

SUSTAINABLE CHANGES OF AGRICULTURAL LAND USE IN NEW ZEALAND

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Abstract In this paper the author made a point of agricultural land use in New Zealand and tried to make clear characteristics and sustainability of land use changes. New Zealand has experienced drastic changes of land use and development of pastoral farming since European arriving in this land. Because the basis of development of New Zealand pastoral farming is to put livestock out to rich grassland, it is easy to change and to reverse among the sheep, beef and dairy farmings. Therefore, traditional pastoral farming is very flexible and sustainable land use system with using renewable resource. In recent years there have been some changes from traditional pastoral farming to new farming in land use. New farming mainly consists of horse raising, deer grazing and horticulture in new farming. These changes in terms of land use are uni-directional because they are putting high capital in land. Reversion from the new farming to the traditional pastoral farming is not an option.

Key words: New Zealand, agricultural land use, land use change, traditional pastoral farming, new farming, sustainability, feedback system

1. Introduction

Land has had many effects on human life directly and in many different ways. The use to which we put land has conceptually been adopted physical, socio-economic, historical and cultural environments (Kikuchi and Moran, 1990; Kikuchi, 1994). The land use changes have usually been motivated by a complex context of their environment changes such as nature conservation, land improvement, unusual weather, agricultural development, depression, urban expansion, migration, development of settlement, diffusion of innovation, individual desires, habits, spiritual values, and so on (Mather, 1986; Moran, 1978, 1980; Rhind and Hudson, 1980). In this paper the author made a point of agricultural land use in New Zealand as a case study and discussed about land use change in relation to changes of physical, socio-economic, historical and cultural environments. Following its discussion the author tried to make clear characteristics and sustainability of agricultural land use changes in New Zealand.

In New Zealand humans have been present to modify and develop the land during the past around 1,200 years. Although Polynesian occupied land of both islands and

transformed natural into cultural landscapes by degrees during more than 1,000 years. the most drastic changes of landscape and various environments have taken place since the European arrival in New Zealand. The land use and farming systems of Europe were introduced in colonial New Zealand. European settlers were based on their inherent systems and developed peculiar land use and farming systems familiar with geology, soils, climate, biota, market condition and remoteness of new land. Concerning agricultural land use, the pastoral farming has been rapidly developed instead of the native shifting cultivation, and now it is changing into alternative pastoral farming in rural area and into horticulture and urban land use in some parts of urban-rural fringes according to the impact of urban expansion. Therefore, New Zealand is one of the most suitable example to study land use change with the changes of various environments, because land use of New Zealand has remarkably changed in terms of its form and function during the very short period of the past 150 years.

2. Development Processes of New Zealand Agriculture

Development processes of New Zealand agriculture divided into five stages according to changes of the stock unite, sown grasses acreage and the share of main farm products in export market (Fig. 1). These stages are the introduction, the establishment, the revolution, the intensification and the reorganisation of pastoral farmings.

The introduction of pastoral farming

A distinctive feature of New Zealand agriculture before European pioneers arriving is the Maori farming. The Maori produced root crops such as *kumara*, *taro* and *yam* for subsistence. In this farming, the Maori used the burned forests as cultivating land for a few years, and shifted to other land for using forests as new cultivating land after land fertility decreasing. European pioneers have settled in New Zealand since the 1820s. Europeans on their arrival in this country earned in cutting down *kaori* pain, collecting *kaori* game and trading whale oil and sealskin, and were initially depended on Maori food producers.

The latter had evolved a system of agriculture well attuned to their primitive technology, but were not slow to adopt new crops such as fruit, potatoes and maize. to breed pigs and use European steel tools. In the 1840s the European settlers, particularly in the Wakefield settlements of Canterbury plain, tried to re-created the peasant farming system of rural England, but futility of such effort very soon became apparent. European pioneers could be developed in the early stage only on the basis of extensive sheep farming such as Merino sheep grazing.

Between the mid-1840s and the 1860s, all the open country suitable for sheep grazing in both the South Island and the southern part of the North Island was occupied and stocked. Particularly the large scale farms of sheep grazing located on Canterbury plain of the South Island, and Wairarapa and Hawks Bay regions of the North Island. Sheep farmers scattered the plain and the hilly lands, and extensively produced

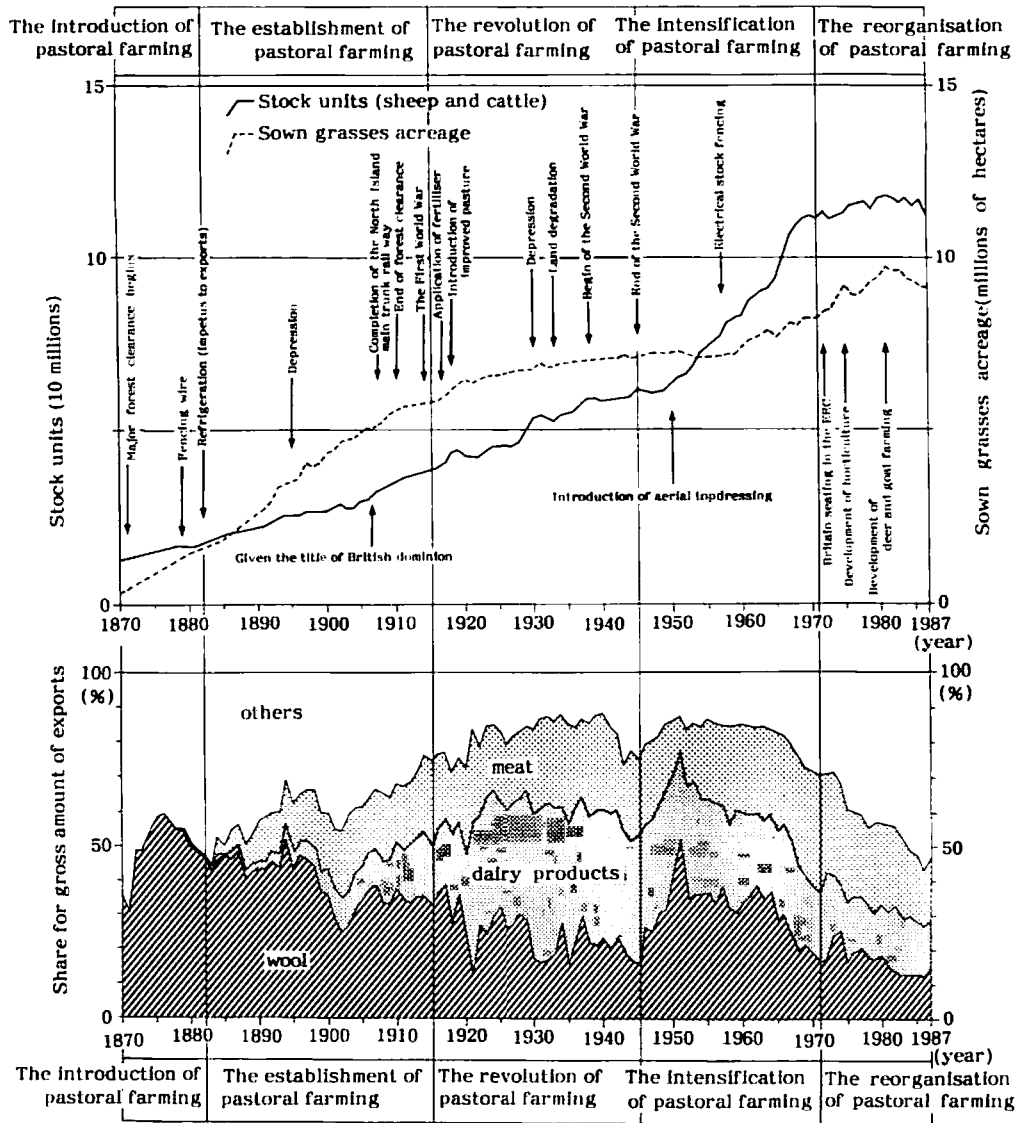


Fig. 1 Changes of the stock units, sown grasses acreage and the share for gross amount of exports in New Zealand
 (Data sources: NZ official yearbooks, NZ agricultural and pastoral statistics, and reports on the farm production)

wool for exporting to Europe. The larger scale farms of sheep grazing, so-called "station", were developed and concentrated in the South Island because they mainly depended on native *tussock* grass. On the contrary, the North Island was later for the agricultural development than the South Island because many parts of the North Island were covered with *kauri* forests and bush.

The Establishment of pastoral farming

One of the opportunities for the establishment of pastoral farming was the beginning of the refrigeration ship service between Dunedin and London in 1882. The advent of refrigeration then provided to change exported articles from non-perishable wool and wheat to perishable meat and daily products, so that the system of extensive sheep farming had gone about as far as was possible in the light of existing knowledge. Although the share of wool, meat and daily products for the gross amount of exports was 47.0, 0.7 and 1.7 percent respectively in 1885, exports of meat and daily products tended to increase every year with the development of refrigeration. Refrigeration's main contributions were the creation of a better economic bases for the closer settlement, and early developments of the integration from agriculture to food processing industries.

According to the rapid increase of exports of meat and dairy products, sown grasses acreage enlarged from about 300,000 hectares in 1850 to about 2,600,000 hectares in 1890, and to about 5,500,000 hectares in 1910. As more enlargement of sown grasses acreage, more bush covered areas and forests were cleared and burned for making sure of feed production bases of intensive pastoral farming such as lamb fating, beef cattle growing and dairy farming.

The advance of cleaning and burning forests peaked between the 1870s and the 1880s in the South Island, in turn peaked between the 1880s when the Maori wars were over and the 1900s in the North Island. According to Fig. 2, which shows the changes of forest land use 1850 to 1950 in New Zealand, many parts of the North Island without low lands, coastal plains and volcanic plateaus were covered with forests

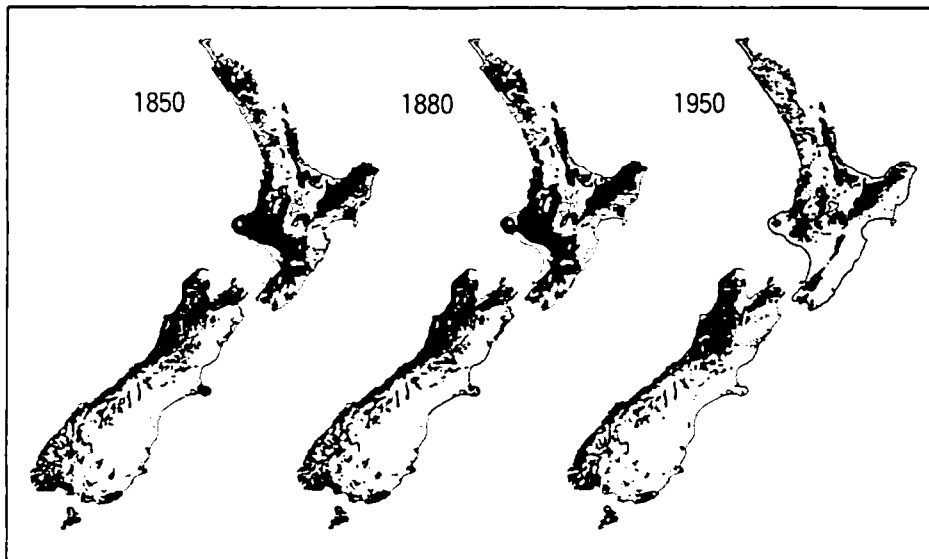


Fig. 2 Natural forests of New Zealand at three different periods
(From Watters 1965, p.78.)

in 1850. The rail network was built for transportation of cutting woods to harbors such as Auckland and Wellington, so that the task of clearing and burning forests finished nearly by 1910. Therefore the sown grasses were prepared coinciding with increase of the stock unit, and the infrastructure for the intensive pastoral farming was established in reference to the arrangement of the rail network.

Although closer settlements in the South Island were assumed to be a step towards the establishment of a system of mixed farming on English peasant model during the 1890s, in the North Island these traditional farming concepts proved much less satisfactory because of rainy climate and volcanic soil. Farmers in the North Island had to adopt the wholly new concept such as grassland farming. Another factor encouraging the evolution of grassland farming was the growth of the dairy industry that provided a better economic bases for closer settlements. As the enlargement of sown grasses acreage in the North Island, the number of dairy farms and dairy factories increased from the 1890s onwards in Taranaki region and more slowly in Waikato region. As looking over agricultural regions in this stage, dairy farming, fat-lamb growing and mixed farming located on low lands, and extensive sheep farming for wool production located on the volcanic slops and hilly lands. But the change to grassland farming came about abruptly and it was until after the First World War that New Zealand agriculture came to depend mainly on effective exploitation of pastures.

The revolution of pastoral farming

New Zealand tended to make strong character of the food supplier for Britain as experiences of bulk food exportation during the First World War, so that a larger quantities of agricultural products exported to Britain than those in the previous stage of pastoral farming. The total share of wool, meat and dairy products for the gross amount of exports reached to more than 70 percent in this stage. It was characteristic that the export of dairy products rapidly enlarged from the 1920s to the 1940s, because production and exportation costs of New Zealand butter and cheese were lower than those of other countries. The share of dairy products for the gross amount of exports in New Zealand increases from 17.3 percent in 1915 to 45.6 percent in 1921, so that their monopolistic market was established in Britain.

The development of dairy farming has been supported by many agricultural innovations, so-called "dairy revolutions", since the First World War. In terms of grassland management, farmers made efforts to increase productivity of grass per hectare because sown grasses acreage got to a limit of enlargement. They changed from single grass to mixed grasses cultivation with clover and ryegrass, and applied a large amount of superphosphate, which became much cheaper with the exploitation of the rock phosphate on Nauru Island and the establishment of large works in New Zealand, to grassland. The heavy application of superphosphate and the careful management of land use helped to build up fertility and to allow a higher carrying capacity of livestock.

Another important innovation of dairy farming was in terms of milking techniques that were much assisted by the development of home milk separation, milking machines and improvements in milking shed. As the home milk separation rapidly spread by 1922, dairy farms could separate milk fat from raw milk and forward only milk fat to

closer dairy factories. This innovation brought about not only the labour saving of milk collection but also the improvement of milk quality. On the other hand, milking machines have been diffused many dairy regions since their device in 1902. The pace of diffusion, particularly in the Waikato region where 3,556 dairy farms set up milking machines in 1922, was accelerated after the First World War. Therefore the adaptation of milker made dairy farmers increased carrying dairy cattle, and dairy farming became a significant land use in grassland farming of the North Island.

The intensification of pastoral farming

It was in this stage that the present structure of New Zealand agriculture and land use emerged on the basis of the intensive utilisation of pasture to produce meat, milk and wool. This stage was also characterised with the rapid growth of stock united from 598 million of 1945 to 946 million of 1965 in the whole of New Zealand. The most significant development over the 1950s and the 1960s was the great increase in the number and proportion of cattle run in combination with sheep because of the opening up of the American beef market, and the effective management of sown grasses. In spite of the rapid increase of the stock unit, sown grasses acreage increased 7.18 million to just 7.77 million hectares. The most of farmers had to have more heavy application of superphosphate in order to built up more fertility and to allow higher carrying capacity of livestock within the limited grassland.

Land productivity was rapidly improved and developed on low lands and the gently hill country which were accessible to wheeled vehicles, but on the steeper hill country little could be accomplished. As fertiliser input per hectare more increased in the North Island, the stock unite and grass productivity per hectare in low lands of the North Island, particularly in dairy regions such as Waikato and Taranaki, tended to be greater than those in the South Island. Since the 1950s the fertility of million hectares of previously inaccessible hill country has been built up with aerial topdressing that aeroplane has been used to drop fertiliser from the air. The rate of aerial topdressing acreage for the total area topdressed was lower in low lands and higher in the hill country (Fig. 3). In the hill country many farms were topdressed each year with dropping superphosphate potash mixture of about 400 kilogramme per hectare from the air.

On the other hand, it was also important for the effective and rational management of grassland to adapt the electric stock fence. Farmers divided their farmland into twenty or thirty paddocks with the adaptation of electric stock fences to rotate cattle and sheep grazing, and to take effect the management of grassland. The herd is moved around the farm to make the most effective use of the new growth in each paddock of grassland. The adaptation of electric stock fences was one of the significant factors for the progress and the intensification of grassland farming, because better subdivision has been also followed by aerial topdressing, the construction of access tracks, the building of stock water dams and the introduction of higher-producing pasture strains. Therefore farmers could perform year-round and economic grazing easily in accordance with the identification of higher-producing strains of ryegrass, the emphasis on the key role of clover and the evolution of superior strains of various pasture.

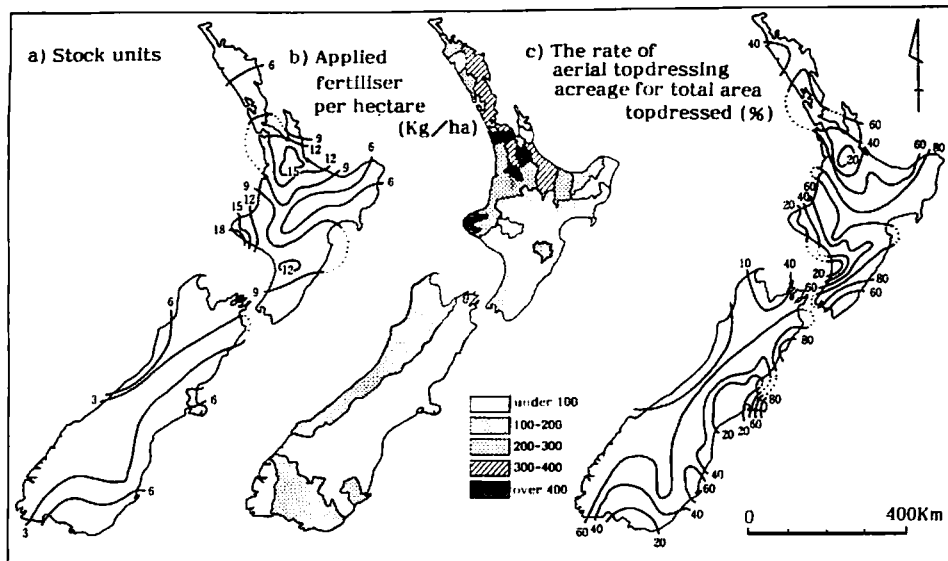


Fig. 3 Distribution of the stock units, applied fertiliser and topdressed area in New Zealand, 1970
(Data source: NZ Agricultural and Pastoral Statistics)

The reorganisation of pastoral farming

Although Britain was the most important market for agricultural products from New Zealand, their priority in the British market went down because Britain became a member nation of the European Economic Community in 1972. This fact was vitally important to New Zealand because it signalled that Britain was no longer going to provide an assured market for farm products from New Zealand. It was reflected in the decrease of agricultural exports from New Zealand to Britain, particularly the share of New Zealand dairy products in British market decreased from 69.6 percent in 1970 to 18.8 percent in 1980. Therefore, New Zealand has been obliged to reorganise pastoral farming with the diversification of exported articles and countries, and had to find new products and new markets to send them.

In terms of dairy products, for example, skim powder and casein have been as more important exports as butter and cheese. With the progress of producing skim powder and casein, dairy factories have begun to use whole milk for processing. The development of using whole milk has always been closely associated with the improvement of various infrastructure such as road and transportation. Whole milk collection by tanker and the expansion of milk powder and casein manufacture have enable the industry to rationalise its production, to eliminate small factories and to introduce a greater degree of mechanisation.

In many dairy farms, furthermore, carrying dairy cattle changed Jersey to Friesian herds that produced a grate deal of the whole milk and combined character of dairy cattle with one of beef cattle. Although dairy farms kept Friesian herd as milking cattle in the period of higher milk price, the most of dairy farms could keep a part of Friesian

herd as beef cattle in the period of lower milk price and higher meat price. Because the most essential basis of development of New Zealand pastoral farming is to put livestock out to rich grassland, it is easy to change from dairy farming to beef farming or sheep and beef farming and to more specialised beef farming, and to reverse among the sheep, beef and dairy farming complementarily. In this sense its traditional pastoral farming is very flexible and sustainable land use system with using renewable resource.

In recent years there have been another trend of diversification of New Zealand agriculture and some changes from traditional pastoral farming to new farming in land use. New farming mainly consists of horse raising, deer grazing and horticulture. Horse raising for trotting, racing and stables has been developed in some urban-rural fringes. Its development is associated with the increasing property taxes and land values with the expansion of urban land use. Deer farming has been converted from traditional pastoral farms with investing capital in grazing equipments such as fence, and has been developed in city's countryside and rural area. These new pastoral farming play an important role of capital intensive, labour extensive and high profitable farming in competition agricultural with urban land uses. On the other hand, horticulture has been more developed in the urban-rural fringe. Fertile and sheltered land which supported livestock farming is being broken into smaller blocks for orchards and vegetables. This farming is more intensive use of land resource, labour and capital. The development of subdivision in pastoral land and a high demand of rural land for urban use contributed to the changes in agricultural land use with the increasing of property taxes. These land use changes are uni-directional because they are putting high capital in land. Reversion from the new farming to the traditional pastoral farming is not an option.

3. Characteristics of Agricultural Land Use Changes in New Zealand: in a Substitution for Conclusion

As mentioned above, New Zealand has experienced drastic changes of land use and development of pastoral farming since European arriving on this land. European settlers have modified and improved physical environment such as land terrain, soil and biota to establish their life style of pastoral farming instead of the native cultivation and British peasant farming. In this sense, the development of pastoral farming was turning point in land use changes of New Zealand. After that pastoral farming system is controlled, and its well-handled land use plays an important role of environmental conservation.

In New Zealand traditional pastoral farming consists of sheep grazing, sheep and cattle grazing, beef farming and dairy farming (Fig. 4). Their elements have been affected by various factors of farm, regional and national levels. At initial development of pastoral farming it was mainly affected by physical environment such as land terrain, soil, sunshine and native grass cover, and its distribution was suitable for physical conditions and land resources. As development of pastoral farming, it has affected by socio-economic, historical and cultural environments.

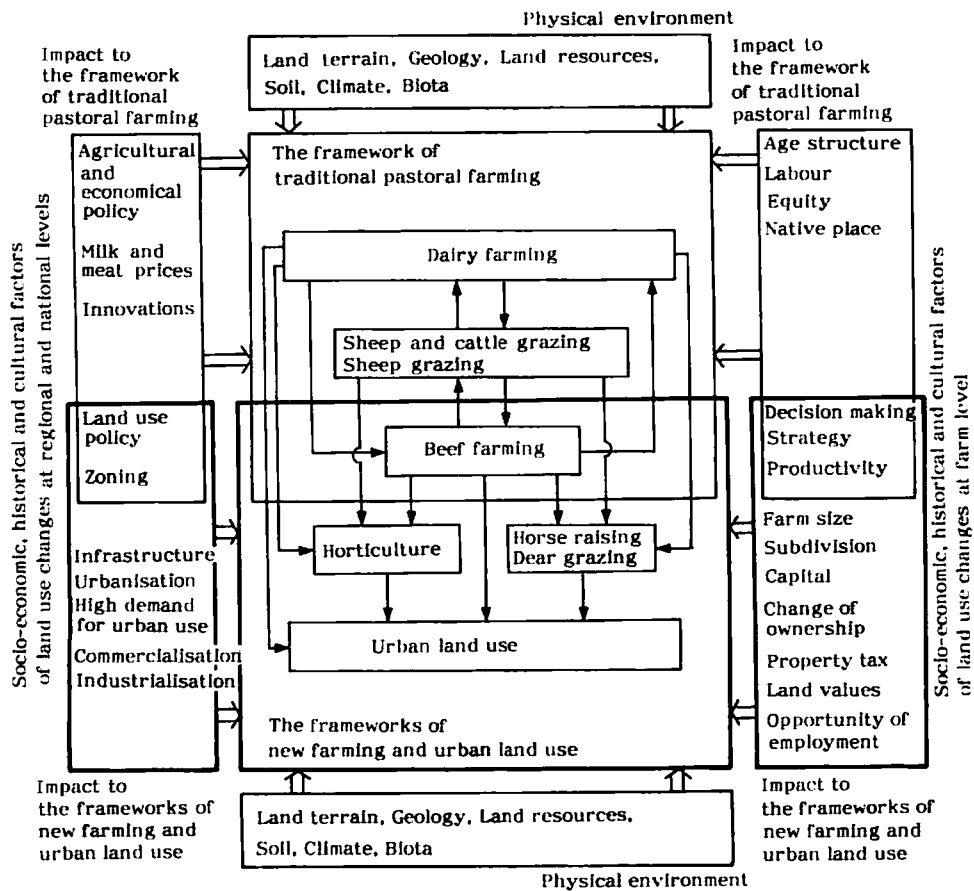


Fig. 4 Conceptual changes of agricultural land use in New Zealand

Practically in the 1970s and early 1980s a trend from dairy farming to beef farming and from sheep and beef farming to more specialise beef farming was apparent in the framework of traditional pastoral farming (Fig. 4). Dairy farming remained important during this period with changing ownership of land and changing location of town milk production, but the less labour intensive beef farming became attractive with decreasing agricultural labour force. Traditional pastoral farming permits such changes in livestock specialisation as the system is very flexible and not capital intensive. These trends could be reversed with fluctuation of milk and meat price, so that land use sequence of traditional pastoral farming is rotative and sustainable system including the feedback system under the influence of various environmental changes.

Since the 1980s land use change was characterised by various farms of horse raising and horticulture, and in some regions traditional pastoral uses, occupying former dairy and cattle farms. Although these changes had not been evident in the previous period, the rural land use zoning has encouraged them, and the trends to horse raising and horticulture have become stronger. The development of horse grazing was associated

with the purchase of rural land by other farmers and with the growing importance of commercial blood stock and racing industries. The horticulture is developed with zoning Rural Tow, in which fruit growing have priority, and with using labour, land and capital intensively. Availability of small parcels of land in the subdivision of urbanised rural zone, increasing property taxes as land values increased, and much demand for high profitability of rural land, contributed to the changes in the function of agricultural land use.

These sequences of land use changes were uni-directional. Reversion to the traditional pastoral farming of some regions is not an option. Thus, in comparison with the framework of traditional pastoral farming, a feedback system is not included in the framework of land use changes of new farming.

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