerobic environments. Burial can result in the release of fewer air emissions than incineration operations, depending on the additional control technologies employed by incinerators, and tends to be the most economical disposal method with the fewest design and operational requirements. It is commonly used to handle mass burial events, such as those following natural disasters or catastrophic disease losses. However, burial offers

the least protection for groundwater and tends to promote anaerobic conditions, including emissions of H_2S and high odor levels.

5.12 Landfill

Another method of burial is the disposal of carcasses in a permitted landfill. Not all landfills routinely accept animal carcasses and there are significant fees associated with the disposal of carcasses in landfills. However, landfills are designed with sophisticated controls that provide increased protection for groundwater and that capture air emissions from the decomposing waste. Landfills may be more commonly used for mass burial events, such as those following natural disasters.

5.13 Incineration

Incineration involves the quick and complete consumption of carcasses by fire and heat. While sophisticated designs of incinerators are commonly used in other sectors (e.g., disposal of municipal waste), incineration is often limited to much smaller equipment for small carcasses at animal production operations. With regards to carcass disposal, incineration offers additional biosecurity benefits for animal production operations.

5.14 Rendering

Rendering is a process that uses high temperature and steam to convert waste animal tissue into value-added materials. While the process is not very complicated, there are very few rendering facilities across the Southern Africa and the associated fees at these facilities can vary. Factors that should be considered include availability of and distance to rendering facilities, cost, transportation and potential for bio-security breaches when compared to other available methods.

5.15 Dust Suppressants

Dust suppressants, or palliatives, come in many forms and can vary greatly in PM control effectiveness and longevity. Suppressants such as water are typically effective for only a short period of time (hours to a day or two), while biologically-based products like lignosulfonate have longer lifetimes, and petroleum-based products (like heavy road oil) can have lifetimes of a year or more.

6.0 CROPLAND OPERATIONS

Cropland operations include growing cereals (e.g. maize, sorghum), legumes, root crops, ornamentals, vegetable, and cash crops (sugarcane and pineapples). Cropland requires sustaining and maintaining soil fertility through good crop husbandry practices such as crop rotation, addition of manures, and fertilization. Annex 2 show three major crops.

6.1 ANNEXURE 2

CROP LAND OPERATIONS REQUIREMENTS
(the largest requirement is considered

The largest crop requirement that has been considered is sugar cane, green mealies and dry beans. These crops require a bigger production area that the other crops. This will hinder land owners from further subdividing their land.

REQUIREMENTS	***CROP***
6.1.1 Sugar Cane	
Soil Suitability	Humid soils from 100 to 150 cm deep, well-drained with pH range from 6.0 to 7.7.
Water Requirement	1600-2700 mm for the sugarcane crop to reach maturity
Gross Margins	E10 000/t of Sucrose yield in approximately 14t/ha. Good profit is realized when the area ranges from 30 ha upwards when within the Malkerns region
Harvesting and Water Management	Requires burning, machinery or manual harvesting. Good irrigation practices need to be followed in sugarcane production. Furrow, sprinkler, drip irrigation [A considerable distance is required when burning sugar cane] Identify smoke sensitive areas, Obtain a fire weather forecast, Develop farm prescribed burn plan, Determine the smoke category day, Determine smoke and ash screening distance, Determine the direction of the smoke and ash, plume, Evaluate the prescribed burn results.

Pesticide Requirement	Insect pest and Disease control and ripening chemicals [Consider distance when applying the chemicals]
Crop Residue and Soil Fertility	Good soil fertility management practices should be followed
Conservation and Land Degradation Control	Contributing factors to the degradation of soils include soil compaction and structural breakdown occurring during harvest and cultivation operations, losses of organic matter due to burning of crop residues and acidification of soils due to large applications of nitrogen fertilizers. Soil management practices should aim to increase soil organic matter levels, provide a more favourable biological environment, reduce physical damage to soils during harvesting and cultivation, reduce soil acidity and improve the effectiveness of fertilizing practices.
Production and Profitability	Large farm area is required for sugarcane production and profitability. For profitability in Malkerns a minimum of 30 ha is required. This is due to transport cost to the point of sugar cane sale and possessing
REQUIREMENTS	***CROP***
6.1.2 Green Mealies (Maize)	
Soil Suitability	Well-drained soils with pH range from 5.5 to 6.0.
Water Requirement	Green mealies requires 800-1200 mm for the maize crop to reach maturity depending on the maturity date of the crop
Gross Margins	E50000/ha. Good profit is realized when the area ranges from 5 ha upwards when within the Malkerns region
Harvesting and Water Management	Green mealies is hand harvested
Pesticide Requirement	Insect pest and Disease control chemicals [Consider distance when applying the chemicals]
Crop Residue and Soil Fertility	Stover can be ploughed under to improve soil structure

Conservation and Land Degradation Control	Contributing factors to the degradation of soils include soil compaction and structural breakdown occurring during cultivation operations Soil management practices should aim to increase soil organic matter levels, provide a more favourable biological environment, reduce physical damage to soils during cultivation, reduce soil acidity and improve the effectiveness of fertilizing practices.
Production and Profitability	For profitability in Malkerns a minimum of 5 ha is required.

REQUIREMENTS	CROP
6.1.3 Dry Beans	
Soil Suitability	Well-drained soils with pH range from 5.5 to 6.0.
Water Requirement	Green mealies requires 300-500 mm for dry bean crop to reach maturity depending on the maturity date of the crop
Gross Margins	E15000/ha. Good profit is realized when the area ranges from 10 ha upwards when within the Malkerns region
Harvesting and Water Management	Green mealies are hand harvested. Harvesting should be done early in the morning when the crop is still moist to avoid shattering
Pesticide Requirement	Insect pest and Disease control chemicals [Consider distance when applying the chemicals]
Crop Residue and Soil Fertility	Stover can be ploughed under to improve soil structure
Conservation and Land Degradation Control	Contributing factors to the degradation of soils include soil compaction and structural breakdown occurring during cultivation operations Soil management practices should aim to increase soil organic matter levels, provide a more favourable biological environment, reduce physical damage to soils during cultivation, reduce soil acidity and improve the effectiveness of fertilizing practices.
Production and Profitability	For profitability in Malkerns a minimum of 10 ha is required.
Based on a worse scenario, a minimum of 40 ha is required for crop production	

7.0 BEEKEEPING OPERATION

Beekeeping is an agricultural use and shall qualify for agricultural productivity if used for the production of human food or other tangible products having a commercial value. Annexure 3 below show requirements for bee keeping.

7.1 ANNEXURE 3: BEE KEEPING OPERATIONS REQUIREMENTS

PRODUCTION REQUIREMENT	REQUIRED STANDARD
Space Requirement	*Hectarage Requirement:* The Ministry of Agriculture has set a minimum of **7ha** for qualify beekeeping as an agricultural use. *Distance Requirement:* Honey bee hives **cannot** be placed within **30 meters** of a property line separating the land on which the hives are placed, or left from land occupied as a dwelling or used for a community center, Public Park or other place of public assembly or recreation. Hives, with or without bees, should be located far away from access roads or public roads or places with intense noise. *Degree of Intensity:* The degree of intensity standard is set at a minimum of 6 hives within 2ha.
Water Requirement	Bees should be provided with a consistent source of fresh water to prevent them from seeking water from other sources where bees might be considered a 'nuisance'.
Waste management	Dead honey bee colonies and used equipment must not be abandoned or left exposed where they can be accessed by healthy, foraging honey bees.
Disease Control	Beekeepers must report all cases of the disease American Foulbrood (*Paenibacillus larvae*) and the

	pest Small Hive Beetle (*Aethinatumida*) to the Veterinary Department, Ministry of Agriculture.
Risk Management	To minimize disturbance to people and the environment as well as nuisance conditions of bees, beekeepers should ensure the following: *i)* *Signs and Postings:* Signs should be posted to alert passersby to the presence of hives; *ii)* Hives should be kept as far away as possible from roads, sidewalks, and rights of way; iii) Hives should not be placed directly against a neighboring property unless a solid fence or dense plant barrier of six feet or higher forms the property boundary; iv) Hives should be situated so that bees' flight paths do not intersect human rights of way. In some cases, this might require erecting a fence or other barrier to redirect bees' flight; v) Swarming should be prevented or minimized, and any hive with unusually defensive behavior or excessive swarming tendencies should be re-queened; *vi) Registration:* Anyone who owns or is in possession of honey bees must register annually with the Malkerns Town Board *vii)* *Compliance with regulations:* Beekeepers are required to adhere to good bee farming practices and comply with beekeeping regulations. *viii)* *Bee hives* should be placed in close proximity to orchards to prevent bees from travelling long distances seeking pollen whereby bees might be a 'nuisance'[1].

Gross Margin

[1] Nuisance include any unpleasant circumstance or thing causing discomfort such as noise, bad ordour, danger etc.

Gross Margin for 20 Bee Hives Enterprise (TOP BAR)						
	YIELD (Kg)	YIELD (Kg)	Quantity	E/unit	Year 1	Year 2
Income						
2 Harvest per year	320	640		30	19,200.00	19,200.00
Start Up Costs			Quantity	E/Unit	Total cost	Total cost
Hive Boxes			20	500	10,000.00	-
Trap Box			4	250	1,000.00	-
Bee Suits			1	1500	1,500.00	-
Gum Boots			1	150	150.00	-
Gloves			1	260	260.00	-
Hive Tool			1	150	150.00	-
Bee brush			1	150	150.00	-
Beeswax			1	230	230.00	
Smoker			1	510	510.00	-
Variable Costs						
Transport					500.00	500.00
Labour Costs					500.00	500.00
Total costs					14,950.00	1,000.00
Gross Margin					4,250.00	18,200.00
	Year 1	Year 2				
BEP 1st Year (E/kg)	23.36	1.56				
BEY (Kg/Enterprise)	498.33	33.33				

PRODUCTIVITY AND PROFITABILITY

Beekeeping enterprise is viable, but in the first year profit is not realized. In the second year of production the farmer will start to realise profit. A farmer has to start-up with 20 bee hives. A farmer can earn **E18, 200.00** in profits in the second year when using the Swazi Top Bar.

8 HA IS REQUIRED FOR BEE PRODUCTION

8.0 ORCHARD AND VINEYARD OPERATIONS

These operations are in the business of cultivating trees or grapevines that produce nuts or fruits (such as pecans, peaches, and grapes) which are sold commercially. Typically these

operations have a regular schedule of pruning, spraying, and cultivation as well as keeping the area around the trees or vines mowed or disked. This is encouraged on class C soils within Malkerns

8.1 ANNEXURE 4: ORCHARD AND VINEYARD OPERATIONS REQUIREMENTS

8.1.1 Gross Margin For Litchi

ITEM	*UNITS*	*UNITS/HA*	*E/UNIT*	*E/HA*	*0.5 HA*
Income	**15 kg box/ha**	**520**	**100**	**52000**	**26000**
Operational costs					
Seedlings	Plants	156	100	15600	7800
seedlings replacement	Plants	10	100	1000	500
Land preparation	Hrs	4	400	1600	800
Fertilizer - 5:1:5(46)	50Kg	6	390	2340	1170
Lime	50Kg	20	63	1260	630
Irrigation (fuel)	L	180	13	2340	1170
Chemicals					
Hamba aphids	100ml	1	40	40	20
Bravo	L	2	242	484	242
Actara	L	1	780	780	390
GF 120	100ml	2	120	240	120
Labour					
Land preparation	M/days	15	65	975	487,5
Planting	M/days	10	65	650	325
weeding	M/days	18	65	1170	585
Side dressing	M/days	5	65	325	162,5
Irrigation Maintenance	M/days	1	65	65	32,5
irrigation labour	M/days	10	65	650	325
pruning	M/days	20	65	1300	650
Transport	E/km	10	5	50	25
Pest and disease control	M/days	3	65	195	97,5
Harvesting	M/days	15	65	975	487,5
Total Operating costs				**32039**	**16019.5**
Gross margin				**19961**	**9980.5**

BEP (E/15 kg box)	**E/15kg box**			**61.61**	**61.61**
BEY (15kg boxes/ha)	**15kg boxes/ha**			**320.4**	**160.2**

N.B. Each tree needs 40 litres of water per week for the duration of first 16 weeks after planting

Viability of Litchi Production in Swaziland

The gross margin of E19 961.00 indicates that a farmer should procure at least 156 trees and follow good management practices if profit is to be realized. The breakeven yield is 320.4 boxes/ha and a farmer should not sell below E61.61 per box. The first harvest is done in the third year and yield of which will gradually increase in subsequent years as the tree matures.

Market opportunities

The market for litchis is available countrywide. Most litchis in Swaziland are imported from South Africa which shows that it is open to be grown by local farmers on commercial basis.

8.1.2 Gross Margin Analysis For Avocado

Total Area 1 Ha	Units	Units/ha	E/unit	E/ha	0.5ha
Income	**Box (5kg)**	**1310**	**32,00**	**41 920,00**	**20 960,00**
Operational costs					
Seedlings	1	156	70,00	10 920,00	5 460,00
Tree replacement	1	8	70,00	560,00	280,00
Land preparation	Hrs	4	400,00	1 600,00	800,00
Fertilizer -5:1:5(46)	50kg	10	390,00	3 900,00	1 950,00
Lime	50kg	20	63,00	1 260,00	630,00
Chemicals					
Cypermetrin	L	1	124	124	62
Hamba aphids	100ml	2	40	80	40
Bravo	L	2	242	484	242

Actara	L	1	780	780	390
Tilt	100ml	1	40	40	20
GF 120	100ml	2	120	240	120
				0	0
Labour					
Planting	M/days	15	65	975	487,50
Weeding	M/days	10	65	650	325,00
Pruning	M/days	20	65	1300	650,00
Fertilizer application	M/days	30	65	1950	975,00
Irrigation	M/days	10	65	650	325,00
Pest and disease control	M/days	3	65	195	97,50
Harvesting	M/days	15	65	975	487,50
Transport cost	E/Km	10	5	50	25,00
Total variable cost				**26 733.00**	**13 366.50**
Gross margin				**15 187.00**	**7 593.50**
Break Even Price	**E/box**			**20.41**	**201.41**
Break Even Yield	**Box/Ha**			**835.4**	**417.7**

N.B. Each tree needs 40 litres of water per week for the duration of first 16 weeks after planting.

Viability of Avocado Production in Swaziland

The gross margin of E15 187.00/ha indicates that a farmer should procure at least 156 avocado trees and follow good management practices if profits are to be realized. The breakeven yield is 835.4 boxes/ha and a farmer should not charge below E20.41 per box. The first harvest is done in the third year, with a gradual increase in yield on subsequent years as the tree matures.

Marketing Opportunities

In Swaziland, avocados are in demand, thus both formal and informal markets are available. Formal markets include major local retailers or supermarkets. Informal markets include street vendors and the public at large. Currently most avocados are imported outside the country.

8.1.3 MACADAMIA NUTS ESTABLISHMENT COSTS

These are generalised costs from a detailed feasibility study done in 1995 for a 120 ha macadamia project established over a two year period. A **plant spacing** of **8m x 6m** giving **208 trees/ha** is used, but this can be changed on the spreadsheets.The total costs of establishing one hectare of macadamias (excluding the cost of acquiring the land) from scratch have been included. All costs are in Rands/ha with production and sales also on a per hectare basis.

The enclosed 13 year projection, starting with the year of planting as year O, shows a peak funding requirement of R101 541/ha in year 5 and a cash positive situation occurring in year 8 for the high yield scenario and year 10 for the average yield scenario. This is a very simplistic analysis and does not take account of any interest on loans which may be necessary. It is also based on experience gained in large agricultural developments in a corporate environment, where high standards of management were maintained. An individual small farmer may find that he can do the job with a much lower cost structure. However, the investment in establishing one hectare of macadamias is significant and 8 to 10 years is a long time to wait for the return on that investment. It is therefore extremely important for every new macadamia grower to sit down and prepare a long term projection (business plan) such as this, in order to know exactly what you are in for and to be able to accurately plan and control the project.

NOTES:

1. Production:

Two fairly conservative yield projections have been used based on yields which have actually been achieved under good management conditions. The average yield scenario was based on the average yields produced by all cultivars at the SAMAC cultivar trial at Merensky school, Tzaneen. The high yield scenario was based on the yields of the top 4 cultivars in this trial. In both the high and average yield scenarios, the actual trial yields were reduced by 20% to reflect commercial production more realistically.

In any sensitivity analysis which you will probably do on these numbers, you will note the significant positive effect on the cash flows of increasing the plant density (spacing), while keeping yield per tree the same as used in this projection. However, the 8m x 4m spacing is a very workable arrangement and one which has been used extensively to good effect in both South Africa and Australia.

2. Sales:

A price of **R45/kg of Dry-in-Shell (DIS)** nuts supplied to the processor has been used, and this price is presently applicable to Dry-in-Shell nuts achieving a **28.5% Sound Kernel Recovery (SKR%)** at **1.5% kernel moisture content (mc).** The current world macadamia prices are trading in the range **US$7.00 to 8.30/kg** of premium grade kernel (Styles 0-3). The average DIS price to the grower – after processing and marketing costs is R10.50/kg DIS. Once again, you can change the price in the spreadsheets to see what impact the price has on the bottom line.

3. Direct costs:

Clearing has been included although established banana plantations will not incur major bush clearing costs if converted to macadamias. Removal of the bananas will nevertheless incur a cost, but the banana plant material could be used as an effective mulch for young macadamia trees.

A cost has also been included for the preferred deep ripping (down to 1m with tynes 1m apart) and ploughing land preparation method. Establishment and maintenance labour includes the cost of planting and weed control in year 0, the year of planting. Thereafter the labour requirement for maintenance jobs declines significantly. The other direct field costs are not such accurate estimates. Perhaps you could obtain better estimates from one or two of the macadamia growers in your area.

4. Harvesting:

Harvesting labour costs are based on the productivity of labour in harvesting Nut-in-Husk (NIH). NIH is roughly equivalent to 2.2 times the weight of DIS. IN the early years when only a small volume of nuts are available to harvest at each pick-up round, a productivity of ±60kg NIH per person per day was assumed (project year 4). This increases as trees age to ±450kg NIH per person per day, on average for the season (from tree age 10). The cost is based on a wage of **R47** (current minimum wage) per person per day.

5. Dehusking/ storage/ drying:

The cost here was estimated at **R1.10c/kg DIS**, for the entire on-farm operation.

6. Overheads:

These will vary greatly from farm to farm and depending on how different costs are allocated. The constant R2000/ha/year used here includes building and machinery maintenance, management salaries and an allowance for depreciation of agricultural machinery and equipment.

7. Capital Expenditure:

This is difficult to account for on a per hectare basis but a constant amount has been included for tractors/agricultural equipment. The amount of R18000 is included for installation of a permanent micro-jet irrigation system. This would include the entire infrastructure required for irrigation like new pump stations and main lines etc. Provision is also made for dehusking/storage/drying facilities at first harvest (year 4) and for expansion of these facilities as volumes increase (year 8).

The average yield gave a **gross margin of R32 606.11** per/ha/year and a net income of R15 175.78.

On the high yield scenario the **gross margin was R55 755.27** and the net farm income was R38 324.95

Therefore taking into consideration the 13 year period to reliaze maximum gross margin the minimum lot size required is **40 ha.**

9.0 GREEN HOUSE – TUNNEL FARMING OPERATIONS

This type of operation is in the business of cultivating crop under controlled / altered environment. It is typical for this type of operation to utilize some type of irrigation system (e.g. drip, micro). Examples of crops grown in such farming operations include tomatoes, baby vegetables, peppers, and carrots. This is **NOT** encouraged on prime agricultural land.

10.0 ZONING AND SUBDIVISION REQUIREMENTS AND CONDITIONS

Agricultural Uses: The growing of crops, including nursery, biomass and horticultural crops; raising of livestock; raising of other animals for food, fur or fibre, including poultry and fish; aquaculture; apiaries; agro-forestry; maple syrup production; and associated on-farm buildings and structures, including, but not limited to livestock facilities, manure storages, value-retaining facilities and accommodation for full-time farm labour when the size and nature of the operation requires additional employment.

Agriculture-Related Uses: **T**hose farm-related commercial and farm-related industrial uses that are directly related to farm operations in the area, support agriculture, benefit from being in close proximity to farm operations, and provide direct products and/or services to farm operations as a primary activity. All of the following criteria must be met to qualify as agriculture-related uses in prime agricultural areas.

A. Farm-Related Use

Farm-Related Commercial Uses may include uses such as retailing of agriculture-related products (e.g., farm supply co-ops, farmers' markets and retailers of value-added products like wine or cider made from produce grown in the area), livestock assembly yards and farm equipment repair shops if they meet all the criteria for this category of uses.

Farm-Related Industrial Uses may include uses such as industrial operations that process farm commodities from the area such as abattoirs, feed mills, grain dryers,

cold/dry storage facilities, fertilizer storage and distribution facilities, food and beverage processors (e.g., wineries and cheese factories) and agricultural biomass pelletizers if they meet all the criteria for this category of uses. Many of these uses add value to the agricultural commodities produced in the area.

Residential, recreational and institutional uses do not fit the definition of agriculture-related uses

1. Shall be compatible with, and shall not hinder, surrounding agricultural operations. "Surrounding agricultural operations" are interpreted in these guidelines to include both the property on which the use is located and the area of potential impact around the property. The area of impact may vary depending on the use. To be compatible with and not hinder surrounding agricultural operations, agriculture related uses should meet all of the following criteria

- Ensure surrounding agricultural operations are able to pursue their agricultural practices without impairment or inconvenience. While agriculture-related uses (and on-farm diversified uses) may or may not be subject to the minimum distance separation formulae, proximity to nearby livestock facilities may still be a consideration in locating these uses. This will help to avoid conflict between new uses and farming due to odour or other nuisances related to normal farm practices. Examples of other potential sources of conflict include noise that disturbs nearby farm operators and their livestock, trespass incidents, soil compaction, dust and impacts on water quantity or quality. Some uses can result in an increase in traffic that may conflict with slow-moving farm vehicles on local roads. Avoid these uses or mitigate their impacts in prime agricultural areas.

- Uses should be appropriate to available rural services (e.g., do not require the level of road access, water and wastewater servicing, utilities, fire protection and other public services typically found in settlement areas). Approval for a new land use on a property with individual, on-site water and sewage services requires demonstration of "no negative impacts". Urban-type uses typically unsuitable in prime agricultural areas include large food or beverage processing plants. These facilities should be on municipal services.

- Maintain the agricultural character of the area (in keeping with the principles of these guidelines). Compatibility may be achieved by:

  – Re-using existing buildings or locating businesses within existing buildings unless an alternative location reduces overall impacts on agriculture in the area.
  – Designing new structures to fit in aesthetically with the agricultural area.
  – Minimizing outdoor storage and lighting.

  - Avoiding major modification of land and removal of natural heritage features.
  - Visually screening uses from neighbours and roadways.
  - Limiting the use of signage and ensuring that any signage fits with the character of the area.

- Meet all applicable national air emission, noise, water and wastewater standards and receive all relevant environmental approvals. A use that will result in air, noise or odour emissions (e.g., fabrication plant or equipment repair shop) may require an Environmental Compliance Approval issued under the Environmental Management Act, 2000.

- The cumulative impact of multiple uses in prime agricultural areas should be limited and not undermine the agricultural nature of the area. Whether a proposed new use is compatible depends in part on other uses in the area and how the area would be affected by all of these uses. For example, the cumulative impact on ground and surface water in the area, wear and tear on roads, traffic safety and demand for policing and fire protection are basic compatibility considerations.

2. Directly related to farm operations in the area. Agriculture-related uses must be directly related to farms in the area, primarily providing products or services that are associated with, required by or that enhance agricultural operations in the area. “Directly related to” means that the use should reflect the type of agricultural production in the area. Examples include:

  - vegetable processing
  - processing tomatoes
  - farm equipment repair, farm input suppliers and grain drying in major cash crop areas.

3. Supports agriculture. This criterion limits uses to those primarily focused on supporting agriculture. Uses by farmers in the area supports and benefits area farms.

4. Provides direct products and/or services to farm operations as a primary activity. This criterion requires that agriculture-related uses directly service farm operations as a primary activity.

5. Benefits from being in close proximity to farm operations. To meet this criterion, agriculture-related uses must benefit from or need to be located near the farm operations they serve. Benefits may include more effective or efficient operations due to access to feedstock, roads suited to slow-moving farm vehicles, reduced transportation distance and risk of spoilage and marketing opportunities associated with being part of an agricultural cluster.

B. ON-FARM DIVERSIFIED USES

Means uses that are secondary to the principal agricultural use of the property, and are limited in area. On-farm diversified uses include, but are not limited to, home occupations, home industries, agri-tourism uses, and uses that produce value-added agricultural products. Shall be compatible with, and shall not hinder, surrounding agricultural operations.

- On-farm diversified uses may occupy no more than 2% of the property on which the uses are located, to a maximum of 1 ha.

- The gross floor area of buildings used for on-farm diversified uses is limited (e.g., 20% of the 2%)

11.0 REQUIRED PLOT SIZE CONSIDERATION

Agriculture is a dynamic industry and changes over time depending on consumer demands/preferences, equipment, plant varietals, farmers' skills, labour, processing capacity and technology. Changes in the type of agricultural uses should not trigger planning process, applications or approvals, but may have Minimum Distance Separation implications. Guidelines will limit the establishment or intensity of livestock operations in terms of the location, intensity or design of these operations, such as:

- Minimum distance separation formulae (MDS) requirements (e.g., odour setbacks between livestock facilities and other land uses)
- Nutrient Management Standards
- Protection of drinking water
- Conservation

This criterion is not intended to suggest that small farm lots may be created. In general, the larger the farm parcel, the more adaptable it is to changing conditions and the more efficient it is to run the farm. Keeping farms large enough to maintain flexibility is key to agricultural viability and to achieving the requirement of protecting prime agricultural areas for long-term use in agriculture.

Lot size may vary depending on the agricultural use. For traditional field crops, large farm sizes are optimal. Higher- value specialty crops tend to be located on smaller parcels. In all cases, lots must still be large enough to maintain flexibility for future changes in the type or size of the agricultural operation.

12.0 AGRICULTURAL LAND ZONING

"The conversion of agricultural land is a complex process, often taking place over a period of fifteen or twenty years. It involves such factors as farm profitability, urban growth pressures, land values, personal decisions about work and retirement, community expectations, taxes and government programs, incentives, and regulations. At some point, the process becomes irreversible, and farm after farm is subdivided and developed" (Coughlin and Keene, 1981).

Coughlin and Keene,categorize these programs under three purposes:

(1) Programs that reduce the relative attractiveness of a farming area for development,

(2) Programs that offset additional burdens placed on farmers by approaching urbanization, and

(3) Programs that prevent changes of use from agriculture to built-up uses.

"Agricultural Zoning" is the most common method of preventing the development of agricultural land; and, is the method that holds the most promise for protecting a major portion of the nation's farmland. Agricultural zoning ordinances have to meet three tests:

(1) Is the ordinance an exclusive agricultural zoning ordinance?
(2) If not, does the ordinance require a minimum lot size or density standard of at least 20 ha?
(3) If not, does the ordinance require a minimum lot size or a density standard of 15 ha coupled with additional controls over site improvements?

Serious agricultural zoning has two distinguishing features:

a. The basic purpose of the ordinance is to protect and maintain farms and farm operations;

b. Non-farm uses, especially housing, are curtailed or excluded altogether.

There are two basic types of agricultural zoning ordinances: exclusive and nonexclusive (Coughlin and Keene, 1981). The least common and most extreme is exclusive agricultural zoning which prohibits the construction of any non-farm dwellings.

More prevalent is the nonexclusive agricultural zoning, which allows a limited amount of non-farm development. Two major types of nonexclusive agricultural zoning ordinances are large minimum-lot-size zoning and area-based allocation. As the term indicates, large minimum-lot-size zoning requires a substantial minimum lot size, often 40+ ha; however, ordinances from

around the world have varied from as little as 10 ha to over 120 ha. The two main approaches to large-lot zoning involve non-farm residences as either a permitted use or a "special" or "conditional" use.

Area-based allocations allow the landowner to build a number of dwelling units as determined by the total area of the property; small building lots, often 1 acre, are utilized. The two types of area-based allocation ordinances are fixed and sliding scale. Owners are allowed to build one dwelling per 10 ha, or some other specified area of land, under the fixed area-based allocation ordinance. The number of dwellings allocated per unit area, under sliding scale, decreases as the size of the tract increases.

"Subdivision regulations" are a comprehensive set of guidelines for physical development. As the term may indicate, these regulations set standards for dividing larger tracts of land into smaller lots. These regulations directly influence infrastructure decisions and ensure conformity among standards within a community. These regulations also seek to avoid haphazard and inefficient development patterns.

Maintaining the land in a form that allows the continuation of agriculture is a major objective of agricultural zoning. The first sub-objective is to restrict the division (or parcellation) of farmland to avoid its breaking-up into small parcels. However, the critical question. "How do you define the hectareage beneath which division of a tract should not be permitted?" remains a big challenge for most cities. The extensive literature on the economics of farm size is of little direct use, according to Coughlin and others, in determining the minimum acreage that should be permitted. A 1984 study attempted to determine how large individual farms were in the area of interest, and at the "farm core" to identify the minimum amount of contiguous land necessary to farm in an efficient manner. A general standard of 40 ha was chosen as the limit beneath which division should not be permitted outside of the subdivision process (Coughlin, Keene and Laarakker, 1984). A similar result was found by Coughlin and Keene (1987).

The second sub-objective of agricultural zoning, according to Coughlin, is to keep open enough land that agriculture remains functionally viable. Area-based allocation zoning provides flexibility in site planning to allow a large portion of land to remain open. The total amount of land depends upon the tract size-class schedule, the minimum allowable lot size and the size distribution of all the tracts existing at the date specified in the zoning ordinance.

Although zoning is viewed as a suspect technique because it is easily changed when development pressures rise, agricultural zoning is less likely than other types of zoning to be changed to allow development. The public purpose, incentives and presence of supportive state legislation enhance the effectiveness of agricultural zoning. In addition, growth management programs that facilitate development in other areas where public facilities are

provided, along with available development incentives and an expedited approval process were found to increase the long-term effectiveness of agricultural zoning.

12.1 Partial Lot Zoning

Municipalities may wish to consider using partial lot zoning for on-farm diversified uses. The portion of the property dedicated to on-farm diversified uses would be zoned for those uses, with the remainder of the property remaining in an agricultural zone. The area zoned for on-farm diversified uses may be up to the recommended land area limit discussed in these guidelines.

12.2 Zoning Designations

The principal intended use within the Malkerns Zone B is agriculture. Zoning should reflect this understanding and, wherever possible, a single agricultural zone should be applied to the Zone.

There may be situations, however, where more than one zone is necessary. Some examples include where there are significantly different agricultural landscapes, such as floodplains and upland areas, or where non-farm uses (either old uses or newer ones which have been approved by the Local Authority) are present. Non-farm uses that may require accommodation include cemeteries, parks, fire halls, and schools. When nonagricultural zoning is required to reflect non-farm uses, the zone should be as specific as possible in order to prevent further encroachment of non-farm uses on agricultural land, even to the point of split-zoning the lot.

13.0 SUBDIVISIONS GUIDELINES

Category A: Crop Production

- On Prime agricultural Land
- Annual gross income (deduction of all variable costs) higher than 120 000 Emalangeni annually
- Based on economies of scale : Minimum farm size is 40 ha

Category B: Livestock Production

- On Prime agricultural Land and B group of soils
- Annual gross income(deduction of all variable costs) higher than 120 000 Emalangeni annually
- Based economies of scale : Minimum farm size is 90 ha

Category C: Horticulture (Fruit and Vegetable) Production

- Vegetables On Prime agricultural Land and Fruit trees on Class C
- Annual gross income (deduction of all variable costs) higher than 120 000 Emalangeni annually
- Based economies of scale : minimum farm size is 30 ha

Category D: Built structures within Agricultural Zone

- 2% of property land or but not exceeding 1 ha
  E.g. 100 ha property: 2% of 100 ha = 2 ha. The farmer can only utilize up to 1ha

[The area to cater for development is 1 ha excised from agricultural land, but only 20% of this hectare can be covered by structures. Where development is in various locations within farm, the combined total of these development shall meet this threshold]

- On poor soil not regarded as prime agricultural Land
- Based on area in relation to farm size
- Built structures include farm house, farm sheds, storage, dwelling units for labourers,

Based on area in relation to farm size:

- principal farm dwelling unit not more than 500 m^2
- workers houses = 250 m^2
- sheds and storage = 200m^2
- temporary structure = 100 m^2

14.0 MINIMUM FARM SIZES

To control the subdivision of farms in the agricultural area, the minimum size of 20 hectares, is required given the availability of irrigation. To limit indiscriminate farm subdivisions, the Malkerns agricultural area has been zoned into four permanent zones (I, II, III and IV) with the following provisions:

ZONE	*FARM SIZE (HA)*	*MINIMUM FARM SIZE (HA)*
I	Less than 40	No Further Subdivision (NFS)
II	40 - 59	20
III	60 - 99	30
IV	100+	40

The farm zones (I, II, III, IV) are permanent and where farm subdivided it still remains on respective zone.

14.0 REFERENCES

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