

Summary

The Unilever & Horticulture Australia, Sustainable Agriculture Project, "Grow Sustainably™" has developed a system to incorporate farm biodiversity into Environmental Management Systems (EMS) via a six (6) step process. Ten biodiversity parameters were selected and used to assess the biodiversity status of five pilot farms over two monitoring seasons. A farm biodiversity management and enhancement plan was developed in line with project goals, local and regional biodiversity goals. Significant opportunities for biodiversity enhancement were found with existing areas of permanent vegetation per farm ranging 5% to 10% of farm area. Enhancement plans also considered the role of permanent vegetation for stock and crop shelter, water table management, surface water management, timber products, and aesthetics.

STEP 1: SELECT BIODIVERSITY PARAMETERS

Biodiversity is one of ten sustainability indicators selected as part of the Unilever global sustainable agriculture program.

International literature was consulted for possible biodiversity parameters and parameter selection criteria. The primary criteria used to select biodiversity parameters were that the parameters must be;

- 1) Measurable (including it being repeatable, accurate, scientifically sound and flexible);
- 2) Interpretable against a threshold value;
- 3) Representative of high quality biodiversity;
- 4) Sensitive to environmental change; and
- 5) Cost effective.

Parameters reflective of high quality native vegetation and linked to the following criteria were considered. Additionally, parameters needed to;

- 1) Be measurable at a property or farm level
- 2) Enable threshold values to be established at a farm level
- 3) Facilitate practical farm level monitoring
- 4) Link to degradation issues
- 5) Provide wider benefit (regional or catchment level)

The biodiversity parameters considered for application to Processing Tomato farms are listed in Table 1.

Table 1: Biodiversity parameters evaluated

Flora	Fauna
<ul style="list-style-type: none"> • Size • Shape • Connectivity • Structural profile • Floristic composition • Conservation status • Habitat features • Health • Degradation • Soil cover • Soil micro-flora • Presence of regeneration • Weed invasion • Excessive native fauna pressure 	<ul style="list-style-type: none"> • Birds • Mammals • Reptiles • Aquatic macro-invertebrates • Insects • Spiders • Amphibians • Soil fauna • Feral fauna



STEP 2: RESOLVE THRESHOLDS FOR BIODIVERSITY PARAMETERS

Parameters were selected and threshold values were determined for each biodiversity parameter (Table 2).

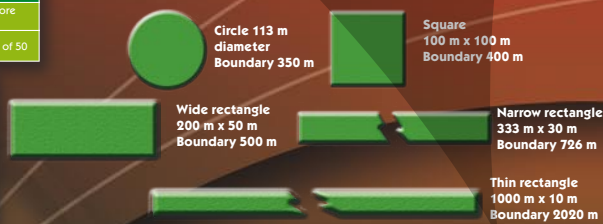
Table 2: The selected biodiversity parameters, how they are measured & their threshold values

Assessment of On-Farm Permanent Vegetation Areas		
Parameters Selected	How measured	Threshold value
1. Size of permanent vegetation areas	% of farm	10%
2. Shape of permanent vegetation areas	B:A ratio	100% of area in blocks with B:A < 400
3. Vegetation strata	Rating based upon comparison with undisturbed EVC	Rating of 10
4. Species richness	% of species in undisturbed EVC	100%
5. Conservation status	Rating based upon the published status	Rating of 100
6. Health of native vegetation	Rating	Rating of 100
7. Weed invasion of native vegetation	Rating	Rating of 100
8. Feral fauna in native vegetation	Rating	Rating of 100
Assessment of Water Bodies		
Parameters Selected	How measured	Threshold value
9. Frogs	% abnormally converted to a score	Abnormality score of 100
10. Aquatic macro-invertebrates	Pollution index using the "Streamwatch" system	Pollution index of 50

Some examples of parameters and rationale for establishing thresholds;

1. Threshold for size of permanent vegetation area
In a study in the project region analysed the habitat requirements of woodland birds because woodland birds are more likely to be influenced by habitat change at the landscape scale than species able to live partly or wholly in cleared environments. The study showed that to prevent decline of woodland birds 10% tree cover is the minimum for an infrastructure of native vegetation in rural landscapes. Below 10% tree cover species decline is rapid, so 10% was selected as the threshold value.
2. Threshold for shape of permanent vegetation area
Blocks or round shaped areas of native vegetation are better for biodiversity than narrow, long areas. This is related to the fact that vegetation areas have differences in microclimate, weed invasion and fauna movement between their edges and centre. Hence edges or boundaries should be minimised in order to maximise the internal stability of an ecosystem.
The effect of the shape of one hectare of native vegetation on its boundary distance is illustrated in Figure 1. The boundary to area ratio (B:A) increases dramatically in the progression from circles and squares to wide rectangles then to thin rectangles.

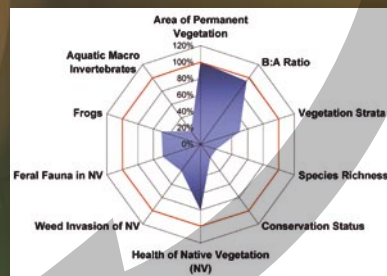
Figure 1: Effect of shape on boundary for one hectare of native vegetation areas



STEP 3: MEASURE PARAMETERS TO EVALUATE FARM BIODIVERSITY STATUS

Biodiversity parameters were then measured on pilot tomato grower farms and monitoring results expressed using an Eco-map (Figure 2). The Eco-map threshold of 100% represents a target for each selected parameter, <100% shows areas for possible enhancement.

Figure 2: Example Biodiversity Eco-map



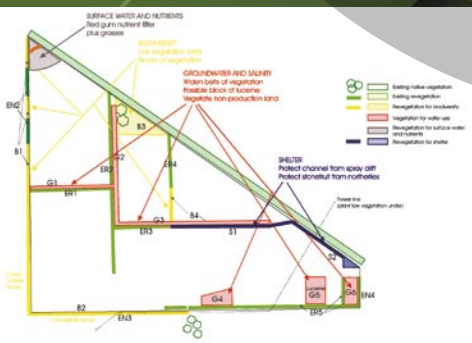
STEP 6: INCORPORATE BIODIVERSITY INTO THE EMS (GROW SUSTAINABLY™)

Grow Sustainably™ system has been developed in a manner consistent with the Plan, Do, Measure and Improve cycle (PDMI) common to most Environmental Management Systems.

Ongoing monitoring of selected biodiversity parameters and implementation of biodiversity enhancement plans are key components of the Grow Sustainably™ management system. Monitoring also involves reassessing the biodiversity parameters, modifying the Eco-map and quantifying 'Improvements'.

STEP 5: DEVELOP BIODIVERSITY ENHANCEMENT PLANS

Biodiversity enhancement plans were then developed on each pilot farm to improve selected biodiversity parameters and integrate with whole farm management goals and operational requirements.



Some possible farm management practices to improve biodiversity are given in Table 5.

Table 5: Management strategies that can be used to help achieve biodiversity targets

Indicator	Management Strategies
Size of native vegetation	Revegetation to establish buffer zones and extend areas of native vegetation
Shape of native vegetation	Revegetation to establish buffer, r zones and extend areas of native vegetation
Vegetation strata	Remove or control grazing (fencing), control weeds, control feral vertebrates, revegetation, fire as a management tool to release germination, reduce effects of irrigation, nutrient loading and soil erosion that create the environment favourable for weeds and less favourable for native vegetation
Species richness	As per above
Conservation status	Reduce effects of irrigation, nutrient loading and soil erosion that create the environment favourable for weeds and less favourable for threatened native vegetation. Initiate species recovery programs
Health of native vegetation	Groundwater or salinity management, remove pressure from excessive nutrients. (use vegetation buffer zones, review fertiliser use, review leaching – location/flow & amount), Revegetation to establish floristic composition to balance the ecosystem. Revegetation to buffer native vegetation from wind exposure and agricultural practices
Weed invasion of native vegetation	Farm weed management to reduce weed seed source, weed control in native vegetation, including fire as a weed management tool, stock removal to reduce weed seed source and lower nutrient loading (includes the use of fencing), modified irrigation practices to reduce groundwater levels that are favourable for weed growth and less favourable for native vegetation health, modified fertiliser practices to lower nutrient loading of the area
Feral fauna	Implement control programs
Frog abnormalities	Reduce use of pesticides and surfactants, increase the use of IPM and beneficial insects (reducing dependence on chemicals), avoid spraying near irrigation channels & waterways (buffer zones), ensure chemical spray equipment is calibrated regularly with records kept, train staff and contractors on risks and BMP's
Aquatic macro-invertebrates	Reduce pollution of water with nutrients, heavy metals and pesticides Strategic use of pesticides

STEP 4: CONSIDER THE RISKS AND BENEFITS OF BIODIVERSITY

Possible threats, impacts and benefits of biodiversity were considered in developing the Grow Sustainably™ biodiversity assessment and enhancement strategy (Tables 3 and 4).

Table 3: Example of possible farm threats from biodiversity

Possible threat from biodiversity	Comments on on-farm threats	Threat perceived by a tomato grower
1. Habitat value	Reptiles, birds and mammals may migrate to crops and cause losses. For example, crows pull out tomato seedlings.	Not obvious
2. Fire risk	Loss of assets and resources.	Potential risk
3. Opportunity cost	Potential cost of lost production from areas with native vegetation.	Of concern
4. Management costs (e.g. environmental weeds, rabbits and foxes)	Cost of time and money.	Not major
5. Revegetation costs for biodiversity enhancement	Cost of lost production from land, plus cost of revegetation works.	Not major cost

Table 4: Potential Management Impacts upon Biodiversity & Potential Benefits of Investing in Farm Biodiversity

Potential (Negative) Management Impacts	Potential Biodiversity Benefits
<ul style="list-style-type: none"> • Clearance of native vegetation • Pesticide residue build-up in soil • Pesticide contact with vegetation or aquatic systems • Fertilizer leakage into aquatic systems • Soil nutrient toxicity for Native vegetation or promotion of introduced species • Change in landscape hydrology affecting native vegetation ecosystem survival • Livestock destruction of native vegetation & soil structure • Cultivation & Cultural degradation of native vegetation • Habitat creation for introduced predators & feral herbivores • Introduced weed competition disadvantaging native species • Reduction in stream flow affecting aquatic life 	<ul style="list-style-type: none"> • Aesthetics and recreation • Genetics • Groundwater and salinity control • Pollination • Surface water management and nutrient and silt filtration • Honey production • Shelter • Bush foods and new industries • Firewood, fence-posts and building timber • Biodiversity credits • Seed sales • Carbon credits • Habitat value • Reduction in council rates due to biodiversity protection • Micro-flora – improving soil structure and nutrient cycling

¹ Tomato Growers acknowledge there is or may be an issue

² Tomato Growers acknowledge there are or may be benefits

Conclusion

The farm biodiversity system developed as part of the "Grow Sustainably™" project has helped growers implement prioritised management actions to improve on-farm biodiversity.

This biodiversity assessment and enhancement methodology is currently being integrated into other Unilever Lead Agricultural Programs in Brazil and Greece.

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