Case Study 9: Orcharding and sustainable land and water management in Eves Valley, Nelson

Philip Kempthorne produces apples for export on his Eves Valley property at the base of the Moutere Hills near Nelson. He calls himself an orchardist although in addition to the 36 acres (15 ha) he has under orchard he has 130 acres (53 ha) of pine trees, 15 acres (6 ha) of protected native bush, and 150 acres (61 ha) of pasture on which he runs 350 ewes, 120 replacements and 20 cattle.

His property lies on flat river terraces and rolls to steep hills on both sides of the Eves Valley Stream, and runoff from his land feeds that stream.

Photograph 43: Looking up Eves Valley to Philip Kempthorne's apple orchard on the river flats and gentle slopes in the middle ground. Some of the pine forestry on the left belongs to Philip and his father. This property provides a good example of appropriate landuse.

Philip produces apples largely for the North American market, which, while generally being more lucrative than the European market, has more stringent conditions relating to the quality of fruit, especially in terms of the freedom of the produce from insect and fungal pests and pest damage. Until recently the American market required that apples be treated with a selection of organophosphate pesticides as a condition of their importation. This is contrary to the situation in Europe where markets are increasingly demanding chemical residue free and sustainably produced food.

Understanding the problem

Orcharding potentially offers the following threats to water quality:

- contamination of groundwater with pesticides by leaching
- pesticide contamination of waterways by spray drift
- nitrogen contamination of groundwater by leaching, with the assistance of applied irrigation water
- fertiliser contamination in surface runoff
- processing contaminants in outwash from fruit packing sheds.

Pesticides

Pesticides, especially insecticides and fungicides, are an essential part of the orcharding industry enabling it to meet stringent international fruit quality specifications.

Black spot (apple scab) and powdery mildew are the most prevalent fungal diseases affecting apples, and fire blight, although not a commonly occurring disease on well-managed orchards, is used as a trade barrier to exports.

Leafroller and mealy bug are the most prevalent insect pests in apple orchards.

Traditional spray programmes in the past used large volumes of toxic organophosphates as a preventative measure of pest and disease control. These chemicals were generally less specific in their activity and more persistent in the environment than many of the more recent chemicals. Increasing international market and consumer pressure has lead to the reduced use of organophosphates and more restrained usage of more crop specific new generation chemicals that have a lower environmental persistence.

Pesticide residues have been detected in recent times in groundwater in various parts of New Zealand, more so beneath areas of intensive cropping (especially maize) and intensive horticulture (including orcharding) (Smith et al, 1993; MAF, 1993/10). While these recorded concentrations have been below criteria for drinking-water they are cause for some concern. Research studies have also recorded the presence of some widely used herbicides in measurable concentrations in streams following surface runoff events (which could include heavy rain or irrigation). Although they did not persist in the stream water for long there is potential for harm to be caused to instream plant and animal life.

Fertiliser

Philip applies 150 kg of a superphosphate mix per hectare to his orchard and an autumn dressing of 150 kg/ha of CAN (compound ammonia nitrogen). Young and weak trees will get an additional 100 kg/ha in spring. The fertiliser is applied as a band along each tree row to avoid wastage between rows. Soil tests are carried out annually and foliage analysis at regular intervals.

The rates of fertiliser being applied are well within the plants' capacity to utilise it, although the concentrated nature of the band application does lend itself to loss in surface runoff and, for the CAN, loss due to leaching. The applications in spring and autumn do avoid the period of irrigation when leaching and runoff could occur.

Irrigation

Philip uses a drip irrigation system in his orchard over the summer and applies the water up to a maximum rate of 50–60 litres per tree per day leading up to harvest. The drip system is the most efficient in terms of water utilisation and applies water only to the soil above each trees root system.

It is important with this system to match the amount of water applied with the needs of the tree. Otherwise excess water may be lost to groundwater and nitrate fertiliser may well be leached with the water.

Managing the problem

Philip has implemented several sensible land and water management practices to improve the sustainability of his operation, several of which have originated from a New Zealand-wide initiative.

ENZA IFP programme

ENZA (the New Zealand Apple and Pear Marketing Board) is introducing a scheme called the Integrated Fruit Production programme (IFP) which has been developed to improve the sustainability of orchard production in New Zealand, and to meet the increasing international consumer demand for improved food safety and increased environmental responsibility. The programme is a voluntary one and aims to supply growers with knowledge and tools to better manage the inputs to orchard production and reduce the impacts on the environment.

The programme was started in 1997 with an initial focus on pest and disease control and the reduction and more justifiable use of pesticides on orchards. Several more modules are planned to be introduced in 2000 including water, weed and soil management modules. Fifty percent of New Zealand orchardists now participate in the ENZA IFP scheme and this is expected to increase to 75–85 percent this year. Philip Kempthorne is one of those participating.

The pest and disease module encourages growers to apply agrichemicals on a justifiable basis and to reduce residue. That is, chemicals need not be applied until they are needed and then only in the quantities necessary to perform a function. There are three approaches or tools available to growers to determine justifiable use:

- insect/disease monitoring equipment and supporting information: for example, when leafroller numbers trapped exceed a certain prescribed threshold the application of insecticide is justified to prevent likely crop damage
- a phenology-based approach where growers are schooled in the stages of insect or fungus lifecycles or tissue growth that are most vulnerable to chemical control
- an early warning or predictive system, where the onset of certain conditions, especially weather conditions, can be used as an indicator of the likelihood of a pest or disease problem.

ENZA supplies growers with the information and tools necessary for them to carry out these measurements.

To participate in this module growers are required to submit their spray diaries twice yearly and the information in them is screened for compliance in the chemical products used, rates of application, intervals between applications and adherence to withholding periods leading up to harvest. Occasional random audits occur in addition to monitor compliance.

The soon to be released water management module emphasises the responsible use of water on orchards and provides the tools and understanding of processes for growers to do water budgeting to determine when their crops need water and how much is required. Crop and Food Research is developing a kit for the ENZA IFP programme that will enable growers to determine crop water deficit levels.

The weed management module focuses on the use of residual herbicides and promotes non-chemical weed management methods.

The soil management module emphasises the need to justify fertiliser use. Regular soil testing complemented by foliage testing is advocated to determine fertiliser requirements, and ENZA is developing a kit to enable growers to determine aspects of soil health including worm counts, other biological indicators and soil compaction.

There are no market premiums offered by ENZA or the international markets to growers who comply with the IFP programme; however, ENZA has offered an incentive of 25 cents per carton for growers to join the programme. This incentive will cease soon now that more than 50 percent of growers participate in IFP and may in future be replaced by a penalty for those not complying.

There are no international markets that require IFP compliance as a condition of supply, but this has more to do with the fact that ENZA has managed to achieve such a high level of compliance amongst its growers. If, for any reason, ENZA ceased the IFP programme it is likely that many of its European markets would request its return.

The fact that ENZA has managed to achieve such a high and rapid level of grower support for a new concept that promises no increase in grower return and has a strong environmental emphasis is something of a revelation. The ENZA IFP manager, Graham Hull, puts it down to the development of a good network base and taking time to deal to the perceived risks held by growers. The first 10 percent of growers who joined the programme are described by Graham as those with a real vision for sustainable orchard production and marketing in New Zealand. ENZA worked with this group to test the system and disseminate the ideas to other growers. The next 40 percent of growers are genuinely motivated to improve the environmental soundness of their operations, whereas the remaining 50 percent are less motivated and are taking more time to make the change. ENZA has 75 staff ("facilitators") in the field working directly with growers and assisting remaining growers to see the practical benefits in the IFP programme.

Disregarding any future marketing benefits that might accrue from IFP, and the obvious environmental improvements that will result through reduced chemical and nutrient pollution of soil and water and more sustainable water utilisation, the programme offers the potential for substantial savings for growers, especially in the form of reduced agrichemical, fertiliser and water usage costs. The programme has already shown in three years of operation in New Zealand that fruit quality is at least as good if not better than that produced with conventional management.

Appropriate land use

In addition to the orchard-specific sustainable land and water management practices espoused by ENZA, Philip has applied aspects of sustainable and sensible land and water management to his

property as a whole. Sheep are run to complement orchard management, where they can be used as a cheap means of grass and weed control in the orchard, and they are productive on the steeper land where orcharding is not feasible. Pine plantations occupy the heads of the valleys and function to intercept rainfall and reduce runoff through the farm to the stream.

Summary of good orchard management practices that will minimise impacts on water quality and riparian and instream habitat

Pesticide use

- Minimise the need for pesticide applications by applying them only when needed, at times when they are most likely to be effective and in recommended concentrations.
- Use new generation chemicals wherever possible, that have a high degree of target specificity, have low persistence in the environment and are less inclined to be leached to groundwater or carried in surface runoff.
- Apply chemicals in conditions and with equipment that prevents spray drift and coverage of non-target plants and waterways.
- Avoid, whenever possible, applying chemicals immediately prior to rain.
- Investigate alternative methods to the use of herbicides for the control of weeds and unwanted grass in the orchard.

Fertiliser use

- Apply only as much fertiliser as the crop can utilise.
- Use soil testing and foliage analysis to determine crop fertiliser needs.
- Apply fertiliser in split dressings to maximise plant utilisation and minimise losses to groundwater and streams.
- Whenever possible avoid applying fertiliser immediately prior to rain, on saturated soils and during winter months when plants are not growing.

Photograph 44: Across-contour tree rows and the application of heavy fertiliser dressings on the ground beneath the trees increases the risk of fertiliser loss by surface runoff and subsequent contamination of stream water. Pesticides may also be carried to streams by surface runoff. With-contour tree rows and grass filter strips along stream margins can reduce the likelihood of water contamination.

Water usage

- Avoid excess water applications that could lead to surface runoff.
- Apply water at times and at rates equal to the crops' needs.

Land and vegetation management

- Maintain a sizeable buffer zone between the orchard edge and any stream, pond, lake or wetland, and maintain a thick cover of grasses or sedges in that zone to serve as a filter for water, fertiliser, sediment and pesticide runoff.
- Maintain a healthy grass sward between tree rows and at the end of them, as a filter.
- Avoid excessive soil compaction that could promote surface runoff.