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The AgriBase™ farm location database

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ABSTRACT

AgriBase™ is a national spatial farms database. It was launched in 1993 and now holds information on approximately 105,000 live (current) farms. Each distinct farm has a unique farm identifier - the Farm_ID. AgriBase holds key contact details for the farm, predominant farm type, overall size, animal numbers by stock class, planted areas for different orchard or crop types (including forestry), and the spatial coordinates of the farm usable within a geographic information system. Both government and private sector groups use AgriBase™ as a master index for all rural land holdings involved in some form of primary production. It has been used in exotic disease and pest investigations and responses, rescue helicopter missions, epidemiological research into human and animal health issues, development of environmental indicators, within-farm fertiliser planning, among others. AgriBase™ was extensively used during the February 2004 floods in the lower North Island to locate and contact affected farmers and survey the levels of damage. It is proposed that AgriBase™ has a central role to play in the development and delivery of food safety traceability and verification systems for New Zealand.

Key Words: farm; database; Geographic Information System (GIS); food safety; traceability.

INTRODUCTION

AgriBase™ is a multi-sectoral national spatial database that records information on rural land use at the farm management unit level (Sanson & Pearson, 1997; Sanson, 2000). Data capture started in earnest in 1993, and archived records since January 1999 are available.

AgriBase™ was originally conceived to provide farm data for the EpiMAN decision support system, for managing foot-and-mouth disease (FMD) or other vesicular disease outbreaks (Sanson *et al.*, 1991; Sanson *et al.*, 1996; Sanson *et al.*, 1999). However, two significant government policies of the day (*circa* 1993) - namely user-pays and policy/delivery separation within government departments - meant that the government was not prepared to underwrite the cost of the development and maintenance of the system purely for biosecurity preparedness. This resulted in AgriBase™ being developed with a much broader range of intended uses within the field operational arm of the Ministry of Agriculture and Forestry (MAF Quality Management), which became AgriQuality Limited in 1998, a state-owned enterprise.

The overriding philosophy behind AgriBase™ was that it would be a central register of every farm (including orchards and forests) involved in some form of primary production in New Zealand (NZ). It would enable the linking of disparate farm-based datasets referenced to the unique Farm_ID; it would hold contact details for key personnel involved in the ownership or management of the farm; it would furnish denominator data to facilitate epidemiological investigations and research; and importantly, would provide the spatial coordinates to enable data to be manipulated within geographic information systems (GIS).

Registration within the database is essentially free. The revenue for AgriBase™ comes entirely from

paying users, who value the services that it provides. It is therefore not entirely unexpected, that development effort has been directed primarily into those sectors or regions within which revenue streams have been established. Notwithstanding this, AgriBase™ now has approximately 105,000 live properties registered in the system, with either established industry programmes or new initiatives covering most of the livestock, arable cropping, horticulture and forestry sectors in train.

A number of advantages accrue from the multi-purpose, joint government-private sector partnership, semi-commercial nature of AgriBase™. A growing number of farmers and industry groups are calling for greater cohesion between government departments, to avoid duplication of effort and minimise the need to fill in multiple forms. Having a multi-purpose database means that it is possible to follow a 'collect once - use many' paradigm. By linking AgriBase™ data capture to uses that benefit farmers and industry groups in demonstrable ways, means that response rates remain high. For example, AgriBase™ is used by a number of regional rescue helicopter trusts to furnish the coordinates of rural homesteads to be used as navigational waypoints in the event of emergencies. Paying users are the best critics of data quality; hence errors or omissions are picked up quickly and rectified. This invariably improves the trustworthiness of the data. This is in stark contrast to the state of the farm registers in the United Kingdom at the beginning of the FMD epidemic of 2001, when thousands of farm location points had to be discarded as they were literally placed 'out at sea' as they had never been validated.

Finally, by serving more sectors and regions, the data acquisition nets are being cast wider and wider, leading to greater confidence that all farms are represented in the system.

It is believed that AgriBase™ has a key role to play in food safety traceability and verification systems.

Core data

A farm is essentially a business management unit that utilises a defined area of NZ's land and in-land or in-shore water resources in the production of food or other primary products. The core data held in AgriBase™ comprises the Farm_ID - a unique identifier for each farm, key contact details, livestock numbers by class, crop areas for major crop or plant categories, and the spatial coordinates of the land areas utilised by the farm. Other variables include the predominant farm type, and the total area of the farm.

AgriBase™ recognises and supports the data model shown in Figure 1. Under this model, a person or corporate entity can own or manage several farms, and within each farm there can be one or many enterprises. Herds and flocks can move from farm to farm, but must always reside on a single farm at any one point in time. Farm data can be recorded at any level of resolution necessary to support the particular requirement e.g. individual animal ID; or the locations of individual vines in kiwifruit orchards. It is acknowledged that not all of these details may be in AgriBase™ itself, but stored in complementary databases, with AgriBase™ acting as the glue.

The Farm_ID is a 7-character alphanumeric number, with the first two letters signifying the district in which the farm is located e.g. 'MN' for Manawatu; and the next five numbers being a unique number within the district. There are defined business rules regarding the creation and archiving of Farm_IDs, but essentially the Farm_ID is designed to survive multiple farm sales, so that it acts as a long-term identifier of the land.

Persons or corporate entities owning or managing farms or within-farm enterprises are only recorded once. However, each person can have one or more roles defined for one or many farms. These roles are time stamped, so that roles can cease or change over

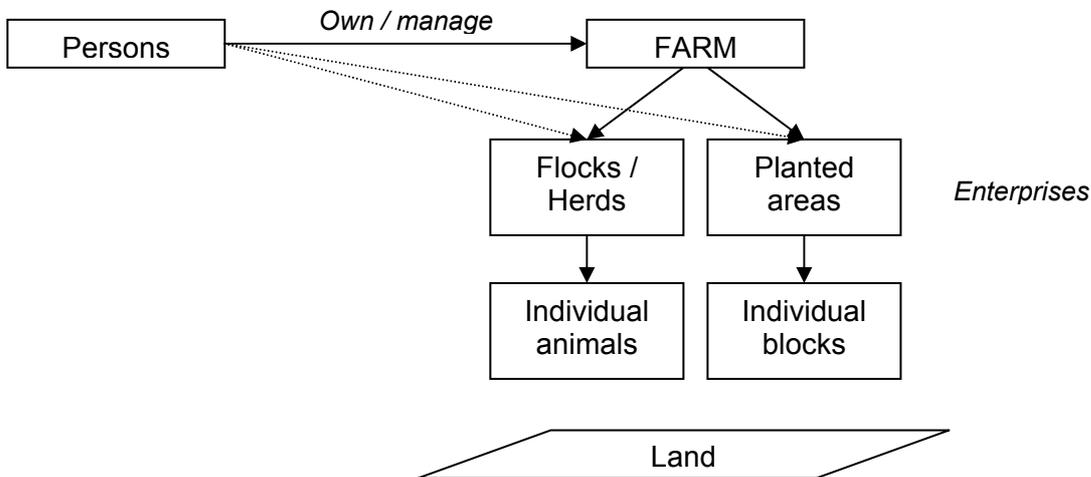
time. One of the roles is 'key decision maker', which refers to the person with day-to-day responsibility for the farm, who would be the first point of contact for investigating a possible disease or food safety issue. Each person is issued with an AgriName and password, which allows for on-line access to farm information held in the database. Role holders have varying access rights, and can extend access rights to others for specific purposes, e.g. a farmer could grant access to his/her farm details to a nominated veterinary practitioner.

In terms of spatial location, AgriBase™ has developed a methodology for linking the Farm_ID to the set of land parcels utilised by the farm, and maintaining this linkage as the basis for defining the farm boundary. A land parcel is the smallest legal land unit in NZ and is described by its surveyed coordinates and legal description. The description of each land parcel is maintained by Land Information New Zealand (LINZ) within their Land-on-Line system. AgriBase™ obtains a complete national copy of this spatial layer every 3 months. The frequency of updating will soon be increased to monthly, which will facilitate almost real-time detection of subdivisions.

From the set of land parcels, a farm centroid is computed within the largest contiguous block of land parcels. Significant point locations within the farm, including the main farm gate and main homestead have been captured to support emergency service dispatch and navigation. The system also has the capacity to record other coordinates such as dairy sheds or stockyard locations using high resolution orthophotography or global positioning systems (GPS).

The variety of spatial data stored within AgriBase™ facilitates mapping and spatial analyses at any scale, from national scale mapping to large scale within-farm management of animals and crops.

FIGURE 1: AgriBase™ conceptual data model.



In addition to the core data elements defined above, AgriBase™ has at its disposal, a team of specialist GIS operators and database and Web developers. AgriQuality has built up the required infrastructure to support database and Web hosting, to provide services to agencies that do not have the expertise or necessary computer systems. It can also interface with other complementary databases using Web service applications and eXtensible Markup Language (XML).

Potential roles in traceability and verification

AgriBase™ acts as a master reference of all farms in NZ, hence supports positive identification of the farm(s) responsible for growing/producing any particular food item. Once a Farm_ID is 'attached' to an animal or product, it can be used to trace back to farm of origin. Further, it provides a means of accessing other data linked to the farm, such as laboratory records or current certification status held by certification agencies such as Certenz. For instance, it would be possible to build a system that would allow a European supermarket customer to pick up a food item originating from NZ, take it over to a barcode scanner, and see a map of where the item originated from, and what the farm disease, welfare and environmental quality ratings were at the time the item was produced.

The Farm_ID allows cross-referencing or aggregation of records from multiple plants involved in food processing. For example, Ovis Management Limited (OML) combines monthly line prevalence data on sheep measles (*Cysticercus ovis*) from different meat companies. Each meat company's supplier codes have been matched to Farm_IDs. This means that it does not matter which company a farmer uses during any given month to process lambs or sheep, as the data are referenced back to the same farm by OML at the end of each month. The assimilated data can then be mapped and analysed, to support targeted extension programmes to individuals or clusters of farms with high sheep measles prevalence in stock sent for slaughter.

The persistence of the Farm_ID (the Farm_ID stays with the same land area when a farm is sold) means that those farms identified as the source of stock with heavy metal or pesticide residues detected by random sampling, can be monitored over time.

Whilst the above has concentrated on the utility of the Farm_ID, cross-referencing can similarly be achieved with spatial datasets. For example, suppose a historical soil sampling survey had been conducted on soil cadmium (Cd) levels throughout NZ, with a latitude/longitude coordinate recorded at each soil sampling location. It would be possible to convert the raw data into a toxicity risk map by combining the soil Cd levels with information on the cation exchange capacity (CEC) of the soils using the national spatial soils database held by Landcare Research. Once locations with a high level of available Cd and low CEC had been identified, it would then be possible to identify the farms at those locations for subsequent tissue

analyses. Another example would be the identification of farms affected by atmospheric fallout resulting from a volcanic eruption, or a toxic plume emanating from an industrial site.

The geo-referencing capability of AgriBase™ makes it possible to convert tables of data into informative maps, so that disease, defect or product quality data can be analysed spatially. Clusters can be identified and targeted for further investigations. By combining denominator data with case data, prevalence and/or incidence rates can be inferred. This adds tremendous value to the information routinely captured at many food-processing plants.

AgriBase™ can be used as a sampling frame for cross-sectional surveys or unbiased control selection in case control studies. This makes it a powerful epidemiological research resource.

By far the greatest value will be achieved however, when AgriBase™ is part of an integrated decision support system, which links all facets of the food chain from 'farm to fork', combined with quantitative risk-based assessments (QRA) at all critical stages. The Livestock and Animal Products Tracing and Information System (LAPTIS) project initiated by MAF and the NZ Food Safety Authority (T.J. Ryan, *pers comm.*) is an attempt to link a number of key national databases in New Zealand, with a view to developing an integrated food safety traceability and verification system. The Swiss Kodavet system is another example of such a development, where surveillance information originating in the various cantons is being integrated at national level (R.S. Morris, *pers. comm.*).

Access to AgriBase™

In order to take advantage of the services offered by AgriBase™, it is usually a prerequisite that data held by the agency concerned are linked to the Farm_ID. This typically means a matching exercise using one or more of the variables common to both datasets, such as name, address, telephone numbers or Valuation Roll numbers. The AgriBase™ team offers a matching service on commission, or can provide access to a secure Web site where data can be searched, to enable the agency to attach Farm_IDs themselves.

Once the Farm_ID is attached, additional data such as denominator data or spatial locations can be requested from AgriQuality Limited. This can be provided in numerous formats suitable for common desktop tools such as spreadsheets or statistical programs, GIS or SQL databases.

Alternatively, AgriBase™'s team of GIS experts and epidemiologists can conduct the analyses and produce the reports on behalf of the customer.

A growing requirement is for dedicated Web sites, tailor made for particular purposes. These can be constructed to provide real-time access to information derived from both the customer's database and AgriBase™. The emergence of Web services within the

World Wide Web is facilitating the linking of disparate databases across the Internet in order to exchange key data in a controlled and secure manner.

AgriBase™ operates according to Privacy Act (1993) principles. The statement of purpose for the data held is as follows:

AgriQuality is collecting the information in order that it may collate, deal with and use the information in such manner as AgriQuality reasonably thinks fit, and includes to:

- *Enhance NZ's agricultural productivity and ability to trade.*
- *Help respond to and manage rural emergencies, diseases, pests, environmental quality issues and product quality issues.*
- *Help produce agricultural statistics.*
- *Assist fundraising by rescue services.*

The themes include biosecurity, food safety, verification, generation of agricultural statistics, and responding to civil emergencies.

DISCUSSION

When EpiMAN was first developed, a clear requirement for a national spatial farms database was identified. No such database existed at the time, and AgriBase™ was launched to fill the need. The Government's user pays and policy/delivery split philosophies drove AgriBase™ to be multi-purpose and jointly private/government sector funded. Whilst its use in biosecurity has long been exploited, its utility in food safety is only now being harnessed. AgriBase™ has been recognised by the NZ Food Safety Authority (NZFSA) as one of the key national databases required to support traceability and verification. However, the Treasury encourages competition. There is a risk that other agencies will try and develop AgriBase™ equivalents. NZ is too small a country to sustain

multiple competing farm databases. There is far greater benefit in working together for the common good. The use of XML and related technologies for data transfer will permit different agencies with niche competencies to provide specialist services that can be integrated within a comprehensive surveillance and risk-based assessment system.

AgriBase™ has been built on trust. Whilst farmers appreciate the 'record once – use many' paradigm, there is a need to balance the requirements for access to the data with protection of individual privacy rights. AgriBase™ has walked this line successfully for 12 years. It is hoped it will continue to do so as new food safety programmes are developed and deployed.

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